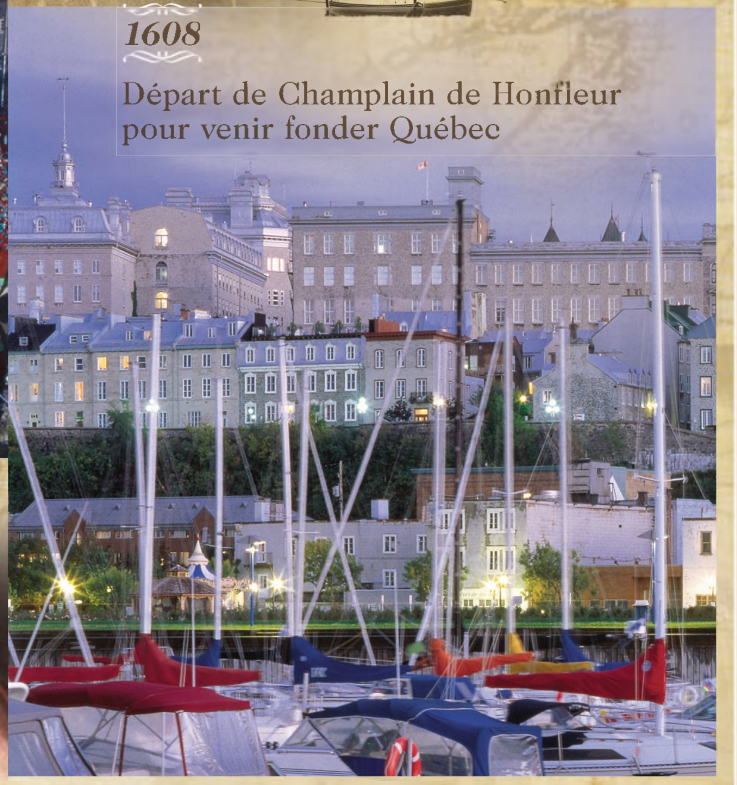
PHYSICS IN CANADA
LA PHYSIQUE AU CANADA
Vol. 64 No. 2 (supplement)
Congress 2008
Congrès 2008

QUÉBEC
1608–2008

1608

Départ de Champlain de Honfleur pour venir fonder Québec



1852

Charte de L'Université Laval

2008 400ième anniversaire de Québec

CAP CONGRESS
CONGRÈS DE L'ACP
2008

JUNE 8 – 11 JUIN

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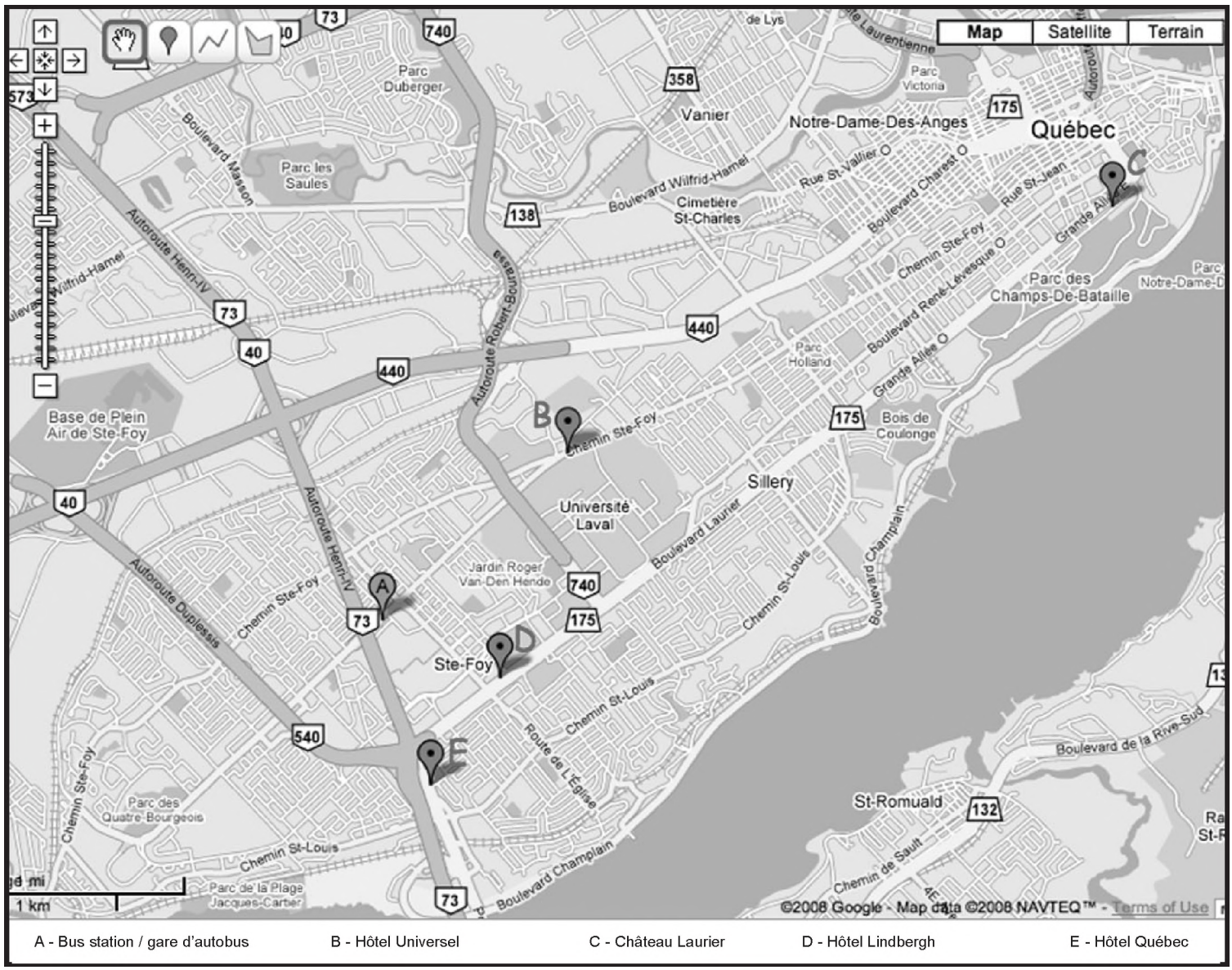
Travel Information / Comment se rendre à la conférence



A - Bus station / gare d'autobus B - Hôtel Universel C - Château Laurier D - Hôtel Lindbergh E - Hôtel Québec

Laval University is about 20 minutes away from the Jean Lesage International Airport and 10 minutes away from the Sainte-Foy bus station.

Taxi to the University from the Airport

$30 flat rate.

Main Conference Venue

Most of the conference events, including registration, will take place in the Pavillon Alexandre-Vachon (building 11) on campus at Laval University. See page iii for a campus map, pages iv-v for room locations, and page 5 for registration hours and information.

Walking from the Hotels to the University

From Hôtel Universel (15 min) - Take chemin Ste-Foy to the left, then turn right on avenue du Séminaire. At the lights turn right on rue du PEPS and then left on the 2nd street, rue de la Médecine. Walking down this street, you'll find Alexandre-Vachon and Adrien-Pouliot buildings one after the other on your left.

From Hôtel Québec and Hôtel Lindberg (40 min) - Take boulevard Laurier to the right to route du Vallon. Walk down route du Vallon until the second traffic lights. Cross route du Vallon, walk down the path leading to the parking lot, walk along Agathe-Lacerte building and turn left on rue de la Médecine. You'll find Alexandre-Vachon and Adrien-Pouliot buildings one after the other on your right.

L'Université Laval est située à environ 20 minutes de l'aéroport international Jean Lesage et à environ 10 minutes de la gare d'autocars de Sainte-Foy.

Taxi vers l'Université à partir de l'aéroport De Québec

Taux fixe de 30$.

Site principal du congrès

La plupart des activités du congrès, y compris l'inscription, auront lieu au Pavillon Alexandre-Vachon (édifice 11) sur le campus de l'Université Laval. Voir la page iii pour une carte de campus, les pages iv-v pour la situation des salles, et la page 5 pour l'horaire d'inscription et d'information.

Marche vers l'Université à partir des hôtels

De l'Hôtel Universel (15 min) - Prendre le chemin Ste-Foy à gauche, tourner ensuite à droite sur l'avenue du Séminaire. Au feu, tournez à droite sur la rue du PEPS et ensuite à la 2e rue à gauche, rue de la Médecine. Remonter cette rue, vous trouverez les Pavillons Alexandre-Vachon et Adrien-Pouliot l'un à côté de l'autre à votre gauche.

De l'Hôtel Québec et de l'Hôtel Lindberg (40 min) - Prendre le boulevard Laurier à droite jusqu'à la route du Vallon. Remonter la route du Vallon jusqu'au 2e feu. Traverser la route du Vallon et emprunter le sentier menant au stationnement, longer le Pavillon Agathe-Lacerte et tourner à gaucher sur la rue de la Médecine. Vous trouverez les Pavillons Adrien-Pouliot et Alexandre-Vachon l'un à côté de l'autre à votre droite.

Bussing from hotels to University

From Château Laurier - Walk down Place George-V Ouest, cross Grande Allée E and continue on rue D'Artigny. Turn right on rue St-Amable and left on rue Louis-Alexandre-Tachereau. Walk down the street to boulevard René Lévesque E. Cross the boulevard and take metrobus 800 or 801 to Laval University. Coming out of the bus, keep to the same side of the street and head to the left. At the traffic lights, cross the street and walk the path till rue de la Médecine. Turn right on that street and you'll find Alexandre-Vachon and Adrien-Pouliot buildings one after the other on your right.

From Hôtel Québec and Hôtel Lindberg - Take Boulevard Laurier to the right to rue de l'Église. Cross rue de l'Église and get to the nearest stop for metrobus 800 or 801. Step out of the bus at Laval University. Keep to the same side of the street and head to the right. At the traffic lights, cross the street and walk the path till rue de la Médecine. Turn right on that street and you'll find Alexandre-Vachon and Adrien-Pouliot buildings one after the other on your right.

Driving from Airport to University Parking Lot

From the airport, drive south on rue Principale to 6 E avenue ouest. Turn right on route de l'Aéroport and continue on autoroute Duplessis. Take boulevard Laurier and turn left at the entrance of Laval University. Turn left at flashing lights and then right on rue de la Médecine. You'll find the parking lots of Alexandre-Vachon and Adrien-Pouliot buildings one after the other on your right. There is a parking fee. You should find a ticket distributor and leave the ticket on your car's dashboard. A parking permit can be purchased for $20 when you pick up your registration package.

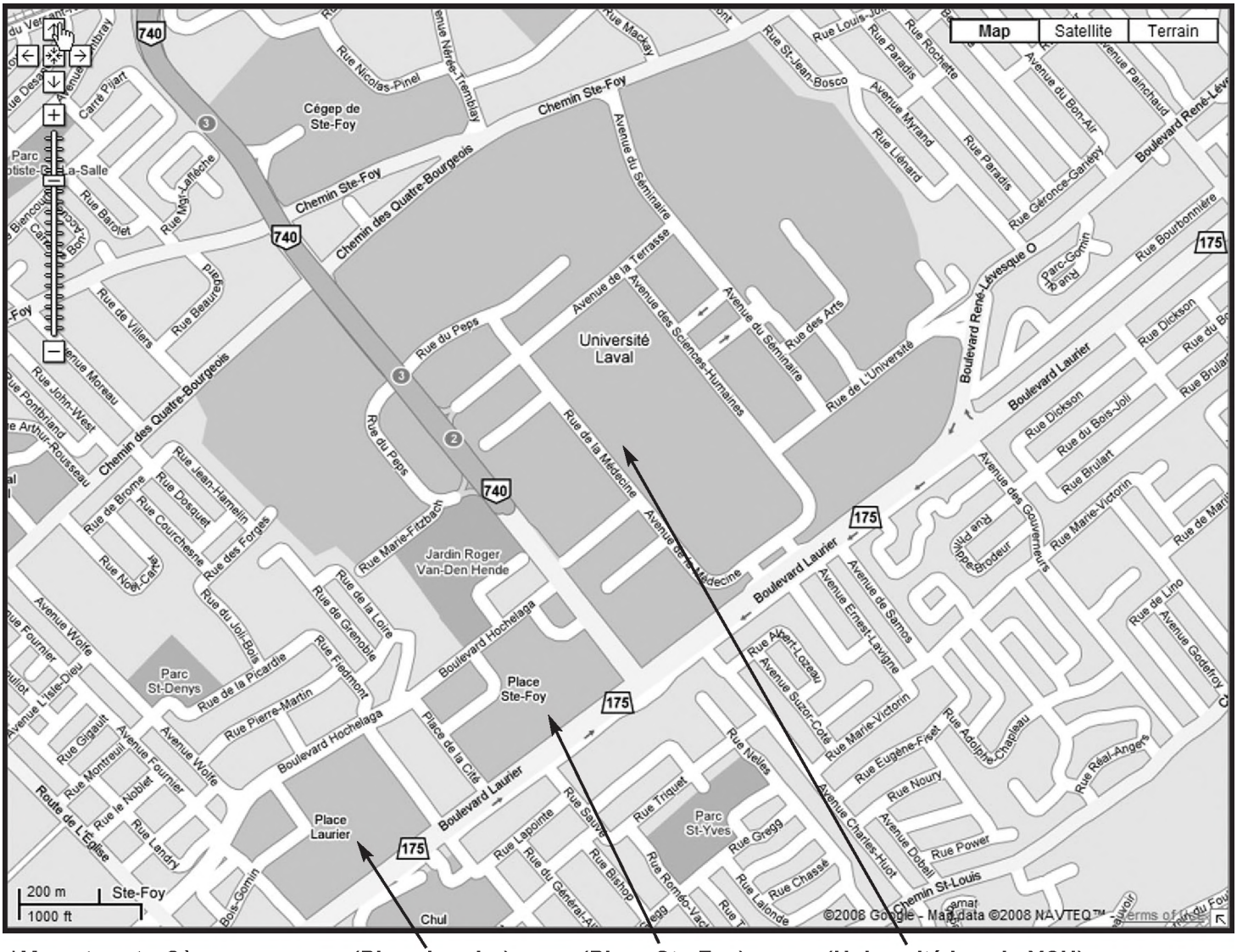
Bus vers l'Université à partir des hôtels

Du Château Laurier - Remonter la rue Place George-V Ouest, traverser Grande Allée E et continuer sur rue D'Artigny. Tourner à droite sur rue St-Amable et à gauche sur rue Louis-Alexandre-Taschereau. Descendre la rue jusqu'au boulevard René Lévesque E. Traverser le boulevard et prendre le métrobus 800 ou 801 jusqu'à l'Université Laval. En sortant de l'autobus, restez sur le même côté de rue et dirigez-vous vers la gauche. Au feu, traversez la rue et emprunter le sentier jusqu'à la rue de la médecine. Tourner à droite sur cette rue, vous trouverez les Pavillons Adrien-Pouliot et Alexandre-Vachon l'un à côté de l'autre à votre droite.

De l'Hôtel Québec et de l'Hôtel Lindberg - Prendre le Boulevard Laurier à droite jusqu'à l'intersection de rue de l'Église. Traversez rue de l'Église et vous rendre au prochain arrêt de métrobus 800 ou 801. Débarquez à l'Université Laval. En sortant de l'autobus, restez sur le même côté de rue et dirigez vous vers la droite. Au feu, traversez la rue et emprunter le sentier jusqu'à la rue de la médecine. Tourner à droite sur cette rue, vous trouverez les Pavillons Adrien-Pouliot et Alexandre-Vachon l'un à côté de l'autre à votre droite.

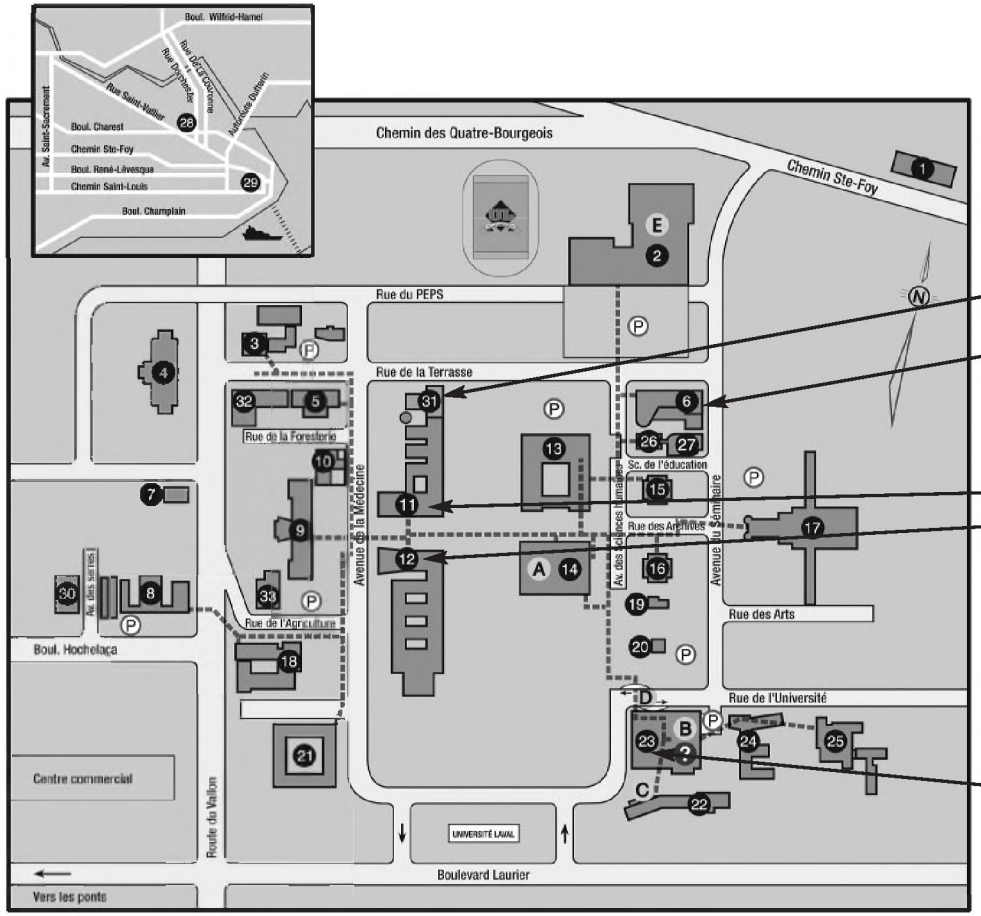
En voiture jusqu'au stationnement de l'Université, à partir de l'aéroport

De l'aéroport, aller en direction sud sur rue Principale vers 6 E avenue ouest. Tourner à droite sur la route de l'Aéroport et continuer sur autoroute Duplessis. Continuer sur le boulevard Laurier et tournez à gauche à l'entrée de l'Université Laval. Tournez à gauche au feu clignotant et ensuite à droite sur la rue de la Médecine. Vous trouverez les stationnement des Pavillons Adien-Pouliot et Alexandre-Vachon l'un à côté de l'autre à votre droite. Le stationnement est payant. Vous devez vous rendre à un poste de péage pour payer votre stationnement et déposer le coupon sur le tableau de bord de votre véhicule. Vous pouvez acheter une passe de stationnement au coût de 20$ lorsque vous viendrez récupérer votre trousse de participant.



Where to eat - Où manger **(Place Laurier)** **(Place Ste-Foy)** **(Université Laval - VCH)**

Campus de l'Université Laval



Pavillons

1 Pavillon de l'Est
2 Pavillon de l'éducation physique et des sports (PEPS)
3 Pavillon de Médecine dentaire
4 Centre de foresterie des Laurentides
5 Pavillon Abitibi-Price
6 Pavillon Palasis-Prince (PPP)
7 Maison Omer-Gingras
8 Pavillon des services
9 Pavillon Ferdinand-Vandry
10 Pavillon Charles-Eugène-Marchand
11 Pavillon Alexandre-Vachon (VCH) *
12 Pavillon Adrien-Pouliot (POU)
13 Pavillon Charles-De Koninck
14 Pavillon Jean-Charles-Bonenfant
15 Pavillon des Sciences de l'éducation
16 Pavillon Félix-Antoine-Savard
17 Pavillon Louis-Jacques-Casault
18 Pavillon Paul-Comtois
19 Maison Eugène-Roberge
20 Maison Marie-Sirois
23 Pavillons Alphonse-Desjardins et Maurice-Pollack (PAD)
26 Pavillon J.-A.-De Sève
27 Pavillon La Laurentienne
28 Édifice La Fabrique
29 Édifice du Vieux-Séminaire-de-Québec
30 Pavillon de l'Environotron
31 Pavillon d'optique-photonique (en construction) (POP)
32 Centre de transformation sur le bois ouvré
33 Édifice logeant Héma-Québec

Services

A Bibliothèque / Library
B Caisse populaire Desjardins, guichet automatique / Bank with ATM
C Sécurité-stationnement / Parking & Security
D Arrêt métrobus (800-801) / Bus Stop (800-801)
E Activités sportives / Sports Centre

Résidences

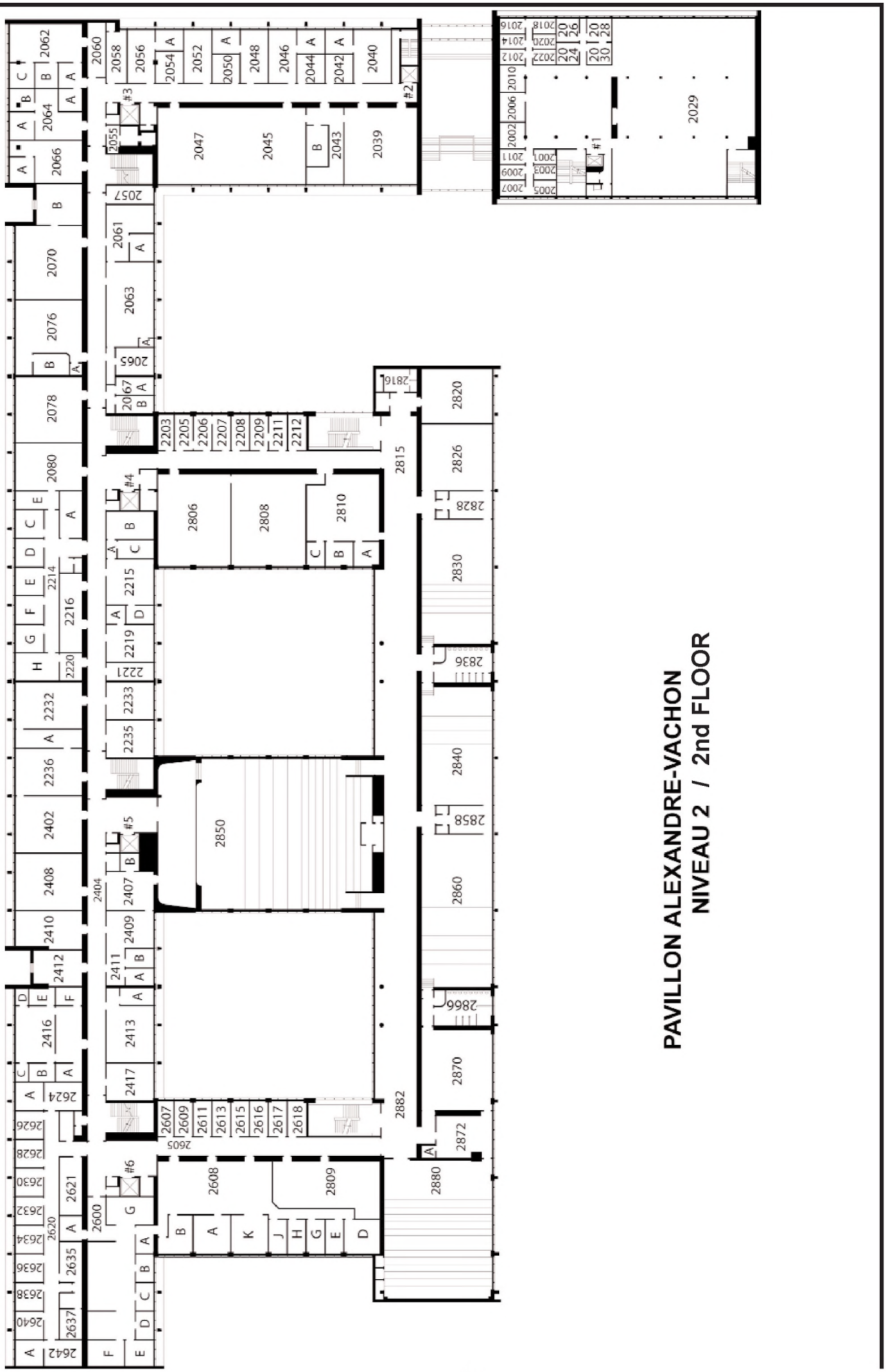
21 Pavillon Agathe-Lacerte
22 Pavillon Ernest-Lemieux
24 Pavillon H.-Biermans-L.-Moraud
25 Pavillon Alphonse-Marie-Parent

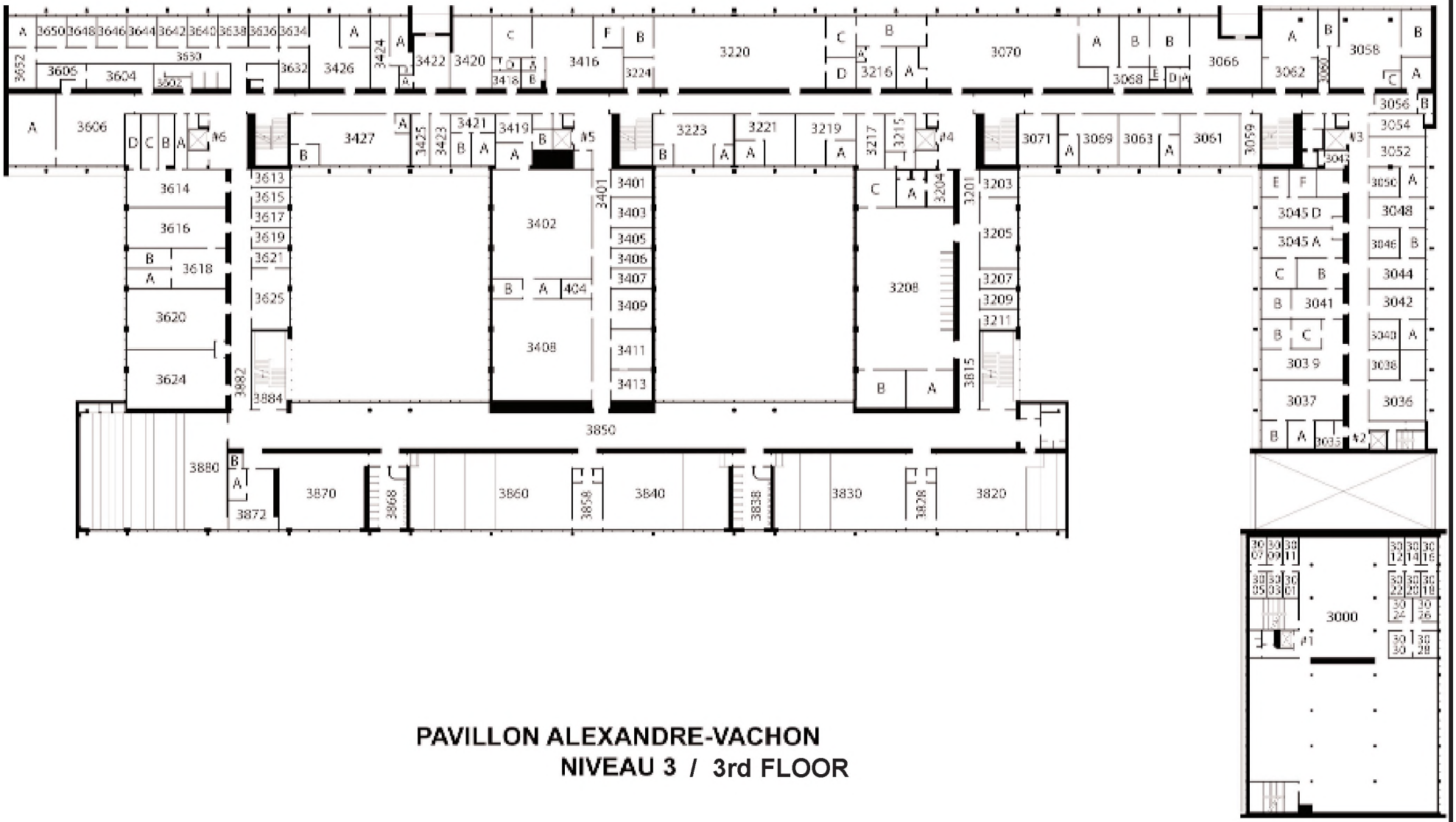
--- Tunnel
Ⓟ Postes de péage (permis à l'heure)
? Information

* Main conference venue, including registration, exhibitors, posters and coffee breaks

UNIVERSITÉ LAVAL

* Site principal du congrès, y compris l'inscription, les exposants, les affiches, et les pauses café


PAVILLON ALEXANDRE-VACHON
NIVEAU 2 / 2nd FLOOR

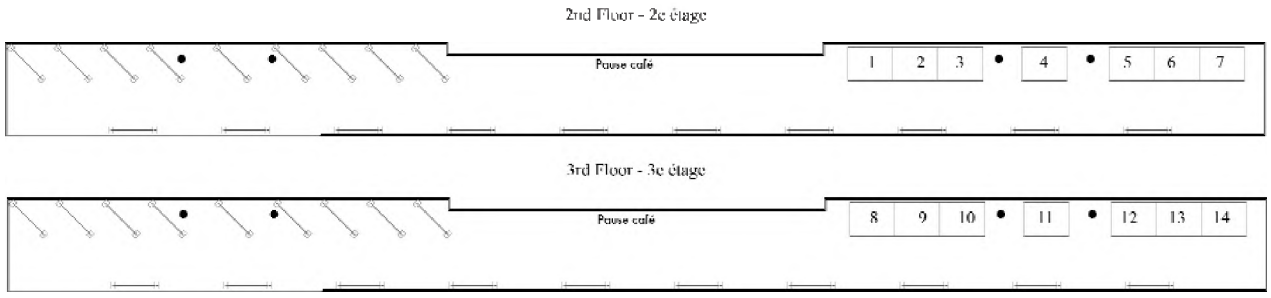


PAVILLON ALEXANDRE-VACHON
NIVEAU 3 / 3rd FLOOR

EXHIBITORS / EXPOSANTS

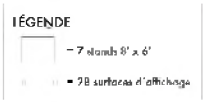
Atomic Energy of Canada Ltd. (#7)
Canberra Co. (#11)
e-Instruction (#14)
Gamble Technologies Ltd. (#9)
John Wiley & Sons Canada (#3)
NRC Research Press (#10)
Nelson Education Ltd. (#8)
Pearson Education Canada (#4)
Plasmionique Inc. (#13)
Defence R & D Canada – Valcartier (#2)
Systems for Research (#12)
Varian Inc. (#5)

Énergie atomique du Canada Ltée. (#7)
Canberra Co. (#11)
e-Instruction (#14)
Gamble Technologies Ltd. (#9)
John Wiley & Sons Canada (#3)
Presses scientifiques du CNRC (#10)
Nelson Education Ltd. (#8)
Pearson Education Canada (#4)
Plasmionique Inc. (#13)
R & D pour la Défense Canada – Valcartier (#2)
Systems for Research (#12)
Varian Inc. (#5)



Layout for exhibit booths and posters in Pavillon Alexandre-Vachon (2nd and 3rd floors).
Exhibit booths will be available from noon Sunday, June 8 to 13h30 Tuesday, June 10.
Poster session will be held on Monday, June 9 from 17h00 to 19h45.

Disposition des kiosques d'exposants et des affiches au Pavillon Alexandre-Vachon (2e et 3e étages).
Les kiosques seront disponibles du dimanche 8 juin à midi jusqu'au mardi 10 juin à 13h30.
La session d'affiches aura lieu le 9 juin de 17h00 à 19h45.



SPONSORS

The Congress organizers thank each of the sponsors and partners for their generous contributions. As the time of printing they are:

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COPL, Université Laval
Canadian Institute for Photonics Innovation (CIPI)
Department of Physics, Engineering Physics and Optics, Laval University
Exfo
Faculty of Sciences and Engineering of Laval University
Institute of Physics
Laval University Administration
NanoQuébec
Newport
NSERC National Office
NSERC Quebec Office
Perimeter Institute
TRIUMF
Varian Inc.

(Sponsoring student competitions)
Pearson Education Canada
Plasmionique Inc.
Gamble Technologies
John Wiley & Sons Canada Ltd.

A final list of all exhibitors and sponsors will be distributed at the Congress.

COMMANDITAIRES

Les organisateurs du congrès remercient tous les commanditaires et partenaires de leurs généreuses contributions. Au moment d'aller sous presse, ce sont :

ABB Bomem
COPL, Université Laval
Institut canadien pour les innovations en photonique (ICIP)
Département de physique, génie physique et optique, Université Laval
Exfo
Faculté des sciences et génie de l'Université Laval
Institute of Physics
Administration de l'Université Laval
NanoQuébec
Newport
CRSNG, Bureau national
CRSNG, Bureau du Québec
Institut Perimeter
TRIUMF
Varian Inc.

(Commanditaires pour les compétitions étudiantes)
Pearson Education Canada
Plasmionique Inc.
Gamble Technologies
John Wiley & Sons Canada Ltd.

La liste finale de tous les exposants et commanditaires sera distribuée lors du congrès.

PHYSICS IN CANADA
LA PHYSIQUE AU CANADA

Vol. 64 No. 2 Supplement
CONGRESS 2008
CONGRÈS 2008

TABLE OF CONTENTS / TABLE DES MATIÈRES

2008 CAP CONGRESS
CONGRÈS DE L'ACP 2008

Notice to Delegates

A copy of the printed Congress program will be provided to delegates at the Annual Congress at Laval University in Quebec City, QC.

Avis aux délégués

Une copie du programme imprimé sera donnée aux délégués au Congrès annuel, à l'Université Laval à Québec, QC.

FRONT COVER / *COUVERTURE*

2008 CAP Congress poster designed by the Local Organizing Committee at Laval University.

Affiche du congrès 2008 de l'ACP dessinée par le Comité d'organisation local à l'Université Laval.

CANADIAN ASSOCIATION OF PHYSICISTS
ASSOCIATION CANADIENNE DES PHYSICIENS ET PHYSICIENNES

ANNUAL GENERAL MEETING
ASSEMBLÉE GÉNÉRALE ANNUELLE

DATE: Tuesday, June 10, 2008
Mardi, le 10 juin, 2008

TIME/HEURE: 16h30

PLACE: Room/Salle VCH 2850, Université Laval, Québec, QC

DRAFT AGENDA / ORDRE DU JOUR PROVISOIRE

1. Call to Order and Approval of the Agenda

2. Approval of the Minutes of the June 19, 2007 Annual General Meeting
   .1 Matters arising from the Minutes

3. Annual Report
   .1 Audited Financial Statements to December 31, 2007
   .2 Membership Report

4. Appointment of Auditors

5. Presidential Address summarizing year's activities

6. Report by the Chair of the 2008 Local Organizing Committee

7. Host Universities - Future Congresses

8. New Business
   .1 2009 Membership Fees (R. Hemingway)
   .2 Report of the Canadian National IUPAP Liaison Committee (G. Drake)
   .3 Report by the Editor of Physics in Canada (B. Joos)
   .4 Report by the Editor of the Canadian Journal of Physics (M. Steinitz)
   .5 CUPC 2008 at U.Toronto (Sarah Kavassalis, U.Toronto)
   .6 Other matters

9. Report of the Nominating Committee

10. Votes of Thanks and Change of the Chair

11. Date and Place of Next Meeting

12. Adjournment

THE 63rd CAP ANNUAL CONGRESS
63e CONGRÈS ANNUEL DE L'ACP

INFORMATION / PROGRAMME

(See page 18 for the Session Codes /
Voir les indicatifs des sessions à la page 18)

2008 CAP CONGRESS / CONGRÈS DE L'ACP 2008

PROGRAM COMMITTEE / COMITÉ DU PROGRAMME

Chair / Président	S. Page	spage@cc.umanitoba.ca
Atmospheric & Space Physics / physique atmosphérique et de l'espace	T. Jayachandran	jaya@unb.ca
Atomic & Molecular Physics and Photon Interactions / physique atomique et moléculaire et d'interactions avec les photons	D. Tokaryk	dtokaryk@unb.ca
Condensed Matter and Materials Physics / physique de la matière condensée et des matériaux	A. Moewes	alex.moewes@usask.ca
History of Physics / histoire de la physique	W. Davidson	walter.davidsonn@nrc-cnrc.gc.ca
Industrial and Applied Physics / physique industrielle et appliquée	A. Kotlicki	kotlicki@physics.ubc.ca
Instrumentation and Measurement Physics / physique des instruments et mesures	K. Michaelian	michaeli@nrcan.gc.ca
Medical and Biological Physics / physique médicale et biologique	A. Linhananta	apichart.linhananta@lakeheadu.ca
Nuclear Physics / physique nucléaire	M. Butler	mbutler@husky1.smu.ca
Optics and Photonics / optique et photonique	P. Ashrit	ashritp@umoncton.ca
Particle Physics / physique des particules	R. Moore	moore@phys.ualberta.ca
Physics Education / enseignement de la physique	R. Thompson	thompson@phas.ucalgary.ca
Plasma Physics / physique des plasmas	J. Morelli	morelli@physics.queensu.ca
Surface Science / science des surfaces	K. Griffiths	griff@uwo.ca
Theoretical Physics / physique théorique	R. MacKenzie	richard.mackenzie@umontreal.ca

LOCAL ORGANIZING COMMITTEE / COMITÉ ORGANISATEUR LOCAL

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Audio/Visual, Secretariat, Registration, Accommodation / *Audio/Visuel, secrétariat, inscription et hébergement*	K. Brochu
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Roger Lessard Symposium / *Symposium Roger Lessard*	R. Vallée
Support Services - abstract and program Info / *Services de support - résumés et programmes*	F. Ford/C. Harvey
Student Competitions / *Compétitions étudiantes*	M. Campbell
Congress Program Committee / *Comité du programme*	S. Page

CAP OFFICE STAFF / PERSONNEL DE L'ACP

Executive Director / Directrice exécutive	F.M. Ford	CAP@uottawa.ca
Administrative Assistant / Adjointe administrative	C. Harvey	carmen@uottawa.ca

GENERAL INFORMATION / RENSEIGNEMENTS GÉNÉRAUX

2008 CAP Congress / Congrès de l'ACP 2008

Université Laval c/o Hospitalité Québec
580 Grande Allee Est, suite 140
Quebec, QC G1R 2K2
Tel/tél. : (418) 522-8182 or (800) 618-8182
Fax/téléc. : (418) 529-7548 or (800) 889-1126
e-mail/courriel : conference@hospitalite.com ; website: http://acp-cap2008.ca/

Canadian Association of Physicists /
Association canadienne des physiciens et physiciennes
Suite/Bur. 112, Imm. McDonald Bldg. , Univ. of/d'Ottawa
150, avenue Louis Pasteur Avenue OTTAWA, ON K1N 6N5
Tel/tél.: (613) 562-5614; Fax/téléc.: (613) 562-5615
e-mail/courriel : cap@uottawa.ca; website: http://www.cap.ca

REGISTRATION

From Sunday to Wednesday, the Congress registration and information desk will be located on the **2nd floor of the Pavillon Alexandre-Vachon** and will be staffed according to the following schedule:

Sunday June 8th	08h00 - 18h00
Monday June 9th	06h30 - 20h00
Tuesday June 10th	06h30 - 16h30
Wednesday June 11th	07h30 - 17h00

NAME BADGES

All registered conference participants will be issued with a name badge and a copy of the conference program. Badges should be worn at all congress events to identify registered participants. To facilitate the identification of individuals whom you may ask for assistance, please note that these will be designated by coloured name badges as follows:

Local Organizing Committee: *Yellow badges;*
Student Volunteers and Audi-Visual assistants: *Red t-shirts and badges;*
CAP Executive: *Blue badges;*
Student Competition Judges: *Green badges.*

PARKING

If you are traveling by car, you can buy a permit to park at the University for $20 when you pick up your registration package. If you are staying at Laval University, parking is free.

E-MAIL ACCESS

Wireless internet is available on campus. Specific information on how to access the wireless service will be included in the registration package.

The computer lab VCH 0035, with 15 work stations, will be available for those who don't carry a laptop. Fifteen network connections are also available in this room.

WHERE TO EAT

Meals on campus are available in the Pavillon Alexandre-Vachon cafeteria (a.m. only; # 11 on the MAP) and in nearby buildings : Pavillon Charles-De Koninck (#13 on the MAP) and Pavillon Alphonse-Desjardins (#23 on the MAP). The Alphonse-Desjardins building offers a larger choice of restaurants, food kiosks and more elaborate meals. There is also a coffee shop, a bar and other meeting places. The Université Laval campus is also surrounded by a variety of restaurants or fast food counters inside neighboring shopping centers, notably Place Laurier and Place Ste Foy, which are adjacent to the Laval campus (see map on page ii).

INSCRIPTION

De dimanche à mercredi, l'inscription et le kiosque d'information pour le congrès seront situés dans le hall du **2e étage du Pavillon Alexandre-Vachon**. Le personnel sera disponible aux heures suivantes :

Dimanche 8 juin	08h00 - 18h00
Lundi 9 juin	06h30 - 20h00
Mardi 10 juin	06h30 - 16h30
Mercredi 11 juin	07h30 - 17h00

PORTE-NOMS

Tous les participants inscrits à la conférence recevront un porte-nom et une copie du programme. On doit avoir sur soi le porte-nom pour s'identifier comme participant inscrit, à toutes les activités du congrès. Pour faciliter l'identification des personnes à qui vous pouvez demander assistance, veuillez noter qu'elles auront des porte-noms avec le code de couleurs suivant:

comité organisateur local: *porte-noms jaunes*;
étudiants bénévoles et assistants audio-visuel: *porte-noms et t-shirts rouges*;
membres de l'exécutif de l'ACP: *porte-noms bleus*;
juges des concours étudiants: *porte-noms verts*

STATIONNEMENT

Si vous voyagez en voiture, vous pouvez acheter une passe de stationnement au coût de 20$ lorsque vous viendrez récupérer votre trousse du participant. Si vous résidez dans les résidences de l'Université, le stationnement est compris.

ACCÈS AU COURRIEL

L'accès à l'Internet sans fil sera disponible sur le campus. Des renseignements spécifiques sur la façon d'accéder au service sans fil seront inclus dans la documentation remise sur place.

Le local informatique VCH 0035, avec 15 postes de travail, sera disponible pour ceux qui n'ont pas d'ordinateur portable avec eux. Quinze prises réseaux sont aussi disponibles dans ce local.

OÙ MANGER

Les repas sur le campus sont disponibles dans la cafétéria du Pavillon Alexandre-Vachon (matin seulement; #11 sur la carte) et dans les pavillons : Charles-De Koninck (#13 sur la carte) et Alphonse-Desjardins (#23 sur la carte). Le pavillon Alphonse-Desjardins offre une halte-bouffe avec un plus grand choix de restaurants et de repas. Il y a aussi un café, un bar et des lieux de rencontre informels. L'Université Laval est également entourée d'une variété de restaurants et de comptoirs de restauration rapide à l'intérieur des centres commerciaux, notamment les Place Laurier et Place Ste-Foy, qui sont à proximité de l'Université Laval (voir la carte à la page ii).

CAP-NSERC NEW FACULTY* BREAKFAST /
ACP-CRSNG PETIT-DÉJEUNER POUR LES NOUVEAUX PROFESSEUR(E)S*

07h00, MONDAY/LUNDI, JUNE 9 JUIN, 2008 -- PAD "LE CERCLE" (4TH FLOOR / 4e ÉTAGE)

* This includes any new Faculty member who was appointed after September 1, 2006 /
Incluant tous les professeurs qui sont entrés en fonction après le 1er septembre 2006.

Guidelines for the Best Student Oral and Poster Competitions
- https://www.cap.ca/congress/abstracts/beststudpaper.html
Directives pour les concours des meilleures communications étudiantes (orales ou par affiches)
- https://www.cap.ca/congress/abstracts/beststudpaper-f.html

2008 CAP CONGRESS

Quebec City

With its own international airport, and only a two- hour drive northeast from Montreal, a major airline hub in Eastern Canada, Quebec City (or Québec, in French) is the capital of the Canadian Province of Quebec and one of the oldest European settlements in North America. With its 700,000 inhabitants, Quebec City comes as the first major city when sailing upstream on the St. Lawrence River, one of the largest rivers in the world. Located at the junction of the Canadian Shield and Appalachian geotectonic plates, Quebec City, a UNESCO world heritage site, is best known for its famous Citadel and stone walls, large hotels and religious institutions, towering at its highest point on Cap Diamant.

Quebec City offers a majestic view of the St. Lawrence waterway and the deep water harbour, a major commercial and tourist point of entry on the North American continent. The city thrives all year long with cultural, artistic, scientific and tourist activities of all sorts. Its summer festivals and winter carnival are world-renown, and so is its gastronomy.

Quebec City, which celebrates its 400th anniversary this year, has kept much of its original character, including French as the language spoken by the majority of its inhabitants.

Quebec City is located in a famous tourist area which offers many possibilities for leisure, culture, history, learning and outdoor life on both land and water.

Plan to spend some extra time before or after the meeting, exploring the multitude of things to do and see in Quebec City, and better yet plan a trip to explore other areas of this beautiful part of Canada.

Congress venue

The conference will be held at the Université Laval in the Alexandre-Vachon and Adrien-Pouliot buildings. The university campus is located in the Sainte-Foy borough, west of downtown Quebec City which is only 10 to 15 min away by car or public transportation.

The Laval University campus covers an area of 1.9 km^2 (0.73 sq. mi.) in a partly forested area with recreational sites, walkways and a small botanical garden devoted to teaching. Various eating amenities (in the Alphonse-Desjardins building), a major bookstore and other services, as well as sports and training facilities in the PEPS building can be accessed on site.

CONGRESS 2008 HIGHLIGHTS

Sunday June 8th

- **Special Plenary session at 11h30: Isabelle Blain, NSERC Vice president,** on "Update from NSERC", followed by lunch for participants, sponsored by NSERC and CAP.
- **Plenary talk at 13h30: CAP Brockhouse Medal winner, Jess Brewer, University of British Columbia,** on "μSR: Fantasy, Fiction, Physics".
- **Special CAP Session in memory of Roger Lessard at 14h15**, followed by a reception for participants, sponsored by COPL, Université Laval.
- **4th Annual CAP Congress Student Reception, 16h30 - 18h15.** Graduate and undergraduate students are cordially invited to a reception in the Alexandre-Vachon cafeteria. Come meet and network with other students from all over Canada.
- **Special Plenary session at 17h00: Nigel Lockyer, Director of TRIUMF,** on "A Vision for TRIUMF : 2010-2015", followed by a reception for participants, sponsored by TRIUMF and CAP Divisions of Nuclear and Particle Physics.
- **Public lecture at 19h30:** The Herzberg Memorial Public Lecture will be given at the Théâtre de la Cité Universitaire by **Raymond Laflamme** of the University of Waterloo, who will speak on "Harnessing the Quantum World". A reception for delegates and guests will follow.

Monday June 9th

- **New Faculty Breakfast with NSERC at 07h00;** come and meet representatives from NSERC and new faculty members from across the country! Sponsored by NSERC. (NB This includes any new Faculty member who was appointed after September 1, 2006)

CONGRÈS DE L'ACP 2008

La ville de Québec

Desservie par les plus grandes compagnies aériennes du Canada et ayant son propre aéroport international, la ville de Québec est située à seulement deux heures de voiture de Montréal. Elle est la capitale de la province de Québec et un des plus vieux lieux d'établissement européen en Amérique du Nord. Avec ses 700 000 habitants, la ville de Québec est la première ville d'importance que vous rencontrez lorsque vous naviguez en amont du fleuve Saint-Laurent. Située à la jonction du Bouclier Canadien et des plaques tectoniques des Appalaches, la ville de Québec fait partie du patrimoine mondial de l'UNESCO. Elle est reconnue pour sa Citadelle et ses fortifications, ses grands hôtels et ses institutions religieuses, et domine le plus haut point du Cap Diamant.

La ville de Québec offre une vue imprenable sur la voie navigable du St-Laurent et sur son port en eau profonde, point d'entrée commercial et touristique majeur vers le continent Nord-Américain. Le ville propose bon nombre d'activités culturelles, artistiques, scientifiques et touristiques très variées tout au long de l'année. Ses festivals d'été ainsi que son carnaval d'hiver sont reconnus mondialement, tout comme sa gastronomie.

La ville de Québec, qui célébre ses 400 ans cette année, a conservé la majeure partie de ses aspects d'origine, tels que le français comme langue parlée par la majorité de ses habitants.

La ville de Québec est située dans un quartier touristique renommé qui offre plusieurs possibilités de loisir, de culture, d'histoire, d'apprentissage et d'activités extérieures autant sur la terre que sur l'eau.

Pensez à prévoir du temps supplémentaire avant ou après votre conférence pour explorer la multitude de choses à faire et à voir dans la ville de Québec. Et pourquoi ne pas également en profiter pour planifier un voyage vers d'autres lieux magnifiques dans cette partie du Canada?

Site du congrès

La conférence aura lieu à l'Université Laval dans les pavillons Alexandre-Vachon et Adrien-Pouliot. Le campus universitaire est situé dans l'arrondissement de Ste-Foy, à l'ouest du centre-ville de Québec et à seulement 10-15 minutes en automobile ou en autobus de celui-ci.

Le campus de l'Université Laval est d'une superficie de 1,9 km^2 (0,73 mille carrés) et est situé dans un environnement partiellement boisé où l'on retrouve des sites de loisir, des promenades et un petit jardin botanique destiné à l'enseignement. Divers services de restauration (dans le pavillon Alphonse-Desjardins), une grande librairie et plusieurs autres services, tels qu'un complexe sportif dans le pavillon du PEPS, sont accessibles directement sur le site.

LES FAITS SAILLANTS DU CONGRÈS 2008

Dimanche 8 juin

- **Conférence plénière spéciale à 11h30 : Isabelle Blain, vice-présidente du CRSNG,** sur « Mise à jour par le CRSNG », suivie d'un lunch pour les participants, commandité par le CRSNG et l'ACP.
- **Conférence plénière à 13h30 : médaille Brockhouse de l'ACP, Jess Brewer, de l'Université de la Colombie-Britannique** sur « μSR: Fantasie, fiction, physique ».
- **Session commémorative spéciale pour Roger Lessard à 14h15,** suivie d'une réception pour les participants, commanditée par le COPL, Université Laval.
- **4e réception annuelle d'étudiants au congrès de l'ACP, 16h30 - 18h15** Les étudiants de tous les cycles sont cordialement invités à une réception dans la cafétéria du Pavillon Alexandre-Vachon. Venez fraterniser avec des confrères de partout au Canada.
- **Conférence plénière spéciale à 17h00: Nigel Lockyer, directeur de TRIUMF :** « Une vision pour TRIUMF : 2010-2015 », suivie d'une réception pour les participants, commanditée par TRIUMF et les divisions de physique nucléaire et de physique des particules de l'ACP.
- **Conférence publique à 19h30 :** La conférence commémorative Herzberg sera prononcée au Théâtre de la Cité Universitaire par **Raymond Laflamme** de l'Université de Waterloo, qui parlera de « Maîtriser le monde quantique ». Une réception suivra pour les participants et les invités.

Lundi 9 juin

- **Petit-déjeuner-rencontre des nouveaux professeurs avec le CRSNG à 07h00;** rencontrez les représentants du CRSNG et vos nouveaux collègues de partout au pays! Commandité par le CRSNG. (NB *Incluant tous les professeurs qui sont entrés en fonction après le 1er septembre 2006*)

- **Plenary talk at 08h15 by Art McDonald, SNO**
on "SNO and the New SNOLAB Underground Facility".
- **Plenary talk at 09h00 by John Campbell, University of Canterbury**
on "Rutherford - His Path to the Nobel Prize".
- **Plenary talk at 13h30 by Haig Farris, Fractal Capital Corp.,**
on "Physicists in Business and Politics", followed by "A Physicists' Career in the Banking World" at 14h15 by Lee-Ann Jannissen, TD Securities, and a Workshop on Commercialization of Innovation at 14h45, followed by a panel discussion.
- **The Committee to Encourage Women in Physics will meet at 16h30**
to consider "Perspectives from the NSERC / Industry Chair For Women in Science and Engineering in Quebec" by Nadia Ghazzali; men and women interested in women in physics issues are invited to participate. A reception for participants will follow.
- **Poster session:**
The CAP08 poster session will be held from 17h00 to 19h45 in the hallway of the 2nd and 3rd floors of the Pavillion Alexandre-Vachon. Posters should have a maximum size of 4' high x 3.5' wide. Student competitors must be at their posters between 17h00 and 18h00. The poster session features a light meal. Posters can be set up starting at 09h00 Sunday June 8 (except 12h30-13h30 on Sunday) and must be taken down prior to 17h00 on Tuesday, June 10.
- **A Special Public Lecture will be delivered at 20h00** at the Théâtre de la Cité Universitaire **by Jacques Lacoursière, Beauport, Québec,** on "Anecdotes on the History of Sciences and its Teaching in Québec".

Tuesday, June 10th

- **Plenary CAP Teaching Medal talk at 08h15 by Adam Sarty, St-Mary's University,** on "Physics Education Across the Continuum: Opening Doors at All Levels".
- **Plenary talk at 09h00 by Eric Mazur, Harvard University,** on "Confessions of a Converted Lecturer".
- **The 8th CAP High School and CEGEP Teachers' Workshop will take place from 08h15 - 16h00.**
- **Special joint session CAP/HPCS on Numerical Physics at 10h00.**
- **Plenary CAP Medal of Achievement Talk at 13h30 by Louis Taillefer, University of Sherbrooke,** on "The Fermi Surface of High-T_c Superconductors".
- **The CAP Annual General Meeting** will be held in Room 2850 of the Pavillon Alexandre-Vachon from 16h30 to 18h00. Finalists of the student oral competition will be announced immediately before the AGM.
- **Congress 2008 Reception/Banquet at 19h00 :**
will be held in the Grand Salon of the Alphonse Desjardins Pavillon.

Wednesday, June 11th

- **Plenary CAP/INO Medal of Applied Photonics talk at 08h15 by Jacques Beaulieu,** on "From Optics to Photonics in 50 Years".
- **Plenary CAP Herzberg Medal talk at 09h00 by Carl Svensson, University of Guelph,** on "Gamma-Ray Spectroscopy with Radioactive Ion Beams at TRIUMF-ISAC".
- **Finals of the Student oral competition.**
- **Plenary CAP/CRM Prize talk at 13h30 by Richard Cleve, University of Waterloo,** on "Quantum Information, Computation and Communication".
- **Special Invited talk at 14h15 by Laurent Drissen, Université Laval,** on the "International Year of Astronomy, 2009".

ORAL PRESENTATION INSTRUCTIONS:

Presentations/Audio-visual equipment:
All the major conference rooms are equipped with:

- Overhead projector
- Wired internet
- PC (Windows XP with the Office 2003 suite)
- Overhead data projector with a standard RGB connector (Mac users MUST bring their video adaptor)
- VCR

Large theatres are also equipped with visualizers and microphones. For smaller classrooms, microphones are available upon request at least 48hr ahead of time.

- **Conférence plénière à 08h15 par Art McDonald, SNO**
sur « Le SNO et la nouvelle installation souterraine SNOLAB ».
- **Conférence plénière à 09h00 par John Campbell, Université de Canterbury,** sur « Rutherford - son parcours jusqu'au Prix Nobel ».
- **Conférence plénière à 13h30 par Haig Farris, Fractal Capital Corp.**
sur « Les physiciens dans l'industrie et la politique », suivie de « La carrière d'une physicienne dans le monde bancaire » à 14h15 par Lee-Ann Jannissen, TD Securities, et de l'atelier sur la commercialisation de l'innovation à 14h45, suivi d'une discussion.
- **Le comité pour encourager les femmes en physique se réunira à 16h30,** pour entendre « Perspectives de la chaire CRSNG / Industrie pour les femmes en sciences et en génie au Québec » par Nadia Ghazzali; hommes et femmes intéressés aux questions des femmes en physique sont invités à participer. Une réception suivra.
- **Session d'affiches :**
La session d'affiches de 2008 de l'ACP aura lieu de 17h00 à 19h45 dans les halls des 2e et 3e étages du pavillon Alexandre-Vachon. Les affiches doivent avoir une grandeur maximum de 4' de hauteur x 3.5' de largeur. Les concurrents doivent être à leur affiche entre 17h00 et 18h00. Un repas léger est offert. On peut placer les affiches à partir de 09h00 le dimanche 8 juin 2008 (sauf entre 12h30 et 13h30 le dimanche) et elles doivent être enlevées avant 17h00 le mardi 10 juin.
- **Une conférence publique spéciale** sera prononcée à 20h00 au Théâtre de la Cité Universitaire **par Jacques Lacoursière de Beauport, Québec**, sur « La petite histoire des sciences et de leur enseignement au Québec ».

Mardi 10 juin

- **Conférence plénière pour la médaille d'enseignement de l'ACP à 08h15 par Adam Sarty, de l'Université St-Mary's,** sur « L'enseignement de la physique d'un bout à l'autre : ouvrir des portes à tous les niveaux ».
- **Conférence plénière à 09h00 par Eric Mazur, de l'Université Harvard,** sur « Confessions d'un enseignant converti ».
- **Le 8e atelier des enseignants de physique du secondaire et du cégep de l'ACP aura lieu de 08h15 à 16h00.**
- **Session spéciale conjointe ACP/HPCS sur la physique numérique à 10h00.**
- **Conférence plénière pour la médaille pour contributions exceptionnelles à la physique à 13h30 par Louis Taillefer, de l'Université de Sherbrooke,** sur « La surface de Fermi des supraconducteurs à haute T_c ».
- **L'assemblée générale annuelle de l'ACP** aura lieu dans la salle 2850 du Pavillon Alexandre-Vachon de 16h30 à 18h00. Les noms des finalistes du concours de présentations orales seront annoncés immédiatement avant l'assemblée.
- **La réception et le banquet du congrès de 2008 à 19h00**
auront lieu au Grand Salon du Pavillon Alphonse Desjardins.

Mercredi 11 juin

- **Conférence plénière pour la médaille ACP-INO pour la photonique appliquée à 08h15 par Jacques Beaulieu :** « De l'optique à la photonique en 50 ans ».
- **Conférence plénière pour la médaille Herzberg de l'ACP à 09h00 par Carl Svensson de l'Université de Guelph,** sur « Spectroscopie de rayons gamma avec des faisceaux d'ions radioactifs à TRIUMF-ISAC ».
- **La finale du concours de présentations orales d'étudiants.**
- **Conférence plénière pour le prix ACP-CRM à 13h30 par Richard Cleve, de l'Université de Waterloo,** sur « L'Informatique, le calcul et la communication quantiques ».
- **Conférence spéciale à 14h15 par Laurent Drissen, de l'Université Laval,** sur « L'année internationale de l'astronomie, 2009».

DIRECTIVES CONCERNANT LES EXPOSÉS

Matériel audio-visuel pour les exposés :
Toutes les salles de conférences sont équipées de :

- Projecteur à acétate
- Prise internet câblée
- Ordinateur PC (avec Windows XP et la suite office 2003)
- Projecteur numérique au plafond avec prise RGB standard (Les usagers de Macintosh doivent apporter un adaptateur)
- Magnétoscope VHS

Les grandes salles de présentation sont équipées de projecteurs à acétates et de microphones. Pour les plus petites salles, un microphone est disponible sur demande 48 heures à l'avance.

All presenters are encouraged to bring their presentation on a USB memory stick, CD or DVD in one of the formats compatible with the recent versions of:

- acrobat reader v. 7
- microsoft office 2003 (with compatibility package for office 2007)

You are welcome to bring your own laptop computer. If your laptop is a Mac, please bring your video adapter.

If you plan to use your PC or Mac for a presentation, make sure you contact the AV technical assistant in your room 15 minutes before your session starts, in order to pre-connect your laptop to the multimedia system and test your presentation. Since all talks must keep to the schedule, any time lost in setting up your computer will reduce the time available for your talk.

If you need a codec to run video clips, please contact Karine Brochu at karine.brochu@conferium.com before your arrival on campus.

RECREATIONAL FACILITIES:

University Laval's Physical Education and Sports Pavilion (PEPS) is the site of numerous sports events. Open since September 1970, the PEPS was officially inaugurated on January 22, 1971. It has many thousands of users and is the main training site for university athletes participating in the Rouge et Or Program.

All year long, the PEPS offers the university community as well as the general public about a hundred sports activities. Recognized as the largest sports center in Eastern Quebec, the PEPS has exceptional facilities: Olympic swimming pool, roofed stadium, 200-meter interior track, climbing walls, gymnasiums, martial arts rooms, squash and racket ball courts, multipurpose rooms and training rooms. The PEPS also offers many exterior facilities, in particular a golf practice field, a football/soccer stadium, a 400-meter track field, beach volley ball fields, tennis courts as well as softball, soccer and ultimate Frisbee fields. Enough to satisfy just about any taste in sports!

Information: 656-PEPS

GENERAL INFORMATION ON QUEBEC CITY AND LAVAL UNIVERSITY :

More information than could be provided here is available on the Congress web site, http://acp-cap2008.ca. You are encouraged to consult it for additional detailed local information and recreational opportunities in the area of Quebec.

WEATHER:

Expect moderate to warm climate with average temperatures from 11°C - 22°C.

Tous les conférenciers sont invités à mettre leur présentation sur une clé de mémoire USB, un CD ou un DVD dans un format compatible avec :

- Adobe Acrobat 7
- Office 2003 de Microsoft (avec la suite de compatibilité Office 2007)

Vous pouvez utiliser votre propre portable si vous le désirez. Les conférenciers équipés d'un portable Macintosh doivent apporter leur adaptateur vidéo afin de le brancher au projecteur numérique.

Si vous pensez utiliser votre propre portable pour une présentation, nous vous demandons de vous présenter 15 minutes avec le début de celle-ci afin de vous assurer de tester les connexions et éviter des problèmes techniques. Toutes les conférences doivent être ponctuelles et le temps requis pour régler un éventuel problème technique réduira le temps que vous aurez à votre disposition pour votre conférence.

Si vous avez besoin d'une codec vidéo spéciale pour votre présentation, vous devez contacter Karine Brochu à karine.brochu@conferium.com avant votre arrivée sur le campus.

INSTALLATIONS RÉCRÉATIVES :

Le Pavillon de l'Éducation Physique et des Sports (PEPS) de l'Université Laval est le théâtre de nombreuses activités sportives. Ouvert depuis le mois de septembre 1970, le PEPS a été inauguré officiellement le 22 janvier 1971. Il compte à ce jour plusieurs milliers d'usagers et demeure le lieu d'entraînement par excellence des athlètes universitaires du programme Rouge et Or.

Été, automne, comme hiver, le PEPS offre à la communauté universitaire et au grand public près d'une centaine d'activités sportives. Considéré comme le plus grand centre sportif à l'Est du Québec, le PEPS est muni d'installations exceptionnelles: piscine olympique, patinoires, stade couvert, piste intérieure de 200 mètres, murs d'escalade, gymnases, salles de combat, courts de squash et de racquetball, salles multi-sports et salles d'entraînement. Également, le PEPS dispose de plusieurs terrains extérieurs dont un champ de pratique de golf, un stade de football/soccer, une piste d'athlétisme de 400 m, des terrains de volleyball sur le sable, de softball, de tennis, de soccer et d'ultimate frisbee. De quoi satisfaire tous les goûts en matière de sport !

Information: 656-PEPS

RENSEIGNEMENTS GÉNÉRAUX SUR QUÉBEC ET L'UNIVERSITÉ LAVAL :

Plus d'information que ce qu'on peut fournir ici est disponible sur la page web du congrès, http://acp-cap2008.ca. Vous pouvez la consulter pour de l'information locale plus détaillée et des suggestions de loisir.

TEMPÉRATURE :

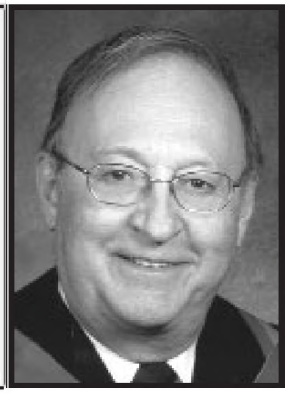
On peut s'attendre à un temps doux ou assez chaud, avec des températures moyennes allant de 11°C à 22°C.

SUNDAY, JUNE 8 DIMANCHE, LE 8 JUIN

CAP SESSION IN MEMORY OF ROGER A. LESSARD
SESSION COMMÉMORATIVE DE L'ACP POUR ROGER A. LESSARD
2008 JUNE 8 JUIN -- ROOM-SALLE POP 1168

14h15 - René Roy, "Des souvenirs qui font vivre / Keeping memories alive"
14h30 - Michael Steinitz, "Roger Lessard and the CAP / Roger Lessard et l'ACP"
14h45 - René Beaulieu, "Revue des principaux travaux de recherche réalisés par le Professeur Roger A. Lessard / Overview of Professor Roger A. Lessard's Main Research Contributions"
15h15 - Coffee Break / pause café
15h30 - Jorge Garcia-Sucerquia, "Digital Holography: A Modern Perspective of Dennis Gabor's invention / Holographie numérique : une perspective moderne sur l'invention de Dennis Gabor"
16h00 - Jafar Shaker, "Volume Holograms at Microwave Frequency Band / Hologrammes volumiques dans la bande de fréquences micro-ondes"
16h30 - Discussion and Remembrances followed by a reception for participants / Discussion et commémoration, suivie d'une réception pour les participants

(session ends at 18h00 / la session se termine à 18h00)



MONDAY, JUNE 9 LUNDI, LE 9 JUIN

INNOVATION SESSION SUR L'INNOVATION
2008 JUNE 9 JUIN -- ROOM-SALLE POU 1112

13h30 - Haig Farris | 14h15 - Lee Ann Janissen | 14h45 - Innovation Session

Haig Farris, Fractal Capital Corp.
Room-Salle POU 1112

Help Wanted- physicists needed in business and politics- apply early and often
On embauche - physiciens demandés dans les affaires et la politique - postulez tôt et souvent

21st century world business challenges and opportunities are based on solving problems in physics. Physicists should play a leading role in 21st century politics and business in developing, implementing and communicating solutions. Physicists should shift their priorities from publishing in Nature and Science to taking the lead in creating new businesses, getting elected to major political offices and political institutions and re-educating students and society on the importance of physics in solving everyday problems in every area of society.

Les défis et les occasions d'affaires dans le monde du XXIe siècle sont basés sur la solution de problèmes de physique. Les physiciens devraient jouer un rôle majeur dans la politique et les affaires du XXIe siècle en développant, mettant en place et diffusant des solutions. Les physiciens devraient revoir leurs priorités et, au lieu de publier dans Nature et Science, ils devraient créer de nouvelles entreprises, se faire élire à des parlements et institutions politiques et rééduquer les étudiants et la société sur l'importance de la physique pour résoudre des problèmes quotidiens dans tous les champs de la société.

14h15 **Lee Ann Janissen** **Room-Salle POU 1112**
A Physicist's Career in the Wholesale Banking World / La carrière d'un physicien dans le monde bancaire

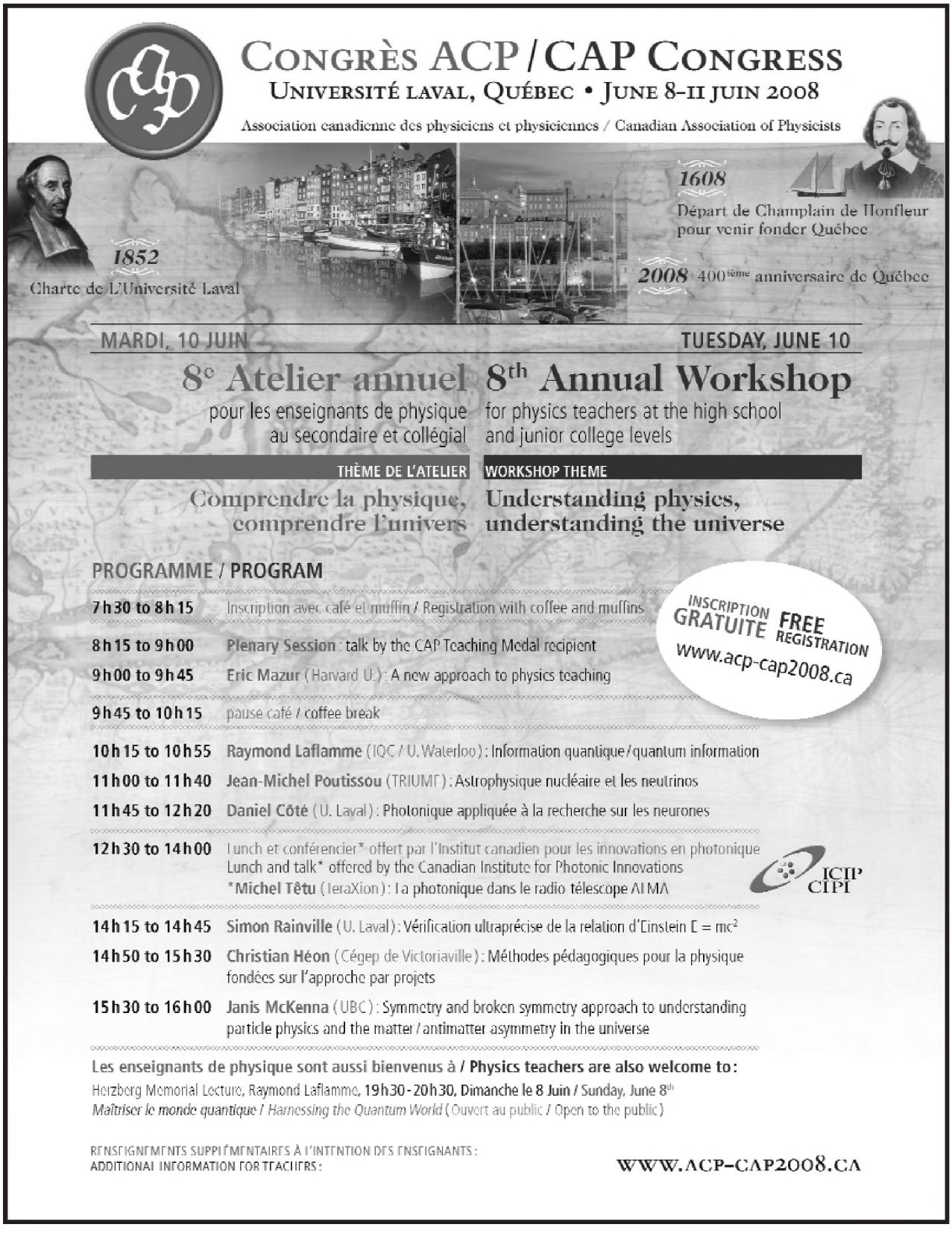
Workshop on Commercialization of Innovation
Atelier sur la commercialisation de l'innovation
Room-Salle POU 1112
14h45 - 17h00

14h45	Tony Rahilly, NRC-IRAP	*From Physics in the Lab to Products at the Retailer : The Speed of Innovation and the Acceleration of Commercialization*
15h15	Jean-Yves Roy, INO	*How INO brings innovation to help companies improve their competitive edge and contributes to their development*
15h45	Philip Gardner, TRIUMF	*Commercializing Fundamental Physics Research : The TRIUMF Experience*
16h00 - 17h00		Panel Discussion

TUESDAY, JUNE 10 — *MARDI, LE 10 JUIN*

8th Annual Physics Teachers' Workshop

8e Atelier annuel des enseignants de physique



SUNDAY, JUNE 8 19h30 DIMANCHE, LE 8 JUIN

2008 HERZBERG MEMORIAL PUBLIC LECTURE
CONFÉRENCE PUBLIQUE COMMÉMORATIVE HERZBERG 2008

Théâtre de la cité universitaire (PPP), Université Laval

Harnessing the Quantum World
Maîtriser le monde quantique

Raymond Laflamme, IQC/U.Waterloo

Information processing devices are pervasive in our society; from the 5 dollar watches to a multi-billion dollar satellite network. These devices have allowed the information revolution which is developing around us. It has transformed not only the way we communicate or entertain ourselves but also the way we do science and even the way we think. All this information is manipulated using the classical approximation to the laws of physics, but we know that there is a better approximation: the quantum mechanical laws. Would using quantum mechanics for information processing be an impediment or could it be an advantage? This is the fundamental question at the heart of quantum information processing (QIP). QIP is a young field with an incredible potential impact reaching from the way we understand fundamental physics to technological applications. I will give an introduction to quantum information by stressing recent interesting developments. I will also comment on the effort in this field at Waterloo and in Canada.

Les dispositifs de traitement d'information se retrouvent partout dans notre société, des montres à 5 dollars aux réseaux de satellites qui en valent des milliards. Ils ont permis la révolution informatique qui se développe autour de nous. Cette révolution a transformé notre façon de communiquer et de nous distraire, mais aussi notre manière de faire la science et même de penser. Toute cette information est manipulée en utilisant l'approximation classique des lois de la physique. Pourtant, nous savons qu'il y a une meilleure approximation: celle des lois quantiques. L'utilisation de la mécanique quantique pour le traitement de l'information est-elle un frein, ou peut-elle être un avantage? Voilà la question fondamentale au coeur du traitement quantique de l'information (TQI). Le TQI est un domaine jeune avec un impact potentiel incroyable allant de la façon de comprendre la physique fondamentale aux applications technologiques. Je vais présenter une introduction à l'informatique quantique en insistant sur de récents développements intéressants. Je vais également faire un survol des travaux dans ce domaine effectués à Waterloo et au Canada.

BIOGRAPHY / BIOGRAPHIE

Rayond Laflamme was born in Quebec city and did his undergraduate studies in Physics at Universite Laval. He then moved to Cambridge, England, where he survived Part III of Mathematical Tripos before doing a PhD in the Department of Applied Mathematics and Theoretical Physics (DAMTP) under the direction of Stephen Hawking. He and Don Page are responsible for having changed Hawking's mind on the reversal of the direction of time in a contracting Universe (see his book "A brief history of time"). After his PhD, Ray became a Killam post-doctoral fellow at UBC where he met his future wife Janice Gregson. Ray moved back to Cambridge in 1990 as a Research Fellow at Peterhouse. He finally settled down for 9 years at Los Alamos National Laboratory. He arrived as a Director funded post-doctoral fellow, became an Oppenheimer Fellow in 1994, just after the birth of his son Patrick. His daughter Jocelyne was born in 1995 and he became Technical Staff in 1997. In 2001 he joined the newly founded Perimeter Institute for Theoretical Physics and the University of Waterloo where he and Michele Mosca have started the Institute for Quantum Computing. Raymond Laflamme holds a Canada Research Chair (CRC) in Quantum Information

Raymond Laflamme est né à Québec et a complété son baccalauréat en physique à l'Université Laval. Il s'est ensuite inscrit à Cambridge, en Angleterre, où il a survécu à la troisième étape des "Tripos" de mathématiques avant d'entreprendre un doctorat au département de mathématiques appliquées et de physique théorique sous la direction de Stephen Hawking. Ce sont lui et Don Page qui ont amené Hawking à changer d'idée sur le renversement du temps dans un univers en contraction (voir le livre "Une brève histoire du temps"). Après son doctorat, Laflamme a été boursier postdoctoral Killam à UBC, où il a rencontré sa future conjointe Janice Gregson. Il est retourné à Cambridge en 1990 comme chercheur à Peterhouse. Il a ensuite passé neuf ans au laboratoire national de Los Alamos, d'abord comme chercheur postdoctoral et, en 1994, comme boursier Oppenheimer, juste après la naissance de son fils Patrick. Sa fille Jocelyne est née en 1995 et il est devenu membre du personnel de recherche en 1997. En 2001, il s'est joint à l'Institut Perimeter pour la physique théorique, nouvellement établi, et à l'Université de Waterloo, où lui et Michele Mosca ont fondé l'Institut d'informatique quantique. Raymond Laflamme est détenteur d'une chaire de recherche du Canada en informatique quantique.

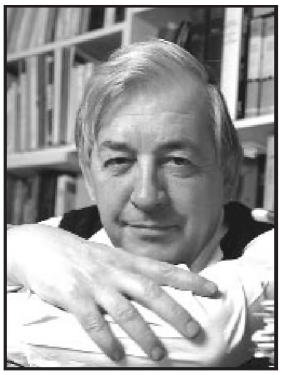
MONDAY, JUNE 9 20h00 LUNDI, LE 9 JUIN

2008 SPECIAL PUBLIC LECTURE

CONFÉRENCE SPÉCIALE PUBLIQUE 2008

Théâtre de la cité universitaire (PPP), Université Laval

Jacques Lacoursière, Beauport, Québec



PETITE HISTOIRE DES SCIENCES ET DE LEUR ENSEIGNEMENT AU QUÉBEC

Samuel de Champlain possédait un astrolabe. Des missionnaires jésuites ont étudié des éclipses de soleil et de lune, ainsi que le passage de quelques comètes. Louis Hébert a envoyé de nouvelles plantes à Paris. Ce n'était là qu'un début. Par la suite, des Canadiens ont, à leur manière, enrichi les connaissances scientifiques. Quelques-uns ont fait partie de grandes académies européennes. Dans plusieurs collèges classiques, on utilisait, pour l'enseignement de la physique, des instruments modernes. Citons le cas de l'abbé Jérôme Demers, du Séminaire de Québec. La fondation de la Société royale du Canada, en 1882, signifiera une rapide propagation des connaissances scientifiques.

ANECDOTES ON THE HISTORY OF SCIENCE AND ITS TEACHING IN QUEBEC

Samuel de Champlain owned an astrolabe. Jesuit missionaries studied solar and lunar eclipses, as well as passages of comets. Louis Hébert sent new plants to Paris. This was only the beginning. Later on, Canadians made their own contributions to enrich our scientific knowledge. Some were members of major European academies. In many classical colleges, modern equipment has been used to teach physics. An example is the priest Jérôme Demers at the Séminaire de Québec. The foundation of the Royal Society of Canada, in 1882, led to a rapid propagation of scientific knowledge.

BIOGRAPHY / BIOGRAPHIE

For more than 40 years, Jacques Lacoursière has dedicated his career to communicating the highlights of our history, particularly to show us the link between past events and today's current events. Author of numerous publications, including a remarkable historical series in four volumes, Histoire populaire du Québec, he is also a renowned radio and television host. As well, he has an enviable reputation as a columnist, notably with Histoire à la une and as a respected lecturer. Valued for his talents as a researcher and for his ability to communicate with the lay person, he has shared his knowledge with the Musée de la Civilisation à Québec, with Pointe-à-Caillère, Montreal's museum of archaeology and history, and with the McCord Museum. Jacques Lacoursière was invested as Member of the Order of Canada in 2006.

Depuis plus de 40 ans, Jacques Lacoursière se consacre à communiquer les faits marquants de notre histoire et surtout à faire le lien entre ces événements et ceux qu'on vit aujourd'hui dans l'actualité. Auteur de nombreux ouvrages, dont une remarquable série historique en quatre tomes, Histoire populaire du Québec, il est également renommé en tant qu'animateur de séries radiophoniques et télévisées. Il s'est aussi illustré comme chroniqueur, notamment à l'émission L'histoire à la une, en plus d'être un conférencier hors pair. Prisé pour ses talents de chercheur et de vulgarisateur, il a entre autres prêté son concours au Musée de la Civilisation à Québec, à Pointe-à-Callière, musée d'archéologie et d'histoire de Montréal, et au Musée McCord. Jacques Lacoursière a été nommé à l'Ordre du Canada en 2006.

SUNDAY, JUNE 8 DIMANCHE, LE 8 JUIN

Room-Salle VCH2850
11h30

ISABELLE BLAIN
VICE-PRESIDENT, NSERC / VICE-PRÉSIDENTE, CRSNG

Update from NSERC / Mise à jour par le CRSNG

NSERC will provide an update on various activities, particularly the two major reviews: the International Review of the Discovery Grants program and the GSC Structure Review.

Le CRSNG fera le point sur diverses initiatives, notamment les deux grandes revues : l'examen international du programme de subventions à la découverte et la revue de la structure des CSS.

Room-Salle VCH2850
13h30

JESS BREWER
UNIVERSITY OF BRITISH COLUMBIA / UNIVERSITÉ DE LA COLOMBIE-BRITANNIQUE

CAP Brockhouse Medal Winner / Récipiendaire de la médaille Brockhouse de l'ACP

μSR: Fantasy, Fiction, Physics
μSR: Fantaisie, fiction, physique

I will bring two talks to the Congress and let the audience decide which I should present on that occasion. One talk will be an introduction to the methods and applications of μSR (muon spin rotation/relaxation/resonance) for those who don't already know what it is or what it can do for science. The other talk will be a personal narrative about how a property of elementary particles that would once have been pure fantasy (forbidden by the "known laws of physics") became science fiction (possible but obviously impractical) in 1957, progressed to routine science in the last quarter of the 20th Century, and is now a standard tool of materials science, thanks to the advent in the 1970s of "meson factories" like TRIUMF.

Je préparerai deux conférences pour le congrès, et laisserai l'auditoire décider laquelle je vais présenter. L'une d'elles sera une introduction aux méthodes et applications de la μSR (rotation, relaxation, résonance du spin muonique) pour ceux qui ne savent pas ce que c'est ou ce que cela peut faire pour la science. L'autre conférence sera le récit personnel de la façon qu'une propriété de particules élémentaires qui aurait jadis été de la pure fantaisie (interdite par les " lois connues de la physique ") est devenue de la science fiction (possible mais manifestement irréalisable) en 1957, se mua en science de tous les jours dans le dernier quart du XXe siècle, et est maintenant un outil standard de la science des matériaux, grâce à l'avènement dans les années 1970 des " usines de mésons " comme TRIUMF.

Room-Salle POU 1112
17h00

NIGEL LOCKYER
DIRECTOR, TRIUMF / DIRECTEUR, TRIUMF

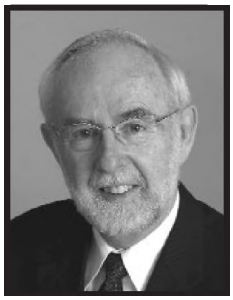
A Vision for TRIUMF / Une vision pour TRIUMF 2010-2015

Together with CAP, the Institute of Particle Physics and the Canadian Institute of Nuclear Physics are hosting a discussion of plans for the future of TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics. Director Nigel Lockyer will present a vision for the next decade of TRIUMF with specific attention to the next five-year funding proposal to the Government of Canada. The next decade will showcase a transformation of TRIUMF's core programs as well as enhance its connections to condensed-matter and materials physics and nuclear medicine. The articulation of this vision is the culmination of a year-long public process and significant effort by many in the broader community. A discussion period is included in the session. Please join us!

Avec l'ACP, l'Institut de physique des particules et l'Institut canadien de physique nucléaire animent une discussion sur la planification de l'avenir de TRIUMF, le laboratoire national canadien de physique nucléaire et de physique des particules. Le directeur Nigel Lockyer présentera une vision de TRIUMF pour la décennie qui vient, en s'attachant plus particulièrement à la prochaine demande de fonds quinquennale au gouvernement du Canada. La prochaine décennie verra une transformation des principaux programmes de TRIUMF dans laquelle les liens avec la physique de la matière condensée et des matériaux et la médecine nucléaire seront renforcés. L'articulation de cette vision est le point culminant d'un processus public d'un an et d'un effort marqué de plusieurs dans la communauté élargie. Cette session comprendra une période de discussion. Joignez-vous à nous!

MONDAY, JUNE 9 LUNDI, LE 9 JUIN

Room-Salle VCH2850
08h15



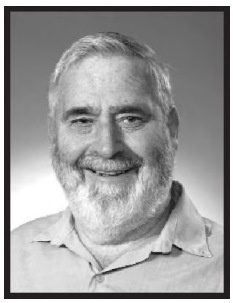
ART MCDONALD
QUEEN'S UNIVERSITY / UNIVERSITÉ QUEEN'S

SNO and the New SNOLAB Underground Facility / Le SNO et la nouvelle installation souterraine SNOLAB

The Sudbury Neutrino Observatory (SNO) has now completed neutrino detection with 1,000 tonnes of heavy water situated 2,000 meters underground in Vale-INCO's Creighton Mine near Sudbury. The final phase of operation involved an array of neutron detectors to observe the neutral current reaction of solar neutrinos on deuterium. These measurements define the flux of all neutrino types from the Sun with very different systematic uncertainties than previous phases of SNO. Comparing this measured flux with the flux of electron neutrinos observed with the charged current reaction on deuterium clearly exhibits neutrino flavor change and accurately determines neutrino properties. The underground facility is now being expanded to create a long-term international facility for underground science (SNOLAB), where measurements of Dark Matter, Double Beta Decay, Solar and Supernova Neutrinos will be performed with the lowest radioactive background available anywhere. The final operational phase of SNO, the future plans for the SNO detector and the plans for other experiments at SNOLAB when it is completed in 2008 will be described.

L'observatoire de neutrinos de Sudbury (SNO) a maintenant complété la détection de neutrinos avec 1000 tonnes d'eau lourde à 2000 mètres sous terre dans la mine Creighton de Vale-INCO près de Sudbury. Le stade final comportait un réseau de détecteurs de neutrons pour observer la réaction à courant neutre de neutrinos solaires sur le deutérium. Ces mesures définissent le flux de tous les types de neutrinos venant du Soleil avec des incertitudes systématiques très différentes de celles des stades antérieurs du SNO. La comparaison de ce flux mesuré avec le flux de neutrinos électroniques observé par la réaction à courant chargé sur le deutérium démontre clairement le changement de saveur des neutrinos et détermine précisément leurs propriétés. L'installation souterraine est présentement agrandie pour créer une installation internationale à long terme pour la science souterraine (SNOLAB), où des mesures de la matière sombre, de la double dégénérescence bêta, des neutrinos solaires ou provenant de supernovae seront effectuées avec le fond radioactif le plus faible en quelque endroit que ce soit. Je décrirai le stade opérationnel final du SNO, les plans futurs du détecteur SNO et les plans d'autres expériences à SNOLAB lors de sa complétion en 2008.

Room-Salle VCH2850
09h00



JOHN CAMPBELL
UNIVERSITY OF CANTEBURY / UNIVERSITÉ DE CANTEBURY

Rutherford - His Path to the Nobel Prize / Rutherford - Son parcours vers le prix Nobel

2008 is the centennial of Ernest Rutherford's Nobel Prize, the first for research carried out in Canada. I will cover some key points on his rise to scientific immortality (his brilliance as an experimentalist was clear in his earliest researches in New Zealand), some little known ones (we spell his name wrongly), and why one of the greatest physicists of all time never received a Nobel Prize in Physics. John Campbell, the author of Rutherford Scientist Supreme and www.rutherford.org.nz, is currently filming the first documentary of Rutherford's life and work.

L'année 2008 est le centième anniversaire du prix Nobel d'Ernest Rutherford, le premier octroyé pour de la recherche effectuée au Canada. Je vais rappeler quelques points majeurs de sa montée vers l'immortalité scientifique (en Nouvelle-Zélande déjà, ses premiers travaux expérimentaux étaient brillants), quelques points mineurs peu connus (nous épelons son nom incorrectement), et pourquoi l'un des plus grands physiciens de tous les temps n'a jamais reçu le prix Nobel de physique. John Campbell, l'auteur de Rutherford Scientist Supreme et de www.rutherford.org.nz, prépare présentement le premier film documentaire sur la vie et l'oeuvre de Rutherford.

Room-Salle POU 1112
13h30

HAIG FARRIS
FRACTAL CAPITAL CORP.

Help Wanted- physicists needed in business and politics- apply early and often / On embauche - physiciens demandés dans les affaires et la politique - postulez tôt et souvent

21st century world business challenges and opportunities are based on solving problems in physics. Physicists should play a leading role in 21st century politics and business in developing, implementing and communicating solutions. Physicists should shift their priorities from publishing in Nature and Science to taking the lead in creating new businesses, getting elected to major political offices and political institutions and re-educating students and society on the importance of physics in solving everyday problems in every area of society.

Les défis et les occasions d'affaires dans le monde du XXIe siècle sont basés sur la solution de problèmes de physique. Les physiciens devraient jouer un rôle majeur dans la politique et les affaires du XXIe siècle en développant, mettant en place et diffusant des solutions. Les physiciens devraient revoir leurs priorités et, au lieu de publier dans Nature et Science, ils devraient créer de nouvelles entreprises, se faire élire à des parlements et institutions politiques et rééduquer les étudiants et la société sur l'importance de la physique pour résoudre des problèmes quotidiens dans tous les champs de la société.

TUESDAY, JUNE 10 MARDI, LE 10 JUIN

Room-Salle VCH2850
08h15

ADAM J. SARTY

SAINT MARY'S UNIVERSITY / UNIVERSITÉ SAINT MARY'S

CAP Teaching Medal Winner / Récipiendaire de la médaille d'enseignement de l'ACP

Physics Education Across the Continuum: Opening Doors at All Levels
L'enseignement de la physique d'un bout à l'autre: ouvrir des portes à tous les niveaux

In the business of university physics education, I have encountered "doors" (both literal and figurative!) that face students and/or instructors - and the road to enhanced educational opportunities lies in the opening of these doors. In this presentation, I will explore the various doors I have found, and how I've attempted to open them. I hope to illustrate that, although these doors are located all across the educational continuum (from the elementary school student first encountering physics, to the first year university engineering student taking introductory physics, to elementary and high school science teachers, to the physics professors themselves), all of them can play an important role in university physics teaching. When closed, these doors present barriers that limit opportunity - for example (to name a few): a barrier between a narrow focus on teaching and the multidisciplinary, methodical practices conducted in the rest of the academy; a barrier between our students learning styles and how physics content is delivered; a barrier between a student's potential to succeed in university physics and their long-ingrained "fear of physics". While none of the "tools" I will discuss are particularly new - nor am I the first to utilize them - I hope that my linking together of many different tools and techniques (in seemingly disparate arenas), with the focus of enhancing accessibility to physics education through "opening doors", can provide some useful insight to others engaged in physics education pursuits.

Dans le travail d'enseignement de la physique à l'université, j'ai trouvé des " portes " (au sens propre et au sens figuré) auxquelles les étudiants et/ou les enseignants font face - et la route vers de meilleures occasions éducatives se révèle en ouvrant ces portes. Dans cet exposé, je vais explorer différentes portes que j'ai rencontrées, et comment j'ai essayé de les ouvrir. J'espère illustrer que, bien que ces portes soient situées d'un bout à l'autre du parcours éducatif (de l'élève du primaire rencontrant la physique pour la première fois, à l'étudiant de première année de génie dans un cours d'introduction à la physique, aux enseignants du primaire et du secondaire, et aux professeurs de physique eux-mêmes), elles peuvent toutes jouer un rôle important dans l'enseignement universitaire de la physique. Fermées, ces portes constituent des barrières qui restreignent les opportunités - par exemple (pour en nommer quelques-unes): une barrière entre un enseignement étroit et les pratiques multidisciplinaires et méthodiques ayant cours ailleurs dans l'institution; une barrière entre la façon d'apprendre de nos étudiants et la façon de leur présenter le contenu physique; une barrière entre la capacité de réussite d'un étudiant dans un cours de physique universitaire et sa " peur de la physique " bien incrustée. Bien qu'aucun des " outils " dont je vais parler ne soit particulièrement nouveau - et je ne suis pas non plus le premier à les utiliser - je souhaite que les liens que je vais établir entre différents outils et techniques (dans des arènes apparemment disparates), et mon insistance d'accroître l'accessibilité à l'enseignement de la physique par " l'ouverture de portes ", pourra donner quelques intuitions utiles à d'autres personnes engagées également dans l'enseignement de la physique.

Room-Salle VCH2850
09h00

ERIC MAZUR

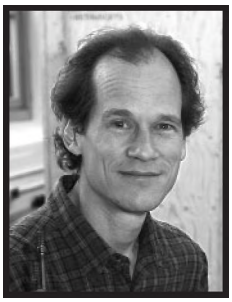
HARVARD UNIVERSITY / UNIVERSITÉ HAVARD

Confessions of a converted lecturer / Confessions d'un enseignant converti

I thought I was a good teacher until I discovered my students were just memorizing information rather than learning to understand the material. Who was to blame? The students? The material? I will explain how I came to the agonizing conclusion that the culprit was neither of these. It was my teaching that caused students to fail! I will show how I have adjusted my approach to teaching and how it has improved my students' performance significantly.

Je croyais être un bon enseignant, jusqu'à ce que je découvre que mes étudiants ne faisaient que mémoriser l'information plutôt qu'apprendre à comprendre la matière. Qui devait-on blâmer? Les étudiants? La matière? Je vais expliquer comment je suis arrivé à la conclusion navrante que le problème ne se trouvait ni dans l'un ni dans l'autre. Les étudiants échouaient à cause de mon enseignement! Je vais montrer comment j'ai adapté ma façon d'enseigner et comment la performance de mes étudiants en a été améliorée de manière significative.

Room-Salle VCH2850
13h30



LOUIS TAILLEFER

UNIVERSITY OF SHERBROOKE / UNIVERSITÉ DE SHERBROOKE

CAP Medal of Achievement Winner / Récipiendaire de la médaille de l'ACP

The Fermi Surface of high-Tc superconductors
La surface de Fermi des supraconducteurs à haute Tc

The recent observation of quantum oscillations in the resistance of high-Tc superconductors [1] has opened up a new pathway to investigate the baffling behavior of electrons in these materials*. I will describe recent experiments along that pathway, which may lead us, after two decades, to the fundamental organizing principles of high-T_c superconductivity.

L'observation récente d'oscillations quantiques dans la résistance des supraconducteurs à haute Tc [1] a ouvert un nouveau chemin pour l'étude du comportement ahurissant des électrons dans ces matériaux. Je vais décrire des expériences récentes le long de ce parcours, qui pourraient nous conduire, après deux décennies, aux principes organisateurs fondamentaux de la supraconductivité à haute T_c.

1. N. Doiron-Leyraud et al., Nature 447, 565 (2007).

* In collaboration with D.A. Bonn, W.N. Hardy and R. Liang at UBC, and Cyril Proust at the LNCMP in Toulouse, France.

WEDNESDAY, JUNE 11 MERCREDI, LE 11 JUIN

Room-Salle VCH2850
08h15

JACQUES BEAULIEU

BEAULIEU CONSULTANT INC.

CAP-INO Medal Winner / Récipiendaire de la médaille de l'ACP-INO

From Optics to Photonics in 50 Years / De l'optique à la photonique en 50 ans

After reviewing the impact of the discoveries of geometrical Optics, the evolution of Quantum Optics since the late 50's and that of associated data processing electronics led to the concept of Photonics. A variety of applications of this technology will be outlined, and some potential future applications will be discussed.

Débutant par une revue de l'impact des découvertes de l'Optique géométrique, puis celle de l'évolution de l'Optique Quantique depuis les années 50 et associée au développement du traitement électronique des données ont mené au concept de la Photonique. Une grande variété des applications de cette technologie sera soulignée et le potentiel de futures applications sera présenté.

Room-Salle VCH2850
09h00

CARL SVENSSON

UNIVERSITY OF GUELPH / UNIVERSITÉ DE GUELPH

CAP Herzberg Medal Winner / Récipiendaire de la médaille Herzberg de l'ACP

Gamma-Ray Spectroscopy with Radioactive Ion Beams at TRIUMF-ISAC
Spectroscopie de rayons gamma avec des faisceaux d'ions radioactifs à TRIUMF-ISAC

Over the past decade, the world's premier online isotope separator and accelerator facility, ISAC, has been developed at TRIUMF, Canada's national laboratory for nuclear and particle physics research. ISAC produces high-quality, high-intensity beams of radioactive ions that greatly expand the selection of isotopes available to both subatomic physics and material science researchers. The evolution of the complex nuclear many-body system far from the stable combinations of neutrons and protons that form the isotopes of everyday experience is probed and its implications for the synthesis of the heavy chemical elements in explosive astrophysical environments explored. Particular isotopes with desirable properties are selected and exploited in applications as diverse as studies of surface magnetization in thin films to tests of the electroweak Standard Model and searches for new fundamental interactions through high-precision measurements. Gamma-ray spectroscopy with large arrays of high-resolution gamma-ray detectors provides a particularly powerful, and versatile, technique for the study and exploitation of these unique beams of radioactive ions and this presentation will provide an overview of recent progress and highlights in the gamma-ray spectroscopy programs with the Canadian 8π Gamma-Ray Spectrometer and the newly-commissioned TRIUMF-ISAC Gamma-Ray Escape Suppressed Spectrometer (TIGRESS) at ISAC.

Au cours de la dernière décennie, le principal accélérateur et séparateur d'isotopes en ligne au monde, ISAC, a été développé à TRIUMF, le laboratoire canadien de recherche en physique nucléaire et des particules. ISAC produit des faisceaux d'ions radioactifs de grande qualité et de grande intensité, qui augmentent beaucoup la sélection d'isotopes disponibles pour les chercheurs de physique subatomique et de science des matériaux. L'évolution du système nucléaire complexe à plusieurs corps loin des combinaisons stables de protons et de neutrons qui constituent les isotopes de l'expérience de tous les jours est analysée et ses implications pour la synthèse des éléments chimiques lourds dans des environnements astrophysiques explosifs sont explorées. Des isotopes spécifiques avec des propriétés désirables sont choisis et exploités dans des applications aussi diverses que des études de la magnétisation de surface dans des couches minces, des tests du modèle standard électrofaible et des recherches de nouvelles interactions fondamentales à travers des mesures de haute précision. La spectroscopie de rayons gamma avec de vastes réseaux de détecteurs de haute résolution constitue une technique particulièrement puissante et versatile pour l'étude et l'exploitation de ces faisceaux uniques d'ions radioactifs. Cette présentation survolera les progrès récents et les faits saillants des programmes de spectroscopie de rayons gamma avec le spectromètre canadien 8π et le nouveau spectromètre TRIUMF-ISAC à échappement supprimé (TIGRESS) à l'ISAC.

Room-Salle VCH2850
13h30

RICHARD CLEVE

UNIVERSITY OF WATERLOO / UNIVERSITÉ DE WATERLOO

CAP-CRM Prize Winner / Récipiendaire du Prix ACP-CRM

Quantum Information, Computation and Communication / L'informatique, le calcul et la communication quantiques

In the past fifteen years, a number of interesting algorithms for hypothetical quantum computers have been discovered. These algorithms are fundamentally different from any algorithms for existing "classical computers". They harness the strange power of quantum mechanics to solve certain computational problems much faster than classical algorithms can. I will give an overview of this subject, including a broader perspective of quantum information.

Au cours des quinze dernières années, plusieurs algorithmes intéressants pour des ordinateurs quantiques hypothétiques ont été découverts. Ceux-ci sont fondamentalement différents de tout algorithme pour les " ordinateurs classiques " actuels. Ils mettent à profit l'étrange pouvoir de la mécanique quantique de résoudre certains problèmes numériques beaucoup plus vite que les algorithmes classiques. Je vais faire un survol du sujet, en ouvrant une perspective plus large sur l'informatique quantique.

Canadian Assocation of Physicists
Association canadienne des physiciens et physiciennes

PRIZE WINNERS / GAGNANTS DES PRIX

University Prize Exam Results 2008
Résultats de l'examen du prix universitaire 2008

79 students from 27 post-secondary institutions competed this year. The exam was run by representatives from the University of Victoria and was held on February 5th, 2008. The examining committee was led by Maxim Pospelov / 79 étudiants de 27 universités ont écrit l'examen cette année. *Le concours universitaire 2008 de l'ACP a eu lieu 5 février, 2008. Cet examen fut administré par Maxim Pospelov, de l'Université Victoria.*

Mark York	**First Prize / Premier Prix**	Queen's Univ. / Univ. Queen's
Cedric Lin	**Second Prize / Deuxième Prix**	Univ. of B.C. / Univ. de la C.-B.
Alan Robinson	**Third Prize / Troisième Prix**	Univ. of B.C. / Univ. de la C.-B.

4.	Michael Jansz	UBC	6.	Benjamin Schmidt	U. of Toronto
5.	Maggie McLean	Queen's U.	9.	Eric Ouellette	Mt. Allison U.
6.	Simon Blackburn	U. de Montréal	9.	Brett Steeple	U. of Calgary
6.	Éric Giguère	U. de Sherbrooke			

2008 University Prize Examination - Examen du prix universitaire 2008
(Highest scoring student from each participating University
L'étudiant supérieur à chaque université participante)

Brandon University / Université Brandon
- Christian Schroeder

Carleton University / Université Carleton
- Artur Kochermin

Dalhousie University / Université Dalhousie
- Stephen Foster

McGill University / Université McGill
- Victor Yu

Mt. Allison University / Université Mt. Allison
- Eric Ouellette

Laurentian University / Université Laurentienne
- Gabriello Presenza-Pitman

Queen's University / Université Queen's
- Mark York

Ryerson University / Université Ryerson
- Arjit Baghwala

Simon Fraser University / Université Simon Fraser
- Joel Zylberberg

Trent University / Université Trent
- Eric Brown

University of Montréal / Université de Montréal
- Simon Blackburn

U.Q.T.R. / U.Q.T.R.
- Eric Bordeleau

Laval University / Université Laval
- Simon Viel

University of Sherbrooke / Université de Sherbrooke
- Éric Giguère

University of Alberta / Université d'Alberta
- Jason Martyn

Univ. of British Columbia / Univ. de la Colombie-Brit.
- Cedric Lin

University of Calgary / Université de Calgary
- Brett Teeple

University of Guelph / Université de Guelph
- Meaghan Ward

University of New Brunswick / Université du Nouveau-Brunswick
- Sam Kirstoffersen

University of Ottawa / Université d'Ottawa
- Jennifer Scharf

University of P.E.I. / Université de l'I.P.E.
- Kaveh Mozafari

University of Saskatchewan / Université de la Saskatchewan
- Stepan Wiedenmann

University of Toronto / Université de Toronto
- Benjamin Schmidt

University of Waterloo / Université de Waterloo
- Matthew Badali

University of Western Ontario / Université Western Ontario
- Sam Chippin

University of Windsor / Université de Windsor
- Jeff Rau

Wilfrid Laurier University/ Université Wilfrid Laurier
- Gavin Lobo

The first prize winner receives an all-expense paid trip to the CAP Congress to receive his cash award during the banquet. / *Le gagnant du premier prix est invité à participer au congrès annuel de l'ACP, toutes dépenses payées, pour recevoir son prix au banquet.*

ABBREVIATION KEY / CODES DES ABRÉVIATIONS

Divisions

DAMPhi	Division of Atomic and Molecular Physics and Photon Interactions
DPAMip	*Division de physique atomique et moléculaire et d'interactions avec les photons*
DASP	Division of Atmospheric and Space Physics
DPAE	*Division de physique atmosphérique et de l'e-space*
DCMMP	Division of Condensed Matter and Materials Physics
DPMCM	*Division de physique de la matière condensée et matériaux*
DMBP	Division of Medical and Biological Physics
DPMB	*Division de physique médicale et biologique*
DIAP	Division of Industrial and Applied Physics
DPIA	*Division de physique industrielle et appliquée*
DHP	Division of History of Physics
DHP	*Division de l'histoire de la physique*
DIMP	Division of Instrumentation and Measurement Physics
DPIM	*Division de physique des instruments et mesures*
DNP	Division of Nuclear Physics
DPN	*Division de physique nucléaire*
DOP	Division of Optics and Photonics
DOP	*Division d'optique et photonique*
DPE	Division of Physics Education
DEP	*Division de l'enseignement de la physique*
DPP	Division of Plasma Physics
DPP	*Division de physique des plasmas*
DSS	Division of Surface Sciences
DSS	*Division de la science des surfaces*
DTP	Division of Theoretical Physics
DPT	*Division de physique théorique*
PPD	Particle Physics Division
PPD	*Division de physique des particules*
CEWIP	Committee to Encourage Women in Physics
CEFEP	*Comité pour encourager les femmes en physique*

(G) = Graduate student
étudiant diplômé
(U) = Undergraduate student
étudiant de première cycle
* = Student competitor
compétiteur étudiant

Sessions

SA-Exec	Saturday Executive Meeting / Réunion de l'exécutif du samedi
SA-Coun	Saturday Council Meeting / Réunion du conseil du samedi
SU-xx	Sunday meeting / Réunion du dimanche
SU-A#	Sunday A.M. Session / Session du dimanche matin
SU-P#	Sunday P.M. Session / Session du dimanche après-midi
SU-KEY	Sunday Night Keynote (Herzberg) Speaker / Session plénière publique (Herzberg) du dimanche soir
MO-xx	Monday meeting / Réunion du lundi
MO-A#	Monday A.M. Session / Session du lundi matin
MO-P#	Monday P.M. Session / Session du lundi après-midi
MO-POS#	Monday evening Poster Session / Session d'affiches du lundi soir
MO-PUBLIC	Monday Night Public Lecture / Session publique du lundi soir
TU-xx	Tuesday meeting / Réunion du mardi
TU-A#	Tuesday A.M. Session / Session du mardi martin
TU-P#	Tuesday P.M. Session / Session du mardi après-midi
WE-xx	Wednesday meeting / Réunion du mercredi
WE-A#	Wednesday A.M. Session / Session du mercredi matin
WE-STUD	Wednesday Best Student Presentations Final Competition / Compétition finale pour les meilleures communications étudiantes, le mercredi matin
WE-P#	Wednesday P.M. Session / Session du mercredi après-midi
xx-Plen	Plenary session on Sunday (SU), Monday (MO), Tuesday (TU) or Wednesday (WE) / Session plénière du dimanche (SU), lundi (MO), mardi (TU), ou mercredi (WE)

INVITED SPEAKERS / *CONFÉRENCIERS INVITÉS*

(in alphabetical order / *selon l'ordre alphabétique*)

AGUILO, Ernest (PPD / PPD)
University of Alberta and York University
Latest Results of the DZero Experiment

ALBERT, Jacques (DOP / DOP)
Carleton University
Multiparameter sensing mechanisms from gratings in optical fibers

BACCA, Sonia (DNP-DTP / DPN-DPT)
TRIUMF
Ab Initio Reactions of Light Nuclei

BARRETTE, Jean (DHP / DHP)
McGill University
Ernest Rutherford at McGill

BEACH, Kevin (DCMMP / DPMCM)
University of Alberta
Simulating frustrated spin systems using valence bonds

BEAULIEU, Jacques (CAP-INO / ACP-INO) **PLENARY-PLÉNIÈRE**
Beaulieu Consultant Inc. (see pg. 16 / voir pg. 16)
From Optics to Photonics in 50 Years / De l'optique à la photonique en 50 ans

BEAULIEU, Rene (CAP-DOP / ACP-DOP)
Institut national d'optique
Revue des principaux travaux de recherche réalisés par le Professeur Roger A. Lessard

BEHR, John (DNP / DPN)
TRIUMF
Standard Model tests by measurement of the daughter nucleus momentum from laser-trapped radioactives

BERCIU, Mona (DCMMP / DPMCM)
University of British Columbia
Manipulating spin and charge in diluted magnetic semiconductors

BERTRAM, Allan (DSS / DSS)
University of British Columbia
Heterogeneous atmospheric chemistry at night

BEYEA, Steven (DMBP / DPMB)
National Research Council of Canada
Novel Acquisition Techniques for High Field Functional MRI (fMRI)

BLAIN, Isabelle (CAP-NSERC / ACP-CRSNG) **PLENARY-PLÉNIÈRE**
NSERC / CRSNG (see pg. 13 / voir pg. 13)
Update from NSERC / Mise à jour par le CRSNG

BLANCHARD, Vincent (DPP / DPP)
FPInnovations-FORINTEK
Plasma technology for the wood product industry

BOUDOUX, Caroline (DOP-DMBP / DOP-DPMB)
Ecole Polytechnique de Montréal
Confocal endoscopy: in vivo cellular resolution imaging of human organs

BOULAY, Mark G. (PPD / PPD)
Queen's University
Status of DEAP/CLEAN at SNOLAB

BRANDENBERGER, Robert (DTP / DPT)
McGill University
Progress in String Gas Cosmology

BREWER, Jess H. (CAP-DCMMP / ACP-DPMCM) **PLENARY-PLÉNIÈRE**
University of British Columbia (see pg. 13 / voir pg. 13)
μSR: Fantasy, Fiction, Physics / μSR : Fantaisie, fiction, physique

CADOGAN, Sean (DCMMP / DPMCM)
University of Manitoba
Magnetism, Valence and the Magnetocaloric Effect in $R_5(Si,Ge)_4$ compounds (R =rare-earth)

CAMPBELL, John (CAP / ACP) **PLENARY-PLÉNIÈRE**
University of Canterbury New Zealand (see pg. 14 / voir pg. 14)
Rutherford - His Path to the Nobel Prize / Rutherford - Son parcours vers le prix Nobel

CHAPMAN, Dean (DIAP-DIMP / DPIA-DPIM)
University of Saskatchewan
The Biomedical Imaging and Therapy Beamline at the Canadian Light Source

CHAPMAN, Gilbert B. (DIAP / DPIA)
DaimlerChrysler Center, University of Windsor
The Greening of Ground Transportation in North America

CHBIHI, Abdelouahad (DNP / DPN)
GANIL
Exploring the symmetry energy with isospin effects in heavy-ion collisions

CHEN, Qiying (DOP-DMBP / DOP-DPMB)
Memorial University of Newfoundland
Fibre Bragg gratings for optical biosensors

CLEVE, Richard (CAP-CRM / ACP-CRM) **PLENARY-PLÉNIÈRE**
University of Waterloo (see pg. 16 / voir pg. 16)
Quantum Information, Computation and Communication / L'informatique, le calcul et la communication quantiques

CLINE, James (DTP / DPT)
McGill University
Nongaussianity in the Cosmic Microwave Background from Nonlocal Inflation Models

CÔTÉ, Daniel (CAP-DPE / ACP-DEP)
Centre de recherche Université Laval Robert-Giffard
Photonique appliquée à la recherche sur les neurones

COUCHMAN, Hugh (CAP / ACP)
McMaster University
Computational Astrophysics

DAMASCELLI, Andrea (DCMMP-DIMP / DPMCM-DPIM)
University of British Columbia
The Legacy of Einstein's Photoelectric Effect: From Light Quanta to Quantum Phenomena in Solids

DAVOUR, Anna (PPD-DNP / PPD-DPN)
Queen's University
The PICASSO Dark Matter Search Project

DESGRENIERS, Serge (DCMMP-DIMP / DPMCM-DPIM)
Université d'Ottawa
X-ray Micro-Diffraction: A Remarkable Tool for the Study of Condensed Matter Under Extreme Conditions

DIXIT, Madhu (PPD / PPD)
TRIUMF/Carleton University
The International Linear Collider - a precision probe for physics in the post-LHC era

DRISSEN, Laurent (DASP / DPAE)
Université Laval
The International Year of Astronomy 2009

DUAN, Luming (DAMPhi-DOP / DPAMip-DOP)
University of Michigan, Ann Arbor
Controlling interaction of ultracold atoms in an optical superlattice

ELFIMOV, Ilya (DCMMP / DPMCM)
University of British Columbia
Novel aspects in oxide's physics

FARRIS, Haig (CAP / ACP) **PLENARY-PLÉNIÈRE**
Fractal Capital Corp. (see pg. 14 / voir pg. 14)
Help Wanted- physicists needed in business and politics- apply early and often / On embauche - physiciens demandés dans les affaires et la politique - postulez tôt et souvent

FLEMING, George (DTP / DPT)
Yale University
Lattice Study of the Conformal Window in QCD-like Theories

FRASER, James M. (DOP / DOP)
Queen`s University
Ultrafast Dynamics of a Single-Walled Carbon Nanotube

FRISKEN, Barbara (DCMMP / DPMCM)
Simon Fraser University
Carbopol - Microrheology and Microstructure

FROHLICH, Carla (DNP / DPN)
University of Chicago
Nuclear Physics Aspects of an Astrophysical Nucleosynthesis Process

GARCIA-SUCERQUIA, Jorge (CAP-DOP / ACP-DOP)
COPL, Université Laval
Digital Holography: A Modern Perspective of Dennis Gabor's Invention

GARDNER, Philip Lawrence (CAP-CORP / ACP-CORP)
TRIUMF
Commercializing Fundamental Physics Research: The TRIUMF Experience

GHAZZALI, Nadia (CEWIP / CEFEP)
Université Laval
Perspectives from the NSERC/Industry Chair for Women in Science and Engineering in Quebec

GILBERT, Raymond (DIAP / DPIA)
Opsun Technologies Inc.
Solar Energy Extraction: A Real Challenge for Physicists / L'Extraction de l'énergie solaire, un défi de taille pour les physiciens

GOMIS, Jaume (DTP / DPT)
Perimeter Institute
Non-local Operators in Gauge Theory and Holography

GRAHAM, Kevin (PPD-DNP / PPD-DPN)
Carleton University
Measuring Neutrino Mass with EXO

GRIFFIN, Allan (DHP / DHP)
University of Toronto
100 years of Liquid Helium: Highlights of Canadian Research

GWINNER, Gerald (DNP / DPN)
University of Manitoba
Test of relativistic time dilation with fast optical atomic clocks at different velocities

HALL, Kimberley (DOP / DOP)
Dalhousie University
Ultrafast Control of Spin Dynamics

HARRISON, David (DPE / DEP)
University of Toronto
Implementing Physics Practicals

HAWKES, Robert (DPE / DEP)
Mount Allison University
Guided Collaborative Learning: Not Just for First Year Physics

HEGMANN, Frank (DPP / DPP)
University of Alberta
High intensity THz pulse generation and imaging at ALLS

HÉON, Christian (CAP-DPE / ACP-DEP)
Cégep de Victoriaville
L'apprentissage par projet en physique

HILL, Ian (DCMMP / DPMCM)
Dalhousie University
The Importance of Interfaces in Organic Electronic Devices

HOLT, Richard (DAMPhi / DPAMip)
University of Western Ontario
Recent progress in fast-ion-beam laser measurements of atomic data for astrophysics

HOLVOET, Servaas (DPP / DPP)
Université Laval
Nano-Coating and Surface Functionalisation: Towards High-Performance Vascular Biomaterials

HUBER, Garth (DNP / DPN)
University of Regina
Physics Potential of the Jefferson Lab 12 GeV Upgrade

HU, Can-Ming (DCMMP / DPMCM)
University of Manitoba
Spin Dynamics in Ferromagnetic and Spintronic Materials

JANISSEN, Lee Ann (CAP-CORP / ACP-CORP)
TD Securities
A Physicist's Career in the Wholesale Banking World

JANSSENS, Robert (DNP / DPN)
Argonne National Laboratory
Hunt for new shell structure in neutron-rich nuclei

JIRASEK, Andrew (DMBP / DPMB)
University of Victoria
Polymer gel dosimetry for 3D dose verification in radiation therapy

KANUNGO, Rituparna (DNP / DPN)
Saint Mary's University
Nuclear halos : A new era in nuclear physics

KAVANAGH, Karen (DCMMP / DPMCM)
Simon Fraser University
Magnetic Semiconductors - The Basics

KIEFFER, Jean-Claude (DPP / DPP)
Université du Québec, INRS
Can relativistic plasmas engineering with femtosecond lasers have societal applications?

KIEFFER, Jean-Claude (DOP / DOP)
Université du Québec, INRS
The 200TW laser at the Advanced Laser Light Source facility: Progress, first experiments and perspectives of high power femtosecond technology

KILFOIL, Maria (DMBP / DPMB)
McGill University
Single cell fast spindle dynamics probed by automated phenotyping

KRUSHELNICK, Karl (PPD / PPD)
University of Michigan
Compact laser-plasma based accelerators

LACOURSIÈRE, Jacques (CAP / ACP) **PLENARY-PLÉNIÈRE**
Beauport, Québec (see pg. 12 / voir pg. 12)
Petite histoire des sciences et de leur enseignement au Québec / Anecdotes on the history of science and its teaching in Québec

LAFLAMME, Raymond (CAP / ACP) **PLENARY-PLÉNIÈRE**
IQC / University of Waterloo (see pg. 11 / voir pg. 11)
Harnessing the Quantum World / Maîtriser le monde quantique

LAFLAMME, Raymond (CAP-DPE / ACP-DEP)
IQC/University of Waterloo
Quantum Information Processing

LANGILL, Philip P. (DPE / DEP)
University of Calgary
Hands-on Physics at an Observatory? (or, is 'Physics' the better half of 'Astrophysics'?)

LEBEL, Céline (DTP-PPD / DPT-PPD)
Université de Montréal
The ATLAS detector at LHC

LEONELLI, Richard (DCMMP / DPMCM)
Université de Montréal
Ga(In)AsN: an unusual semiconductor alloy

LEWIS, Laurent (DCMMP-DTP / DPMCM-DPT)
Université de Montréal
Laser ablation with short and ultrashort laser pulses: basic mechanisms from MD simulations

LOCKYER, Nigel (CAP-TRIUMF / ACP-TRIUMF) **PLENARY-PLÉNIÈRE**
TRIUMF (see pg. 13 / voir pg. 13)
A Vision for TRIUMF 2010-2015 / Une vision pour TRIUMF 2010-2015

LOGAN, Heather (DTP-PPD / DPT-PPD)
Carleton University
What's new at the energy frontier

LVOVSKY, Alexander (DAMPhi-DOP / DPAMip-DOP)
University of Calgary
Quantum memory for continuous-variable optical states

MAEVA, Elena (DIAP / DPIA)
University of Windsor
New BioCar Ontario Initiative: Biocomposite materials

MALONEY, Alexander (DTP / DPT)
McGill University
Partition Functions of Three Dimensional Quantum Gravity

MANDELIS, Andreas (DIMP-DMBP / DPIM-DPMB)
Center for Advanced Diffusion Wave Technologies; Quantum Dental Technologies
Investigation of Demineralization and Remineralization of Human Teeth Using Infrared Photothermal Radiometry and Modulated Luminescence

MANN, Robert (DTP / DPT)
University of Waterloo
Boundaries Unbound

MARCHILDON, Louis (CAP / ACP) **PLENARY-PLÉNIÈRE**
Université du Québec à Trois-Rivières (see pg. 119 / voir pg. 119)
Promouvoir la physique canadienne: réalisations et défis / Achievements and challenges in promoting Canadian physics

MARGOT, Joëlle (DPP / DPP)
Université de Montréal
Plasma-Québec : a unique strategic network in Plasma Science and Applications

MARSIGLIO, Frank (DCMMP / DPMCM)
University of Alberta
Flippin' Spins: a Quantum Mechanical Approach

MARTIN, John F. (PPD / PPD)
University of Toronto
The History and Physics Impact of the HERA e-p Collider

MARTINU, L. (DPP / DPP)
École polytechnique de Montréal
From understanding ion-surface interactions in a plasma environment to advanced surface engineering solutions

MAZUR, Eric (DPE / DEP)
Harvard University
The interactive learning toolkit: technology and the classroom

MAZUR, Eric (CAP / ACP) **PLENARY-PLÉNIÈRE**
Harvard University (see pg. 15 / voir pg. 15)
Confessions of a converted lecturer / Confessions d'un enseignant converti

MCDONALD, Art (CAP / ACP) **PLENARY-PLÉNIÈRE**
Queen`s University (see pg. 14 / voir pg. 14)
SNO and the New SNOLAB Underground Facility / Le SNO et la nouvelle installation couterraine SNOLAB

MCKELLAR, A. Robert (DAMPhi-DIMP / DPAMip-DPIM)
National Research Council
Longer wavelengths, higher resolution, and greater absorption paths with the far infrared beamline at the Canadian Light Source

MCKENNA, Janis (CAP-DPE / ACP-DEP)
University of British Columbia
Symmetries and broken symmetries

MELKO, Roger (DCMMP / DPMCM)
University of Waterloo
Quantum Phase Transitions via Large-Scale Computing

METLITSKI, Max (DTP / DPT)
Harvard University
Duality and Wilson Loops in Non-Compact U(1) Gauge Theories

MEUNIER, Michel (DIAP-DIMP / DPIA-DPIM)
Ecole Polytechnique de Montréal
Ultrafast laser processing of nanomaterials for biomedical applications

MILNER-BOLOTIN, Marina (DPE / DEP)
Ryerson University
Physics for Architects: Design, Implementation and Evaluation of Innovative Physics Curricula

MOUSSEAU, Normand (CAP / ACP)
Université de Montréal
Simuler la dynamique des protéines

PAGE, John (DCMMP / DPMCM)
University of Manitoba
Localization of ultrasound in a three-dimensional elastic network.

PATITSAS, Steve S.N. (DCMMP / DPMCM)
University of Lethbridge
STM studies of the dissociation of trichloroethylene on silicon surfaces: Possible consequences for thin film growth

PEAK, Derek (DSS / DSS)
University of Saskatchewan
Mineral structure, surface complexation, and the solid/water interface: Insights on general aqueous surface chemistry from ATR-FTIR and XAS studies of S and Se oxyanion adsorption

PELLING, Andrew (DMBP / DPMB)
University College London
Mechanics in the Moment

PETRY, Robert (DNP / DPN)
University of Regina
Lattice methods for light-quark mesons

PICHÉ, Michel (DAMPhi-DOP / DPAMip-DOP)
Université Laval
Acceleration of charged particles using ultrafast transverse magnetic laser beams of multiterawatt power

PICKET, Warren (DCMMP / DPMCM)
University of California Davis
Correlated Electrons I: Applications from DFT through DMFT to Complex Materials

POEPPING, Tamie (DMBP / DPMB)
University of Western Ontario
Vascular Modeling and Hemodynamics Research Using Ultrasound and Particle Imaging

POISSON, Eric (DTP / DPT)
University of Guelph
Black holes in tidal environments

POND, James (DIAP / DPIA)
Lumerical Solutions Inc.
Rigorous electromagnetic simulation of current and next-generation photonic devices: challenges and opportunities

POUTISSOU, Jean-Michel (CAP-DPE / ACP-DEP)
TRIUMF
L'étude des phénomènes stellaires en laboratoire à TRIUMF

PREDOI-CROSS, Adriana (DAMPhi / DPAMip)
University of Lethbridge
Laboratory spectroscopy for planetary remote sensing

PYWELL, Robert (DHP / DHP)
University of Saskatchewan
A Scrapbook History of Physics at the University of Saskatchewan

RAGAN, Ken (PPD / PPD)
McGill University
Results of the first year of operation of the VERITAS ground-based gamma-ray observatory

RAHILLY, Tony (CAP-CORP / ACP-CORP)
NRC - IRAP
From Physics in the Lab to Products at the Retailer: The Speed of Innovation and the Acceleration of Commercialization

RAINVILLE, Simon (CAP-DPE / ACP-DEP)
Université Laval
Very high precision mass measurements: does $E = mc^2$?

ROBERTSON, Steven (PPD / PPD)
Institute for Particle Physics / McGill University
SuperB: New Physics Opportunities at a High Luminosity Flavour Factory

ROBERTSON, Steven (PPD / PPD)
Institute for Particle Physics / McGill University
Recent results from the BABAR experiment

ROBINSON, Joseph (DPP / DPP)
Imperial College London
Sub-optical-cycle measurements using high harmonic generation

ROOT, John (DHP / DHP)
National Research Council of Canada
The National Research Universal (NRU) Reactor - Fifty years of Excellence

ROSS, Amanda (DAMPhi / DPAMip)
Université Lyon
Laboratory exploration of gas phase spectra of some transition metal hydrides

ROSS, Stephen (DAMPhi / DPAMip)
University of New Brunswick
Selected Aspects of Large Amplitude Motion in Molecules

ROTTLER, Joerg (DMBP / DPMB)
University of British Columbia
Deformation, flow and aging in glassy materials

ROY, Jean-Yves (CAP-CORP / ACP-CORP)
INO
How INO brings innovation to help companies improve their competitive edge and contributes to their development

ROY, Rene (CAP-DOP / ACP-DOP)
Université Laval
Des souvenirs qui font vivre

RUPRECHT, Gotz (DNP / DPN)
TRIUMF
TACTIC - a tracking detector for ions from nuclear reactions

SARKAR, Dilip (DPP / DPP)
DSA, University of Quebec
Superhydrophobic and icephobic coating by plasma process

SARTY, Adam James (CAP / ACP) **PLENARY-PLÉNIÈRE**
Saint Mary's University (see pg. 15 / voir pg. 15)
Physics Education Across the Continuum: Opening Doors at All Levels / L'enseignement de la physique d'un bout à l'autre : ouvrir des portes à tous les niveaux

SARTY, Adam James (DNP / DPN)
Saint Mary's University
Upcoming Proton Form Factor Ratio Measurements at Extreme Momentum Transfers: from 0.015 to 15.0 GeV^2

SHAKER, Jafar (CAP-DOP / ACP-DOP)
Communications Research Centre Canada
Volume Holograms at Microwave Frequency Band

SHEN, Jun (DIMP / DPIM)
National Research Council of Canada
Top-hat cw laser induced time-resolved mode-mismatched thermal mirror and thermal lens spectroscopies

SKOROBOGATIY, Maksim (DOP / DOP)
École Polytechnique, Montréal
Photonic textiles and their applications

STAFFORD, Luc (DPP / DPP)
Université de Montréal
Studies of plasma reactions on dynamic surfaces using a novel rotating substrate technique

STEINITZ, Michael Otto (CAP-DOP / ACP-DOP)
St. Francis Xavier University
Roger Lessard and the CAP

STEINITZ, Michael Otto (DHP / DHP)
St. Francis Xavier University
In Defense of Peter J. W. Debye

SULLIVAN, Donald Edward (DTP / DPT)
University of Guelph
Field Theory for Polymeric Materials

SUNIL KUMAR, P.B. (DMBP / DPMB)
Indian Institute of Technology, Madras
Strain hardening, avalanches and strain softening in dense cross-linked actin networks

SVENSSON, Carl (CAP / ACP) **PLENARY-PLÉNIÈRE**
University of Guelph (see pg. 16 / voir pg. 16)
Gamma-Ray Spectroscopy with Radioactive Ion Beams at TRIUMF-ISAC / Spectroscopie de rayons gamma avec des faisceaux d'ions radioactifs à TRIUMF-ISAC

TAILLEFER, Louis (CAP / ACP) **PLENARY-PLÉNIÈRE**
Université de Sherbrooke (see pg. 15 / voir pg. 15)
The Fermi Surface of High T_c Superconductors / La surface de Fermi des supraconducteurs à haute T_c

TANAKA, Hirohisa (PPD / PPD)
University of British Columbia
T2K and the Next Generation of Neutrino Oscillation Experiments

TELENKOV, Sergey (DIMP-DMBP / DPIM-DPMB)
CADIFT, Dept. of Mechanical Engineering, University of Toronto
Photothermoacoustic (PTA) imaging of breast tissue: numerical simulation and detection analysis

TÉTU, Michel (CAP-DPE / ACP-DEP)
Université Laval
The Photonics within the ALMA Radiotelescope / La photonique dans le radio-télescope ALMA (Atacama Large Millimeter-Wave Array)

TREMBLAY, Pierre (DAMPhi-DIMP / DPAMip-DPIM)
Université Laval
Work on Fourier-transform spectrometers at Université Laval

TROTTIER, Howard (CAP / ACP)
Simon Fraser University
Quantum Chromodynamics on a space-time lattice

TROYER, Matthias (CAP / ACP)
ETH Zurich
Simulating exotic quantum states of matter

VENUS, David (DCMMP / DPMCM)
McMaster University
Measurements of static and dynamic susceptibility exponents of an ultrathin ferromagnetic film

VETTERLI, Mike (CAP / ACP)
Simon Fraser University/TRIUMF
ATLAS Computing: Dealing with PetaBytes of Data per Year

VIDAL, François (DPP / DPP)
Institut national de la recherche scientifique
Laser ablation threshold dependence on pulse duration and wavelength for corneal tissues: experiments and modeling

WARBURTON, Andreas (PPD / PPD)
McGill University
Recent Results from the Collider Detector at Fermilab (CDF)

WRIGHT, Alex (PPD / PPD)
Queen's University
The SNO+ Experiment at SNOLAB

XU, Yuan (DIMP-DMBP / DPIM-DPMB)
Ryerson University
Magneto-Acousto-Electrical Tomography: a Potential Imaging Modality for Electrical Impedance

CAP Congress 2008

Listeners, Speakers, and Session Chairs

SPECIAL INSTRUCTIONS FOR TIMED PAPERS

In order to ensure that listeners can transfer from one session to another, the oral presentations will be timed. As a courtesy to all conference participants, we would ask that the following simple guidelines be observed. Your cooperation is appreciated.

EVERYONE - Ensure that you are wearing your Congress name badge at all times.

LISTENERS

- Please arrive at a lecture room promptly before the next paper is to begin.
- Please leave a session unobtrusively, preferably during or at the end of the question and answer period.

SPEAKERS

- Make your computer arrangements before the start of your session.
- Be ready to start your talk on time.
- Pace your talk to end well before the next talk begins: about 3 minutes for a contributed paper and about 5 minutes for an invited paper.
- Answer questions and comments as efficiently as possible; defer any follow-up discussions to be continued after the session or in a coffee break.
- Obey your session chair's instructions.

SESSION CHAIRS

- Arrive at the session room no later than 15 minutes before your session begins. Check that all needed projection and auxiliary equipment are present and operational. Check that your speakers, AV technician, and any required judges for student competition entries are also present.
- Introduce yourself to the assistant in room and verify that session timer is working.
- Start each paper right on time.
- Make sure each speaker stops talking well before the next paper begins.
- Keep the question periods interesting, lively, and productive. Read over the papers in your session beforehand. If necessary, prepare comments and questions.
- Do not let any discussion period get out of hand, either on the speaker's or the questioner's side.
- Under no circumstances may the order or time of a presentation differ from that in the Congress program. If a speaker fails to appear, either recess the session until the start of the next scheduled talk, or introduce an ad-hoc discussion of earlier presentations to fill the time slot.
- Make note in your program if a speaker fails to show or a replacement speaker was sent. Send this information to the CAP office (in person at the CAP desk at Congress or by e-mail to cap@uottawa.ca no later than one week following Congress).

Congrès ACP 2008

Auditeurs, conférenciers et présidents de sessions

INSTRUCTIONS POUR LES PRÉSENTATIONS CHRONOMÉTRÉES

Pour s'assurer que les auditeurs puissent passer d'une session à une autre, les présentations orales sont chronométrées. Par courtoisie envers l'ensemble des participants, nous vous demandons de suivre les directives suivantes, et vous remercions de votre collaboration.

TOUS - Assurez-vous de toujours avoir bien en vue votre porte-nom du congrès.

AUDITEURS

- Présentez-vous rapidement à la salle, avant que l'exposé suivant ne commence.
- Quittez la salle discrètement, de préférence pendant ou à la fin de la période de questions.

CONFÉRENCIERS

- Préparez l'ordinateur avant le début de votre session.
- Soyez prêt à commencer votre présentation à temps.
- Planifiez votre exposé de manière à terminer bien avant le suivant: environ 3 minutes pour une présentation contribuée et 5 minutes pour une présentation invitée.
- Répondez aux questions et commentaires le plus efficacement possible; reportez les discussions plus longues à la fin de la session ou à la pause-café.
- Respectez les instructions de votre président de session.

PRÉSIDENTS DE SESSIONS

- Arrivez à la salle au moins 15 minutes avant le début de la session. Vérifiez que tous les appareils sont là et fonctionnent bien. Vérifiez que les conférenciers, le technicien audio-visuel et, s'il y a lieu, les juges des concours d'étudiants sont présents.
- Présentez-vous à l'assistant de la salle et vérifier que le chronomètre fonctionne.
- Annoncez à l'heure exacte le début de chaque exposé.
- Assurez-vous que chaque conférencier cesse de parler bien avant que l'exposé suivant ne commence.
- Animez de manière vivante et productive la période de questions. Lisez d'avance les résumés de votre session. Si nécessaire, préparez des commentaires et des questions.
- Ne laissez ni les questions ni les réponses s'éterniser.
- Sous aucune circonstance l'ordre ou le moment des présentations ne doivent différer de ceux du programme du congrès. Si un conférencier ne se présente pas, interrompez la session jusqu'au début de l'exposé suivant, ou alors amorcez une discussion impromptue des présentations précédentes.
- Notez dans votre programme les conférenciers qui ne se présentent pas ou qui désignent un substitut. Faites parvenir cette information au personnel de l'ACP (à la table de l'ACP lors du congrès ou la semaine qui suit à cap@uottawa.ca).

LEGEND/LÉGENDE

PAD = Pavillon Alphonse-Desjardins (bldg/édifice 23)
POP = Pavillon d'optique-photonique (COPL; bldg/édifice 31)
POU = Pavillon Adrien-Pouliot (bldg/édifice 12)
PPP = Pavillon Palasis-Prince (bldg/édifice 6)
VCH = Pavillon Alexandre-Vachon (bldg/édifice 11)

CAP CONGRESS / CONGRÈS DE L'ACP

LAVAL UNIVERSITY / UNIVERSITÉ LAVAL
QUÉBEC, QUÉBEC
JUNE 8-11 JUIN 2008

Saturday / Samedi, June 7 juin

09h30 - 13h30	CAP Executive Meeting / *Réunion de l'exécutif de l'ACP* (SA-Exec)	POP 2165; COPL Board Room
14h00 - 17h30	CAP Council Meeting (Old and New) / *Réunion du conseil (ancien et nouveau) de l'ACP* (SA-Coun)	POP 1168; COPL Auditorium

Sunday / Dimanche, June 8 juin

08h00 - 18h00	**Conference Registration and Information / *Inscription au Congrès et information***	**VCH - 2nd floor**
08h15 - 11h00	Meeting of Heads/Chairs of Physics Depts / *Réunion des directeurs de départements de physique* (SU-Hd-Chr)	PAD "Le Cercle"; 4th floor
09h00 - 11h30	Applications of Plasmas / *Applications des plasmas* (SU-A1)	VCH 3870
09h00 - 11h30	Neutrino Physics / *Physique des neutrinos* (SU-A2)	VCH 2830
09h00 - 11h30	IPP Board of Trustees Meeting / *Réunion du conseil d'administration de l'IPP* (SU-IPP-Bd)	VCH 2826
09h30 - 11h15	DCMMP Symposium / *Symposium DPMCM* (SU-A3)	VCH 3860
11h30 - 12h30	**Plenary - Isabelle Blain, Recent Initiatives at NSERC / *Plénière - Isabelle Blain, Initiatives récentes du CRSNG* (SU-Plen1)**	**VCH 2850**
12h30 - 13h30	**Lunch and Discussion with NSERC / Dîner et discussion avec le CRSNG (SU-LUNCH)**	**VCH Hallway (2&3 floors)**
12h30 - 13h30	DPP Business Meeting / *Réunion d'affaires DPP* - (lunches available/repas disponible) (SU-DPP)	VCH 3870
12h30 - 13h30	Past Presidents' Luncheon / *Dîner des ancien(ne)s président(e)s* (SU-Past-Pres)	Hotel Universel
13h30 - 14h15	**Plenary - Jess Brewer, Brockhouse Medal / *Plénière - Jess Brewer, Médaille Brockhouse de l'ACP* (SU-Plen2)**	**VCH 2850**
14h15 - 18h00	**CAP Session in Memory of Roger Lessard** (and reception for participants) / ***Session commémorative pour Roger Lessard*** *(et réception pour participants)* **(SU-P1)**	**POP 1168**
14h15 - 17h00	ALLS Plasma-Laser Session / *Session plasma-laser ALLS* (SU-P2)	VCH 3870
14h15 - 16h30	General Theory / *Théorie générale* (SU-P3)	VCH 2870
14h15 - 15h15	Physics of Radiation Therapy / *Physique de la radiothérapie* (SU-P4)	VCH 3830
14h15 - 16h15	DMBP Best Student Paper Competition I / *Compétition pour les meilleures communications étudiantes DPMB I* (SU-P5)	VCH 3820
14h30 - 16h45	IPP General Meeting */ Assemblée générale de l'IPP (SU-IPP-Gen)*	VCH 2860
16h00 - 18h30	**Friends of CAP Meeting and Reception / *Réunion et réception des "Ami(e)s de l'ACP"* (SU-Friends)**	**PAD "Le Cercle"**
16h30 - 18h15	**Student Reception / *Réception pour les étudiant(e)s* (SU-GRAD)**	**VCH Cafeteria**
17h00 - 19h00	**Plenary - Nigel Lockyer, TRIUMF Five-Year Plan** (including a reception for participants at 18h00) / ***Plénière - Nigel Lockyer, Plan quinquennal de TRIUMF*** *(incluant une réception pour les participants à 18h00)* **(SU-Plen3)**	**POU 1112**
19h30 - 20h30	**Herzberg Memorial Public Lecture - Raymond Laflamme / *Conférence publique commémorative Herzberg de l'ACP - Raymond Laflamme* (SU-KEY)**	**PPP - Théâtre de la Cité Universitaire**
20h30 - 22h30	**Opening Reception (light refreshments) / *Réception d'accueil (léger goûter)* (SU-RECEPT)**	

Monday / Lundi, June 9 juin

06h30 - 20h00	**Conference Registration and Information / *Inscription au Congrès et information***	**VCH - 2nd floor**
07h00 - 08h10	Canadian Institute of Nuclear Physics (CINP) Board of Trustees Breakfast meeting */ Réunion-déjeuner du conseil d'administration de l'Institut canadien de la physique nucléaire (ICPN)* (MO-CINP-Bd)	POP 2165; COPL Brdroom
07h00 - 08h10	DPE Business Meeting (with breakfast) / *Réunion d'affaires DEP (avec petit-déjeuner)* (MO-DPE)	VCH 2840
07h00 - 08h00	New Faculty Breakfast with NSERC / Petit-d*éjeuner-rencontre des nouveaux professeurs avec le CRSNG* (MO-NSERC)	PAD "Le Cercle"
08h15 - 09h00	**Plenary - Art McDonald, SNO / *Plénière - Art McDonald, SNO* (MO-Plen1)**	**VCH 2850**
09h00 - 09h45	**Plenary - John Campbell, Rutherford's Nobel Prize: 100th anniversary / *Plénière - John Campbell, Prix Nobel de Rutherford: 100e anniversaire* (MO-Plen2)**	**VCH 2850**

10h00 - 12h15	DCMMP Best Student Paper Competition I / *Compétition pour les meilleures communications étudiantes DPMCM I* (MO-A1)	VCH 2870
10h00 - 11h45	DMBP Best Student Paper Competition II / *Compétition pour les meilleures communications étudiantes DPMB II* (MO-A2)	VCH 3870
10h00 - 12h00	Curriculum Revitalization / *Rafraichissement des programmes* (MO-A3)	VCH 2840
10h00 - 12h30	Optical Switching/Fiber / *Commutation optique/fibre* (MO-A4)	VCH 3830
10h00 - 12h15	Nuclear Structure and Astrophysics / *Structure nucléaire et astrophysique* (MO-A5)	VCH 3840
10h00 - 12h30	History of Physics / *Histoire de la physique* (MO-A6)	VCH 2880
10h00 - 12h30	DIAP-DIMP Joint Session / *Session conjointe DPIA-DPIM* (MO-A7)	VCH 2830
10h00 - 12h30	Particle Physics Instrumentation / *Instrumentation en physique des particules* (MO-A8)	VCH 3860
10h00 - 12h15	Atomic and Molecular Spectroscopy and Dynamics I / *Spectroscopie et dynamique des atomes et molécules I* (MO-A9)	VCH 3820
10h00 - 10h30	Best Condensed Matter Paper Published in CJP / *Meilleur article de matière condensée publié dans RCP* (MO-A10)	VCH 2860
10h30 - 12h15	Condensed Matter Theory / *Théorie de la matière condensée* (MO-A11)	VCH 2860
12h30 - 13h30	DAMPhi Business Meeting (with NSERC GSC-29 report) / *Réunion d'affaires DPAMip (avec rapport du GSC-29 du CRSNG)* - lunches available / *repas disponible* (MO-DAMPhi)	VCH 3820
12h30 - 13h30	DCMMP Business Meeting (with NSERC GSC-28 report) / *Réunion d'affaires DPMCM (avec rapport du GSC-28 du CRSNG)* - lunches available / *repas disponible* (MO-DCMMP)	VCH 2860
12h30 - 13h30	DHP Business Meeting / *Réunion d'affaires DHP* - lunches available / *repas disponible* (MO-DHP)	VCH 2826
12h30 - 13h30	DIAP Business Meeting / *Réunion d'affaires DPIA* - lunches available / *repas disponible* (MO-DIAP)	VCH 2830
12h30 - 13h30	DNP Business Meeting / *Réunion d'affaires DPN* - lunches available / *repas disponible* (MO-DNP)	VCH 3840
13h30 - 14h15	**Plenary - Haig Farris, Physicists in Business and Politics / *Plénière - Haig Farris, Les physiciens dans l'industrie et la politique* (MO-Plen3)**	**POU 1112**
14h15 - 16h30	Canadian Institute of Nuclear Physics (CINP) General Meeting */ Assemblée générale de l'Institut canadien de la physique nucléaire (ICPN)* (MO-CNIP-Gen)	VCH 3840
14h15 - 16h30	Correlated Electrons I / *Électrons corrélés I* (MO-P1)	VCH 2860
14h15 - 16h30	Soft Materials / *Matériaux mous* (MO-P2)	VCH 2830
14h15 - 16h30	Green Power / *Le pouvoir vert* (MO-P3)	VCH 2880
14h15 - 17h00	Interactive Teaching / *Enseignement interactif* (MO-P4)	VCH 2840
14h15 - 17h45	Non-Accelerator Particle Physics / *Physique des particules sans accélérateur* (MO-P5)	VCH 3860
14h15 - 16h45	DCMMP Best Student Paper Competition II / *Compétition pour les meilleures communications étudiantes DPMCM II* (MO-P6)	VCH 2870
14h15 - 16h30	Field Theory / *Théorie des champs* (MO-P7)	VCH 3870
14h15 - 16h45	Instrumentation / *Instrumentation* (MO-P8)	VCH 3820
14h15 - 16h30	Biophotonics / *Biophotonique* (MO-P9)	VCH 3830
14h15 - 14h45	A Physicist's Career in the Banking World / *La carrière d'un physicien dans le monde bancaire* (MO-P10)	POU 1112
14h45 - 17h00	Workshop on Commercialization of Innovation / *Atelier sur la commercialisation de l'innovation* (MO-P11)	POU 1112
16h00 - 17h30	Student Competitors in Instrumentation and Optics / *Compétiteurs étudiants en et optique* (MO-P12)	VCH 2826
16h30 - 18h15	**Women in Physics** (and reception for participants) / ***Les femmes en physique*** *(et réception pour participants)* **(MO-CEWIP)**	**POP 1168**
17h00 - 19h30	**CAP-NSERC Liaison Committee Meeting / *Réunion du comité de liaison ACP-CRSNG* (CAP-NSERC)**	**POP 2165**
17h00 - 19h45	**Poster Session,** with light supper / ***Session d'affiches,*** *léger souper servi* **(MO-POS)** CEWIP/*CEFEP* (1); DAMPhi/*DPAMip* (12); DASP/*DPAE* (1); DCMMP/*DPMCM* (16); DIAP/*DPIA* (4); DIMP/*DPIM* (2); DMBP/*DPMB* (16); DNP/*DPN* (3); DOP (19); DPE/*DEP* (1); DPP (4); DSS (6); DTP/*DPT* (11)	**VCH Main Hall** (2nd & 3rd floors)
17h30 - 19h00	**PiC Editorial Board Meeting / *Réunion du Comité de rédaction de La physique au Canada* (MO-PiC)**	VCH 1039C
19h30 - 21h00	**CJP Editorial Board Meeting / *Réunion du conseil d'édition de la revue canadienne de la physique* (MO-CJP)**	Les Anciens Canadiens restaurant
20h00 - 21h00	**Special Public Lecture (History of Science in Quebec) / *Conférence publique spéciale (histoire des sciences au Québec)* (MO-PUBLIC)**	**Théâtre de la Cité Universitaire**

Tuesday / Mardi, June 10 juin

06h30 - 16h30	**Conference Registration and Information / *Inscription au Congrès et information***	VCH - 2nd floor
07h00 - 08h10	CNILC Breakfast meeting / *Réunion du Comité national canadien de liaison avec l'UIPPA* (TU-CNILC)	POP 2165
07h15 - 08h15	HS teachers' welcoming reception / *Réception d'accueil pour les enseignants* (TU-HS-REGN)	VCH 2870
08h15 - 09h00	**Plenary - Adam Sarty, Teaching Medal / *Plénière - Adam Sarty, la médaille d'enseignement* (TU-Plen1)**	**VCH 2850**
09h00 - 09h45	**Plenary - Eric Mazur, New Approach to Teaching Physics / *Plénière - Eric Mazur, Une nouvelle approche à l'enseignement de la physique* (TU-Plen2)**	**VCH 2850**

10h00 - 12h00	New Investigators in Condensed Matter and Materials Physics (DCMMP) / *Nouveaux chercheurs(ses) en matière condensée et matériaux* (DPMCM) (TU-A1)	VCH 3840
10h00 - 12h30	Theoretical Biophysics / *Biophysique théorique* (TU-A2)	VCH 3830
10h00 - 12h15	Precision Frontier I / *Les limites de la précision I* (TU-A3)	VCH 2830
10h00 - 12h15	Quantum Information and Computing I / *Informatique et calcul quantiques I* (TU-A4)	VCH 3820
10h00 - 12h30	Biomedical Instrumentation / *Instrumentation biomédicale* (TU-A5)	VCH 2840
10h00 - 12h00	Heavy Ion / *Ions lourds* (TU-A6)	VCH 2826
10h00 - 12h15	String Theory / *Théorie des cordes* (TU-A7)	VCH 2870
10h00 - 12h30	CAP/HPCS Numerical Physics / *Physique numérique ACP/HPCS* (TU-A8)	VCH 3860
10h00 - 12h30	DCMMP Best Student Paper Competition III / *Compétition pour les meilleures communications étudiantes DPMCM III* (TU-A9)	VCH 3870
10h00 - 12h00	Teaching with Technology / *Enseigner avec la technologie* (TU-A10)	VCH 2860
10h15 - 12h30	High School Teachers' Workshop- am / *Atelier des enseignant(e)s de la physique - avant-midi* (TU-HS-1)	VCH 2880
12h30 - 13h30	DIMP Business Meeting / *Réunion d'affaires DPIM* - lunches available / *repas disponible* (TU-DIMP)	VCH 2840
12h30 - 13h30	DMBP Business Meeting / *Réunion d'affaires DPMB* - lunches available / *repas disponible* (TU-DMBP)	VCH 3830
12h30 - 13h30	DOP Business Meeting / *Réunion d'affaires DOP* - lunches available / *repas disponible* (TU-DOP)	VCH 3820
12h30 - 13h30	DTP Business Meeting / *Réunion d'affaires DPT* - lunches available / *repas disponible* (TU-DTP)	VCH 2870
12h30 - 13h30	PPD Business Meeting / *Réunion d'affaires PPD* - lunches available / *repas disponible* (TU-PPD)	VCH 2830
12h30 - 14h00	HS Workshop Luncheon / *Atelier des enseignant(e)s de la physique - dîner* (TU-HS-LUNCH)	POP 1168
13h30 - 14h15	**Plenary - Louis Taillefer, Achievement Medal / *Plénière - Louis Taillefer, la médaille pour contributions exceptionnelles à la physique* (TU-Plen3)**	**VCH 2850**
14h15 - 16h00	High School Teachers' Workshop - pm / *Atelier des enseignant(e)s de la physique - après-midi* (TU-HS-2)	VCH 2880
14h15 - 16h30	Materials: Semicondutors / *Matériaux : semiconducteurs* (TU-P1)	VCH 3840
14h15 - 16h30	General Condensed Matter and Materials Physics / *Physique générale de la matière condensée et des matériaux* (TU-P2)	VCH 3870
14h15 - 16h30	Experimental Biophysics / *Biophysique expérimentale* (TU-P3)	VCH 3830
14h15 - 15h45	New Physics - Electroweak Tests / *Nouvelle physique - tests électrofaibles* (TU-P4)	VCH 2840
14h15 - 16h30	New Phenomena / *Phénomènes nouveaux* (TU-P5)	VCH 2830
14h15 - 16h15	Surface Science of Environmental Processes / *Science des surfaces et processus environnementaux* (TU-P6)	VCH 2870
14h15 - 16h45	Quantum Optics - Laser Cooling, and Trapping / *Optique quantique - refroidissement au laser et piégeage* (TU-P7)	VCH 3820
14h15 - 16h15	Industrial Applications of Plasma / *Applications industrielles des plasmas* (TU-P8)	VCH 2860
14h15 - 16h15	Special Topics in Optics / *Sujets spéciaux en optique* (TU-P9)	VCH 3860
16h30 - 18h00	**CAP Annual General Meeting / *Assemblée générale de l'ACP* (TU-AGM)**	**VCH 2850**
19h00 - 22h30	**Reception and Banquet / *Réception et banquet* (CAP-Banq)**	**PAD - Le Grand Salon, 2nd floor**

Wednesday / Mercredi, June 11 juin

07h30 - 17h00	**Conference Registration and Information / *Inscription au Congrès et information***	**VCH - 2nd floor**
08h15 - 09h00	**Plenary - Jacques Beaulieu, Applied Photonics Medal / Plénière - Jacques Beaulieu, la médaille pour la photonique appliquée (WE-Plen1)**	**VCH 2850**
09h00 - 09h45	**Plenary - Carl Svensson, Herzberg Medal / Plénière - Carl Svensson, la médaille Herzberg (WE-Plen2)**	**VCH 2850**
10h00 - 12h30	**CAP Best Student Presentations Final Competition / Compétition finale de l'ACP pour les meilleures communications étudiantes (WE-A1)**	**VCH 2860**
10h00 - 12h30	Hadron Structure, QCD / Structure hadronique, CDQ (WE-A2)	VCH 3820
10h00 - 12h15	Medical Physics / Physique médicale (WE-A3)	VCH 3840
10h00 - 12h45	Advanced Materials and Photonic Crystals / Matériaux avancés et cristaux photoniques (WE-A4)	VCH 2830
10h00 - 12h00	Synchrotron Science / Science des synchrotrons (WE-A5)	VCH 2840
10h00 - 12h30	Precision Frontier II / Les limites de la précision II (WE-A6)	VCH 3830
10h00 - 12h15	Relativity / Relativité (WE-A7)	VCH 2870
10h00 - 12h15	Atomic and Molecular Spectroscopy and Dynamics II / Spectroscopie et dynamique des atomes et molécules II (WE-A8)	VCH 3860
13h30 - 14h15	**Plenary - Richard Cleve, CAP/CRM Medal / Plénière - Richard Cleve, la médaille ACP-CRM (WE-Plen3)**	**VCH 2850**
14h15 - 16h30	Thin Films / Couches minces (WE-P1)	VCH 2840
14h15 - 16h45	Energy Frontier / Frontière énergétique (WE-P2)	VCH 3830
14h15 - 15h30	General Instrumentation / Instrumentation générale (WE-P3)	VCH 3840
14h15 - 15h45	Nuclear Theory / Théorie nucléaire (WE-P4)	VCH 2870
14h15 - 16h30	Quantum Information and Computing II / Informatique et calcul quantiques II (WE-P5)	VCH 3860
14h15 - 15h30	Astronomy, Atmospheric and Space Physics / Astronomie et physique de l'atmosphère et de l'espace (WE-P6)	VCH 2860
14h15 - 16h00	Topics in Physics / Divers sujets en physique (WE-P7)	VCH 2830
16h00 - 17h00	CAP Executive Meeting / Réunion de l'Exécutif de l'ACP (WE-Exec)	POP 2165
17h00 - 19h00	CAP Council Meeting (Old and New) / *Réunion du conseil de l'ACP (nouveau et ancien)* (WE-Counc)	POP 1168

DETAILED CONGRESS SUMMARY
PROGRAMME DÉTAILLÉ DU CONGRÈS

(SEE PAGE 18 FOR DESCRIPTION OF CODES-ABBREVIATIONS / VOIR PAGE 18 POUR UNE DESCRIPTION DES CODES-ABRÉVIATIONS)
(ABSTRACTS START ON PAGE 44 / LES RÉSUMÉS COMMENCENT À LA PAGE 44)

Legend / Légende : **(c) - contributed abstract ; (G) or (U) - Graduate/Undergraduate student ; (G/U*) - competitor in best student presentation**

PAD - Pavillon Alphonse-Desjardins
POP - Pavillon d'optique-photonique
POU - Pavillon Adrien-Pouliot
PPP - Pavillon Palasis-Prince
VCH - Pavillon Alexandre-Vachon

Saturday, June 7, 2008 / *Samedi, le 7 juin*

09h30 - 13h30 CAP Executive Meeting / *Réunion de l'exécutif de l'ACP* (SA-Exec) **POP 2165**
14h00 - 17h30 CAP Council Meeting (Old and New) / *Réunion du conseil (ancien et nouveau) de l'ACP* (SA-Council) **POP 1168**

Sunday, June 8, 2008 / *Dimanche, le 8 juin*

TIME HEURE	Other locations autres endroits	VCH 2826 (cap. 42)	VCH 2830 (cap. 106)	VCH 3860 (cap. 148)	VCH 3870 (cap. 51)
08h15	08h15 **PAD, 4th Floor ("Le Cercle")** Physics Department Heads/Chairs Meeting / *Réunion des directeurs de départements de physique* (SU-Hd-Chr)	**09h00** IPP Board of Trustees Meeting Réunion du conseil d'administration de l'IPP (SU-IPP-Bd)	**SU-A2** (PPD / *PPD*) **NEUTRINO PHYSICS / *PHYSIQUE DES NEUTRINOS*** Chair: M.G. Boulay, Queen's U.		**SU-A1** (DPP / *DPP*) **APPLICATIONS OF PLASMAS / *APPLICATIONS DES PLASMAS*** Chair: J.E. Morelli, Queen's U.
09h00	↓	↓	**WRIGHT, Alex** *The SNO+ Experiment at SNOLAB* (SU-A2-1)		**MARTINU, L.** *From Understanding ion-surface interactions in a plasma environment to advanced surface engineering solutions* (SU-A1-1)
	↓	↓	↓	**SU-A3** (DCMMP / *DPMCM*) **DCMMP SYMPOSIUM / *SYMPOSIUM DPMCM*** Chair: T. Tiedje, UBC	↓
09h30	↓	↓	**O. Simard (G)** *A low energy threshold analysis of the data from the pure heavy water and salt phases of the Sudbury Neutrino Observatory experiment* (SU-A2-2)	**KAVANAGH, Karen** *Magnetic Semiconductors - The Basics* (SU-A3-1)	**VIDAL, François** *Laser ablation threshold dependence on pulse duration and wavelength for corneal tissues: experiments and modeling* (SU-A1-2)
09h45	↓	↓	**R. MacLellan (G*)** *Low threshold ^{8}B Solar Neutrino Energy Spectrum from the First Two Phases of the Sudbury Neutrino Observatory* (SU-A2-3)	↓	↓
10h00	↓	↓	**R. Martin (G*)** *The Neutral Current Detector Phase of the Sudbury Neutrino Observatory* (SU-A2-4)	↓	**HOLVOET, Servaas** *Nano-Coating and Surface Functionalisation: Towards High-Performance Vascular Biomaterials* (SU-A1-3)
10h15	↓	↓	**Coffee Break / *pause café***	**BERCIU, Mona** *Manipulating spin and charge in diluted magnetic semiconductors* (SU-A3-2)	↓
10h30	↓	↓	**TANAKA, Hirohisa** *T2K and the Next Generation of Neutrino Oscillation Experiments* (SU-A2-5)	↓	**M. Bradley (c)** *Prospects for Plasmonic Devices in Photonics* (SU-A1-4)
10h45	↓	↓	↓	↓	**M. Dreval (c)** *Evolution of plasma rotation, radial electric field, MHD activity and plasma confinement in STOR-M tokamak* (SU-A1-5)
11h00	**Session ends / *Fin de la session***	↓	**I. Kato (c)** *Time projection chambers for the T2K experiment* (SU-A2-6)	**G.S. Chang (c)** *Enhanced electronic characteristics of MNB-treated pentacene field-effect transistors with bottom contact structure* (SU-A3-3)	**S. Gamudi Elgriw (G*)** *Studies of Magnetohydrodynamics (MHD) instabilities by Singular Value De-composition (SVD) analysis of Mimov coil signals in the STOR-M tokamak* (SU-A1-6)
11h15		↓	**D. Roberge (G*)** *A Water Target System for the T2K Near Detector Tracker* (SU-A2-7)	**Session ends / *Fin de la session***	**D. Trembach (G*)** *Diamagnetic Measurements of Poloidal Beta on the STOR-M Tokamak* (SU-A1-7)

Sunday, June 8, 2008 / *Dimanche, le 8 juin* *(cont'd / suite)*

POP 1168 (cap. 150)	VCH 2870 (cap. 57)	VCH 3820 (cap. 104)	VCH 3830 (cap. 110)	VCH 3870 (cap. 51)	Other locations / autres endroits	TIME / HEURE
SU-Plen1	**Plenary session / *Session plénière*** (Chair: B. Gaulin, McMaster U.)				(CAP-NSERC / ACP-CRSNG)	11h30
	ISABELLE BLAIN, Vice-President, NSERC / Vice-présidente, CRSNG *Update from NSERC / Mise-à-jour par le CRSNG* **(ends at 12h30 / se termine à 12h30)**				**Room/Salle VCH 2850** (cap. 404)	
		Lunch and Discussion with NSERC / *Dîner et discussion avec le CRSNG* — **VCH Main Hallway (Levels 2 &3)**		**DPP Business Meeting / *Réunion d'affaires DPP*** (lunches available/*repas disponible*)	**"Gréco" at Hotel Universel Past President's Lunch / *Dîner des ancien(ne)s présidents(es)***	12h30
SU-Plen2	**Plenary session - Brockhouse Medal / *Session plénière - médaille Brockhouse*** (Chair: E. Vogt, TRIUMF)				(CAP-DCMMP / ACP-DPMCM)	13h30
	JESS BREWER, University of British Columbia *μSR: Fantasy, Fiction, Physics / μSR: Fantaisie, fiction, physique* **(ends at 14h15 / se termine à 14h15)**				**Room/Salle VCH 2850** (cap. 404)	
SU-P1 (CAP-DOP / ACP-DOP) **CAP SESSION IN MEMORY OF ROGER LESSARD / *SESSION COMMÉMORATIVE POUR ROGER LESSARD*** Chair: R. Vallée U.Laval	**SU-P3** (DTP / *DPT*) **GENERAL THEORY / *THÉORIE GÉNÉRALE*** Chair: R. Dick U. Sask.	**SU-P5** (DMBP / *DPMB*) **BEST STUDENT PAPER COMPETITION / *COMPÉTITION POUR LES MEILLEURS COMMUNCIATIONS ÉTUDIANTES* /** Chair: A. Linhananta Lakehead U.	**SU-P4** (DMBP / *DPMB*) **PHYSICS OF RADIATION THERAPY / *PHYSIQUE DE LA RADIOTHÉRAPIE*** Chair: D. Fleming Mount Allison U.	**SU-P2** (DPP / *DPP*) **ALLS PLASMA-LASER SESSION / *SESSION PLASMA-LASER ALLS*** Chair: J. Ozaki INRS-EMT		
ROY, René *Des souvenirs qui font vivre* **(SU-P1-1)**	**S.Y. Ho (G*)** *A Universal Gaussian Approximation for su(2) type problems* **(SU-P3-1)**	**L. MacQueen (G)** *Gene delivery by electroporation after dielectrophoretic positioning of cells in a non-uniform electric field* **(SU-P5-1)**	**O. Mermut (c)** *Use of magnetic fields to optically probe photodynamic processes in cancer phototherapy* **(SU-P4-1)**	**KIEFFER, Jean-Claude** *Can relativistic plasmas engineering with femtosecond lasers have societal applications?* **(SU-P2-1)**		14h15
STEINITZ, Michael *Roger Lessard and the CAP* **(SU-P1-2)**	**M. Larouche (U*)** *The Rings of n-Dimensional Polytopes* **(SU-P3-2)**	**H. Afsharpour (G*)** *A Monte Carlo study of the impact of seed design on the interseed attenuation in permanent prostate implants* **(SU-P5-2)**	**W.E. Kieser (c)** *Tests of a System for Biomedical and Environmental Carbon-14 Analysis by Accelerator Mass Spectrometry* **(SU-P4-2)**	↓	**14h30-16h45 VCH2860 (142)** IPP General Meeting / Assemblée générale de l'IPP **(SU-IPP-Gen)**	14h30
BEAULIEU, René *Revue des principaux travaux de recherche réalisés par le Professeur Roger A. Lessard* **(SU-P1-3)**	**P. Komorowski (G*)** *An Analytical and Numerical study of the Orbital Decay of a Compact Object Orbiting About a Massive Kerr Black Hole* **(SU-P3-3)**	**J. Boucher (G*)** *Functional Implication of the geometry of Synaptic Cleft in Cell-Cell Communication* **(SU-P5-3)**	**L. Lilge (c)** *Interstitial PDT treatment planning using a gradient descent feasibility algorithm* **(SU-P4-3)**	**ROBINSON, Joseph** *Sub-optical-cycle measurements using high harmonic generation* **(SU-P2-2)**		14h45
↓	**J. Ziprick (G*)** *Singularity and Event Horizon Formation with Quantum Gravity Corrections* **(SU-P3-4)**	**M-J. Colbert (G*)** *Dynamical measurement of the cytoskeletal contribution to the physical properties of living cells* **(SU-P5-4)**	**M. D'Amours (G)** *Planification inverse basée sur une dosimétrie Monte Carlo en curiethérapie à haut débit* **(SU-P4-4)**	↓		15h00
Coffee Break / *pause café*	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**Session ends / *Fin de la session***	**HEGMANN, Frank** *High intensity THz pulse generation and imaging at ALLS* **(SU-P2-3)**		15h15
GARCIA-SUCERQUIA, Jorge *Digital Holography: A Modern Perspective of Dennis Gabor's Invention* **(SU-P1-4)**	**R. Gwyn (G*)** *Magnetic Fields from Heterotic Cosmic Strings* **(SU-P3-5)**	**M-A. Goulet (G*)** *Friction measurements on living HeLa cells* **(SU-P5-5)**		↓		15h30
↓	**W.E. Baylis (c)** *The Classical Geometric Heritage of Fermion Spin* **(SU-P3-6)**	**M. Guillot (G*)** *Indépendance de l'étalonnage d'un dosimètre à scintillation eau-équivalent en fonction de l'énergie pour les faisceaux de photon et d'électron* **(SU-P5-6)**		**T.W. Johnston (c)** *Extremely Nonsinusoidal Emissions and Related Phenomena from Strong Laser Pulses Obliquely P-Incident on Sharp-Edged Plasmas* **(SU-P2-4)**		15h45
SHAKER, Jafar *Volume Holograms at Microwave Frequency Band* **(SU-P1-5)**	**J-F. Laprise (G)** *Fingerprints of Classical Chaos in Statistical measures of Trajectories* **(SU-P3-7)**	**S. Kaluzienski (G*)** *A Semiquantitative Experimental Method of Determining the Collimator/Scatter Component in Single Photon Emission Computed Tomography (SPECT)* **(SU-P5-7)**		**H. Loudyi (c)** *Enhancing the sensitivity of the Laser-Induced Breakdown Spectroscopy technique: spectrally-selective excitation of specific elements in a laser-produced plasma* **(SU-P2-5)**	**16h00-18h30 PAD "Le Cercle"** Friends of CAP Mtg. & Reception / Réunion et réception pour les amis de l'ACP **(SU-Friends)**	16h00
↓	**R. Van Zon (c)** *Fluctuations of work, heat and entropy production in non-equilibrium statistical physics* **(SU-P3-8)**	**Session ends / *Fin de la session***		**Y. Godwal (G)** *Laser-induced Breakdown Spectroscopy and Laser-Induced Fluorescence (LA-LIF) of Microdroplets* **(SU-P2-6)**		16h15
Discussion and Remembrances / Discussion et commémoration (reception follows; ends at 18h00 / réception suit; se termine à 18h00)	**Session ends / *Fin de la sessions***			**J. Fraser (c)** *Interferometric imaging of light/matter interaction during laser drilling* **(SU-P2-7)**	**16h30-18h15 VCH Cafeteria** Student Reception / Réception pour les étudiant(e)s **(SU-Grad)**	16h30
SU-Plen3	**Plenary session / *Session plénière*** (Chair: C. Gay, UBC)				(CAP-TRIUMF / ACP-TRIUMF)	17h00
	NIGEL LOCKYER, President, TRIUMF *A Vision for TRIUMF 2010-2015 / Une vision pour TRIUMF 2010-2015* **(reception at 18h00; ends at 19h00 / réception à 18h00; se termine à 19h00)**				**Room/Salle POU 1112** (cap. 500)	

[SU-KEY] **CAP Herzberg Memorial Public Lecture / *Conférence publique commémorative Herzberg de l'ACP***
Raymond Laflamme, Institute for Quantum Computing / University of Waterloo -
"Harnessing the Quantum World / *Maîtriser le monde quantique*"
Followed by an Opening Reception / suivie d'une réception d'accueil — Théâtre de la cité universitaire (PPP) - see pg 11 / voir pg 11 — **19h30**

Monday, June 9

TIME HEURE	POU 1112 (cap. 500)	VCH 2826 (cap. 42)	VCH 2830 (cap. 106)	VCH 2840 (cap. 98)	VCH 2860 (cap. 142)	VCH 2870 (cap. 57)	VCH 2880 (cap. 200)
07h00	(MO-CINP-Bd) Canadian Institute of Nuclear Physics (CINP) Board of Trustees Breakfast Meeting - 07h00-08h10 - POP 2165						
07h00	(MO-DPE) DPE Business Meeting (with breakfast) - 07h00-08h10 - VCH 2840						
07h00	(MO-NSERC) New Faculty Breakfast with NSERC - 07h00-08h00 - PAD "Le Cercle" (4th floor)						
08h15	**MO-Plen1** **Plenary session** (Chair: S. Page, U.Manitoba.) (CAP) **ART McDONALD, Queen's University** *SNO and the New SNOLAB Underground Facility* **(ends at 09h00)** **Room VCH 2850** (cap. 404)						
09h00	**MO-Plen2** **Plenary session** (Chair: W. Davidson, NRC.) (CAP) **JOHN CAMPBELL, University of Canterbury New Zealand** *Rutherford - His path to the Nobel Prize* **(ends at 09h45)** **Room VCH 2850** (cap. 404)						
			MO-A7 (DIAP-DIMP / *DPIA-DPIM*) **DIAP-DIMP JOINT SESSION / SESSION CONJOINTE DPIA-DPIM** Chair: A. Kotlicki UBC	**MO-A3** (DPE / *DPE*) **CURRICULUM REVITALIZATION / RAFRAÎCHISSEMENT DES PROGRAMMES** Chair: R. Hawkes Mount Allison U.	**MO-A10** (DCMMP / *DPMCM*) **BEST CONDENSED MATTER PAPER PUBLISHED IN CJP / MEILLEUR ARTICLE DE MATIÈRE CONDENSÉE PUBLIÉ DANS RCP** Chair: T. Tiedje UBC	**MO-A1** (DCMMP / *DPMCM*) **BEST STUDENT PAPER COMPETITION I / COMPÉTITION POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES I** Chair: A. Moewes U. of Sask.	**MO-A6** (DHP / *DHP*) **HISTORY OF PHYSICS / HISTOIRE DE LA PHYSIQUE** Chair: W. Davidson NRC
10h00			**MEUNIER, Michel** *Ultrafast laser processing of nanomaterials for biomedical applications* **(MO-A7-1)**	**MILNER-BOLOTIN, Marina** *Physics for Architects : Design, Implementation and Evaluation of Innovative Physics Curricula* **(MO-A3-1)**	**MARSIGLIO, Frank** *Flippin' Spins : a Quantum Mechanical Approach* **(MO-A10-1)**	**F. Béron (G*)** *Magnetic behavior of ferromagnetic nanowire arrays analyzed by first-order reversal curves* **(MO-A1-1)**	**BARRETTE, Jean** *Ernest Rutherford at McGill* **(MO-A6-1)**
10h15			↓	↓	**MO-A11** (DCMMP-DTP / *DPMCM-DPT*) **CONDENSED MATTER THEORY / THÉORIE DE LA MATIÈRE CONDENSÉE** Chair: R. MacKenzie U. Montreal	**L-P. Carignan (G*)** *Dipolar interactions in ferromagnetic nanowire arrays* **(MO-A1-2)**	↓
10h30			**CHAPMAN, Dean** *The Biomedical Imaging and Therapy Beamline at the Canadian Light Source* **(MO-A7-2)**	**A. Kotlicki (c)** *A New Way of Teaching Physics 100; Transportation, Earth Energy Balance and Global Warming* **(MO-A3-2)**	**LEWIS, Laurent** *Laser ablation with short and ultrashort laser pulses: basic mechanisms from MD simulations* **(MO-A11-1)**	**S. Burke (G*)** *PTCDA on a nanotemplated insulator: structure and optoelectronic properties* **(MO-A1-3)**	**PYWELL, Robert** *A Scrapbook History of Physics at the University of Saskatchewan* **(MO-A6-2)**
10h45			↓	**Coffee Break / *pause café***	↓	**C. Lacroix (G*)** *Magnetic behavior of MnP nanoclusters embedded in GaP(001) epilayers* **(MO-A1-4)**	↓
11h00			**Coffee Break / *pause café***		**D. Sprung (c)** *Discrete model for a decaying quantum system* **(MO-A11-2)**	**S.D. Hudson (U*)** *SANS and USANS of Anisotropic PVA Hydrogel* **(MO-A1-5)**	**ROOT, John** *The National Research Universal (NRU) Reactor - Fifty Years of Excellence* **(MO-A6-3)**
11h15			**R. Maev (c)** *Advanced Acoustic Imaging and IR Approaches in Nondestructive Investigations and Diagnostics of Cultural and Environmental Heritage* **(MO-A7-3)**	**R.I. Thompson (c)** *A "Skills for Physicists" Core in Undergraduate Curricula* **(MO-A3-3)**	**M. Young (G)** *A Fractionalized Quantum Spin Hall Effect* **(MO-A11-3)**	**J-M. Lamarre (G*)** *Anisotropic nonlinear absorption of gold nanorods in a silica matrix* **(MO-A1-6)**	↓
11h30			**I. Seviaryna (G*)** *Investigation of the Structure of New Biofiber Composite Materials with Advanced Ultrasonic Imaging Methods* **(MO-A7-4)**	**A. Slavin (c)** *Factors affecting the student drop-out rate in the introductory physics course* **(MO-A3-4)**	**M. Kennett (c)** *Connecting microscopic simulations with kinetically constrained models of glasses* **(MO-A11-4)**	**S. Lambert-Milot (G*)** *Growth of coherent heterogeneous materials structures: the case of manganese phosphide magnetic nanoclusters embedded in gallium phosphide* **(MO-A1-7)**	**GRIFFIN, Allan** *100 Years of Liquid Helium : Highlights of Canadian Research* **(MO-A6-4)**
11h45			**T.J.T. Spanos (c)** *Wavefront Energy and Environment* **(MO-A7-5)**	**T. Antimirova (c)** *Ryerson's Outreach to the High School Community in the GTA* **(MO-A3-5)**	**F. El-Mellouhi (c)** *The Kinetic Activation-Relaxation Technique (KART): an on-the-fly kinetic Monte-Carlo algorithm* **(MO-A11-5)**	**R.B. Lewis (G*)** *Dilute Bismide GaAsBi Light Emitting Diodes* **(MO-A1-8)**	↓
12h00			**J. Thompson (c)** *Forensic electron paramagnetic resonance (EPR) dosimetry of drywall* **(MO-A7-6)**	**Session ends / *Fin de la session***	**J. Li (G)** *Theory of Disk-to-Vesicle Transformation* **(MO-A11-6)**	**D. Marchand (G*)** *Giant Proximity Effect in a Phase-Fluctuating Superconductor* **(MO-A1-9)**	**STEINITZ, Michael** *In Defense of Peter J.W. Debye* **(MO-A6-5)**

Lundi, le 9 juin

VCH 3820 (cap. 104)	VCH 3830 (cap. 110)	VCH 3840 (cap. 106)	VCH 3860 (cap. 148)	VCH 3870 (cap. 51)	Other Locations *Autres endroits*	TIME HEURE
(MO-CINP-Bd) Réunion-déjeuner du conseil d'administration de l'Institut canadien de physique nucléaire (ICPN) - 07h00-08h10 - POP 2165						07h00
(MO-DPE) Réunion d'affaires DEP (avec petit-déjeuner) - 07h00-08h10 - VCH 2840						07h00
(MO-NSERC) Petit-déjeuner-rencontre des nouveaux professeurs avec le CRSNG - 07h00-08h00 - PAD "Le Cercle" (4e étage)						07h00
MO-Plen1 *Session plénière* (Chair: S. Page, U.Manitoba.) **ART McDONALD, Université Queen's** *SNO et la nouvelle installation souterraine SNOLAB* **(se termine à 09h00)**					(ACP) **Salle VCH 2850** (cap. 404)	08h15
MO-Plen2 *Session plénière* (Chair: W. Davidson, NRC.) **JOHN CAMPBELL, Université de Canterbury, New Zealand** *Rutherford - Son parcours vers le prix Nobel* **(se termine à 09h45)**					(ACP) **Salle VCH 2850** (cap. 404)	09h00
MO-A9 (DAMPhi / *DPAMlp*) ATOMIC AND MOLECULAR SPECTROSCOPY AND DYNAMICS I / SPECTROSCOPIE ET DYNAMIQUE DES ATOMES ET MOLÉCULES I Chair: D. Tokaryk UNB	**MO-A4** (DOP / *DOP*) OPTICAL SWITCHING/FIBER / COMMUTATION OPTIQUE/ FIBRE Chair: N. Beaudoin U.Moncton	**MO-A5** (DNP / *DPN*) NUCLEAR STRUCTURE AND ASTROPHYSICS / *STRUCTURE NUCLÉAIRE ET ASTROPHYSIQUE* Chair: P. Garrett U. Guelph	**MO-A8** (PPD / *PPD*) PARTICLE PHYSICS INSTRUMENTATION / INSTRUMENTATION EN PHYSIQUE DES PARTICULES Chair: J.F. Martin U.Toronto	**MO-A2** (DMBP / *DPMB*) BEST STUDENT PAPER COMPETITION II / COMPÉTITION POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES Chair: A. Linhananta Lakehead U.		
ROSS, Amanda *Laboratory exploration of gas phase spectra of some transition metal hydrides* **(MO-A9-1)**	**Y. Hu (G)** *Cationic effect in polymer light-emitting electrochemical cells* **(MO-A4-1)**	**JANSSENS, Robert** *Hunt for new shell structure in neutron-rich nuclei* **(MO-A5-1)**	**KRUSHELNICK, Karl** *Compact laser-plasma based accelerators* **(MO-A8-1)**	**C-R. Wang (G*)** *Pump-Probe Femtosecond Laser Spectroscopic Studies of the Molecular Mechanism for the DNA Sequence Sensitivity of Halopyrimidines as Radiosensitizing Drugs* **(MO-A2-1)**		10h00
↓	**HALL, Kimberley** *Ultrafast Control of Spin Dynamics* **(MO-A4-2)**	↓	↓	**T. Luo (G*)** *Molecular Reaction Pathways for the Generation of Reactive Oxygen Species in Photodynamic Therapy* **(MO-A2-2)**		10h15
A. Faridian (G*) *Spectroscopy of the A-X transition of SrCCH and SrCCD* **(MO-A9-2)**	↓	**KANUNGO, Rituparna** *Nuclear Halos : A new era in nuclear physics* **(MO-A5-2)**	**ROBERTSON, Steven** *SuperB : New Physics Opportunities at a High Luminosity Flavour Factory* **(MO-A8-2)**	**D. Cooper (G*)** *His-tagged membrane proteins for targeted quantum dot labelling and fluorescence resonance energy transfer* **(MO-A2-3)**		10h30
Z-D. Sun (c) *Observation of the Infrared Spectrum of the C-N Stretching Band of Methylamine* **(MO-A9-3)**	**G. Das (c)** *A tunable high power fiber laser* **(MO-A4-3)**	↓	↓	**Coffee Break / *pause café***		10h45
Coffee Break / *pause café*	**P. Lu (c)** *Fiber Bragg grating bending measurement using a high-resolution reflectometer* **(MO-A4-4)**	**FROHLICH, Carla** *Nuclear Physics Aspects of an Astrophysical Nucleosynthesis Process* **(MO-A5-3)**	**A. Bellerive (c)** *International RD collaboration for the development of micro pattern gaseous detectors* **(MO-A8-3)**	**N. Prent (G*)** *Muscle Cell Contraction Dynamics Elucidated by Second Harmonic Generation Microscopy* **(MO-A2-4)**		11h00
PREDOI-CROSS, Adriana *Laboratory spectroscopy for planetary remote sensing* **(MO-A9-4)**	**Coffee Break / *pause café***	↓	**F. Retiere (c)** *The T2K Fine-Grained Detector : design and performances* **(MO-A8-4)**	**O. Pucci (G*)** *Determining cerebral hemodynamic responses to naturally administered cigarette smoke using a fully mobile near-infrared sensor* **(MO-A2-5)**		11h15
↓	**FRASER, James** *Ultrafast Dynamics of a Single-Walled Carbon Nanotube* **(MO-A4-5)**	**RUPRECHT, Gotz** *TACTIC - a tracking detector for ions from nuclear reactions* **(MO-A5-4)**	**B.D. Leverington (G)** *Performance of the prototype module of the GlueX electromagnetic barrel calorimeter* **(MO-A8-5)**	**J. St-Hilaire (G*)** *Planification inverse pour la radiothérapie du cancer du poumon utilisant l'imagerie de perfusion SPECT et la modulation d'intensité* **(MO-A2-6)**		11h30
M. Afshari (G) *The Cyclic CO_2 Trimer: Observation of two parallel bands and determination of intermolecular out-of-plane torsional frequencies* **(MO-A9-5)**	↓	↓	**J.P. Archambault (G)** *Geant4 Studies of the ATLAS Liquid Argon Forward Calorimeter* **(MO-A8-6)**	**Session ends / *Fin de la session***		11h45
M. Dehghany (G*) *Observation of two combination bands involving torsion and asymmetric bending modes of the non-polar N_2O dimer* **(MO-A9-6)**	**B. Ramamoorthy (c)** *A comparative study of thermochromic VO_2 thin films deposited by sputtering and sol-gel techniques* **(MO-A4-6)**	**K.S. Sharma (c)** *Recent mass measurements among proton and neutron rich nuclei with the Canadian Penning Trap Mass Spectrometer* **(MO-A5-5)**	**J. Godfrey (G*)** *Using Boosted Decision Trees for Tau Identification in ATLAS* **(MO-A8-7)**			12h00

Monday, June 9

TIME HEURE	POU 1112 (cap. 500)	VCH 2826 (cap. 42)	VCH 2830 (cap. 106)	VCH 2840 (cap. 98)	VCH 2860 (cap. 142)	VCH 2870 (cap. 57)	VCH 2880 (cap. 200)
12h15			**H-J. Yang (G)** *Development of silicon nanowires for applications in small-dimension transistors and field emission devices* **(MO-A7-7)**		**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**S. Barkanova (c)** *The Russian Space Program : The Things You Know and Things You Never Heard About* **(MO-A6-6)**
12h30		**DHP Business Meeting / *Réunion d'affaires DHP*** (lunches available / *repas disponible*)	**DIAP Business Meeting / *Réunion d'affaires DPIA*** (lunches available / *repas disponible*)		**DCMMP Business Meeting** (with NSERC GSC-28 report) / ***Réunion d'affaires DPMCM*** *(avec rapport du GSC-28 du CRSNG)* (lunches available / *repas disponible*)		**Session ends / *Fin de la session***
13h30	**MO-Plen3** **Plenary session** (Chair: W. Davidson, NRC.) (CAP) **HAIG FARRIS, Fractal Capital Corp.** *Help Wanted - physicists needed in business and politics - apply early and often* **(ends at 14h15)** **Room POU 1112** (cap. 500)						
	MO-P10 (CAP-CORP / *ACP-CORP*) **A PHYSICIST'S CAREER IN THE BANKING WORLD / LA CARRIÈRE D'UN PHYSICIEN DANS LE MONDE BANCAIRE** Chair: W. Davidson NRC		**MO-P2** (DCMMP / *DPMCM*) **SOFT MATERIALS / MATÉRIAUX MOUS** Chair: J. Dutcher U. Guelph	**MO-P4** (DPE / *DPE*) **INTERACTIVE TEACHING / ENSEIGNEMENT INTERACTIF** Chair: T. Antimirova Ryerson U.	**MO-P1** (DCMMP / *DPMCM*) **CORRELATED ELECTRONS I / ÉLECTRONS CORRÉLÉS I** Chair: A. Damascelli UBC	**MO-P6** (DCMMP / *DPMCM*) **BEST STUDENT PAPER COMPETITION II / COMPÉTITION POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES II** Chair: A. Moewes U. of Sask.	**MO-P3** (DIAP / *DPIA*) **GREEN POWER / LE POUVOIR VERT** Chair: A. Kotlicki UBC
14h15	**JANISSEN, Lee Ann** *A Physicists's Career in the Wholesale Banking World* **(MO-P10-1)**		**PAGE, John** *Localization of ultrasound in a three-dimensional elastic network* **(MO-P2-1)**	**HARRISON, David** *Implementing Physics Practicals* **(MO-P4-1)**	**PICKET, Warren** *Correlated Electrons I : Applications from DFT through DMFT to Complex Materials* **(MO-P1-1)**	**M. Zhao (G*)** *Transient photoconductivity and low sheet resistance of CdS thin film prepared by chemical bath deposition* **(MO-P6-1)**	**CHAPMAN, Gilbert** *The Greening of Ground Transportation in North America* **(MO-P3-1)**
14h30	**MO-P11** (CAP-CORP / *ACP-CORP*) **WORKSHOP ON COMMERCIALIZATION OF INNOVATION / ATELIER SUR LA COMMERCIALISATION DE L'INNOVATION** Chair: A. Sarkissian Plasmionique		↓	↓	↓	**F. Oppong (G*)** *Gelation of a colloidal suspension: comparison of two length scales* **(MO-P6-2)**	↓
14h45	**RAHILLY, Tony** *From Physics in the Lab to Products at the Retailer : The Speed of Innovation and the Acceleration of Commercialization* **(MO-P11-1)**		**FRISKEN, Barbara** *Carbopol - Microrheology and Microstructure* **(MO-P2-2)**	**N. Lasry (c)** *Peer Instruction : From Harvard to a Canadian Two-Year College* **(MO-P4-2)**	**ELFIMOV, Ilya** *Novel aspects in oxide's physics* **(MO-P1-2)**	**I. MacKay (G*)** *Bulk Liquid Crystal Phases of Semiflexible Polymers* **(MO-P6-3)**	**GILBERT, Raymond** *Solar Energy Extraction: A Real Challenge for Physicists / L'Extraction de l'énergie solaire, un défi de taille pour les physiciens* **(MO-P3-2)**
15h00	↓		↓	**Coffee Break / *pause café***	↓	**S. Nene (G*)** *A Martensitic-like Transition in a Normal Alkane* **(MO-P6-4)**	↓
15h15	**ROY, Jean-Yves** *How INO brings innovation to help companies improve their competitive edge and contributes to their development* **(MO-P11-2)**		**B. Joós (c)** *Microstructure and dynamics of a polymer glass subjected to shear strain* **(MO-P2-3)**	**HAWKES, Robert** *Guided Collaborative Learning: Not Just for First Year Physics* **(MO-P4-3)**	**M. Gingras (c)** *Recent developments in the theory of the $A_2B_2O_7$ magnetic pyrochlore oxide materials* **(MO-P1-3)**	**A.B. Croll (G*)** *Block Copolymer Lamella: Simple Experiments and Complex Physics* **(MO-P6-5)**	**Coffee Break / *pause café***
15h30	↓	**MO-P12** (DIMP-DOP / *DPIM-DOP*) **STUDENT COMPETITORS IN INSTRUMENTATION AND OPTICS / COMPÉTITEURS ÉTUDIANTS EN INSTRUMENTATION ET OPTIQUE** Chair: B. Southern U. of Manitoba	**J.L. Carvalho (G)** *Crystal nucleation of polyethylene confined to a system of droplets* **(MO-P2-4)**	↓	**D. Chasse (G*)** *Analog of the Josephson effect in antiferromagnets* **(MO-P1-4)**	**K.K. Ho Wong (G*)** *Controlling the Elastic Modulus of Electrospun Polymer Fibres using Broad-Energy Ion Beam Treatment* **(MO-P6-6)**	**POND, James** *Rigorous electromagnetic simulation of current and next-generation photonic devices: challenges and opportunities* **(MO-P3-3)**
15h45	**GARDNER, Philip** *Commercializing Fundamental Physics Research: The TRIUMF Experience* **(MO-P11-3)**		**K. Hildebrand (G*)** *Revealing the dynamics of bubbly suspensions through correlations in the phase of multiply scattered ultrasonic waves* **(MO-P2-5)**	**S. Barkanova (c)** *Popular Culture - Our Friend or our Enemy?* **(MO-P4-4)**	**F. Marsiglio (c)** *High Tc Superconductivity : What the Optical Sum Rule Tells Us* **(MO-P1-5)**	**J.S. Lee (G*)** *Acoustic quasimodes in two-dimensional dispersed random media* **(MO-P6-7)**	↓
16h00	**Panel Discussion**	**R. Béal (G*)** *Multi-wavelength laser diode arrays fabricated by ArF laser induced Quantum Well Intermixing* **(MO-P12-1)**	**D. Pink (c)** *Phase Transitions and Liquid Phase Structure of (mono)triglycerides: Minimal models, computer simulation and Raman spectroscopy* **(MO-P2-6)**	**D. Ahrensmeier (c)** *Zukunftswerkstat Physics Education* **(MO-P4-5)**	**V. Volobuyev (G*)** *Interlayer exchange coupling in EuS/Fe bilayer thin films* **(MO-P1-6)**	**J. McGraw (G*)** *Entanglement density variation by dilution of the polymer network* **(MO-P6-8)**	**MAEVA, Elena** *New BioCar Ontario Initiative : Biocomposite materials* **(MO-P3-4)**
16h15	↓	**M. Patterson (G*)** *Extrinsic Scattering Loss in Planar Photonic Crystal Waveguides* **(MO-P12-2)**	**A. Raegen (G)** *Probing Relaxation in Glassy Freestanding Diblock Copolymer Thin Films* **(MO-P2-7)**	**Discussion**	**S. Soltanian (c)** *Significant Enhancement in nanoparticle SiC and C doping in the MgB_2 superconductor* **(MO-P1-7)**	**J-C. Pothier (G*)** *Defect analysis in ion-implanted crystalline and amorphous silicon using MD simulations* **(MO-P6-9)**	↓

Lundi, le 9 juin

VCH 3820 (cap. 104)	VCH 3830 (cap. 110)	VCH 3840 (cap. 106)	VCH 3860 (cap. 148)	VCH 3870 (cap. 51)	Other Locations *Autres endroits*	TIME HEURE
Session ends / *Fin de la session*	**P. Ashrit (c)** *Chromogenic Properties of Periodically and Non-periodically Nanostructured Transition Metal Oxide Thin Films* **(MO-A4-7)**	**Session ends / *Fin de la session***	**D. Asgeirsson (G)** *Parameter Estimation with a Weighted Monte-Carlo Likelihood Fit* **(MO-A8-8)**			12h15
DAMPhi Business Meeting (with NSERC GSC-29 report) / ***Réunion d'affaires DPAMip*** *(avec rapport du GSC-29 du CRSNG)* (lunches available / *repas disponible*)	**Session ends / *Fin de la session***	**DNP Business Meeting / *Réunion d'affaires DPN*** (lunches available / *repas disponible*)	**Session ends / *Fin de la session***			12h30
MO-Plen3 *Session plénière* (Chair: W. Davidson, NRC.)					(ACP) **Salle POU 1112** (cap. 500)	13h30
HAIG FARRIS, Fractal Capital Corp. *On embauche - physiciens demandés dans les affaires et la politique - postulez tôt et souvent* **(se termine à 14h15)**						
MO-P8 (DAMPhi-DIMP / *DPAMip-DPIM*) **INSTRUMENTATION** Chair: K. Michaelian CANMET, NRCan	**MO-P9** (DOP-DMBP / *DOP-DPMB*) **BIOPHOTONICS / BIOPHOTONIQUE** Chair: P. Ashrit U.Moncton		**MO-P5** (PPD / *PPD*) **NON-ACCELERATOR PARTICLE PHYSICS / PHYSIQUE DES PARTICULES SANS ACCÉLÉRATEUR** Chair: A. Warburton McGill U.	**MO-P7** (DTP / *DPT*) **FIELD THEORY / THÉORIE DES CHAMPS** Chair: R. Lewis York U.		
McKELLAR, Robert *Longer wavelengths, higher resolution, and greater absorption paths with the far infrared beamline at the Canadian Light Source* **(MO-P8-1)**	**BOUDOUX, Caroline** *Confocal endoscopy : In vivo cellular resolution imaging of human organs* **(MO-P9-1)**	**Room / Salle VCH 3840** Canadian Institute of Nuclear Physics (CINP) General Meeting / Assemblée générale de l'Institut canadien de physique nucléaire (ICPN) **(MO-CINP-Gen)** **(ends at 16h30 / se termine à 16h30)**	**MARTIN, John F.** *The History and Physics Impact of the HERA e-p Collider* **(MO-P5-1)**	**FLEMING, George** *Lattice Study of the Conformal Window in QCD-like Theories* **(MO-P7-1)**		14h15
↓	↓		↓	↓		14h30
R.M. Lees (c) *IR Spectroscopy at the Canadian Light Source : The ν_{11} Fundamental and ν_{16}+ν_{18} Hot Band of Trans-Acrolein* **(MO-P8-2)**	**CHEN, Qiying** *Fibre Bragg gratings for optical biosensors* **(MO-P9-2)**	↓	**RAGAN, Ken** *Results of the first year of operation of the VERITAS ground-based gamma-ray observatory* **(MO-P5-2)**	**METLITSKI, Max** *Duality and Wilson Loops in Non-Compact U(1) Gauge Theories* **(MO-P7-2)**		14h45
L. Borvayeh (G*) *High Resolution Infrared Spectrum and Global Analysis of ν_{10}, ν_5 and ν_{12} + ν_6- ν_6 bands in CH_3SiH_3* **(MO-P8-3)**	↓	↓	↓	↓		15h00
Coffee Break / *pause café*	**Coffee Break / *pause café***	↓	**M. McCutcheon (G)** *Camera Health Monitoring for the VERITAS Collaboration at McGill University* **(MO-P5-3)**	**Coffee Break / *pause café***		15h15
TREMBLAY, Pierre *Work on Fourier-transform spectrometers at Université Laval* **(MO-P8-4)**		↓	**S. Yen (c)** *HALO-A lead supernova neutrino detector for SNOLAB* **(MO-P5-4)**	**SULLIVAN, Donald** *Field Theory for Polymeric Materials* **(MO-P7-3)**		15h30
↓	**A. Hassanzadeh (G*)** *Waveguide Evanescent Field Fluorescence Microscopy and its applications for imaging cell-substrate interfaces and ultra-thin solid films* **(MO-P9-3)**	↓	**Coffee Break / *pause café***	↓		15h45
D.R. Tessier (G*) *Passive Electrostatic Recycling Spectrometer of Desk-Top Size for Charged Particles of Low Kinetic Energy* **(MO-P8-5)**	**M. Campbell (c)** *Modeling nonlinear optical interactions in the crystalling lens - defining the light required for a presbyopia cure* **(MO-P9-4)**	↓	**BOULAY, Mark** *Status of DEAP/CLEAN at SNOLAB* **(MO-P5-5)**	**F. Nebia-Rahal (G)** *Phase transitions in the spontaneously broken sector of the 2+1 dimensional abelian Maxwell-Chern-Simons Higgs model* **(MO-P7-4)**		16h00
J-P. Lavoie (G*) *Segmented Linear Radio-Frequency Quadrupole / Laser Ion Source Project at TRIUMF* **(MO-P8-6)**	**S. Rainville (c)** *Punching holes in E-coli* **(MO-P9-5)**	↓	↓	**S. Opps (c)** *Confinement effects on animal movement in fragmented landscapes* **(MO-P7-5)**		16h15

Monday, June 9

TIME HEURE	POU 1112 (cap. 500)	VCH 2826 (cap. 42)	VCH 2830 (cap. 106)	VCH 2840 (cap. 98)	VCH 2860 (cap. 142)	VCH 2870 (cap. 57)	VCH 2880 (cap. 200)
16h30	↓	**A. Reza** (G*) *Slow light in metamaterial waveguide structures* (MO-P12-3)	**Session ends / *Fin de la session***	↓	**Session ends / *Fin de la session***	**C. Harkati** (G*) *Attempt to deform gold nanoparticles embedded in AlAs by high energy ion irradiation* (MO-P6-10)	**Session ends / *Fin de la session***
16h45	↓	**J. Wheeldon** (G*) *Photonic crystals as a novel structure to generate optical vortices* (MO-P12-4)		↓		**Session ends / *Fin de la session***	
17h00	**Session ends / *Fin de la session***	**A. MacLeod** (G*) *Novel method of measuring the gain of photomultiplier tubes for VERITAS* (MO-P12-5)		**Session ends / *Fin de la session***			
17h15		**R. Chatelain** (G*) *Radio-frequency pulse compression for ultrafast electron diffraction experiments* (MO-P12-6)					
17h30		**Session ends / *Fin de la session***					
17h45							

17h00 **Poster Session,** with light dinner — Main Hallway, Pavillon Alexandre-Vachon (2nd/3rd Floors)

Women in Physics / *Les Femmes en Physique* (1)	Atomic and Molecular Physics and Photon Interactions / *Physique atomique et moléculaire et d'interactions avec les photons* (12)	Atmospheric and Space Physics / *Physique de l'atmosphère et de l'espace* (1)	Condensed Matter and Materials Physics / *Physique de la matière condensée et matériaux* (18)	Industrial and Applied Physics / *Physique industrielle et appliquée* (4)	Instrumentation and Measurement Physics / *Physique des instruments et des mesures* (2)	Medical and Biological Physics / *Physique médicale et biologique* (16)
MO-POS-1	MO-POS-2-13	MO-POS-14	MO-POS-15-30, plus 98 and 99	MO-POS-31-34	MO-POS-35-36	MO-POS-37-52

19h30 **CJP Editorial Board Meeting** (MO-CJP) ; ends at 21h00 — Les Anciens canadiens (downtown restaurant)

20h00 [MO-PUBLIC]

CAP Special Public Lecture

Jacques Lacoursière, Beauport, Québec
"Anecdotes on the history of science and its teaching in Québec"

Ends at 21h00 — Théâtre de la cité universitaire (PPP) - (see page 12 for details)

Tuesday, June 10

TIME HEURE	POU 1112 (cap. 500)	VCH 2826 (cap. 42)	VCH 2830 (cap. 106)	VCH 2840 (cap. 98)	VCH 2860 (cap. 142)	VCH 2870 (cap. 57)	VCH 2880 (cap. 200)
07h00	(TU-CNILC)	CNILC Breakfast meeting - 07h00-08h10					POP 2165
07h15	(TU-HS-REGN)	Teachers' Welcoming Reception - 07h15-08h15					VCH 2870
08h15	**TU-Plen1**	**Plenary session - Teaching Medal** (Chair: M. Butler, Saint Mary's University.)					(CAP)
		ADAM J. SARTY, Saint Mary's University *Physics Education Across the Continuum : Opening Doors at All Levels* **(ends at 09h00)**					**Room VCH 2850** (cap. 404)
09h00	**TU-Plen2**	**Plenary session** (Chair: R.I. Thompson, U. Calgary.)					(CAP)
		ERIC MAZUR, Harvard University *Confessions of a converted lecturer* **(ends at 09h45)**					**Room VCH 2850** (cap. 404)

Lundi, le 9 juin

VCH 3820 (cap. 104)	VCH 3830 (cap. 110)	VCH 3840 (cap. 106)	VCH 3860 (cap. 148)	VCH 3870 (cap. 51)	Other Locations *Autres endroits*	TIME HEURE
J. Wong (G*) *Neutron Multiple Scattering Discrimination Studies in DESCANT - DEuterated SCintillator Array for Neutron Tagging* **(MO-P8-7)**	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**P. Pasuthip (G*)** *Triple Coincident Gamma Calibration in Dark Matter Experiment with Argon and Pulse Shape Discrimination (DEAP)* **(MO-P5-6)**	**Session ends / *Fin de la session***	16h30-18h15 (CEWIP / CEFEP) **POP 1168** **GHAZZALI, Nadia** *Perspectives from the NSERC/Industry Chair for Women in Science and Engineering in Quebec* **(MO-CEWIP-1)**	16h30
Session ends / *Fin de la session*			**B. Cai (c)** *Pulse Shape Discrimination (PSD) in Liquid Argon* **(MO-P5-7)**		**Followed by Women in Physics Committee meeting / Suivi par un réunion du Comité pur encourager les femmes en physique. (Session ends at 18h15 / Se termine à 18h15)**	16h45
			P. Nadeau (G*) *Measurement and Analysis of the Droplet Size Distribution of PICASSO Detectors* **(MO-P5-8)**		17h00-19h30 (CAP-NSERC / ACP-CRSNG) **POP 2165** **CAP-NSERC LIAISON COMMITTEE MEETING / *RÉUNION DU COMITÉ DE LIAISON ACP-CRSNG*** *Chair: B. Gaulin, McMaster U.*	17h00
			R. Faust (G*) *Neutron calibration of the PICASSO detector* **(MO-P5-9)**			17h15
			P-L. Drouin (G*) *Towards a Three Phase Analysis at the Sudbury Neutrino Observatory* **(MO-P5-10)**		17h30-19h00 **VCH 1039C** PiC Editorial Board Meeting / Réunion du Comité de rédaction de la PaC. **(MO-PiC)**	17h30
			Session ends / *Fin de la session*			17h45

Foyer principal du Pavillon Alexandre-Vachon (2e/3e étages) — **Session d'affiches,** léger souper servi — 17h00

Nuclear Physics / *Physique nucléaire* (3)	Optics and Photonics / *Optique et photonique* (19)	Physics Education / *L'enseignement de la physique* (1)	Plasma Physics / *Physique des plasmas* (4)	Surface science / *Sciences des surfaces* (6)	Theoretical Physics / *Physique théorique* (11)	PLUS
MO-POS-53-55	MO-POS-56-74, plus 97	MO-POS-75	MO-POS-76-79	MO-POS-80-85	MO-POS-86-96	**Art of Physics competition winners** ***Les gagants du Concours l'Art de la physique***

Réunion du conseil d'édition du journal canadien de la physique (MO-CJP); se termine à 21h00 — Les Anciens Canadiens (restaurant au centre-ville) — 19h30

[MO-PUBLIC] — ***Conférence spéciale publique*** — 20h00

Jacques Lacoursière, Beauport, Québec
"Petite histoire des sciences et de leur enseignement au Québec"

Se termine à 21h00 — Théâtre de la cité universitaire (PPP) - (voir page 12 pour les détails)

Mardi, le 10 juin

VCH 3820 (cap. 104)	VCH 3830 (cap. 110)	VCH 3840 (cap. 106)	VCH 3860 (cap. 148)	VCH 3870 (cap. 51)	Other Locations *Autres endroits*	TIME HEURE
(TU-CNILC)	Réunion du Comité national canadien de liaison avec l'UIPPA - 07h00-08h10				POP 2165	07h00
(TU-HS-REGN)	Réception d'accueil pour les enseignants - 07h15-08h15				VCH 2870	07h15
TU-Plen1	***Session plénière* - *Médaille d'enseignement*** (Chair: M. Butler, Université Saint Mary's)				(ACP)	08h15
	ADAM J. SARTY, Université Saint Mary's *L'enseignement de la physique d'un bout à l'autre: ouvrir des portes à tous les niveaux* **(se termine à 09h00)**				**Salle VCH 2850** (cap. 404)	
TU-Plen2	***Session plénière*** (Chair: R.I. Thompson, U. Calgary.)				(ACP)	09h00
	ERIC MAZUR, Université Harvard *Confessions d'un enseignant converti* **(se termine à 09h45)**				**Salle VCH 2850** (cap. 404)	

Tuesday, June 10

TIME HEURE	POP 1168 (cap. 150)	VCH 2826 (cap. 42)	VCH 2830 (cap. 106)	VCH 2840 (cap. 98)	VCH 2860 (cap. 142)	VCH 2870 (cap. 57)	VCH 2880 (cap. 200)
		TU-A6 (DNP / *DPN*) **HEAVY IONS / IONS LOURDS** Chair: R. Austin Saint Mary's Univ.	**TU-A3** (PPD / *PPD*) **PRECISION FRONTIER I / LES LIMITES DE LA PRÉCISION I** Chair: S. Robertson McGill U.	**TU-A5** (DIMP-DMBP / *DPIM-DPMB*) **BIOMEDICAL INSTRUMENTATOIN / INSTRUMENTATION BIOMÉDICALE** Chair: K. Michaelian CANMET, NRCan	**TU-A10** (DPE / *DEP*) **TEACHING WITH TECHNOLOGY / ENSEIGNER AVEC LA TECHNOLOGIE** Chair: R.I. Thompson U.Calgary	**TU-A7** (DTP / *DPT*) **STRING THEORY / THÉORIE DES CORDES** Chair: K. Dasgupta McGill U.	**TU-HS-1** (CAP-DPE / ACP-DEP) **HIGH SCHOOL TEACHERS' WORKSHOP - A.M. / ATELIER DES ENSEIGNANT(E)S DE LA PHYSIQUE - AVANT-MIDI** Chair: M.A. Duguay U. Laval
10h00		**CHBIHI, Abdelouahad** *Exploring the symmetry energy with isospin effects in heavy-ion collisions* (TU-A6-1)	**ROBERTSON, Steven** *Recent results from the BABAR experiment* (TU-A3-1)	**MANDELIS, Andreas** *Investigation of Demineralization and Remineralization of Human Teeth Using Infrared Photothermal Radiometry and Modulated Luminescence* (TU-A5-1)	**LANGILL, Philip** *Hands-on Physics at an Observatory? (or, Is 'Physics' the better half of 'Astrophysics'?)* (TU-A10-1)	**CLINE, James** *Nongaussianity in the Cosmic Microwave Background from Nonlocal Inflation Models* (TU-A7-1)	**Coffee Break / *pause café***
10h15		↓	↓	↓	↓	↓	**LAFLAMME, Raymond** *Quantum Information Processing* (TU-HS-1-1)
10h30		**M.O. Frégeau (G*)** *Design and implementation of a gain control system for the Héraclès multidetector* (TU-A6-2)	**D. Lindemann (G*)** *Search for the Rare Decay $B \to l\gamma$ at BaBar* (TU-A3-2)	**TELENKOV, Sergey** *Photothermoacoustic (PTA) imaging of breast tissue: numerical simulation and detection analysis* (TU-A5-2)	**T. Antimirova (c)** *Teaching Physics with Visual Arts* (TU-A10-2)	**MALONEY, Alexander** *Partition Functions of Three Dimensional Quantum Gravity* (TU-A7-2)	↓
10h45		**J. Gauthier (G*)** *New HERACLES setup and further experiments with ISAC-II* (TU-A6-3)	**M. Simard (G*)** *Measurement of the B -> η (') lv Form-Factor Shapes and Branching Fractions* (TU-A3-3)	↓	**Coffee Break / *pause café***	↓	↓
11h00		**M.L. Bastien (G*)** *BUU calculations with isospin and momentum dependence for mid rapidity emission in heavy-ion collisions* (TU-A6-4)	**M. Lewczuk (G)** *Measurement of the $\tau^- \to \eta\pi^-\pi^+\pi^-\nu_\tau$ Branching Fraction and a Search for a Second-Class Current in the $\tau^- \to \eta'(958)\,\pi^-\nu_\tau$ Decay* (TU-A3-4)	**XU, Yuan** *Magneto-Acousto-Electrical Tomography: a Potential Imaging Modality for Electrical Impedance* (TU-A5-3)		**Coffee Break / *pause café***	**POUTISSOU, Jean-Michel** *L'étude des phénomènes stellaires en laboratoire à TRIUMF* (TU-HS-1-2)
11h15		**J. Moisan (G*)** *Heavy residues produced in Xe+Sn collisions* (TU-A6-5)	**R. Bayes (G*)** *A Muon Decay Spectrum Measurement from TWIST* (TU-A3-5)	↓	**MAZUR, Eric** *The interactive learning toolkit: technology and the classroom* (TU-A10-3)	**BRANDENBERGER, Robert** *Progress in String Gas Cosmology* (TU-A7-3)	↓
11h30		**A. Vallée (G)** *Fragments recognition at finite temperature* (TU-A6-6)	**J. Schwartz (G*)** *Towards the First Direct Measurement of the Longitudinal Structure Function at the ZEUS Experiment* (TU-A3-6)	**M. Martin (c)** *Diffusion Weighted Imaging of Optic Chiasm in Experimental Autoimmune Encephalomyelitis Mice* (TU-A5-4)	↓	↓	↓
11h45		**J. Svenne (c)** *Coulomb energy differences and Coulomb displacement energies from a coupled-channel scattering theory* (TU-A6-7)	**Z. Liu (G*)** *Cross section measurement of single top quark in tau+jets channel by decision trees* (TU-A3-7)	**S. Haider (G)** *Magneto-Acousto-Electrical-Tomography: A novel imaging modality for current density and electrical impedance* (TU-A5-5)	**D. de Kerckhove (c)** *Music in the physics classroom* (TU-A10-4)	**GOMIS, Jaume** *Non-local Operators in Gauge Theory and Holography* (TU-A7-4)	**COTE, Daniel** *Photonique appliquée à la recherche sur les neurones* (TU-HS-1-3)
12h00		**Session ends / *Fin de la session***	**E. Rollin (G*)** *Barium tagging for the Enriched Xenon Observatory* (TU-A3-8)	**J. Frimeth (c)** *Determination of the Least Significant Change in Bone Densitometry* (TU-A5-6)	**Session ends / *Fin de la session***	↓	↓
12h15			**Session ends / *Fin de la session***	**E. Renzhiglova (G*)** *Nonlinear effect in Magneto-Acousto-Electrical Tomography to improve the imaging modality* (TU-A5-7)		**Session ends / *Fin de la session***	↓
12h30	**HS Workshop Luncheon / Atelier des ensignant(e)s de la physique - dîner**		**PPD Business Meeting / *Réunion d'affaires PPD*** (lunches available / *repas disponible*)	**DIMP Business Meeting / *Réunion d'affaires DPIM*** (lunches available / *repas disponible*)		**DTP Business Meeting / *Réunion d'affaires DPT*** (lunches available / *repas disponible*)	**Session ends / *Fin de la session***
13h15	**TETU, Michel** *The Photonics within the ALMA Radiotelescope / La photonique dans le radio-télescope ALMA (Atacama Large Millimeter-wave Array)* (TU-HS-LUNCH) ends at 14h00 / se termine à 14h00						

Mardi, le 10 juin

VCH 3820 (cap. 104)	VCH 3830 (cap. 110)	VCH 3840 (cap. 106)	VCH 3860 (cap. 148)	VCH 3870 (cap. 51)	Other Locations *Autres endroits*	TIME HEURE
TU-A4 (DAMPhi-DOP / *DPAMip-DOP*) **QUANTUM INFORMATION AND COMPUTING I / INFORMATIQUE ET CALCUL QUANTIQUE I** Chair: A. Lvovsky U. Calgary	**TU-A2** (DMBP / *DPMB*) **THEORETICAL BIOPHYSICS / BIOPHYSIQUE THÉORIQUE** Chair: M. Karttunen UWO	**TU-A1** (DCMMP / *DPMCM*) **NEW INVESTIGATORS IN CONDENSED MATTER AND MATERIALS PHYSICS / NOUVEAUX CHERCHEUR(SES) EN MATIÈRE CONDENSÉE ET MATÉRIAUX** Chair: S.N. Patitsas U. Lethbridge	**TU-A8** (CAP / ACP) **CAP-HPCS NUMERICAL PHYSICS / PHYSIQUE NUMÉRIQUE ACP-HPCS** Chair: D. Senechal U. Sherbrooke	**TU-A9** (DCMMP / *DPMCM*) **BEST STUDENT PAPER COMPETITION III / COMPÉTITION POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES III** Chair: A. Moewes U. Sask.		
DUAN, Luming *Controlling interaction of ultracold atoms in an optical superlattice* **(TU-A4-1)**	**ROTTLER, Joerg** *Deformation, flow and aging in glassy materials* **(TU-A2-1)**	**HU, Can-Ming** *Spin Dynamics in Ferromagnetic and Spintronic Materials* **(TU-A1-1)**	**COUCHMAN, Hugh** *Computational Astrophysics* **(TU-A8-1)**	**J. Topple (G*)** *3,4,9,10-Perelynetetracarboxylic Diimide on NaCl: Dynamics of Dewetting* **(TU-A9-1)**		10h00
↓	↓	↓	↓	**H. Myers (G*)** *Effect of sodium in $CuInSe_2$ ingots grown by the Bridgman method* **(TU-A9-2)**		10h15
B. Sanders (c) *Escaping decoherence* **(TU-A4-2)**	**SUNIL KUMAR, P.B.** *Strain hardening, avalanches and strain softening in dense cross-linked actin networks* **(TU-A2-2)**	**CADOGAN, Sean** *Magnetism, Valence and the Magnetocaloric Effect in $R_5(Si,Ge)_4$ compounds (R= rare-earth)* **(TU-A1-2)**	**VETTERLI, Mike** *ATLAS Computing : Dealing with PetaBytes of Data per Year* **(TU-A8-2)**	**B. Boates (G*)** *Nitrogen Under Extreme Conditions* **(TU-A9-3)**		10h30
A.D. Abazari (G*) *Towards unambiguous quantum state discrimination in an optical memory* **(TU-A4-3)**	↓	↓	↓	**J-M. Ménard (G*)** *Characterization of coherently controlled ballistic charge currents in semiconductors and carbon nanotubes via the emitted THz radiation* **(TU-A9-4)**		10h45
Coffee Break / *pause café*	**A. Linhananta (c)** *Protein Folding Simulation of Mutant Go Models of the Trp-cage Protein* **(TU-A2-3)**	**BEACH, Kevin** *Simulating frustrated spin systems using valence bonds* **(TU-A1-3)**	**TROTTIER, Howard** *Quantum Chromodynamics on a space-time lattice* **(TU-A8-3)**	**J. Parete (G*)** *Novel Structure Formation via Thermal Patterning of Diblock Copolymer Films* **(TU-A9-5)**		11h00
J. Slater (G*) *A simple method to characterize a synchronous heralded single photon source* **(TU-A4-4)**	**B-Y. Ha (c)** *Membrane-Charge Selectivity of Cationic Antimicrobial Peptides* **(TU-A2-4)**	↓	↓	**Y. Chen (G*)** *Electric field requirements for the suppression of short channel effects of organic thin film transistors* **(TU-A9-6)**		11h15
M. Laforest (G*) *Benchmarking single and multi-qubit control in liquid state NMR quantum information processing* **(TU-A4-5)**	**A. Sain (c)** *Origin of contractile force during cell division of bacteria* **(TU-A2-5)**	**MELKO, Roger** *Quantum Phase Transitions via Large-Scale Computing* **(TU-A1-4)**	**TROYER, Matthias** *Simulating exotic quantum states of matter* **(TU-A8-4)**	**D. Wang (G)** *Tunable terahertz amplification in optically-excited biased semiconductor superlattices* **(TU-A9-7)**		11h30
M. Boissonneault (G*) *Quantum optics in superconducting circuits : The side-effects of measurement* **(TU-A4-6)**	**J. Berashevich (c)** *The energetics of G.A mis-pairs and their recognition in DNA* **(TU-A2-6)**	↓	↓	**M. Anderson (U*)** *Acoustic wave propagation in a bubbly liquid* **(TU-A9-8)**		11h45
C. Erven (G*) *Entangled Free-Space Quantum Key Distribution* **(TU-A4-7)**	**M. Karttunen (c)** *Controlling crystal growth using peptides* **(TU-A2-7)**	**Session ends / *Fin de la session***	**MOUSSEAU, Normand** *Simuler la dynamique des protéines* **(TU-A8-5)**	**R. Wilks (G*)** *Theoretical and Experimental Study of the Radiation Induced Decomposition of Glycine* **(TU-A9-9)**		12h00
Session ends / *Fin de la session*	**C. Dias (c)** *Catching the cold: Can computational modeling explain the physical mechanisms behind cold denaturation* **(TU-A2-8)**		↓	**S. Savard (G*)** *Terahertz Radiation from $YBa_2Cu_3O_7$ Thin Film on Sapphire Substrate* **(TU-A9-10)**		12h15
DOP Business Meeting / *Réunion d'affaires DOP* (lunches available / *repas disponible*)	**DMBP Business Meeting / *Réunion d'affaires DPMB*** (lunches available / *repas disponible*)		**Session ends / *Fin de la session***	**Session ends / *Fin de la session***		12h30
						12h45

Tuesday, June 10

TIME HEURE	POP 1168 (cap. 150)	VCH 2826 (cap. 42)	VCH 2830 (cap. 106)	VCH 2840 (cap. 98)	VCH 2860 (cap. 142)	VCH 2870 (cap. 57)	VCH 2880 (cap. 200)
13h30	**TU-Plen3** Plenary session - Medal of Achievement (Chair: L. Marchildon, UQTR) (CAP) **LOUIS TAILLEFER, University of Sherbrooke** *The Fermi Surface of high-Tc superconductors* **(ends at 14h15)** **Room VCH 2850** (cap. 404)						
			TU-P5 (DTP-PPD / *DPT-PPD*) NEW PHENOMENA / PHÉNOMÈNES NOUVEAUX Chair: R. Moore, U. Alberta	**TU-P4** (DNP / *DPN*) NEW PHYSICS - ELECTROWEAK TESTS / NOUVELLE PHYSIQUE - TESTS ÉLECTROFAIBLES Chair: M. Butler, Saint Mary's U.	**TU-P8** (DPP / *DPP*) INDUSTRIAL APPLICATIONS OF PLASMAS / APPLICATIONS INDUSTRIELLES DES PLASMAS Chair: A. Sarkissian, Plasmionique Inc.	**TU-P6** (DSS / *DSS*) SURFACE SCIENCE OF ENVIRONMENTAL PROCESSES / SCIENCE DES SURFACES ET PROCESSUS ENVIRONNEMENTAUX Chair: H. Al-Abadleh, WLU	**TU-HS-2** (CAP-DPE / ACP-DEP) HIGH SCHOOL TEACHERS' WORKSHOP - P.M. / ATELIER DES ENSEIGNANT(E)S DE LA PHYSIQUE - APRÈS-MIDI Chair: M.A. Duguay, U. Laval
14h15			**LOGAN, Heather** *What's new at the energy frontier* (TU-P5-1)	**GWINNER, Gerald** *Test of relativistic time dilation with fast optical atomic clocks at different velocities* (TU-P4-1)	**MARGOT, Joëlle** *Plasma-Québec : a unique strategic network in Plasma Science and Applications* (TU-P8-1)	**BERTRAM, Allan** *Heterogeneous atmospheric chemistry at night* (TU-P6-1)	**RAINVILLE, Simon** *Very high precision mass measurements: does E = mc²?* (TU-HS-2-1)
14h30			↓	↓	↓	↓	↓
14h45			**D.M. MacQueen (G*)** *Searches for New Physics in the Exclusive Dijet + Missing E_t Signature at the CDF-II Experiment* (TU-P5-2)	**BEHR, John** *Standard Model tests by measurement of the daughter nucleus momentum from laser-trapped radioactives* (TU-P4-2)	**STAFFORD, Luc** *Studies of plasma reactions on dynamic surfaces using a novel rotating substrate technique* (TU-P8-2)	**S. Cowen (G*)** *Hygroscopic Properties and Reactivity of Multicomponent Aerosol Proxies Studied using Diffuse Reflectance Fourier Transform Infrared Spectroscopy* (TU-P6-2)	**HÉON, Christian** *L'apprentissage par projet en physique* (TU-HS-2-2)
15h00			**R. Dick (c)** *Cosmic rays through the Higgs portal* (TU-P5-3)	↓	↓	**Coffee Break / *pause café***	↓
15h15			**A. Buzatu (G*)** *Search for Higgs Bosons Produced in association with W bosons at CDF* (TU-P5-4)	**J. Brewer (c)** *Relativistic shifts of μ^- g factors : finite nuclear size effects* (TU-P4-3)	**SARKAR, Dilip** *Superhydrophobic and ice-phobic coating by plasma process* (TU-P8-3)	**PEAK, Derek** *Mineral structure, surface complexation, and the solid/water interface: Insights on general aqueous surface chemistry from ATR-FTIR and XAS studies of S and Se oxyanion adsorption* (TU-P6-3)	↓
15h30			**LEBEL, Céline** *The ATLAS detector at LHC* (TU-P5-5)	**S. Barkanova (c)** *Computational models for the physics of electroweak and hadronic interactions* (TU-P4-4)	↓	↓	**McKENNA, Janis** *Symmetries and broken symmetries* (TU-HS-2-3)
15h45			↓	**Session ends / *Fin de la session***	**BLANCHARD, Vincent** *Plasma technology for the wood product industry* (TU-P8-4)	**H. Al-Abadleh (c)** *Adsorption of Organoarsenicals on Iron (oxyhydr)oxides: In situ ATR-FTIR Studies* (TU-P6-4)	↓
16h00			**R. Sandapen (c)** *Diffractive Z and Upsilon production at the LHC* (TU-P5-6)		↓	**P. Sun (G*)** *Phenol Interactions with Iron Oxide Colloids and Aluminum Oxide Colloids by Chemical Force Microscopy* (TU-P6-5)	**Session ends / *Fin de la session***
16h15			**A. Datta (c)** *Testing explanations of the Polarization Puzzle* (TU-P5-7)		**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	
16h30			**Session ends / *Fin de la session***				
	16h30 CAP Annual General Meeting - Achievements and challenges in promoting Canadian physics (Chair: L. Marchildon, UQTR) **(ends at 18h00)** **Room VCH 2850** (cap. 404)						

Mardi, le 10 juin

VCH 3820 (cap. 104)	VCH 3830 (cap. 110)	VCH 3840 (cap. 106)	VCH 3860 (cap. 148)	VCH 3870 (cap. 51)	Other Locations *Autres endroits*	TIME HEURE
TU-Plen3 *Session plénière* - ***Médaille de l'ACP*** (Chair: L. Marchildon, UQTR) **LOUIS TAILLEFER, Université de Sherbrooke** *La surface de Fermi des supraconducteurs à haute Tc* **(se termine à 14h15)**					(ACP) **Salle VCH 2850** (cap. 404)	13h30
TU-P7 (DAMPhi-DOP / *DPAMip-DOP*) **QUANTUM OPTICS - LASER COOLING, AND TRAPPING / OPTIQUE QUANTIQUE - REFROIDISSEMENT AU LASER ET PIÉGEAGE** Chair: D. Tokaryk UNB	**TU-P3** (DMBP / *DPMB*) **EXPERIMENTAL BIOPHYSICS / BIOPHYSIQUE EXPÉRIMENTALE** Chair: A. Linhananta Lakehead U.	**TU-P1** (DCMMP / *DPMCM*) **MATERIALS : SEMICONDUCTORS / MATÉRIAUX : SEMICONDUCTEURS** Chair: G.S. Chang U. Sask.	**TU-P9** (DOP / DOP) **SPECIAL TOPICS IN OPTICS / SUJETS SPÉCIAUX EN OPTIQUE** Chair: P. Ashrit U. Moncton	**TU-P2** (DCMMP / *DPMCM*) **GENERAL CONDENSED MATTER AND MATERIALS PHYSICS / PHYSIQUE GÉNÉRALE DE LA MATIÈRE CONDENSÉE ET DES MATÉRIAUX** Chair: Y. Zahra NRC		
PICHÉ, Michel *Acceleration of charged particles using ultrafast transverse magnetic laser beams of multiterawatt power* (TU-P7-1)	**KILFOIL, Maria** *Single cell fast spindle dynamics probed by automated phenotyping* (TU-P3-1)	**LEONELLI, Richard** *Ga(In)AsN : an unusual semiconductor alloy* (TU-P1-1)	**M. Fortin (G*)** *Les faisceaux Bessel courbés et leurs applications* (TU-P9-1)	**I. L'Heureux (c)** *The effect of volatile bubble growth on the periodic dynamics of volcanic eruptions* (TU-P2-1)		14h15
↓	↓	↓	**Y. Kamali (G*)** *Using Telescope and Adaptive Optics to the Generation and Locally Control of Filament for Filament-Induced Fluorescence Spectra to Remote Sensing of Hydrocarbon Pollutants* (TU-P9-2)	**F. Mansour (c)** *NMR and QENS Study of Phase Transition in Supercooled Confined Water* (TU-P2-2)		14h30
J. Bernhardt (G) *Spectroscopic characterization of a filament induced by a femtosecond laser pulse in a gaseous medium* (TU-P7-2)	**PELLING, Andrew** *Mechanics in the Moment* (TU-P3-2)	**HILL, Ian** *The Importance of Interfaces in Organic Electronic Devices* (TU-P1-2)	**P. Thibault (c)** *High-resolution scanning X-ray diffraction microscopy* (TU-P9-3)	**J. Stotz (c)** *Electron spin modulation using local strain fields* (TU-P2-3)		14h45
A. Carmichael (G*) *Mean-field Stationary State of a Bose Gas at a Feshbach Resonance* (TU-P7-3)	↓	↓	**Y. Chen (G*)** *Evolution and termination of a femtosecond laser filament in air* (TU-P9-4)	**L. Covaci (c)** *Extensions of the Momentum Average approximation* (TU-P2-4)		15h00
Coffee Break / *pause café*	**N. Kucerka (c)** *Detection of Lipid Rafts by Neutron Scattering* (TU-P3-3)	**A.E. Botha (c)** *General Approach for the Design of Semiconductor Heterostructures via Direct and Inverse Methods* (TU-P1-3)	**Coffee Break / *pause café***	**J. Harden (c)** *Dynamics of structural arrest in nanocolloidal suspensions undergoing gelation and aging* (TU-P2-5)		15h15
S. Beattie (c) *Effect of Spontaneous Emission on Matter Wave Interference* (TU-P7-4)	**J. Katsaras (c)** *Effect of Cations on the Structure of Lipopolysaccharide Bilayers Isolated from P. aeruginosa PAO1* (TU-P3-4)	**C. Allen (c)** *Strain-induced Electronic Level splitting in CdSe/Cd$_{(x)}$Zn$_{(1-x)}$S Colloidal Quantum Dots* (TU-P1-4)	**L.M. Chen (c)** *High contrast fs laser driven intense Ar K-shell x-ray source and its imaging application* (TU-P9-5)	**A. Teweldeberhan (c)** *First-principles study of the high pressure phases of alkaline-earth metals* (TU-P2-6)		15h30
B. Barrett (c) *Improving the precision Measurement of the Atomic Recoil Frequency using a Single-State Time-Domain Atom Interferometer* (TU-P7-5)	**J. Dutcher (c)** *Probing Protein Conformations at the Oil-Water Interface Using Single Molecule Force Spectroscopy* (TU-P3-5)	**X. Wang (c)** *Preparation of ZnO nanoparticles and particle size estimation by PL spectra* (TU-P1-5)	**M. Dallaire (G*)** *Génération expérimentale de faisceaux Bessel-Gauss spatiotemporels* (TU-P9-6)	**J. Houska (c)** *Atomistic simulations of the microstructural evolution of TiSiN nanocomposites* (TU-P2-7)		15h45
C. Mok (c) *Progress on Measurements of Gravitational Acceleration Using a Single State Atom Interferometer* (TU-P7-6)	**J. Dutcher (c)** *High Resolution Structure of Bacterial Cell Sacculi* (TU-P3-6)	**O. Voznyy (c)** *Reconstructions of the Au(111) and GaAs(001) surfaces driven by the thiol-thiol interactions* (TU-P1-6)	**C. Van Vlack (G*)** *Proposal for a solid state carrier-envelope-offset phase (CEP) detector* (TU-P9-7)	**M-P. Nieh (c)** *Morphology of comb-Shaped Proton Exchange Membrane (PEM) Copolymers Using Small Angle Neutron Scattering* (TU-P2-8)		16h00
I. Chan (c) *Evolution of Magnetic Coherences in Magnetic Fields* (TU-P7-7)	**M.R. Morrow (c)** *Effect of palmitoylation on perturbation of model lung surfactant by the N-terminal segment of surfactant protein SP-C* (TU-P3-7)	**T. Tiedje (c)** *Atomistic Basis for Continuum Growth Equation in GaAs Molecular Beam Epitaxy* (TU-P1-7)	**Session ends / *Fin de la session***	**P. Piercy (c)** *Microscopic surface deformation of Si(111) due to low energy ion bombardment* (TU-P2-9)		16h15
E. Paradis (c) *Observation of Superfluorescent Emissions from Laser-Cooled Atoms* (TU-P7-8)	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***		**Session ends / *Fin de la session***		16h30
Assemblée générale de l'ACP - Promouvoir la physique canadienne : réalisations et défis (Chair: L. Marchildon, UQTR) **(se termine à 18h00)**					***16h30*** **Salle VCH 2850** (cap. 404)	

19h00	Banquet Reception	PAD Le Grand Salon 2nd Floor
19h30-22h30	Banquet	

Wednesday, June 11

TIME HEURE	VCH 2830 (cap. 106)	VCH 2840 (cap. 98)	VCH 2860 (cap. 142)	VCH 2870 (cap. 57)
08h15	**WE-Plen1** Plenary session - CAP-INO Medal (Chair: R. Corriveau, CIPI) (CAP-INO) **JACQUES BEAULIEU, Beaulieu Consultant Inc.** *From Optics to Photonics in 50 Years* **(ends at 09h00)** **Room VCH 2850** (cap. 404)			
09h00	**WE-Plen2** Plenary session - CAP Herzberg Medal (Chair: L. Marchildon, UQTR (CAP) **CARL SVENSSON, University of Guelph** *Gamma-Ray Spectroscopy with Radioactive Ion Beams at TRIUMF-ISAC* **(ends at 09h45)** **Room VCH 2850** (cap. 404)			
	WE-A4 (DOP / *DOP*) ADVANCED MATERIALS AND PHOTONIC CRYSTALS / MATÉRIAUX AVANCÉS ET CRISTAUX PHOTONIQUES Chair: S. Gauvin, U. Moncton	**WE-A5** (DCMMP-DIMP / *DPMCM-DPIM*) SYNCHROTRON SCIENCE / SCIENCE DES SYNCHROTRONS Chair: A. Moewes, U. Sask.	**WE-A1** (CAP / *ACP*) CAP BEST STUDENT PRESENTATIONS FINAL COMPETITION / COMPÉTITION FINALE DE L'ACP POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES Chair: M. Campbell, U. Waterloo	**WE-A7** (DTP / *DPT*) RELATIVITY / RELATIVITÉ Chair: D. Witt, UBC
10h00	**KIEFFER, Jean-Claude** *The 200TW laser at the Advanced Laser Light Source facility: Progress, first experiments and perspectives of high power femtosecond technology* **(WE-A4-1)**	**DAMASCELLI, Andrea** *The Legacy of Einstein's Photoelectric Effect : From Light Quanta to Quantum Phenomena in Solids* **(WE-A5-1)**	**tba** **(G*)** *Student competitor #1 / Compétiteur étudiant #1* **(WE-A1-1)**	**MANN, Robert** *Boundaries Unbound* **(WE-A7-1)**
10h15	↓	↓	**tba** **(G*)** *Student competitor #2 / Compétiteur étudiant #2* **(WE-A1-2)**	↓
10h30	**Y. Zhang** **(G)** *Polymer Homo-junction photovoltaic cells* **(WE-A4-2)**	**DESGRENIERS, Serge** *X-ray Micro-Diffraction: A Remarkable Tool for the Study of Condensed Matter Under Extreme Conditions* **(WE-A5-2)**	**tba** **(G*)** *Student competitor #3 / Compétiteur étudiant #3* **(WE-A1-3)**	**POISSON, Eric** *Black holes in tidal environments* **(WE-A7-2)**
10h45	**ALBERT, Jacques** *Multiparameter sensing mechanisms from gratings in optical fibers* **(WE-A4-3)**	↓	**tba** **(G*)** *Student competitor #4 / Compétiteur étudiant #4* **(WE-A1-4)**	↓
11h00	↓	**Coffee Break / *pause café***	**tba** **(G*)** *Student competitor #5 / Compétiteur étudiant #5* **(WE-A1-5)**	**Coffee Break / *pause café***
11h15	**Coffee Break / *pause café***	**R. Gordon** **(c)** *High multipole transitions in NIXS: Valence and hybridization in 4f systems* **(WE-A5-3)**	**tba** **(G*)** *Student competitor #6 / Compétiteur étudiant #6* **(WE-A1-6)**	**S. Das** **(c)** *Predictions of the Generalized Uncertainty Principle* **(WE-A7-3)**
11h30	**SKOROBOGATIY, Maksim** *Photonic textiles and their applications* **(WE-A4-4)**	**R. Brüning** **(c)** *Monitoring the Glass Transition in Vitreous Silica with Temperature-Scanning Small Angle X-Ray Scattering* **(WE-A5-4)**	**tba** **(G*)** *Student competitor #7 / Compétiteur étudiant #7* **(WE-A1-7)**	**V. Faraoni** **(c)** *Do black holes accreting phantom energy violate Cosmic Censorship?* **(WE-A7-4)**
11h45	↓	**E. Dufresne** **(c)** *Nanosecond Domain Wall dynamics in Ferroelectric $PbZrTiO_3$ Thin Films* **(WE-A5-5)**	**tba** **(G*)** *Student competitor #8 / Compétiteur étudiant #8* **(WE-A1-8)**	**A. Dasgupta** **(c)** *A Complex Universe* **(WE-A7-5)**
12h00	**J. Khalack** **(c)** *Effect of film thickness and filling ratio on ΓLphotonic pseudogap in WO_3 inverse opal thin films* **(WE-A4-5)**	**Session ends / *Fin de la session***	**tba** **(G*)** *Student competitor #9 / Compétiteur étudiant #9* **(WE-A1-9)**	**D. Singh** **(c)** *Potential Evidence for Noncommutative Geometry in Muon Decay* **(WE-A7-6)**
12h15	**A. Rezaee** **(G)** *Fabrication of Gold Nanoparticles Based Optical Sensors Using Focused Ion Beam Lithography* **(WE-A4-6)**		**tba** **(G*)** *Student competitor #10 / Compétiteur étudiant #10* **(WE-A1-10)**	**Session ends / *Fin de la session***
12h30	**G. Cyr** **(G)** *Photoluminescence of colloidal CdSe/ZnS quantum dots coupled to whispering gallery modes of a microsphere for label-free biodetection* **(WE-A4-7)**		**Session ends / *Fin de la session***	
12h45	**Session ends / *Fin de la session***			

19h00	**Réception du banquet**	PAD Le Grand Salon 2e étage
19h30-22h30	**Banquet**	

Mercredi, le 11 juin

VCH 3820 (cap. 104)	VCH 3830 (cap. 110)	VCH 3840 (cap. 106)	VCH 3860 (cap. 148)	TIME HEURE
WE-Plen1 *Session plénière* - ***Médaille de l'ACP-INO*** (Chair: R. Corriveau, ICIP)			(ACP-INO)	08h15
JACQUES BEAULIEU, Beaulieu Consultant Inc. *De l'optique à la photonique en 50 ans* **(se termine à 09h00)**			**Salle VCH 2850** (cap. 404)	
WE-Plen2 *Session plénière* - ***Médaille de l'ACP*** (Chair: L. Marchildon, UQTR)			(ACP)	09h00
CARL SVENSSON, Université de Guelph *Spectroscopie de rayons gamma avec des faisceaux d'ions radioactifs à TRIUMF-ISAC* **(se termine à 09h45)**			**Salle VCH 2850** (cap. 404)	
WE-A2 (DNP / *DPN*) HADRON STRUCTURE, QCD / STRUCTURE HADRONIQUE, CDQ Chair: R. Lewis York U.	**WE-A6** (PPD-DNP / *PPD-DPN*) PRECISION FRONTIER II / LES LIMITES DE LA PRÉCISION II Chair: R. Moore U. Alberta	**WE-A3** (DMBP / *DPMB*) MEDICAL PHYSICS / PHYSIQUE MÉDICALE Chair: D. Fleming Mount Allison U.	**WE-A8** (DAMPhi / *DPAMip*) ATOMIC AND MOLECULAR SPECTROSCOPY AND DYNAMICS II / SPECTROSCOPIE ET DYNAMIQUE DES ATOMES ET MOLÉCULES II Chair: A. Ross U. de Lyon	
HUBER, Garth *Physics Potential of the Jefferson Lab 12 GeV Upgrade* **(WE-A2-1)**	**DAVOUR, Anna** *The PICASSO Dark Matter Search Project* **(WE-A6-1)**	**JIRASEK, Andrew** *Polymer gel dosimetry for 3D dose verification in radiation therapy* **(WE-A3-1)**	**HOLT, Richard** *Recent progress in fast-ion-beam laser measurements of atomic data for astrophysics* **(WE-A8-1)**	10h00
↓	↓	↓	↓	10h15
SARTY, Adam J. *Upcoming Proton Form Factor Radio Measurements at Extreme Momentum Transfers: from 0.105 to 15.0 GeV^2* **(WE-A2-2)**	**M-C. Piro** **(G)** *Status of PICASSO Detector for direct dark matter detection* **(WE-A6-2)**	**POEPPING, Tamie** *Vascular Modeling and Hemodynamics Research Using Ultrasound and Particle Imaging* **(WE-A3-2)**	**G. Drake** **(c)** *QED and Isotope Shifts in Li and Be+* **(WE-A8-2)**	10h30
↓	**G. Giroux** **(G)** *Data analysis of the ongoing PICASSO 3kg-phase* **(WE-A6-3)**	↓	**P. Beiersdorfer** **(c)** *Atomic data for magnetic fusion diagnostics* **(WE-A8-3)**	10h45
PETRY, Robert *Lattice methods for light-quark mesons* **(WE-A2-3)**	**C. Levy** **(c)** *Calibration for the PICASSO dark matter search project* **(WE-A6-4)**	**BEYEA, Steven** *Novel Acquisition Techniques for High Field Functional MRI (fMRI)* **(WE-A3-3)**	**Coffee Break /** ***pause café***	11h00
↓	**W. Rau** **(c)** *News from Direct Dark Matter Search with CDMS* **(WE-A6-5)**	↓	**ROSS, Stephen** *Selected Aspects of Large Amplitude Motion in Molecules* **(WE-A8-4)**	11h15
D. Hornidge **(c)** *Measurement of the Photon Asymmetry in Neutral Pion Production from the Proton near Threshold* **(WE-A2-4)**	**M.C. Fujiwara** **(c)** *New Results from ALPHA Antihydrogen Project at CERN* **(WE-A6-6)**	**M. Gherase** **(c)** *K-shell X-ray fluorescence measurements using the fundamental parameter method* **(WE-A3-4)**	↓	11h30
C. Davis **(c)** *The compton polarimeter for Qweak* **(WE-A2-5)**	**J. Martin** **(c)** *Ultracold Neutrons at TRIUMF* **(WE-A6-7)**	**W. Whelan** **(c)** *Near-infrared optoacoustic imaging of tissue mimicking phantoms* **(WE-A3-5)**	**A. Predoi-Cross** **(c)** *Nitrogen-broadened lineshapes in the oxygen A-band; experimental results and theoretical calculations* **(WE-A8-5)**	11h45
P. Wang **(G)** *Diamond Detectors for Compton Polarimetry* **(WE-A2-6)**	**GRAHAM, Kevin** *Measuring Neutrino Mass with EXO* **(WE-A6-8)**	**L. Lilge** **(c)** *Can tissue aging and transformation be detected optically?* **(WE-A3-6)**	**T.J. Reddish** **(c)** *Interplay between Electronic and Nuclear Motion in the Photodouble Ionization of H_2* **(WE-A8-6)**	12h00
A. Coppens **(G)** *The G0 experiment, parity violation of Delta photoproduction* **(WE-A2-7)**	↓	**Session ends /** ***Fin de la session***	**Session ends /** ***Fin de la session***	12h15
Session ends / ***Fin de la session***	**Session ends /** ***Fin de la session***			12h30
				12h45

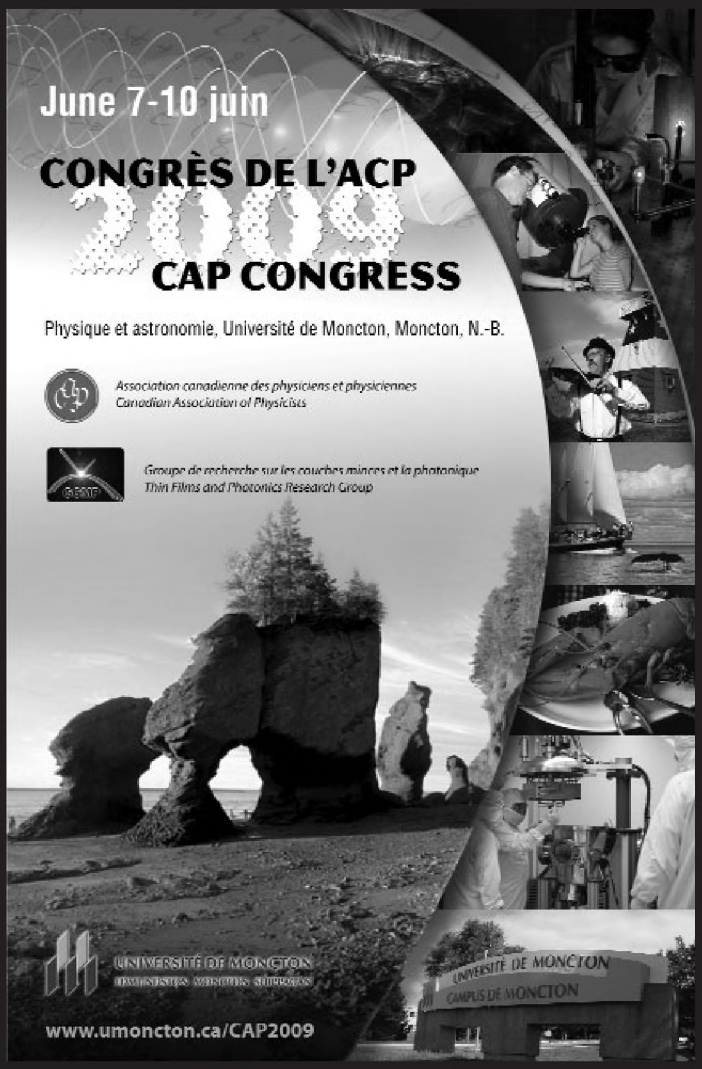
Wednesday, June 11

TIME HEURE	VCH 2830 (cap. 106)	VCH 2840 (cap. 98)	VCH 2860 (cap. 142)	VCH 2870 (cap. 57)
13h30	**We-Plen3** Plenary session - CAP-CRM Prize (Chair: R. MacKenzie, U.Montreal) (CAP-CRM) **RICHARD CLEVE** *Quantum Information, Computation and Communication* **(ends at 14h15)** **Room VCH 2850** (cap. 404)			
	WE-P7 (CAP / ACP) TOPICS IN PHYSICS / DIVERS SUJETS EN PHYSIQUE Chair: R. Mann U. Waterloo	**WE-P1** (DCMMP / *DPMCM*) THIN FILMS / COUCHES MINCES Chair: D. Venus McMaster U.	**WE-P6** (DASP / *DPAE*) ASTRONOMY, ATMOSPHERIC AND SPACE PHYSICS / ASTRONOMIE ET PHYSIQUE DE L'ATMOSPHÈRE ET DE L'ESPACE Chair: R. Roy U. Laval	**WE-P4** (DNP-DTP / *DPN-DPT*) NUCLEAR THEORY / THÉORIE NUCLÉAIRE Chair: P. Blunden U. Manitoba
14h15	**K. Mitchell** (c) *Non-linear PDE model for pattern dynamics observed on sun-ablated snow* **(WE-P7-1)**	**VENUS, David** *Measurements of static and dynamic susceptibility exponents of an ultrathin ferromagnetic film* **(WE-P1-1)**	**DRISSEN, Laurent** *The International Year of Astronomy 2009* **(WE-P6-1)**	**BACCA, Sonia** *Ab Initio Reactions of Light Nuclei* **(WE-P4-1)**
14h30	**B. Barrett** (c) *Numerical Simulations of a Single State Atom Interferometer* **(WE-P7-2)**	↓	↓	↓
14h45	**S. Beattie** (c) *Investigation of Light Scattering and Collisions on an Atom Interferometer* **(WE-P7-3)**	**PATITSAS, Steve** *STM studies of the dissociation of trichloroethylene on silicon surfaces: Possible consequences for thin film growth* **(WE-P1-2)**	**F. Nichitiu** (c) *Extreme CO pollution events measured by the MOPITT instrument* **(WE-P6-2)**	**H.S. Sherif** (c) *Inclusive Photoproduction of η Mesons on Nuclei and the in-medium properties of the S_{11} Resonance* **(WE-P4-2)**
15h00	**I. Mastikhin** (c) *Comparative Dynamics of the liquid and dissolved gas during cavitation* **(WE-P7-4)**	↓	**J.K. Lepson** (c) *Atomic Data from Magnetic Fusion Devices for Solar and Stellar Physics* **(WE-P6-3)**	**J-S. Gagnon** (c) *Leading Order Calculation of Transport Coefficients in Hot Quantum Electrodynamics from Diagrammatic Methods* **(WE-P4-3)**
15h15	**M.H. Boukhatem** (c) *Température électronique pour l'étude du fonctionnement des jonctions* **(WE-P7-5)**	**F. Delgado** (c) *Spin selective Aharonov-Bohm oscillations in a lateral triple quantum dot* **(WE-P1-3)**	**E. Galiano-Riveros** (c) *An empirical determination of the mass to size ratio in modern commercial air transports* **(WE-P6-4)**	**S. de Baerdemacker** (c) *The collective model from a Cartan-Weyl perspective* **(WE-P4-4)**
15h30	**H. Dominguez** (c) *Simulations of electrostatic systems at high temperatures* **(WE-P7-6)**	**G. Granger** (c) *Observation of Chiral Heat Transport in the Quantum Hall Regime* **(WE-P1-4)**	**Session ends / *Fin de la session***	**J. Fortier** (c) *Rotational deformations on B=1 and B=2 Skyrmions* **(WE-P4-5)**
15h45	**K. Vos** (c) *Effects of extreme anisotropies in the t-J model* **(WE-P7-7)**	**L. Livadaru** (c) *Elemental Contrast in Nanostructures by Low Energy Electron Point Source Holography* **(WE-P1-5)**		**Session ends / *Fin de la session***
16h00	**Session ends / *Fin de la session***	**C. Barrett** (c) *Azobenzene Polymers for Photo-Reversible Surfaces and Structures* **(WE-P1-6)**		
16h15		**G. Beydaghyan** (c) *Effect of nanostructure on the phase and crystallinity of molybdenum oxide films* **(WE-P1-7)**		
16h30		**Session ends / *Fin de la session***		
16h45				
17h00	**WE-Counc** (CAP) **CAP Council Meeting (New and Old)** **(ends at 19h00)** **Room POP 1168** (cap. 150)			

Mercredi, le 11 juin

VCH 3830 (cap. 110)	VCH 3840 (cap. 106)	VCH 3860 (cap. 148)	Other Locations / Autres endroits	TIME HEURE
WE-Plen3 *Session plénière - Prix ACP-CRM* (Chair: R. Mackenzie, U. Montréal) **RICHARD CLEVE** *L'informatique, le calcul et la communication quantiques* **(se termine à 14h15)**			(ACP-CRM) **Salle VCH 2850** (cap. 404)	13h30
WE-P2 (PPD / *PPD*) ENERGY FRONTIER / FRONTIÈRE ÉNERGÉTIQUE Chair: S. Robertson McGill U.	**IWE-P3** (DIMP / *DPIM*) GENERAL INSTRUMENTATION / INSTRUMENTATION GÉNÉRALE Chair: K. Michaelian CANMET, NRCan	**WE-P5** (DAMPhi-DOP / DPAMip-DOP) QUANTUM INFORMATION AND COMPUTING II / INFORMATIQUE ET CALCUL QUANTIQUES II Chair: B. Sanders U. Calgary		
WARBURTON, Andreas *Recent Results from the Collider Detector at Fermilab (CDF)* **(WE-P2-1)**	**SHEN, Jun** *Top-hat cw laser induced time-resolved mode-mismatched thermal mirror and thermal lens spectroscopies* **(WE-P3-1)**	**LVOVSKY, Alexander** *Quantum memory for continuous-variable optical states* **(WE-P5-1)**		14h15
↓	↓	↓		14h30
AGUILO, Ernest *Latest Results of the DZero Experiment* **(WE-P2-2)**	**L. Poirier (G)** *Optimization of rocker measurements with a portable gauge* **(WE-P3-2)**	**A. MacRae (c)** *Double electromagnetically-induced transparency in rubidium vapor* **(WE-P5-2)**		14h45
↓	**B. Newling (c)** *Measurements of Turbulent Flow Phenomena with Magnetic Resonance Imaging (MRI)* **(WE-P3-3)**	**E. Saglamyurek (G)** *Towards Quantum Memory* **(WE-P5-3)**		15h00
S. Carron Montero (c) *Measurement of the Top Quark Mass with the template method in the dilepton and lepton+jets decay channels from pp collisions at 1.96 TeV* **(WE-P2-3)**	**K. Michaelian (c)** *Mid- and far-infrared photoacoustic spectroscopy at the Canadian Light Source* **(WE-P3-4)**	**Coffee Break / *pause café***		15h15
B. Vachon (c) *Search for direct production of a heavy charged Higgs boson decaying to tb final state in proton-antiproton collisions* **(WE-P2-4)**	**Session ends / *Fin de la session***	**P. Xue (c)** *Quantum Walks on Circles in Phase Space via Cavity or Circuit Quantum Electrodynamics* **(WE-P5-4)**		15h30
B. Brelier (G) *Associated production ZH/WH -> photons with the Atlas detector* **(WE-P2-5)**		**P. Chan (G)** *Towards Fast Error Correction for Quantum Key Distribution* **(WE-P5-5)**		15h45
DIXIT, Madhu *The International Linear Collider - a precision probe for physics in the post-LHC era* **(WE-P2-6)**		**I. Lucio (G)** *Combining Quantum Key Distribution and Internetworking over a 12 km real-world fibre link* **(WE-P5-6)**	**WE-Exec** (CAP-ACP)	16h00
↓		**O. Moussa (G)** *Implementation of Quantum Error Correction in Solid State NMR* **(WE-P5-7)**	**CAP Executive Meeting / Réunion de l'Exécutif de l'ACP** **Room / salle POP 2165** (cap. 28) **(ends at 17h00 / se termine à 17h00)**	16h15
M. Barbi (c) *Study of Dark Matter with the International Linear Collider* **(WE-P2-7)**		**Session ends / *Fin de la session***		16h30
Session ends / *Fin de la session*				16h45
WE-Counc **Réunion du conseil de l'ACP (nouveau et ancien)** **(se termine à 19h00)**			(ACP) **Salle POP 1168** (cap. 150)	17h00

Next CAP Annual Congress
2009 June 7-10
at the University of Moncton, Moncton, NB



Prochain Congrès annuel de l'ACP
7-10 juin 2009
à l'Université de Moncton, Moncton, N-B.

Come and visit the Art of Physics exhibition on display at the 2008 Congress. Entry forms for the 2009 competition will be available at the CAP Information Desk (deadine Jan. 31/09). Winning entries will be added to the travelling exhibition.

Venez visiter l'exposition l'<<Art de la Physique>> tenue lors du Congrès 2008. Les formulaires d'inscription pour le concours 2009 seront disponibles au bureau d'information (la date limite est le 31 janvier 2009). Les gagnants verront leurs œuvres ajoutées à l'exposition itinérante.

2008 CONGRESS ORAL SESSION ABSTRACTS
RÉSUMÉS DES SESSIONS ORALES - CONGRÈS 2008

The oral session abstracts presented here are organized by session codes (SU-A1 to WE-P7). Each presentation is cross-referenced in the Author Index (pg. 159). *Les résumés des sessions orales ci-après sont par code (SU-A1 à WE-P7). L'index des auteurs (pg. 159) établit des renvois à cette liste de présentations.*

Please see the Congress Program Summary for details on the times and locations of each of the sessions as well as all other (non-session) meetings organized in conjunction with the 2008 Congress. *Veuillez vous référer au résumé du programme du Congrès pour les heures et endroits de chaque session ainsi que pour toutes les autres rencontres organisées en conjonction avec le Congrès 2008.*

SATURDAY, JUNE 7 - SAMEDI, 7 JUIN

[SA-Exec] (CAP-Exec / Exec-ACP)
Meeting of CAP Executive / *Réunion de l'exécutif de l'ACP*
SATURDAY, JUNE 7 / SAMEDI, 7 JUIN
09h30 - 13h30

ROOM / SALLE POP 2165 **(cap. 28)** ***Chair: L. Marchildon, UQTR***

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

13h30 **Session Ends** / ***Fin de la session***

[SA-Council] (CAP-Council / *Conseil-ACP*)
Meeting of CAP Council (Old and New) / *Réunion du conseil (ancien et nouveau) de l'ACP*
SATURDAY, JUNE 7 / SAMEDI, 7 JUIN
14h00 - 17h30

ROOM / SALLE POP 1168 **(cap. 150)** ***Chair: L. Marchildon, UQTR***

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

17h30 **Session Ends** / ***Fin de la session***

SUNDAY, JUNE 8 - DIMANCHE, 8 JUIN

[SU-HD-CHR] (Heads / *Directeurs*)
Meeting of Heads/Chairs of Physics Departments / *Réunion des directeurs de départements de physique*
SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN
08h15 - 11h00

ROOM / SALLE PAD "Le Cercle", 4th floor ***Chair: R. Roy, U. Laval***

Agenda circulated to participants separately. / *Ordre du jour distribué aux participants séparément.*

11h00 **Session Ends** / ***Fin de la session***

[SU-A1] (DPP / *DPP*)
Applications of Plasmas / *Applications des plasmas*
SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN
09h00 - 11h30

ROOM / SALLE VCH 3870 **(cap. 51)** ***Chair: J. Morelli, Queen's University***

SU-A1-1 **09h00**

L. MARTINU, École polytechnique de Montréal

From understanding ion-surface interactions in a plasma environment to advanced surface engineering solutions †

Recent advances in science and technology stimulate the development of new coating materials, surface and interface engineering processes and thin film systems that provide an ever increasing performance in numerous areas ranging from optics and optoelectronics to aerospace, automotive, biomedical, microelectronic, and other applica-

tions. Many successful solutions in these particular fields have been identified when using ion-assisted deposition of thin films and thin film systems with tailored functional characteristics including the complex refractive index, the mechanical and tribological properties such as stress, hardness, friction coefficient and wear, the electrical conductivity, the gas and vapour permeation, and many others. In this presentation, we will describe our recent studies of the ion-surface interactions in a plasma environment (biased-controlled PECVD and PVD techniques) using a methodology combining *in situ* real-time spectroscopic ellipsometry (RTSE), dynamic Monte-Carlo simulations, and different complementary microstructural and chemical analysis methods. These have the capability to detect and simulate subplantation-related processes, such as subsurface structural and compositional modifications, and interface broadening, on time and depth scales relevant to functional coatings deposition. Specifically, we will discuss ion-induced effects resulting in rapid structural and compositional changes below film or substrate surfaces, as well as significant ion mixing and interface broadening, and relocation of a large proportion of deposited atoms below the growth surface. Following a description of the principal physical processes, we will show examples when the above-mentioned methodology helped to enhance our understanding of the film growth and interface evolution for numerous single and multilayer functional coatings. This includes TiO_2, SiO_2, Si_3N_4, ITO and the nanocomposite superhard TiN/SiN and TiCN/SiCN systems suitable for numerous advanced technological applications.

† In collaboration with A. Amassian, P. Jedrzejowski, R. Vernhes, O. Zabeida, P. Desjardins, J.E. Klemberg-Sapieha, École polytechnique de Montréal

SU-A1-2 09h30

FRANÇOIS VIDAL, Institut national de la recherche scientifique

Laser ablation threshold dependence on pulse duration and wavelength for corneal tissues: experiments and modeling †,*

It is well known that shorter laser pulses ablate at lower energy and thus with smaller thermal and mechanical collateral damage than longer pulses. A route toward improving the femtosecond laser in surgical applications consists in exploring the effects of the laser parameters on the ablation of biological tissues. The key parameter to consider for characterizing the laser-tissue interaction is the ablation threshold, defined as the minimum laser energy per unit surface (fluence) required to induce detectable changes in the material. In this talk we will present results of experiments and theoretical modeling on laser ablation of porcine corneal tissues in which we varied two essential laser parameters: (1) pulse duration and (2) wavelength. In the pulse duration study (1), we investigated the ablation threshold of corneas in the range 100 fs-5 ps, for a wavelength of 800 nm. The plateau-like region observed between 100 fs and 1 ps indicates that for use in laser surgery, laser pulse durations chosen within this range should be practically equivalent. In the wavelength study (2), we used 100 fs laser pulses, with wavelengths between 800 nm and 1450 nm, generated by a Ti:sapphire-pumped optical parametric amplifier. The data suggest a rapid increase of the ablation threshold for wavelengths up to about 1000 nm, followed by a plateau for longer wavelengths. We discuss a simple theoretical model which explains most of these features.

† In collaboration with Dominic Giguère [1], Gilles Olivié [1], Tsuneyuki Ozaki [1], Jean-Claude Kieffer [1], Ossama Nada [2], Isabelle Brunette [3], [1] Institut national de la recherche scientifique, [2] Ain Shams University (Egypt), [3] Université de Montréal

* This work is being supported by Canadian Institutes of Health Research and the FRSQ Research in Vision Network

SU-A1-3 10h00

SERVAAS HOLVOET, Université Laval

Nano-coating and surface functionalisation: towards high-performance vascular biomaterials †

Nowadays, vascular diseases are the primary cause of death in the world and at least 1 million patients undergo surgical operation for prosthesis implantation each year, however not without complications. As the major problem still resides in an interfacial mismatch between the synthetic inert graft and the natural living tissue surrounding it, the common approaches consist of modulating the tissue/biomaterial interface by modifying the synthetic graft surface properties, in an attempt to improve their long-term bio- and haemocompatibility. Thus, several coating techniques, including plasma-based treatments, were investigated during the last 20 years to improve clinical performances of cardiovascular devices. Strong binding of selected bio-molecules, including protein-repellent ones, surface patterning, and a number of other strategies has already been investigated in order to obtain biological-like surfaces based on the hypothesis that the human body would positively interact with these biologically coated materials. Nevertheless, such coatings did not completely success clinically as it turned out that the bioactive materials could not play their biological role as expected and eventually led to negative interactions and, as a consequence, to clinical complications. Today, nanotechnology and surface modifications provide a new insight to the current problem of biomaterial failures. Within this general framework, this talk will focus on highly-adherent and strongly-cohesive (after deployment) fluorocarbon nanocoatings for intravascular stents, and bio-mimicking coatings for vascular prostheses. The intrinsic goal is to present a personal look at how materials and surface modifications have progressed, from the glory days of their introduction, to the promising future that nanotechnology may or may not hold for improving the quality of the life of millions worldwide.

† In collaboration with Diego Mantovani, Laval University

SU-A1-4 10h30

Prospects for plasmonic devices in photonics*, **Michael Bradley**, *University of Saskatchewan* — There has recently been a strong resurgence of interest in plasmon-related physics. Diverse effects such as sub-wavelength confinement and lensing, negative refractive indices, and surface-enhanced Raman scattering, among others, can all be related to interactions of incident photons and free electrons at metal-dielectric interfaces. Nano-scale patterning of these interfaces can result in remarkably strong coupling between incident light fields and plasmon/polariton modes. This has a number of interesting and potentially important implications for photonics. This talk will review the basic physics of these effects and discuss some potential applications in photonic devices.

* This work is being supported by NSERC

SU-A1-5 10h45

Evolution of plasma rotation, radial electric field, MHD activity and plasma confinement in STOR-M tokamak*, **Mykola Dreval**, Chijin Xiao, Dallas Trembach, Akira Hirose, Sayf Gamudi Elgriw, Andre Pant, Damian Rohraff, Tianye Niu, *University of Saskatchewan* — Experimental results from the STOR-M tokamak detailing simultaneous behavior of plasma rotation, radial electric field, MHD activity, and plasma confinement are presented. These parameters are important factors affecting transport and confinement in tokamaks. In the STORM tokamak, fast (~ 1 ms) simultaneous alterations of the radial electric field (75 V/cm to +10 V/cm), plasma rotation ($M_{||}$=0 to 0.4 in plasma current direction), floating potential fluctuations in the periphery and MHD activity generated by rotating islands in the vicinity of the periphery have been observed experimentally during normal ohmic discharges. Estimation of global confinement time and H_α shows that STORM confinement is marginal to L-H transition in ohmic discharge without external perturbations. MHD activity in STORM is suppressed in the presence of a negative electric field and, MHD frequency decreases with negative electric field.

* This work is being supported by Canada Research Chair Program and Natural Sciences and Engineering Research Council of Canada

SU-A1-6 **11h00** **(G*)**

Studies of magnetohydrodynamics (MHD) instabilities by singular value decomposition (SVD) analysis of mirnov coil signals in the STOR-M tokamak*, **Sayf Gamudi Elgriw**, Akira Hirose, Chijin Xiao, Mykola Dreval, Damian Rohraff, Dallas Trembach, Andre Pant, Tianye Niu, *University of Saskatchewan* — Magnetohydrodynamics (MHD) instabilities in STOR-M tokamak have been investigated using 32 Discrete Mirnov coils arranged into 4 poloidal arrays and installed at different toroidal locations separated by 90°. Two of those arrays are mounted at toroidal angles of 0° and 180°, each consisting of 12 Mirnov coils poloidally separated by 30°. Those arrays are used to detect poloidal mode numbers up to 6. The other two arrays are installed at toroidal angles of 90° and 270°, each consisting of 4 Mirnov coils and poloidally separated by 90°. The set of outboard coils of 4 arrays, at the same poloidal angle, are used to detect the toroidal mode numbers up to 2. The collected signals are processed by Singular Value Decomposition (SVD) algorithm. It has been found that the poloidal mode number varies from 2 to 4 with oscillating frequency range of 20~40 kHz during the normal Ohmic discharges. It has been found that the m=2 oscillations have been suppressed during the improved plasma confinement phase induced by injecting Compact Torus (CT). However, before the transition to normal Ohmic mode, an m=1 gong mode has been triggered, followed by the reappearance of m=2 Mirnov oscillations. SVD analysis has also identified the dominant n=1 toroidal mode number.

* This work is being supported by the Natural Sciences and Engineering Research Council (NSERC) and the Canada Research Chair (CRC)

SU-A1-7 **11h15** **(G*)**

Diamagnetic measurements of poloidal beta on the STOR-M tokamak*, **Dallas Trembach** [1], Mykola Dreval [1], Chijin Xiao [1], Akira Hirose [1], Damian Rorhaff [1], Sayf Elgriw [1], Andre Pant [1], Tianye Niu [2], [1] *University of Saskatchewan*, [2] University of Science and Technology of China — Diamagnetic measurements of poloidal beta have been successfully performed on the Saskatchewan Torus-Modified (STOR-M) using a compensated coil system mounted exterior to the vacuum chamber wall. A significant challenge in performing these measurements on STOR-M is the presence of a decaying toroidal magnetic field over the duration of the discharge. A simple method for compensating these measurements based on independently measuring the vacuum field signal and correcting during post-processing is presented. Measurements of poloidal beta using the diamagnetic coil arrangement are compared to calculations of poloidal beta based on the Spitzer conductivity corrected for trapped electrons.

* This work is being supported by Canada Research Chair Program and Natural Sciences and Engineering Research Council of Canada

11h30 **Session Ends / *Fin de la session***

[SU-A2] Neutrino Physics / *Physique des neutrinos*

(PPD / *PPD*)

SUNDAY, JUNE 8
DIMANCHE, 8 JUIN
9h00 - 11h30

ROOM / SALLE ***VCH 2830*** **(cap. 106)** ***Chair: M.G. Boulay, Queen's University***

SU-A2-1 **09h00**

ALEX WRIGHT, Queen's University

*The SNO+ Experiment at SNOLAB**

SNO+ is a follow-on experiment to the Sudbury Neutrino Observatory (SNO) that will involve replacing the SNO heavy water with an organic liquid scintillator. This new active medium will make SNO+ sensitive to the lower energy pep and CNO solar neutrinos, reactor anti-neutrinos, geoneutrinos, and supernova neutrinos and thus allow the experiment to make measurements interesting to neutrino physics, stellar physics and geophysics. In addition, by doping the scintillator with neodymium, SNO+ will carry out a competitive, and possibly leading, next generation search for neutrinoless double beta decay. This talk will discuss the physics goals of the SNO+ experiment and update the project's status.

*This work is supported by NSERC

SU-A2-2 **09h30** **(G)**

A low energy threshold analysis of the data from the pure heavy water and salt phases of the Sudbury Neutrino Observatory experiment*, **Olivier Simard**, *Carleton University* — The Sudbury Neutrino Observatory (SNO) provided the first clear evidence of solar neutrino flavour change. The success of SNO resides in its ability to measure, with heavy water, both the flux of solar electron neutrinos and the total neutrino flux using two different reactions, the charge-current and neutral-current reactions, in addition to the elastic-scattering interaction which also occurs in light water Cherenkov detectors. The SNO experiment was divided into three phases, each one using a different method for detecting neutrons produced in the neutral-current interaction, thus providing three different measurements of the total flux of solar neutrinos. In preparation for the final combined analysis of the whole SNO data set, the data of the two first phases are re-examined, after lowering the energy threshold from 5.5 MeV to 3.5 MeV. At this threshold, a good understanding of the detector and backgrounds is crucial to separate the neutrino events and associate them with a reaction. The additional information at low energies allows for an extended analysis of the various neutrino oscillation mechanisms and hypothesis tests of the solar standard model. The constraints on the oscillation parameters are shown, as obtained from both the low-energy SNO analysis and when the latter is combined with other solar and non-solar neutrino oscillation experiments.

* This work is being supported by Carleton University

SU-A2-3 **09h45** **(G*)**

Low threshold ^{8}B solar neutrino energy spectrum from the first two phases of the Sudbury Neutrino Observatory*, **Ryan MacLellan**, *Queen's Univerity* — The Sudbury Neutrino Observatory (SNO) is a one kiloton heavy water (D_2O) Cerenkov detector. SNO has the unique ability to detect both the electron flavour content of solar neutrinos, a charged current (CC) reaction, and the total flux of active neutrinos, through a neutral current reaction (NC). Comparisons of the CC and NC solar neutrino flux published by SNO have provided direct evidence of solar neutrino oscillation. The NC flux has also confirmed solar model predictions of the ^{8}B solar neutrino flux. A description of an analysis combining the data from the pure D_2O and salt phases of SNO with a lower energy threshold will be presented. The increased statistics will provide tighter constrains on neutrino oscillation parameters while the lower energy threshold will probe possible electron neutrino spectral distortions. The primary challenges of such an analysis, including the much higher rates of low energy backgrounds in the dataset and minimizing systematic uncertainties, will also be discussed.

* This work is being supported by NSERC

SU-A2-4 **10h00** **(G*)**

The Neutral Current Detector phase of the Sudbury Neutrino Observatory*, **Ryan Martin** — In this talk, I will present results from the Neutral Current Detector (NCD) phase of the Sudbury Neutrino Observatory (SNO). In this phase of the experiment, the total ^{8}B solar neutrino flux is measured independently from the other phases using an array of ^{3}He proportional counters (NCDs) immersed in one kiloton of heavy water. The proportional counters detect the neutrons produced when all flavours of neutrinos interact (through the neutral current) with the deuterons in the heavy water. Comparing the number of neutral current events with the number of charged-current events (sensitive to only the electron neutrino flavour and measured by an array of PMTs) gives a measure of the solar neutrino oscillation mixing parameters.

* This work is being supported by NSERC

10h15 **Coffee Break / *Pause café***

SU-A2-5 **10h30**

HIROHISA A. TANAKA, University of British Columbia

T2K and the Next Generation of Neutrino Oscillation Experiments *

One of the most important recent developments in the field of elementary particle physics is the establishment of neutrino oscillations, in which neutrinos can transmute between three flavors as they propagate through space. The pattern of oscillations is determined by the masses of the neutrinos and a mixing matrix that relates the neutrino flavors to the masses. Currently, there is an exciting world-wide program to elucidate the properties of neutrinos through further study of neutrino oscillations. One could probe details of the mixing matrix and the possibility of CP violation (differences in the oscillations of neutrinos and their antiparticle counterparts). This in turn could have important implications for understanding how our universe came to its matter-dominated state, as well as the quest to have a unified understanding of the quarks and leptons. The Tokai-to-Kamioka (T2K) experiment will study neutrino oscillations using an intense neutrino beam produced by the J-PARC accelerator complex north of Tokyo directed towards the Super-Kamiokande detector 295 km away. Canadian groups have a critical role in the experiment associated with the construction of a set of detectors to determine the properties of the neutrino beam prior to oscillation effects, a novel monitoring device using optical transition radiation to determine the properties of the proton beam, and components of the neutrino beamline. Construction of the beamline and detectors is underway, with data-taking commencing in 2009.

* This work is being supported by NSERC

SU-A2-6 **11h00**

Time projection chambers for the T2K experiment*, **Issei Kato**, *TRIUMF* — The Tokai-to-Kamioka long baseline neutrino experiment (T2K experiment) is one of the next generation neutrino experiments that will intensively study oscillations of muon neutrinos. A beam of muon neutrinos produced by a newly constructed 50 GeV proton synchrotron accelerator at Tokai in Japan that travel 295 km to the Super-Kamiokande detector will have one to two orders of magnitude higher intensity than past experiments. With this facility we aim to measure disappearance oscillation of muon neutrinos and search for undiscovered electron neutrino appearance signal with the highest-ever sensitivities. A set of detectors will be placed at 280 m downstream of the proton target, where the properties of the neutrino beam and neutrino interactions will be measured before neutrinos have a chance to oscillate to other flavors. Time projection chambers (TPC's), together with fine grained detectors (FGD's), make up the primary tracker in the ND280 detector giving the kinematical information of muons, as well as other secondaries, produced by neutrino interactions in FGD's. The TPC has been designed and constructed by a collaborating work of Canadian and European groups. Its design has been finalized and the construction is underway toward installation in the T2K experiment scheduled in fall 2009. This presentation will describe the physics requirements, the design, and the construction status of the TPC modules.

* This work is being supported by NSERC and TRIUMF

SU-A2-7 **11h15** **(G*)**

A Water Target System for the T2K Near Detector Tracker. **Daniel Roberge**, T2K Canada Group, *University of British Columbia* — One of the goals of the near detector in the T2K long-baseline neutrino experiment is to measure neutrino interaction rates in the T2K beam, allowing us to calculate the expected rate in the far detector. One component of the near detector is the Tracker, which consists of three large-volume time-projection chambers and two 2-ton fine-grained plastic scintillator detectors (FGDs). Since the far detector, Super-Kamiokande, is made of water, then the near detector must also measure interaction rates on water to minimize systematic errors from nuclear effects. One of the FGDs thus has an integrated water target, which allows a determination of the interaction rate on water from a comparison of the all-plastic FGD with the plastic/water FGD. This talk will outline the goals of the FGD water system and the practical details of its implementation, including water module design, water supply systems, and leak containment.

11h30 **Session Ends / *Fin de la session***

[SU-IPP-Bd] IPP Board of Trustees Meeting / *Réunion du conseil d'administration de l'IPP*

(IPP / *IPP*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

9h00 - 11h30

ROOM / SALLE ***VCH 2826*** **(cap. 42)**

Chair: W. Trischuk, University of Toronto

Agenda circulated to participants separately / Ordre du jour distribué aux participants séparément

11h30 **Session Ends / *Fin de la session***

[SU-A3] DCMMP Symposium / *Symposium DPMCM*

(IDCMMP / *DPMCM*)

SUNDAY, JUNE 8
DIMANCHE, 8 JUIN
9h30 - 11h15

ROOM / SALLE ***VCH 3860*** **(cap. 148)** ***Chair: T. Tiedje, University of British Columbia***

SU-A3-1 **09h30**

KAREN KAVANAGH, Simon Fraser University

Magnetic Semiconductors - The Basics *

The basic properties of magnetic semiconductors such as GaMnAs will be introduced. A review of the history of the field, how they are grown, success at enhancing conventional applications, as well as their potential for spintronics will be presented.

* This work is being supported by NSERC

SU-A3-2 **10h15**

MONA BERCIU, University of British Columbia

Manipulating spin and charge in diluted magnetic semiconductors *

All spintronics applications are faced with formidable challenges in providing fast and efficient ways to create, detect, control and manipulate spin textures and currents. Here we show how most of these operations can be performed in a relatively simple manner in a hybrid system consisting of a superconducting film and a paramagnetic diluted magnetic semiconductor (DMS) quantum well. The giant Zeeman response of the magnetic semiconductor in conjunction with the highly non-uniform magnetic field of the superconductor create local spin and charge textures in the DMS, leading to effects such as Bloch oscillations, an unusual Quantum Hall Effect, etc. The substantial recent progress in manipulating the magnetic vortices in superconductors also suggest how these can be used to create, manipulate and control the spin textures in DMS.

* This work is being supported by NSERC, CIFAR Nanoelectronics, Research Corporation, A. Sloan Foundation

SU-A3-3 **11h00**

Enhanced electronic characteristics of MNB-treated pentacene field-effect transistors with bottom contact structure*, **Gap Soo Chang** [1], Dae Sik Park [2], Junghwa Seo [3], Alexander Moewes [1], Chung Nam Whang [4], [1] *University of Saskatchewan*, [2] Yonsei University, [3] University of California Santa Barbara, [4] Yonsein University — Organic electronics dealing with polymeric conductors and molecular semiconductors has been intensively exploited as a promising alternative to current Si-based metal-oxide semiconductor technology because simplification of the design and manufacture of electronic and optoelectronic devices, such as field-effect transistors (FETs) and light emitting diodes (LEDs), can be achieved with the use of organic semiconductor materials. In an effort to enhance the device performance of organic FETs, a self-assembled monolayer (SAM) treatment to Au electrodes with 2-mercapto-5-nitrobenzimidazole (MNB) was employed and pentacene bottom-contact FETs were fabricated using those MNB-treated Au. Our results show that when a pentacene thin film is deposited onto MNB-treated Au electrodes, the current-voltage (*I-V*) characteristics are significantly enhanced. To understand the measured device-characteristics, the morphology and crystalline structure of pentacene in untreated and MNB-treated BC-TFTs were investigated using atomic force microscopy (AFM) and x-ray diffraction (XRD). In addition, we measured the band structure of occupied and unoccupied states of pentacene using soft x-ray spectroscopy. This presents our recent work on the electronic characteristics of pentacene FETs using the MNB SAM.

* This work is being supported by Natural Sciences and Engineering Research Council of Canada (NSERC) and the Korea Science and Engineering Foundation (KOSEF)

11h15 **Session Ends / *Fin de la session***

[SU-Plen1] Plenary Session - Isabelle Blain : NSERC / *Session plénière - Isabelle Blain : CRSNG*

(CAP-NSERC / *ACP-CRSNG*)

SUNDAY, JUNE 8
DIMANCHE, 8 JUIN
11h30 - 12h30

ROOM / SALLE ***VCH 2850*** **(cap. 404)** ***Chair: B. Gaulin, McMaster University***

SU-PLEN1-1 **11h30**

ISABELLE BLAIN, NSERC, Vice-President, Research Grants & Scholarships / CRSNG, Vice-présidente, Subventions de recherche et bourses

Update from NSERC / Mise à jour par le CRSNG

NSERC will provide an update on various activities, particularly the two major reviews: the International Review of the Discovery Grants program and the GSC Structure Review.

Le CRSNG fera le point sur diverses initiatives, notamment les deux grandes revues : l'examen international du programme de subventions à la découverte et la revue de la structure des CSS.

12h30 **Session Ends / *Fin de la session***

[SU-NSERC] Lunch and Discussion with NSERC / *Dîner et discussion avec le CRSNG*

(CAP-NSERC/ *ACP-CRSNG*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

12h30 - 13h30

ROOM / SALLE ***VCH Main Hallway, 2nd & 3rd Floors*** ***Chair: S.A. Page, University of Manitoba***

NSERC and CAP are sponsoring a lunch for all delegates. Take advantage of this opportunity to discuss developments with NSERC personnel and to tour the exhibit and poster areas / *Le CRSNG et l'ACP offrent un lunch à tous les délégués. Profitez de l'occasion pour échanger avec le personnel du CRSNG sur différents développements et pour voir les kiosques et les affiches*

13h30 **Session Ends / *Fin de la session***

[SU-DPP] DPP Business Meeting (lunch available) / *Réunion d'affaires DPP (dîner disponible)*

(DPP / *DPP*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

12h30 - 13h30

ROOM / SALLE ***VCH 3870*** **(cap. 51)** ***Chair: J.E. Morelli, Queen's University***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[SU-Past-Pres] CAP Past Presidents' Luncheon / *Dîner des ancien(ne)s président(e)s de l'ACP*

(CAP / *ACP*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

12h30 - 13h30

ROOM / SALLE ***Restaurant "Gréco", Hotel Universel*** ***Chair: M.C.W. Campbell, University of Waterloo***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[SU-Plen2] Plenary Session: CAP Brockhouse Medal / *Session plénière: Médaille Brockhouse de l'ACP*

(CAP-DCMMP / *ACP-DPMCM*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

13h30 - 14h15

ROOM / SALLE ***VCH 2850*** **(cap. 404)** ***Chair: E. Vogt, TRIUMF***

SU-Plen2-1 **13h30**

JESS H. BREWER, University of British Columbia

μSR: Fantasy, Fiction, Physics *

I will bring two talks to the Congress and let the audience decide which I should present on that occasion. One talk will be an introduction to the methods and applications of μSR (muon spin rotation/relaxation/resonance) for those who don't already know what it is or what it can do for science. The other talk will be a personal narrative about how a property of elementary particles that would once have been pure fantasy (forbidden by the "known laws of physics") became science fiction (possible but obviously impractical) in 1957, progressed to routine science in the last quarter of the 20th Century, and is now a standard tool of materials science, thanks to the advent in the 1970s of "meson factories" like TRIUMF.

* This work is being supported by NSERC, NRC (through TRIUMF), CIFAR

14h15 **Session Ends / *Fin de la session***

[SU-P1] CAP Session in Memory of Roger Lessard / *Session commémorative pour Roger Lessard*

(CAP-DOP / *ACP-DOP*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

14h15 - 18h00

ROOM / SALLE ***POP 1168*** **(cap. 150)** ***Chair: R. Vallée, Université Laval***

SU-P1-1 **14h15**

RENE ROY, Université Laval

Des souvenirs qui font vivre

Roger A. Lessard nous a quittés mais il m'a laissé des souvenirs impérissables comme à de nombreuses autres personnes qui ont été des collègues, des amis, des collaborateurs, des étudiants. Nous regarderons en arrière, dans ces événements qui nous portent et qui nous le gardent avec nous. Des œuvres impérissables existent, nous parlerons de leur création, de leur développement et de leur pérennité.

SU-P1-2 **14h30**

MICHAEL OTTO STEINITZ, St. Francis Xavier University

Roger Lessard and the CAP

Roger was vice-president of the CAP when he changed the course of my life by asking me to join the executive. His service as president was important, both to the CAP nationally and to the profile of the CAP in Quebec. However, he will be most remembered in the CAP for the two Congresses he organized in Quebec City and the inspiration he lent to the location of this year's Congress in his home town. His success was in making each Congress a great event, memorable for its excellence and its elegance in concept and execution. His scientific accomplishments will be illuminated by others at this meeting, but his contributions to the CAP are equally important.

Roger était vice-président de l'ACP quand il a changé la direction de ma vie en m'offrant l'opportunité de devenir membre de l'exécutif. Son mandat de président a été significatif, à la fois pour l'organisation au plan national et pour le visage de l'ACP au Québec. Mais les meilleurs souvenirs de son passage à l'ACP demeurent les deux congrès qu'il a organisés à Québec, et l'inspiration qu'il a fournie pour notre réunion ici cette année. Son grand talent était de faire de chaque congrès un événement mémorable par son excellence et son élégance. Son oeuvre scientifique sera mise en lumière par d'autres conférenciers aujourd'hui, mais ses contributions à l'ACP sont également importantes.

SU-P1-3 **14h45**

RENE BEAULIEU, Institut national d'optique

Revue des principaux travaux de recherche réalisés par le Professeur Roger A. Lessard

La carrière scientifique du Pr Roger A. Lessard est remarquable comme en témoignent les nombreux articles qu'il a publiés dans différentes revues internationales prestigieuses. Il s'est spécialisé dans le domaine de l'holographie et le thème principal de son programme de recherche était relié au développement de nouveaux matériaux pour enregistrer des hologrammes. Il a consacré presque toute sa carrière scientifique au développement de nouveaux milieux enregistreurs holographiques qui sont sensibles aux longueurs d'onde visibles et à celles des lasers à CO_2. Sa renommée comme spécialiste en holographie est reconnue sur la scène internationale. Le sujet de cette conférence portera sur les principaux travaux scientifiques du Pr Lessard.

15h15 **Coffee Break / *Pause café***

SU-P1-4 **15h30**

JORGE GARCIA-SUCERQUIA, COPL, Université Laval

Digital Holography: A Modern Perspective of Dennis Gabor's Invention

The invention of holography by Denis Gabor as a lensless imaging technique has been one the most striking developments of the history of physics. For the first time, it was possible to recover the complex optical field scattered by an object and from it to recreate the three-dimensional shape of the object in great detail of similitude; digital holography, understood as the numerical reconstruction of digitally recorded holograms, is a modern implementation of this brilliant idea. In this seminar, a brief discussion of some of the reasons that propelled the development of digital holography as well as its fundamentals and applications are discussed. Different sorts of digital holography microscopy, perhaps the ultimate application of Gabor's ideas, and some of their applications to life sciences and biology are discussed. The seminar is concluded by presenting the in-line type of this microscopy approach; the simplest but not less powerful technique of digital holography microscopy, it is presented as an alternative tool for in-situ studies of underwater environments and colloidal sciences.

SU-P1-5 **16h00**

JAFAR SHAKER, Communications Research Centre Canada

Volume Holograms at Microwave Frequency Band †

Volume holographic technology has been widely used in optics to carry out a wide range of functions such as beam multiplexing, beam splitting, beam shaping, data storage, *etc.* The interference of two coherent beams (reference and object beams) on a thick film is used to fabricate thick volume holograms for applications in the optical frequency band. Application of the design criteria that is used in the optical band to realize similar structures in the millimeter wave band leads to a range of sample thicknesses for which the technology for the transverse modulation of refractive index is presently non-existent. Therefore, a research program was initiated at the Communications Research Centre Canada seven years ago in order to emulate volume hologram applications in the millimeter wave band using artificial dielectric technology [1]. Artificial dielectric composed of conducting disks was selected as the building block for the realization of the volume hologram. Initially, simple closed form expressions from a quasi-static field analysis were used to estimate the disk dimensions to mimic the refractive index modulation. Various types of volume holograms were generated using this technology. The first implementation was a volume hologram with the interference pattern of two plane waves. Illumination of the hologram with the record excited the object beam with 70% efficiency. A multiplexed volume and beam splitter were also fabricated using the same technology and experimentally characterized.

1. J. Shaker, A. Ittipiboon, and M. Cuhaci, IEE Proc. in Microwaves, Antennas, and Propagations, Vol. 153, No. 5, pp. 413-419

† In collaboration with A. Ittipiboon, M. Cuhaci

16h30

Discussion and Remembrances / *Discussion et commémoration* — Attendees are invited to say a few words about their interactions with Roger Lessard. A general discussion in remembrance of Roger, and a reception for participants, sponsored by the Centre d'optique, photonique et laser, Université Laval, will follow / *Les participants sont invités à dire quelques mots au sujet de leur relation avec Roger Lessard. Une discussion générale à la mémoire de Roger, et une réception pour les participants (offerte par le Centre d'optique, photonique et laser, Université Laval), suivront*

18h00 **Session Ends / *Fin de la session***

[SU-P2] ALLS Plasma-Laser Session / *Session plasma-laser ALLS*

(DPP / *DPP*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

14h15 - 17h00

ROOM / SALLE ***VCH 3870*** **(cap. 51)** ***Chair: J. Ozaki, INRS-EMT***

SU-P2-1 **14h15**

JEAN-CLAUDE KIEFFER, Université du Québec, INRS

Can relativistic plasmas engineering with femtosecond lasers have societal applications? †,*

With the 200TW laser at the Advanced Laser Light Source facility we can now achieve extreme light intensities on targets, producing relativistic plasmas which display a very broad range of exotic process. We will described the ALLS 200TW facility and present the first experiments realized at INRS to qualify the laser system on solid target in this intensity regime. We will describe the new radioprotected area allowing particule acceleration and relativistic plasmas experiments.

† In collaboration with Sylvain Fourmaux, Stephane Payeur

* This work is supported by NSERC, FCI, FQRNT, le programme de Chaire de Recherche du Canada and INRS.

SU-P2-2 **14h45**

JOSEPH ROBINSON, Imperial College London

Sub-optical-cycle measurements using high harmonic generation †

Electron recollisions in atoms and molecules, driven by intense laser-fields, can result in the emission of a broad spectrum of energetic photons via high harmonic generation (HHG). Encoded in this spectrum is sub-cycle information about the electric-field of the drive laser and the dynamics of the ionised system during the excursion of the electron wavepacket. We describe progress in two techniques that utilise signatures in these spectra to measure the structural rearrangement of molecules in the moments immediately following ionisation, and also to diagnose the carrier-envelope phase of the drive laser field. Experiments conducted at the Advanced Laser Light Source have enabled the observation of dynamic two-centre interference in molecules using the first method. In the second method, we use phase-matching effects in an extended gas target to identify cut-off emission from each half-cycle of the laser field, from which we can determine the carrier-envelope phase of the field. Finally, we report on the determination of a waveform which maximises the recollision energy of the returning electron during strong-field ionisation, and practical routes to generating this field. Such a waveform may prove useful in the development of attosecond duration light-sources and measurements.

† In collaboration with Sarah Baker [1], Luke Chipperfield [1], Ciprian Chirila [2], Heidi Bandulet [3], Daniel Comtois [3], Dave Villeneuve [4], Peter Knight [1], Manfred Lein [2], John Tisch [1], Jon Marangos [1], [1] Imperial College London, [2] University of Kassel, [3] INRS-EMT, Université du Québec, [4] National Research Council Canada

SU-P2-3 **15h15**

FRANK HEGMANN, University of Alberta

High intensity THz pulse generation and imaging at ALLS †,*

There is a lot of interest in using terahertz (THz) radiation for materials characterization and specialized imaging applications. Traditionally, there has been a lack of sources in the terahertz region of the spectrum from 0.1 to 5 THz. More recently, however, ultrafast laser sources have been used to generate and coherently detect THz pulses approximately 1 ps in duration. THz pulses are ideal for performing time-resolved terahertz spectroscopy on materials, and are also very useful in THz imaging applications. The intensity of these THz pulse sources is typically low, but there has been a push towards more intense THz pulse sources for improving imaging applications and exploring new nonlinear optical phenomena in the terahertz frequency range. We have established a high intensity THz pulse source at ALLS, and have recently demonstrated the generation of single-cycle THz pulses with energies up to 1.5 μJ by optical rectification in a large-aperture ZnTe single crystal wafer. We have also performed real-time imaging of the focused terahertz beam using a pyroelectric infrared camera. In this talk, a general introduction to terahertz pulse techniques is given and the characteristics of the ALLS THz source are discussed.

† In collaboration with F. Blanchard [1], L. Razzari [2], H.-C. Bandulet [1], G. Sharma [1], R. Morandotti [1], J.-C. Kieffer [1], T. Ozaki [1], M. Reid [3], H.F. Tiedje [4], H.K. Haugen [4], [1] INRS-EMT, Université du Québec, [2] INRS-EMT, Université du Québec; Universita di Pavia, Italy, [3] University of Northern B.C., [4] McMaster University

* This work is being supported by NSERC Strategic Projects and INRS

SU-P2-4 **15h45**

Extremely Nonsinusoidal Emissions and Related Phenomena from Strong Laser Pulses Obliquely P-Incident on Sharp-Edged Plasmas*, **T.W. Johnston** [1], L.J. Nikolic [1], Y. Tyshetskiy [2], F. Vidal [1], [1] *INRS-EMT*, [2] Univ. Sydney (Australia) — Extremely high laser harmonic emissions [1] emerge from the Vulcan petawatt laser's sub-picosecond laser pulses obliquely incident on slab targets with extremely low pre-pulse energy. Similar studies are to be made using the ALLS 200 TW Ti-Saph laser (24 fs at 10 Hz with 10^{-10} contrast even without plasma mirrors). We discuss our 2-D PIC simulations with a view to understanding the basic mechanism(s) for the production of (a) the harmonics and (b) the fast electrons. Typical results resemble those of Naumova *et al.* [2] and of Thaury *et al.* [3], including the presence of a very large and asymmetric electromagnetic "spikes" which account for the high harmonic content. These are produced by extremely concentrated, superluminously moving, very nonlinear current structures on the plasma surface. These moving structures are also where the fast electrons are energized extremely rapidly. The effects of the fast electrons are also discussed. These include (i) the interesting quasi-steady magnetic fields produced, (ii) the flow of the fast ions from electrostatic interaction driven by the fast electrons, and (iii) remarkable variation in detailed behavior of the energized electrons.

1. B. Dromey, M. Zepf, A. Gopal, K. Lancaster, M.S. Wei, K. Krushelnick, M. Tatarakis, N. Vakakis, S. Moustaizis, R. Kodama, M. Tampo, C. Stoeckl, R. Clarke, H. Habara, D. Neely, S. Karsch and P. Norreys, *Nature Phys.*, **2**, 456-459 (2006).
2. N. Naumova, I. Sokolov, J. Nees, A. Maksimchuk, V. Yanovsky, and G. Mourou *Phys. Rev. Lett.* **93**, 195003 (2004).
3. C. Thaury, F. Quéré, J.-P. Geindre, A. Levy, T. Ceccotti, P. Monot, M. Bougeard, F. Réau, P. d'Oliveira, P. Audebert, R. Marjoribanks and Ph. Martin *Nature Phys.* **3**, 424 (2007)

* This work is being supported by NSERC

SU-P2-5 **16h00**

Enhancing the sensitivity of the Laser-Induced Breakdown Spectroscopy technique: spectrally-selective excitation of specific elements in a laser-produced plasma. **Hakim Loudyi** [1], Christian Goueguel [1], Kheireddine Rifai [1], Stéphane Laville [2], Mohamad Sabsabi [2], Mohamad Chaker [1], François Vidal [1], [1] *Institut National de la Recherche Scientifique-Energie, Matériaux, Télécommunications*, [2] Conseil National de Recherches Canada-Institut des Matériaux Industriels — Over recent years, the LIBS (Laser-Induced Breakdown Spectroscopy) technique has become widely used in the field of spectrochemical analysis, with applications in numerous fields. Conventional single-pulse LIBS consists in focusing a moderate-energy pulsed laser (usually tens to hundreds of millijoules per pulse) onto a target material to vaporize a small amount of the sample, thus generating a hot, transient plasma. Qualitative and quantitative analytical information is then obtained thanks to the spectrally resolved study of the emitted radiation from this plasma. Compared to other existing analytical techniques, LIBS offers major advantages (little or no sample preparation, in-situ real-time measurements, and, in contrast to almost any other method, stand-off (remote) analysis), but usually suffers from a relatively lower sensitivity. Our work is addressing this issue. Indeed, two approaches involving a second laser pulse were investigated in order to enhance the intensity of the spectral lines emitted by trace elements, namely LIBS-LIF (LIBS coupled with Laser Induced Fluorescence) and RELIBS (Resonance Enhanced LIBS). Both of them rely on a spectrally-selective reexcitation of specific elements in the pre-formed plasma. The former consists in inducing a specific transition of the trace element under investigation, which leads to a dramatically improved fluorescence, and the latter is based on the excitation of the most abundant element, which results in an efficient re-heating of the plasma through collisional energy transfers. This presentation will review some of the major experimental results obtained so far, and propose a discussion on the processes involved in both approaches.

SU-P2-6 **16h15** **(G)**

Laser-Induced Breakdown Spectroscopy and Laser-Induced Fluorescence (LA-LIF) of Microdroplets*, **Yogesh Godwal**, Siu-Lung Lui, Ying Tsui, Robert Fedosejevs, *University of Alberta* — Over the past few years there have been studies of Laser Induced Breakdown Spectroscopy (LIBS) to scale the laser pulse energy down to the hundreds of microjoule level. This regime is called micro-LIBS or μ-LIBS. This low energy characteristic not only makes the implementation of fiber or microchip lasers in a LIBS system possible but also allows analysis of the microsamples. Conventional sampling of aqueous media is usually in the form of a liquid jet, aerosols spray, or simply in a bulk solution. In microfluidic applications, the amount of sample available is limited and the above methods become impractical. Thus, analysis of single isolated microdroplets using μ-LIBS has been investigated. In addition, we have integrated LIBS with laser-induced fluorescence (LIF), and this technique, laser-ablation laser-induced fluorescence (LA-LIF), allows one to achieve a much higher sensitivity than traditional LIBS at the expense of tuning to only one specific element of interest at a time. We present our preliminary study of LIBS and LA-LIF on monodispersed microdroplets where we look for lead in solution. The microdroplets, ranging from 10 to 25 microns, are extruded from a drop-on-demand (DOD) piezoelectric dispenser. They are ablated by a hundred microjoule nanosecond laser pulses. The micro-plasma created is then re-excited by a second laser pulse tuned to the 283 nm resonant line of Pb. The results indicate the feasibility of a compact microfluidic LIBS or LA-LIF system for use in applications such as Lab-on-a-Chip (LOC) or micro Total Analytic Systems (μTAS) for chemical analysis applications using inkjet-like droplet ejectors.

* This work is being supported by NSERC, MPB Technologies Inc.

SU-P2-7 **16h30**

Interferometric imaging of light/matter interaction during laser drilling*, **James Fraser**, Paul Webster, *Queen's University* — We demonstrate simultaneous optical drilling and coaxial depth imaging of holes in stainless steel at axial rates of 46 kHz using 20 ps duration optical pulses. Since the same optical pulses are used to both cut and image the sample, we monitor the interaction region during optical processing and can observe both permanent changes and short-lived transients. Fourier-domain interferometry, similar to optical coherence tomography, allows us to achieve 6 μm axial imaging resolution. We directly observe changes in the dynamics of the cutting process, including plasma development and dissipation. This technique may prove useful to improve our understanding of the intense light-matter interaction and to provide a practical feedback mechanism for on-the-fly material processing.

* This work is being supported by Natural Sciences and Engineering Research Council, Canadian Foundation for Innovation, Ontario Ministry of Research and Innovation, Ontario Centres of Excellence

17h00 **Session Ends / *Fin de la session***

[SU-P3] General Theory / *Théorie générale*

(DTP / *DPT*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 2870*** **(cap. 57)** ***Chair: R. Dick, University of Saskatchewan***

SU-P3-1 **14h15** **(G*)**

A Universal Gaussian Approximation for *su*(2) type problems*, **Shen Yong Ho**, David Rowe, *University of Toronto* — We show how *su*(2) type quantum many-body Hamiltonians can be approximated by shifted harmonic oscillator Hamiltonians. Over a wide range of parameters, the Shifted Harmonic Approximation (SHA) provides a good estimation of eigenvalues and matrix representations. We illustrate this technique using the Canonical Josephson Hamiltonian and the Lipkin-Meshkov-Glick model. The SHA can also be used to identify Hamiltonians of different total spins j that have nearly identical eigenvectors in the low-lying states. This allows us to learn about the scaling properties of systems as they approach macroscopic limits. Extending the predictions of SHA, we are able to locate the most relevant basis states for diagonalizing a Hamiltonian. This enables us to obtain highly accurate results for low-lying states by just diagonalizing Hamiltonians with large spins j using a small fraction of the Hilbert space. SHA has also potential applications to problems with *su*(2) x *su*(2) x *su*(2) algebraic structures.

* This work is being supported by in part by an E.C. Stevens Fellowship

SU-P3-2 **14h30** **(U*)**

The Rings of n-Dimensional Polytopes. **Michelle Larouche** [1], Lenka Hakova [2], Jiri Patera [1], [1] *Université de Montréal*, [2] Czech Technical University — Points of an orbit of a finite Coxeter group G, generated by n reflections, are considered as vertices of a polytope (G-polytope) centered at origin of a real n-dimensional Euclidean space. A general efficient method is recalled for geometric description of G-polytopes, their faces of all dimensions and their adjacencies. Products and symmetrized powers of G-polytopes are introduced and their decompositon into the sums of G-polytopes is described. Several invariants of G-polytopes are found, namely the analogs of Dynkin indices, anomaly numbers, and congruence classes of the polytopes. Reduction to important subrings are described. Examples and applications are shown.

SU-P3-3 **14h45** **(G*)**

An Analytical and Numerical Study of the Orbital Decay of a Compact Object Orbiting About a Massive Kerr Black Hole*, **Peter Komorowski**, Francois Ouegnin, Sreeram Valluri, Martin Houde, *University of Western Ontario* — The orbital evolution of extreme binary black hole systems was modelled using Post-Newtonian (PN) approximations to quantify the evolution of compact object (CO) angular momentum (L) and energy (E) [1]. Although the last stable orbit (R_{LSO}) is understood for the Schwarzschild black hole (SBH), an extension to the Kerr black hole (KBH) case is needed to better understand gravitational wave (GW) emission. The mathematics described, sprang from the effective potential (V) derived from the Kerr Metric, which encapsulates the Lense-Thirring precession. That allowed us to develop, for circular orbits, an analytical relationship (consistent with [2]) for R_{LSO} in terms of black hole spin, S, and an analytical relationship between R_{LSO} and L for a fixed value of S. We created a numerical algorithm to determine R_{LSO} for elliptical orbits around a KBH which matched those obtained by others [1, 3]. We extended the formulae for E^2 and L^2 (in terms of eccentricity, ε, and latus rectum, l) [3] to the KBH case. The PN evolution equations were analysed numerically by two methods: the SUNDIAL Package (Lawrence Livermore Laboratory), an ordinary differential equation solver and by a prediction correction method. The results obtained were found to be in good agreement and consistent with earlier results [1]. The spin of the KBH was found to strongly affect the radius of the LSO, which affected the final plunge the CO.

1. Barack, Cutler, Phys.Rev. D69, 082005 (2004).
2. Bardeen, Press, Teukolsky, Astrophys.J. **178,** 347 (1972).
3. Cutler, Kennefick, Poisson, Phys.Rev.D 50, 3816 (1994).

* This work is being supported by NSERC

SU-P3-4 **15h00** **(G*)**

Singularity and Event Horizon Formation with Quantum Gravity Corrections*, **Jonathan Ziprick** [1], Gabor Kunstatter [2], [1] *University of Manitoba*, [2] University of Winnipeg — We study the behaviour of a collapsing massless scalar field coupled to a 2-d dilaton gravity potential. Using computational methods to evolve the system, we find that the solutions exhibit Choptuik scaling as expected. Choosing Painlevé-Gullstrand coordinates allows for evolution past event horizon formation and enables a novel study of singularity formation. We also examine the effects of a discrete spacetime by implementing quantum gravity corrections. We conclude with a discussion of these results and their implications to quantum theory.

* This work is being supported by NSERC

15h15 **Coffee Break / *Pause café***

SU-P3-5 **15h30** **(G*)**

Magnetic Fields from Heterotic Cosmic Strings*, **Rhiannon Gwyn** [1], Stephon Alexander [2], Robert Brandenberger [1], Keshav Dasgupta [1], [1] *McGill University*, [2] Pennsylvania State University — As our best candidate for the theory applicable at the highest energies, string theory must also be relevant in the early universe. Although we cannot reach the string scale, all around us are the remnants of a huge once-off experiment that did: the universe's own evolution. This might supply indirect evidence for string theory. An interesting possibility, presented in this talk, is that string theory may explain some astrophysical observations. Specifically, large (galactic)-scale magnetic fields of several microgauss are observed today. The dynamo mechanism, whereby turbulence effects amplify seed magnetic fields, can explain both the amplitude and configuration of fields observed, but large enough seed fields to undergo this amplification are still required, and their origin remains a matter of debate. These seed fields could be generated by string-like objects, produced during phase transitions in the early universe. Such cosmic strings are compelling candidates because they reach a scaling solution in which the characteristic length is proportional to the time passed. This guarantees the coherence of associated magnetic fields at the time of galaxy formation. They can also arise in string theory, for example from wrapped membranes in a higher-dimensional theory. Using a specific 11-dimensional string theoretic construction, we can arrive at cosmic string candidates in our 4-dimensional world, which pass stability and tension tests and can generate magnetic fields. We propose these strings as generators of the seed magnetic fields present at galactic formation, which then can explain the large-scale fields observed today if the dynamo mechanism is invoked.

* This work is being supported by Chalk-Rowles fellowship

SU-P3-6 **15h45**

The Classical Geometric Heritage of Fermion Spin*, **William E. Baylis**, *University of Windsor* — The intrinsic spin of elementary fermions is commonly considered a purely quantum property with no classical analog, but its roots can be traced to a classical description of the geometry of physical space. It arises naturally in a Clifford-algebra treatment of the relativistic dynamics of classical particles when these are assumed to be "elementary" systems. The motion and orientation of the particle is described by a spinor that gives the amplitude of the Lorentz transformation from the rest frame to the lab. The particle is said to be "elementary" if a single spinor suffices for the description. The two-state property and change in sign under a 360-degree rotation follow immediately, and if the particle is charged, it must have a g-factor of 2. Intrinsic spin enters as a rotational gauge freedom and is shown to produce de Broglie-like matter waves that can give quantum-like interference. While classical physics does not restrict the spin rate, measured de Broglie wavelengths fix this rate at the Zitterbewegung frequency, and this in turn determines both the spin angular momentum and the magnetic moment of the elementary charge. The spinor is closely related to the quantum Dirac spinor, and the rapid intrinsic rotation implies that the particle must appear point-like. The relationship of spin and geometry is strengthened by the fact that physical space and its geometric algebra can be derived from annihilation and creation operators. The approach is important because of the insights it provides about spin and quantum phenomena more generally.

* This work is being supported by NSERC

SU-P3-7 **16h00** **(G)**

Fingerprints of Classical Chaos in Statistical Measures of Trajectories*, **Jean-Francois Laprise** [1], Olivier Blondeau-Fournier [1], Jens Kroger [2], Helmut Kroger [1], Pierre-Yves St-Louis [1], Louis J. Dubé, Reza Zomorrodi, [1] *Universite Laval*, [2] Universite McGill — We suggest that random matrix theory applied to a classical trajectory lengths matrix can be used in classical physics to distinguish chaotic from non-chaotic behavior. We consider the 2-D stadium billiard vs. spherical billiard and the 2-D anharmonic vs. harmonic oscillator. By unfolding the spectrum of such matrix we compute the level spacing distribution, the spectral auto-correlation and spectral rigidity. We observe Wignerian behavior in the chaotic case and non-generic respectively Poissonian behavior in the integrable case. We find that the trajectory lengths matrix elements of the stadium billiard display GOE behavior and give an explanation in terms of the Central Limit Theorem. The findings present evidence for universality of level fluctuations - known from quantum chaos - also to hold in classical physics.

* This work is being supported by NSERC

SU-P3-8 **16h15**

Fluctuations of work, heat and entropy production in non-equilibrium statistical physics. **Ramses Van Zon** , *University of Toronto* — General relations for fluctuations of thermodynamic quantities like work, heat and entropy production in transient and stationary non-equilibrium states have been discovered in the last fifteen year. The fluctuation theorem relates the probability to observe negative entropy production compared to that for positive entropy production in transient or stationary states, the Jarzynski equality relates free energies to transient non-equilibrium averages, while the Crook's relation is a combination of the two for systems initially in equilibrium. These relations are especially important for small non-equilibrium systems (e.g. micron-sized or smaller) in which fluctuations are pronounced. After giving a brief overview of these relations and their applications, a Langevin model of a Brownian particle dragged through a fluid will be presented, for which they can be tested in detail. It turns out that work fluctuations satisfy the fluctuation theorem as expected, but heat fluctuations satisfy an extended form deviating from the conventional fluctuation theorem especially for large heat fluctuations. These predictions are in excellent agreement with experiments by Ciliberto *et al.*

16h30 **Session Ends / *Fin de la session***

[SU-P4] Physics of Radiation Therapy / *Physique de la radiothérapie*

(DMBP / *DPMB*)

SUNDAY, JUNE 8
DIMANCHE, 8 JUIN
14h15 - 15h15

ROOM / SALLE ***VCH 3830*** **(cap. 110)** ***Chair: D. Fleming, Mount Allison University***

SU-P4-1 **14h15**

Use of magnetic fields to optically probe photodynamic processes in cancer phototherapy*, **Ozzy Mermut** [1], Jean-François Cormier [1], Pascal Gallant [1], Nicolas Hô [1], Sébastien Leclair [1], Isabelle Noiseux [1], Marcia Vernon [1], Kevin Diamond [2], Mike Patterson [2] , [1] *INO* , [2]McMaster University — We will discuss the use of photosensitizer probes affected by weak magnetic fields for potential use in real-time monitoring of cytotoxic responses in photodynamic therapy (PDT). In photochemical reactions of photosensitizing agents, radicals are produced in spin-correlated pairs as reaction intermediates (Type I photosensitization). We propose utilizing both paramagnetic and luminescent photosensitizing molecules to perturb, via application of weak magnetic fields, spin dynamics in the Type I pathway PDT. We take advantage of magnetic fields to affect the spin rephasing processes of solvent–separated radical pairs involving photosensitizers. The electron spins are manipulated magnetically, which affects the photophysical properties of the photosensitizer. To explore this effect, a time-domain luminescence lifetime apparatus (excitation source of 405 nm or 661nm) has been developed, and integrated with a variable, low field magnet (0–800 G). The luminescence lifetime response function was measured in the presence of a sweeping magnetic field for custom-designed paramagnetic photosensitizers in solution. The magnetic field was found to modify the spin states of photosensitizer radical pairs via Zeeman splitting of degenerate triplet states. Both steady-state and lifetime measurements were conducted over variable levels of sample oxygenation (0–6 ppm) and temperatures (123–298 K) to elucidate the dependence of the magnetic perturbation on the photophysics. We examine the magnetic-derived optical responses with solvents of varying dielectric constants and compare to micellular environments. Lastly, the measured differences in the luminescence properties were correlated to photo-induced cytotoxicity by conducting photodynamic/magnetically-coupled treatments of tumor cells and obtaining the associated survival curves.

* This work is being supported by CIHR

SU-P4-2 **14h30**

Tests of a System for Biomedical and Environmental Carbon-14 Analysis by Accelerator Mass Spectrometry*, **William E. Kieser** [1], Kissena Leung [1], Natasha Krestina [1], Roelf Beukens [1], Xiaolei Zhao [1], Ted Litherland [1], Jack Cornett [2], [1] *IsoTrace Laboratory*, [2] Health Canada RPB — The use of ^{14}C labelled compounds as tracers in bio-medical measurements and the need to determine ^{14}C concentrations in environmental assessments have greatly increased the requirements for ^{14}C analysis by accelerator mass spectrometry (AMS). Typically, solid samples, requiring the graphitization of the sample material, are required for AMS analysis. For the large numbers of samples needed for environmental and biomedical work, this requirement has a significant impact on cost and turnaround time. The current availability of gas-fed AMS ion sources permits the elimination of the graphitization stage as well as the integration and automation of combustion and analysis. This presentation will describe progress on the development of a system which includes an elemental analyser for the combustion of samples and a hybrid gas / solid sample, high current ion source. These components are connected by a gas handling and transfer line which is needed to accommodate the discharge of CO_2 in the 200 ml per minute He carrier stream from the elemental analyser and to prepare a uniform CO_2/He mixture for injection into the ion source a rate of ~ 100 µl per minute. The automated control and the testing of this system will be discussed and details of its use for pharmaceutical applications, such as microdosing measurements and for environmental monitoring in the event of accidental or malicious release of ^{14}C, will be presented.

* This work is being supported by CRTI, NSERC

SU-P4-3 **14h45**

Interstitial PDT treatment planning using a gradient descent feasibility algorithm. **Lothar Lilge**, Augusto Rendon, *Division of Biophysics and Bioimaging, Ontario Cancer Institute* — Interstitial photodynamic therapy (PDT) for prostate cancer has seen a revival with several clinical trials currently underway. This effort has demanded the development of optimization methods for treatment planning, particularly to determine source placement and power output. Most investigators have chosen linear feasibility algorithms to solve the treatment planning problem. Linear feasibility algorithms attempt to find any solution that simultaneously satisfies a set of constraints dictated by the dose prescription. Altschuler *et al* and Johansson *et al.* have implemented the Cimmino algorithm originally proposed by Censor *et al*. Based on the work of Jiang and Wang, we have proposed an alternative gradient-descent linear feasibility (GDLF) algorithm. Using the GDLF algorithm, we compared the treatment plans arising from tailored versus conventional diffusers. The algorithm was particularly useful because it allowed the regularization of the inverse problem, which can be quite problematic for tailored diffusers. Our findings suggested that, in the prostate, tailored diffusers offered a marginal improvement of the light dose distribution, with better improvement achieved for smaller effective attenuation coefficients ($\mu_{eff} < 2$ cm^{-1}). While both the Cimmino and GDLF algorithms have been proven useful to optimize the light dose distribution, they converge to minimizers of different cost functions. No study has compared the properties of the Cimmino and GDLF algorithms, particularly, in the context of PDT. The nascent field of optimization based treatment planning for PDT can profit substantially from such studies.

1. Altschuler, Zhu, Li, and Hahn, Optimized interstitial PDT prostate treatment planning with the Cimmino feasibility algorithm.," Med Phys 32, pp. 3524-3536, Dec 2005. Johansson, Axelsson, Swartling, *et al*. Interstitial photodynamic therapy for primary prostate cancer incorporating real-time treatment dosimetry," 6427(1), p. 64270O, SPIE, 2007. Y. Censor, M.D. Altschuler, and W.D. Powlis, On the use of cimmino simultaneous projections method for computing a solution of the inverse problem in radiation-therapy treatment planning," Inverse Probl 4, pp. 607-623, Aug. 1988. Jiang and Wang Convergence studies on iterative algorithms for image reconstruction," Medical Imaging, IEEE Transactions on 22(5), pp. 569-579, 2003.

SU-P4-4 **15h00** **(G)**

Planification inverse basée sur une dosimétrie Monte Carlo en curiethérapie à haut débit*. **Michel D'Amours** [1], Jean-François Carrier [2], Étienne Lessard [3], Jean Pouliot [3], Frank Verhaegen [4], Luc Beaulieu [1], [1] *Université Laval, CHUQ*, [2] Université de Montréal, CHUM, [3] UCSF, [4] Mc Gill, General Hospital — *Problématique*: La curiethérapie à haut débit est une technique de traitement du cancer qui vise irradier une tumeur à partir d'un source radioactive d'iridium-192 (gamma environ 480 keV) insérée directement dans le patient. Le calcul actuel approxime la composition du milieu à l'eau par une formule paramétrique. Ce travail vise à démontrer qu'il est possible de remplacer cette approximation clinique par un calcul hétérogène Monte Carlo (MC). *Matériel et Méthode*: Plusieurs informations du système clinique sont recueillies : positions et temps d'arrêt de la source, images CT de la densité du patient et contours anatomiques. Ces informations sont utilisées afin de recréer une voxélisation du patient dans le logiciel de simulations MC GEANT4. L'optimisation du plan, avec l'algorithme de recuit simulé « IPSA », est obtenue en calculant avec notre logiciel la distribution de dose pour chaque position possible de la source. L'algorithme à été testé sur un traitement de sein (30 Gy en 10 fractions). Utilisant la même fonction de coût, quatre courbes DVH sont créés: optimisation homogène avec dosimétrie finale homogène (eau/eau), optimisation homogène recalculé MC (eau/MC) et optimisation MC (MC/MC). *Résultat et Conclusion*: La majeure partie du temps de calculs est associée au calcul Monte Carlo. Le reste de l'optimisation demeure aussi rapide qu'avec l'approche homogène. Le D90 a la tumeur est diminué de 4 % du TG43/TG43 au TG43/MC et est compensé de 3% en MC/MC, et sans augmenter significativement la dose aux tissus sains. L'approche permet donc la correction adéquate du plan.

* This work is being supported by National Cancer Institute of Canada

15h15 **Session Ends** / ***Fin de la session***

[SU-P5] DMBP Best Student Paper Competition I / *Compétition pour les meilleures communications étudiantes DPMB I*

(DMBP / *DPMB*)

SUNDAY, JUNE 8
DIMANCHE, 8 JUIN
14h15 - 16h15

ROOM / SALLE ***VCH 3820*** **(cap. 104)** ***Chair: A. Linhananta, Lakehead University***

SU-P5-1 **14h15** **(G)**

Gene delivery by electroporation after dielectrophoretic positioning of cells in a non-uniform electric field*, **Luke MacQueen**, Michael Buschmann, Michael Wertheimer, *Ecole Polytechnique de Montreal* — We report the use of dielectrophoresis (DEP) [1] to position U-937 monocytes within a non-uniform electric field, prior to electroporation (EP) [2] for gene delivery. DEP positioning and EP pulsing were both accomplished using a common set of inert planar electrodes, micro-fabricated on a glass substrate. A single-shell model of the cell's dielectric properties and finite-element modeling of the electric field distribution permitted us to predict the major features of cell positioning. The extent to which electric pulses increased the permeability of the cell-membranes to florescent molecules and to pEGFP-Luc DNA plasmids were found to depend on prior positioning. For a given set of pulse parameters, EP was either irreversible (resulting in cytolysis), reversible (leading to gene delivery), or not detectable, depending on where cells were positioned. Our results clearly demonstrate that position-dependent EP of cells in a non-uniform electric field can be controlled by DEP.

1. H.A. Pohl, Dielectrophoresis, Cambridge University Press, Cambridge, UK, 1978.
2. A.E. Sowers, and C.A. Jordan (Eds.), Electroporation and Electrofusion in Cell Biology, Plenum Press, New York, 1989.

* This work is being supported by Natural Sciences and Engineering Research Council of Canada (NSERC), and by the Canadian Institutes of Health Research (CIHR)

SU-P5-2 **14h30** **(G*)**

A Monte Carlo study of the impact of seed design on the interseed attenuation in permanent prostate implants*, **Hossein Afsharpour** [1], Michel D'Amours [1], Benoit Côté [2], Jean-Francois Carrier [3], Frank Verhaegen [4], Luc Beaulieu [1], [1] *Hôtel-Dieu de Quebec*, [2] Université Laval, [3] Hôpital Notre-Dame Montreal, [4] McGill University — *Purpose* This work is set to investigate the impact of different radioactive seed designs on the interseed attenuation for prostate permanent implants. *Materials and Methods* Six brachytherapy radioactive seeds covering a wide variety of seed designs were modeled with GEANT4 and their TG43 parameters compared to existing publications to validate our modelization. From clinical configurations, a water-prostate has been designed and simulations with the various seed models were made. For this study four Monte Carlo simulations were considered to investigate the impact of high-Z materials: 1) water equivalent, 2) complete seed geometry, 3) seed capsule with only the capsule taken into account and 4) considering only the internal markers. In all simulations, if a component is not taken into account, it is set as water. *Results* The overall attenuation on D90 (clinical marker for the outcome of a treatment) for SelectSeed, ProstaSeed and OptiSeed are 4.04%, 3.25% and 1.19% respectively (32.26 cm^3 prostate, 72 seeds). The Gold/Copper ball markers in N.A.S. 3631 caused 0.79 % of D90 attenuation when it was about 2.1% for the silver bar in SelectSeed. Low-energy ^{103}Pd gamma-emission is attenuated up to 4% because of Ti encapsulation in BestMedical 2335 while it is negligible when using a polymer shell. *Conclusion* The Ti capsule is the major contributor to the interseed attenuation. A bead design produces less attenuation than a rod design. The polymer seed produces very low interseed attenuation. Interseed attenuation is strongly dependent on seed design making some seeds more attenuating than others.

* This work is being supported by National Cancer Institute of Canada with funds from the Canadian Cancer Society

SU-P5-3 **14h45** **(G*)**

Functional Implication of the Geometry of Synaptic Cleft in Cell-Cell Communication*, **Jérôme Boucher** [1], Helmut Kröger [2], Attila Sik [1], [1] *Centre de recherche Université Laval Robert-Giffard*, [2] Université Laval — Information exchange between neurons is conveyed through chemical synapses. Release, diffusion of neurotransmitter, binding to its receptors determines the efficacy of the synaptic communication. Our neuroanatomical data using a novel preparation technique for electron microscopy analysis shows that the received wisdom that the synaptic cleft has a fixed width may be an artifact of the fixation procedures used in conventional methods. Because the geometry of synaptic cleft might vary using Multiphysics modelling approach we calculated neurotransmitter concentration, receptor occupancy, the spill-over and clearing of neurotransmitter by various mechanisms at different synaptic cleft height (5-15nm). Our simulation indicates that even though all receptors are activated independent of the synaptic cleft size, the time for the neurotransmitter to occupy the receptors takes considerably longer in larger synaptic cleft (1µs vs 3µs). We also demonstrate that neurotransmitter reuptake by glial cells has no effect on the occupancy of the receptors. The analysis of neurotransmitter spill-over on neighboring synapses shows that approximately 7% of the receptors are activated in the neighboring synaptic cleft in the case of single vesicular release. However, if the glial uptake is efficient enough no receptor is activated by spill-over mechanism, whereas the number of neurotransmitter occupied receptor is doubled when simultaneous release of neurotransmitter from two vesicles occurred. This knowledge might have fundamental impact on our understanding of synaptic communication between neurons.

* This work is being supported by CIHR

SU-P5-4 **15h00** **(G*)**

Dynamical measurement of the cytoskeletal contribution to the physical properties of living cells*, **Marie-Josee Colbert**, Cecile Fradin, Kari Dalnoki-Veress, *McMaster University* — A cell's biomembrane is supported by an underlining actin network forming part of the cytoskeleton. This network is involved in the interaction of the cell with its surrounding through the adhesion and the elastic response of the cell. To dynamically probe these properties, we have developed a new tool that takes advantage of an 'L' shaped micropipette to micromanipulate a single cell and put it in contact with an adhesive surface mounted on a translation stage. The spring constant of the micropipette is carefully measured and its deflection is used to apply a calibrated force. This technique gives access to real time monitoring of the cell response to an applied deformation, thus exploring the relaxation processes of the cell when subjected to an external load. The polymerization of actin is prevented to explore the cytoskeletal contribution to the processes involved in the interaction with the substrate, such as the elastic response, the relaxation and the adhesion.

* This work is being supported by NSERC

15h15 **Coffee Break / *Pause café***

SU-P5-5 **15h30** **(G*)**

Friction measurements on living HeLa cells*, **Marc-Antoni Goulet**, Marie-Josée Colbert, Kari Dalnoki-Veress, *McMaster University* — The interaction of cells with various interfaces, and especially man-made surfaces, is an active field of research. In our experiment we use a micropipette to measure both the friction and normal force of a cell sliding across a surface. A substrate coated with Poly-l-lysine is brought into contact with a living HeLa cell. The adjustable substrate motion is used to study the response of the cell at various normal forces and speeds. Analysis of the micropipette deflection provides dynamic measurements of both the friction and normal force. With our novel setup we are able to probe the adhesion process of living cells.

* This work is being supported by NSERC

SU-P5-6 **15h45** **(G*)**

Indépendance de l'étalonnage d'un dosimètre à scintillation eau-équivalent en fonction de l'énergie pour les faisceaux de photon et d'électron*, **Mathieu Guillot** [1], François Thériault [1], Frédéric Lacroix [2], Luc Beaulieu [1], Luc Gingras [1], [1] *Université Laval*, [2] Centre hospitalier universitaire de Montréal — Les dosimètres à scintillateur plastique sont d'un intérêt certain en radiothérapie en raison de leur haute résolution spatiale, leur lecture en temps réel ainsi que de leur réponse dosimétrique eau-équivalente qui en font un candidat idéal pour des applications comme détecteurs matriciels servant à mesurer des distributions de dose tridimensionnelles complexes. Dans ce résumé, nous mettons l'accent sur une propriété qui découle directement de l'eau-équivalence des scintillateurs plastiques soit, l'indépendance des coefficients d'étalonnages sur un large spectre d'énergie pour les faisceaux de photon et d'électron. L'étalonnage du dosimètre à fibre scintillante a été effectué pour des faisceaux de photon 6 et 23MV ainsi que pour des faisceaux d'électron de 6, 9, 12, 15 et 18MeV en utilisant une chambre à ionisation Farmer A-12. Une technique de discrimination chromatique a été utilisée afin d'éliminer complètement la contribution du rayonnement Cerenkov produit dans le guide optique. L'ensemble des manipulations a été effectué selon les recommandations du groupe de travail TG51 de l'American Association of Physicists in Medicine. Nos résultats montrent une variation des coefficients d'étalonnages inférieure à ± 2,5% par rapport à la moyenne sur l'ensemble de ce spectre d'énergie en incluant les deux types de particules. Cette variation est inférieure à 1,5% lorsqu'on exclut l'étalonnage obtenu avec le faisceau d'électron 6MeV. Cette propriété des scintillateurs pourrait servir à améliorer la précision des mesures de dose dans plusieurs situations cliniques tout en réduisant significativement le recours à des facteurs de corrections.

* This work is being supported by Les Instituts de Recherche en Santé du Canada

SU-P5-7 **16h00** **(G*)**

A Semiquantitative Experimental Method of Determining the Collimator/Scatter Component in Single Photon Emission Computed Tomography (SPECT).
Stefan Kaluzienski, Eduardo Galiano, *Laurentian University* — The purpose of this research is the experimental quantification of the collimator attenuation in SPECT as a function of energy window. For the purposes of data collection, a cylindrical (20 cm diameter, 5 cm height) hollow acrylic phantom has been built. This phantom is filled with approximately 5 mCi of Tc-99m solution and SPECT images for increasingly narrow energy acceptance windows were acquired using an Elscint/G.E. APEX SP-4 SPECT camera. The transaxial slices of the reconstructed images were analyzed by graphing an intensity profile of a horizontal line through the midpoint of the centermost slice. An exponential fit was then used to determine effective attenuation values for the profiles corresponding to each acceptance window. The experimental process was completed for both a medium resolution, and high resolution collimator. The published value of the linear attenuation coefficient for a 140keV photon in water (ideal geometry) is 0.15 cm^{-1} . Assuming that scatter is absent at the narrowest (1%) acceptance window, then only the effect of the collimator is present to attenuate the signal by photon removal, resulting in a higher "effective" attenuation. The value of acceptance window that yields an effective attenuation value equal to that of an ideal geometry occurs when scatter repopulates the photons lost by collimator attenuation. This condition occurs at the ~5% window for the medium resolution collimator, and ~8% window for the high resolution collimator.

16h15 **Session Ends / *Fin de la session***

[SU-IPP-Gen] IPP General Meeting / *Assemblée générale de l'IPP*

(IPP / *IPP*)

SUNDAY, JUNE 8
DIMANCHE, 8 JUIN
14h30 - 16h45

ROOM / SALLE ***VCH 2860*** **(cap. 142)** ***Chair: W. Trischuk, University of Toronto***

Agenda circulated to participants separately / Ordre du jour distribué aux participants séparément

16h45 **Session Ends / *Fin de la session***

[SU-Friends] Friends of CAP Reception and Meeting / *Réception et réunion des "Ami(e)s de l'ACP"*

(CAP / *ACP*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

16h00 - 18h30

ROOM / SALLE ***PAD "Le Cercle" (4th floor)*** ***Chair: R.B. Mann, University of Waterloo***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

18h30 **Session Ends** / ***Fin de la session***

[SU-GRAD] Student Reception / *Réception pour étudiant(e)s*

(CAP / *ACP*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

16h30 - 18h15

ROOM / SALLE ***VCH cafeteria*** **(cap. 200)** ***Chair: M.C.W. Campbell, University of Waterloo***

Graduate and undergraduate students are cordially invited to a reception in the Alexandre-Vachon cafeteria. Come meet and network with other students from all over Canada. / *Les étudiants de tous les cycles sont cordialement invités à une réception dans la cafétéria du Pavillon Alexandre-Vachon. Venez fraterniser avec des confrères de partout au Canada.*

18h15 **Session Ends** / ***Fin de la session***

[SU-Plen3] Plenary Session - Nigel Lockyer : TRIUMF / *Session plénière - Nigel Lockyer : TRIUMF*

(CAP-TRIUMF / *ACP-TRIUMF*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

17h00 - 19h00

ROOM / SALLE ***POU 1112*** **(cap. 500)** ***Chair: C. Gay, University of British Columbia***

SU-PLEN3-1 **17h00**

NIGEL LOCKYER, TRIUMF

A Vision for TRIUMF 2010-2015 †

Together with CAP, the Institute of Particle Physics and the Canadian Institute of Nuclear Physics are hosting a discussion of plans for the future of TRIUMF, Canada's National Laboratory for Particle and Nuclear Physics. Director Nigel Lockyer will present a vision for the next decade of TRIUMF with specific attention to the next five-year funding proposal to the Government of Canada. The next decade will showcase a transformation of TRIUMF's core programs as well as enhance its connections to condensed-matter and materials physics and nuclear medicine. The articulation of this vision is the culmination of a year-long public process and significant effort by many in the broader community. A discussion period is included in the session. Please join us!

18h00 Reception for participants, sponsored by TRIUMF and CAP Divisions of Nuclear and Particle Physics / *Une réception pour les participants, commanditée par TRIUMF et les divisions de physique nucléaire et de physique des particules de l'ACP*

19h00 **Session Ends** / ***Fin de la session***

[SU-KEY] CAP Herzberg Memorial Public Lecture / *Conférence publique commémorative Herzberg de l'ACP*

(CAP / *ACP*)

SUNDAY, JUNE 8 / DIMANCHE, 8 JUIN

19h30 - 22h30

ROOM / SALLE ***PPP - Théâtre de la Cité Universitaire*** ***Chair: L. Marchildon, UQTR***

SU-KEY-1 **19h30**

RAYMOND LAFLAMME, Institute for Quantum Computing / University of Waterloo

Harnessing the Quantum World / Maîtriser le monde quantique

Information processing devices are pervasive in our society; from 5 dollar watches to multi-billion satellite networks. These devices have allowed the information revolution which is developing around us. It has transformed not only the way we communicate or entertain ourselves but also the way we do science and even the way we think. All this information is manipulated using the classical approximation to the laws of physics, but we know that there is a better approximation: the quantum mechanical laws. Would using quantum mechanics for information processing be an impediment or could it be an advantage? This is the fundamental question at the heart of quantum information processing (QIP). QIP is a young field with an incredible potential impact reaching from the way we understand fundamental physics to technological applications. I will give an introduction to quantum information by stressing recent interesting developments. I will also comment on the effort in this field at Waterloo and in Canada.

Les dispositifs de traitement d'information se retrouvent partout dans notre société, des montres à 5 dollars aux réseaux de satellites qui en valent des milliards. Ils ont permis la révolution informatique qui se développe autour de nous. Cette révolution a transformé notre façon de communiquer et de nous distraire, mais aussi notre manière de faire la science et même de penser. Toute cette information est manipulée en utilisant l'approximation classique des lois de la physique. Pourtant, nous savons qu'il y a une meilleure approximation: celle des lois quantiques. L'utilisation de la mécanique quantique pour le traitement de l'information est-elle un frein, ou peut-elle être un avantage? Voilà la question fondamentale au coeur du traitement quantique de l'information (TQI). Le TQI est un domaine jeune avec un impact potentiel incroyable allant de la façon de comprendre la physique fondamentale aux applications technologiques. Je vais présenter une introduction à l'informatique quantique en insistant sur de récents développements intéressants. Je vais également faire un survol des travaux dans ce domaine effectués à Waterloo et au Canada.

20h30 **Reception for participants, with light refreshments, sponsored by CAP, Perimeter Institute, U.Laval, and Varian Inc.** / ***Une réception pour les participants, avec léger goûter, commanditée par l'ACP, Institut périmètre, U.Laval, et Varian Inc.***

22h30 **Session Ends** / ***Fin de la session***

MONDAY, JUNE 9 - LUNDI, 9 JUIN

[MO-CINP-Bd] Canadian Institute of Nuclear Physics (CINP) Board of Trustees Breakfast Meeting / *Réunion-déjeuner du conseil d'administration de l'Institut canadien de la physique nucléaire (ICPN)*

(DNP / *DPN*)

MONDAY, JUNE 9
LUNDI, 9 JUIN
07h00 - 08h10

ROOM / SALLE ***POP 2165*** (cap. 28) ***Chair: G. Huber, University of Regina***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

08h10 **Session Ends** / ***Fin de la session***

[MO-DPE] DPE Business Meeting (with breakfast) *Réunion d'affaires DEP (avec petit-déjeuner)*

(DPE / *DEP*)

MONDAY, JUNE 9
LUNDI, 9 JUIN
07h00 - 08h10

ROOM / SALLE ***VCH 2840*** (cap. 98) ***Chair: R.I. Thompson, University of Calgary***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

08h10 **Session Ends** / ***Fin de la session***

[MO-NSERC] New Faculty Breakfast with NSERC *Petit-déjeuner-rencontre des nouveaux professeurs avec le CRSNG*

(CAP-NSERC / *ACP-CRSNG*)

MONDAY, JUNE 9
LUNDI, 9 JUIN
07h00 - 08h00

ROOM / SALLE ***PAD "Le Cercle" (4th floor)*** ***Chair: B.D. Gaulin, McMaster University***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

08h00 **Session Ends** / ***Fin de la session***

[MO-Plen1] Plenary Session - Art McDonald : SNO *Session plénière - Art McDonald : SNO*

(CAP / *ACP*)

MONDAY, JUNE 9
LUNDI, 9 JUIN
08h15 - 09h00

ROOM / SALLE ***VCH 2850*** (cap. 404) ***Chair: S.A. Page, University of Manitoba***

MO-PLEN1-1 **08h15**

ART MCDONALD, Queen`s University

SNO and the New SNOLAB Underground Facility

The Sudbury Neutrino Observatory (SNO) has now completed neutrino detection with 1,000 tonnes of heavy water situated 2,000 meters underground in Vale-INCO's Creighton Mine near Sudbury. The final phase of operation involved an array of neutron detectors to observe the neutral current reaction of solar neutrinos on deuterium. These measurements define the flux of all neutrino types from the Sun with very different systematic uncertainties than previous phases of SNO. Comparing this measured flux with the flux of electron neutrinos observed with the charged current reaction on deuterium clearly exhibits neutrino flavor change and accurately determines neutrino properties. The underground facility is now being expanded to create a long-term international facility for underground science (SNOLAB), where measurements of Dark Matter, Double Beta Decay, Solar and Supernova Neutrinos will be performed with the lowest radioactive background available anywhere. The final operational phase of SNO, the future plans for the SNO detector and the plans for other experiments at SNOLAB when it is completed in 2008 will be described.

09h00 **Session Ends** / ***Fin de la session***

[MO-Plen2] Plenary Session - John Campbell : Rutherford
Session plénière - John Campbell : Rutherford

(CAP / *ACP*)

MONDAY, JUNE 9
LUNDI, 9 JUIN
09h00 - 09h45

ROOM / SALLE VCH 2850 **(cap. 404)** ***Chair: W.F. Davidson, National Research Council Canada***

MO-PLEN2-1 **09h00**

JOHN CAMPBELL, University of Canterbury, New Zealand

Rutherford - His Path to the Nobel Prize

2008 is the centennial of Ernest Rutherford's Nobel Prize, the first for research carried out in Canada. I will cover some key points on his rise to scientific immortality (his brilliance as an experimentalist was clear in his earliest researches in New Zealand), some little known ones (we spell his name wrongly), and why one of the greatest physicists of all time never received a Nobel Prize in Physics.

09h45 **Session Ends** / ***Fin de la session***

[MO-A1] DCMMP Best Student Paper Competition I
Compétition pour les meilleures communications étudiantes DPMCM

(DCMMP / *DPMCM*)

MONDAY, JUNE 9
LUNDI, 9 JUIN
10h00 - 12h15

ROOM / SALLE VCH 2870 **(cap. 57)** ***Chair: A. Moewes, University of Saskatchewan***

MO-A1-1 **10h00** **(G*)**

Magnetic behavior of ferromagnetic nanowire arrays analyzed by first-order reversal curves*, **Fanny Béron**, Louis-Philippe Carignan, David Ménard, Arthur Yelon, *École Polytechnique de Montréal* — While major hysteresis curves only provide information about global behavior of magnetic systems, first-order reversal curves (FORC), and especially FORC diagrams, are appropriate tools for investigating the processes taking place during the magnetization reversal of a set of magnetic entities. They have proved to be useful in the case of geomagnetic samples, recording media, magnetic arrays of submicron dots, nanopillars, and nanowires, for example. A FORC diagram consists of a statistical distribution of square hysteresis loops, called hysterons, each of which are described by an irreversible critical field H_c and interaction field H_u. These hysterons have often been considered as mathematical objects, which do not necessarily have any physical significance, leading to difficulties and ambiguities in the analysis of experimental FORC diagrams. FORC diagrams of physically meaningful hysterons were therefore simulated, in order to provide insights on the physical interpretation of FORC distributions. On the experimental side, homogenous ferromagnetic nanowire arrays with an applied field parallel to the nanowire axis have been closely examined in the investigation of FORC diagrams, because each nanowire can, in principle, be related to a hysteron. Other systems have also been investigated: homogenous nanowire arrays with the applied field perpendicular to the nanowire axis, and Ni/Cu multilayer nanowire arrays, in both field directions. Models of their magnetization reversal were deduced from their FORC diagrams. The geometric parameters of the arrays are between 15 and 200 nm diameter, with a length between 1 μm and 60 μm, but with a minimum aspect ratio of 50.

* This work is being supported by Conseil de Recherches en Sciences Naturelles et en Génie du Canada (CRSNG) et Fonds Québécois de Recherche sur la Nature et les Technologies (FQRNT)

MO-A1-2 **10h15** **(G*)**

Dipolar interactions in ferromagnetic nanowire arrays*, **Louis-Philippe Carignan**, Christian Lacroix, Fanny Béron, Vincent Boucher, Christophe Caloz, Arthur Yelon, David Ménard, *École Polytechnique de Montréal* — Arrays of closely packed and elongated ferromagnetic nanowires (FMNW) are promising candidates for the fabrication of high density storage media, sensors and actuators or non- reciprocal microwave devices [1,2]. FMNW possess highly anisotropic magnetic properties, mainly due to the magnetostatic interactions between (inter-wire dipolar interaction) and within the wires (shape effect). The anisotropy of FMNW can be further adjusted with the use of multilayer nanowires, that is, alternating layers of magnetic and non magnetic metals [3]. Modeling of dipolar interactions and magnetocrystalline anisotropy of the individual wires leads to predictions of the response of the array and shows how to tune the overall response of the device. Such a model is presented. Arrays of Ni and CoFeB homogeneous nanowires and Ni/Cu and CoFeB/Cu multilayer nanowires were grown into nanoporous alumina templates by electrodeposition. Nanowires several microns long, 170 nm in diameter, and 330 nm interwire distance, were obtained. Their magnetic behaviour was investigated using vibrating sample magnetometry (VSM) and ferromagnetic resonance (FMR) experiments, using cylindrical cavities, at 17, 24, 31 and 38 GHz. Predictions of the model are in good agreement with experimental data from both types of measurements.

1. C.A. Ross, *Annu. Rev. Mater. Sci.* **31**, 203 (2001).
2. A. Fert and L. Piraux, *J. Magn. Magn. Mater.* **200**, 338 (1999).
3. L.-P. Carignan *et al.*, *J. Appl. Phys.* **102**, 023905 (2007).

* This work is being supported by NSERC, FQRNT, RQMP, NanoQuébec

MO-A1-3 **10h30** **(G*)**

PTCDA on a nanotemplated insulator: structure and optoelectronic properties*, **Sarah Burke**, Jeffrey LeDue, Jeffrey Mativetsky, Jessica Topple, Shawn Fostner, Peter Grutter, *McGill University* — There has been considerable interest in recent years in the use of organic molecules as active electronic and optoelectronic materials, whether for use in thin film structures or single molecule devices. As such, the structural ordering and properties of promising molecular semiconductors on surfaces have been under considerable study, especially at the nanoscale where scanning probe microscopes have proven to be invaluable tools. One such molecule, 3,4,9,10-perylene tetracarboxylic dianhydride (PTCDA), has been studied extensively as a prototypical organic semiconductor. In this study, we use nanotemplated NaCl as an model insulating substrate to confine PTCDA molecular crystals in rectangular pits with edge lengths of ~15nm. Noncontact atomic force microscopy (nc-AFM) is used as a high resolution tool to investigate the structures formed at the nanotemplated surface revealing 3 types of molecular structures: bulk-like crystallites, nanoconfined monolayers and extended monolayer islands. A combination of force spectroscopy (df-V) and frequency modulation Kelvin probe force microscopy (FM-KPFM) are also used to investigate the relative electrostatic properties, and differing response to photo-excitation of these 3 structures. The optoelectronic properties of the 3 structures will be related to the molecular scale structure of each thus linking the functional properties relevant for a device to the detailed structure of the molecular deposit.

* This work is being supported by NSERC, CFI, CIfAR, FQRNT, NanoQuebec, RQMP

MO-A1-4 10h45 (G*)

Magnetic behavior of MnP nanoclusters embedded in GaP(001) epilayers*. **Christian Lacroix**, Samuel Lambert-Milot, Patrick Desjardins, Remo A. Masut, David Ménard, *École Polytechnique de Montréal* — Hybrid structures consisting of magnetic nanoclusters embedded in a III-V semiconductor matrix are a promising approach to integrate magnetism in semiconductor technology. For example, MnAs clusters embedded in GaAs have been reported to exhibit large galvanomagnetic and magneto-optical effects at room temperature [1,2]. So far, phosphide III-V semiconductors have been largely ignored despite their potential for integration in optoelectronic devices. In this work, the magnetic properties of GaP(001) epilayers containing 27-nm-diameter MnP clusters grown by metal-organic vapor phase epitaxy were studied using magnetometry and angle dependent ferromagnetic resonance (FMR) spectroscopy. A magnetic model of the system has been developed based on a strong biaxial magnetic anisotropy associated to each cluster, with their anisotropy axes oriented along specific GaP crystallographic directions. Using the second derivatives of the magnetic energy, we modeled the angular dependence of the resonance fields obtained from FMR data [3]. By assuming a homogenous rotation of the magnetization in the clusters, the model reproduced the general trends of the hysteresis curve of the samples. From this analysis, we conclude that the clusters are essentially single domains coherently rotating during the magnetization reversal while their magnetocrystalline anisotropy determines mainly the effective magnetic properties of the structure. These results are thus a step towards the control of the electromagnetic properties of this hybrid system.

1. M. Yokoyama *et al.*, *J. Appl. Phys.* **99**, 08D502 (2006).
2. H. Akinaga *et al.*, *Appl. Phys. Lett.* **76**, 97 (2000).
3. C. Lacroix *et al.*, *J. Appl. Phys.* **103**, 07D531 (2008).

* This work is being supported by the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Fonds québécois de la recherche sur la nature et les technologies (FQRNT).

MO-A1-5 11h00 (U*)

SANS and USANS of Anisotropic PVA Hydrogel*. **Stephen D. Hudson** [1], Jeffrey L. Hutter [1], Mu-Ping Nieh [2], Jeremy Pencer [2], Leonardo E. Millon [3], Wankei Wan [3], [1] *Dept. of Physics & Astronomy, The University of Western Ontario*, [2] Canadian Neutron Beam Centre, National Research Council Canada, [3] Dept. of Chemical & Biochemical Engineering, The University of Western Ontario — Poly(vinyl alcohol) (PVA) hydrogels are formed from PVA solution when physical cross-links form during freeze/thaw cycling. By choosing suitable processing parameters and applying mechanical strain during processing, anisotropic gels with elastic properties closely matching those of cardiovascular tissues are made, making them suitable for cardiovascular prostheses (Millon *et al.*, *J. Biomed. Mat. Res. B*, **79B**:305). However, the hydrogel formation mechanisms and resulting microstructure are not well understood, particularly for anisotropic gels. It is generally accepted that ice crystals formed during freezing force polymer chains together, enhancing nucleation and growth of cross-linking crystallites. Willcox *et al.* suggest the first thermal cycle creates a mesh of 3–8 nm crystallites with average spacing 30 nm upon which a larger, polymer depleted pore structure is superimposed (Willcox *et al.*, *J. Polym. Sci. B*, **37**:3438). To understand the connection between microstructure and bulk properties, we performed small- and ultra small-angle neutron scattering (SANS and USANS) measurements covering scales from 2 nm–10 μm. We analyze the small-scale PVA structure with the Geissler-Horkay model (Geissler *et al.*, *Phys. Rev. Lett.* **71**:645). This shows the presence of both cross-linked and free components after one thermal cycle, indicating that additional polymer is available to reinforce the structure and preserve anisotropy. The characteristic length scale of the mesh decreases with further cycling, possibly due to nucleation of new crystallites. At larger length scales, domains of PVA mesh of size 30–60 nm form mass-fractal aggregates with fractal behaviour extending to the limit of the USANS data (10 μm).

* This work is being supported by AFMNet, NSERC

MO-A1-6 11h15 (G*)

Anisotropic nonlinear absorption of gold nanorods in a silica matrix*, **Jean-Michel Lamarre** [1], Franck Billard [2], Chahineze Harkati Kerboua [3], Sjoerd Roorda [3], Ludvik Martinu [1], [1] *École Polytechnique de Montréal*, [2] Institut Fresnel, Marseille, [3] Département de Physique, Université de Montréal — Nanocomposite films formed by aligned gold nanorods embedded in a silica matrix have been prepared using a 3-step fabrication process: 1) hybrid deposition using plasma-enhanced chemical vapor deposition of SiO_2 and pulsed-DC co-sputtering of gold, 2) high temperature annealing, and 3) 30 MeV Cu^{5+} heavy ion irradiation. Such structures exhibit anisotropic linear and nonlinear optical properties related to the presence of transversal and longitudinal surface plasmon resonances corresponding to the particle short and long axes, respectively. Linear optical properties are related to the nanostructure and the fabrication parameters (ion irradiation doses and annealing temperature) of the material by using polarized transmission measurements and ellipsometry. The linear optical properties were modeled using the generalized Maxwell-Garnett equation. Nonlinear optical properties were measured using a Z-Scan / P-Scan setup modified in order to probe the polarization dependent properties. Gold nanorod samples were found to exhibit anisotropic saturable absorption. The obtained values were compared with reference measurements on gold nanospheres-containing samples. Gold nanorod nanocomposite nonlinear absorption coefficient (at 532 nm) was found to vary between -0.9×10^{-2} cm/W for a polarization along the particle short-axis and -5.1×10^{-2} cm/W for a polarization along the particle long-axis. The anisotropic nonlinear optical properties were modeled using anisotropic local field calculations based on the Maxwell-Garnett formalism.

* This work is being supported by CRSNG, FQRNT

MO-A1-7 11h30 (G*)

Growth of coherent heterogeneous materials structures: the case of manganese phosphide magnetic nanoclusters embedded in gallium phosphide*, **Samuel Lambert-Milot** [1], Simon Gaudet [1], Christian Lacroix [1], Christian Lavoie [2], David Ménard [1], Remo Masut [1], Patrick Desjardins [1], [1] *Regroupement Québécois sur les Matériaux de Pointe*, [2] IBM T.J. Watson Research Center — The active region of most high-performance commercially-available electronic and optoelectronic devices is typically either a single semiconductor layer or a coherent stack of thin films having relatively similar structural and chemical characteristics. In recent years, however, several new materials exhibiting novel and exciting properties such as ferroelectric, magneto-resistance, magneto-optic or spin polarization effects, but having widely varying structural properties have been developed. The integration of these new functional materials with well established semiconductors in order to exploit their full potential brings new challenges and is stimulating considerable research in the area of epitaxial film growth. In this research, we focus on integrating magnetic nanostructures (orthorhombic MnP nanoclusters) in a wide band-gap semiconductor matrix (zincblende GaP) as a model system. Obtaining coherent structures is required to minimize electron scattering for the envisioned magnetoelectronic applications. The hybrid layers have been grown on GaP(001) substrates by metalorganic vapor phase epitaxy, and characterized structurally using transmission electron microscopy (TEM) and x-ray diffraction (XRD) pole figure measurements. TEM analyses reveal the presence of 15-30 nm wide MnP nanoclusters that are coherent and distributed homogeneously in a dislocation-free GaP layer. XRD pole figure measurements indicate that the nanoclusters are strained but maintain their orthorhombic structure. They also reveal strong preferential orientation of the nanoclusters due to a combination of epitaxial and axiotaxial [1] alignments with the surrounding GaP matrix. This specific alignment configuration, which permits the growth of coherent hybrid structures, could be possible in similar materials.

1. C. Detavernier *et al.*, *Nature* (London) **426**, 641 (2003).

* This research was supported by the Natural Sciences and Engineering Council of Canada (NSERC), the Canada Research Chair Program, and the Fonds québécois de la recherche sur la nature.

MO-A1-8 **11h45** **(G*)**

Dilute Bismide GaAsBi Light Emitting Diodes*, **Ryan B. Lewis**, Daniel A. Beaton, Xianfeng Lu, Thomas Tiedje, *University of British Columbia* — The first GaAsBi light emitting diodes have been grown by molecular beam epitaxy and characterized. Doped GaAs *p-i-n* structures, containing single quantum wells embedded in the intrinsic layer, have been grown pseudomorphically at low temperatures (280-300C) on [100] gallium arsenide substrates. Devices with emission wavelengths of 925 nm, corresponding to 1% bismuth incorporation in a 40 nm thick quantum well, have been measured. Bulk epi-layers with 5% [Bi] show strong luminescence at 1210 nm as compared with InGaAs multiple quantum well structures, suggesting longer wavelength are possible. Bismuth concentrations and quantum well thicknesses were determined by high resolution X-ray diffraction. Bismuth incorporation allows for large bandgap reductions [1] 7x and 4x greater than what is possible with indium or antimony respectively. The low growth temperatures necessary for high quality GaAsBi epi-layer growth lead to larger critical thicknesses. Electroluminescence and photoluminescence data from $GaAs_{1-x}Bi_x$, x = 0.01-0.05, will be presented and comparisons of GaAsBi light emitting diodes to similarly structured InGaAs light emitting diodes will be discussed. These results suggest efficient long wavelength GaAsBi devices exceeding 1.5 μm will be realized in the near future.

1. S. Francoeur M.-J. Seong, A. Mascarenhas, Sebastien Tixier, Martin Adamcyk, and Thomas Tiedje, Band gap of $GaAs_{1-x}Bi_x$, 0<x<3.6%, Appl. Phys. Lett. 82 (2003), no. 22, 3874-3876}

* This work is being supported by NSERC

MO-A1-9 **12h00** **(G*)**

Giant Proximity Effect in a Phase-Fluctuating Superconductor*, **Dominic Marchand** , Lucian Covaci, Mona Berciu, Marcel Franz , *University of British Columbia* — When a tunneling barrier between two superconductors is formed by a normal material that would be a superconductor in the absence of phase fluctuations, the resulting Josephson effect can undergo an enormous enhancement. We establish this novel proximity effect by a general argument as well as a numerical simulation and argue that it may underlie recent experimental observations of the giant proximity effect between two cuprate superconductors separated by a barrier made of the same material rendered normal by severe underdoping.

* This work is being supported by NSERC, CIFAR, FQRNT and the A.P. Sloan Foundation

12h15 **Session Ends / *Fin de la session***

[MO-A2] DMBP Best Student Paper Competition II / *Compétition pour les meilleures communications étudiantes DPMB II*

(DMBP / *DPMB*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

10h00 - 11h45

ROOM / SALLE ***VCH 3870*** **(cap. 51)** ***Chair: A. Linhananta, Lakehead University***

MO-A2-1 **10h00** **(G*)**

Pump-Probe Femtosecond Laser Spectroscopic Studies of the Molecular Mechanism for the DNA Sequence Sensitivity of Halopyrimidines as Radiosensitizing Drugs *, **Chun-Rong Wang**, Qing-Bin Lu, *University of Waterloo* — Halopyrimidines, particularly bromodeoxyuridine (BrdU) and Iododeoxyuridine (IdU), are among most important hypoxic radiosensitizers in radiotherapy of cancer. Replacement of thymidine in DNA by BrdU/IdU has long been known to enhance DNA damage and cell death induced by ionizing/UV radiation. We have recently obtained the first real-time observation of the transition states (XdU^{*-}) of the ultrafast electron transfer (UET) reactions of halopyrimidines (XdU, X=Cl, Br and I) with the ultrashort-lived presolvated electron generated under UV/ionizing radiation [1,2]. The UET reaction is followed by dissociation, producing a highly reactive radical $dU^{\cdot}$ that then causes DNA damage and cell death. Another important property of BrdU/IdU as a radio-/photosensitizer is its radio-/photosensitivity dependence on DNA sequence. It was observed that when adjacent to adenine base (i.e., the 5'-dABrdU sequence), BrdU/IdU causes the most significant DNA damage. However, the underlying mechanism for this DNA sequence dependence is still unknown. In this presentation, we will present our first, real-time observation of the molecular mechanism for the sequence selectivity of BrdU/IdU by using high-sensitivity time-resolved femtosecond laser spectroscopy. Our results demonstrate that adenine efficiently captures a presolvated electron to form a long-lived anion, from which electron transfer to BrdU/IdU leads to the enhancement of the radical-generating reaction [3]. Our results provide a deep understanding of the molecular mechanism of action of these sensitizers for radiotherapy of cancer.

1. C.-R. Wang, A. Hu, Q.-B. Lu, *J. Chem. Phys.*, **124** (2006)241102.
2. C.-R. Wang, Q.-B. Lu, *Angew. Chem. Intl. Ed.*, **46** (2007)6316.
3. C.-R. Wang, Q.-B. Lu, (**2008**), *to be published.*

* This work is being supported by Canadian Institutes of Health Research (CIHR) and the Natural Science and Engineering Research Council of Canada (NSERC)

MO-A2-2 **10h15** **(G*)**

Molecular Reaction Pathways for the Generation of Reactive Oxygen Species in Photodynamic Therapy*, **Ting Luo**, Hui-Ying Ding, Donna Strickland, Qing-Bin Lu, *University of Waterloo* — Photodynamic therapy (PDT) has emerged as a novel clinical approach that uses the combination of light and photosensitizing drugs for the treatment of various tumors and some other non-malignant conditions. The therapeutic effect of PDT is generally believed to result from the reactive oxygen species (ROS), which is generated by light activation of a PDT drug. Although a few PDT sensitizers have been approved for clinical uses, the molecular mechanisms of drug action are poorly understood. In particular, the initial photochemical reaction leading to the formation ROS is not well understood. One of the current research focuses is to develop new photosensitizers sensitive to near-infrared (NIR) light for enhancement of the therapeutic depth. Indocyanine green (ICG), which has a strong absorption band around 800 nm coincident with the tissue optical window, is a potential NIR PDT sensitizer. In this work, we present a real-time, high-sensitivity pump-probe femtosecond laser spectroscopic study of the molecular reaction dynamics of NIR-light-activated ICG. Both ground-state bleaching and fluorescence measurements indicate an extremely low quantum yield of the excited triplet state of this compound. Based on these observations, a new reaction pathway is proposed for the generation of ROS in PDT with ICG. This study thus provides new insight into the molecular mechanism of action of PDT.

* This work is being supported by Canadian Institutes of Health Research (CIHR) and the Natural Science and Engineering Research Council of Canada (NSERC)

MO-A2-3 10h30 (G*)

His-tagged membrane proteins for targeted quantum dot labelling and fluorescence resonance energy transfer*, **Daniel Cooper**, Jay Nadeau, Rafael Khatchadourian, Samuel Clarke, *McGill University* — A six-histidine (6His) tag was placed on a flexible outer-membrane loop of the bacterial voltage-gated sodium channel NaChBac. This allowed alkanethiol- solubilized quantum dots (QDs) to assemble specifically onto the tag without affecting the electrophysiological properties of the channel (activation, deactivation, recovery). A fluorescent protein was then added to the intracellular N-terminus of the protein and fluorescence resonance energy transfer (FRET) across the plasma membrane was quantified for different QD colors. This system illustrates the potential for QD-fluorescent protein hybrid systems as biosensors or probes for protein conformational changes.

* This work is being supported by NSERC

10h45 Coffee Break / *Pause café*

MO-A2-4 11h00 (G*)

Muscle Cell Contraction Dynamics Elucidated by Second Harmonic Generation Microscopy*, **Nicole Prent** [1], Catherine Greenhalgh [1], Chantal Green [1], Richard Cisek [1], Arkady Major [2], Bryan Stewart [1], Virginijus Barzda [1], [1] *University of Toronto*, [2] University of Manitoba — Second harmonic generation (SHG) microscopy was used to dynamically visualize changes in length, speed and force in individual sarcomeres during rhythmic contractions in myocytes. Live *Drosophila melanogaster,* fruit fly, larva myocytes were imaged using a home-built multimodal nonlinear microscope coupled to a femtosecond diode pumped Yb:KGW laser centred at 1029 nm. Second harmonic generation is a coherent nonlinear process, which is not plagued with the photobleaching and phototoxic affects associated with fluorescence microscopy. Without the addition of any stains or labels, striated muscle cells efficiently generate second harmonic radiation from the semi-crystalline arrangement of myosin molecules in the anisotropic (A-) bands of sarcomeres. However, the central region of the A-band usually exhibits a reduction in the SHG intensity due to the antiparallel arrangement of myosin molecules in the myosin filaments. Second harmonic radiation from oppositely oriented molecules interfere destructively, however, the magnitude of destructive interference depends on the separation distance of the SHG radiators. An increase in the SHG signal from the central region of the A-band during forced stretching experiments was correlated to an increase in the separation distance between oppositely oriented myosin molecules. In myocytes undergoing rhythmic contractions the observed SHG intensity fluctuations closely follow the periodic changes in sarcomere length, velocity and tension force on the myofilaments. This enables the use of SHG intensity as an internal sensor for measuring nano-displacements and tension forces on myofilaments and facilitates fundamental studies of muscle contraction dynamics at the sub-cellular level.

* This work is being supported by NSERC, CFI and OIT

MO-A2-5 11h15 (G*)

Determining cerebral hemodynamic responses to naturally administered cigarette smoke using a fully mobile near-infrared sensor*, **Olivia Pucci**, Salah Sharieh, Vladislav Toronov, Alexander Ferworn, Sander Stepanov, Anastasios Venetsanopoulos, *Ryerson University* — Smoking is the number one leading cause of preventable death in North America, being responsible for forty thousand deaths per year in Canada alone [1,2]. It is important to determine both long-term and short-term physiological changes caused by smoking, in particular in the brain. Functional magnetic resonance imaging (fMRI) studies have indicated that nicotine causes fast hemodynamic changes in the human brain [3,4,5]. Limitations to these studies were the inability to resolve blood volume, flow and oxygenation changes, and inability to administer nicotine naturally with cigarette smoke. Near-infrared spectroscopy (NIRS) provides an effective alternative over the fMRI limitations, having the ability to penetrate deep into tissue and to measure cerebral blood oxygenation and volume [6]. NIRS equipment can be made mobile, allowing for advancements in experimental data to be acquired from test subjects in their natural environment. In this study the temporal characteristics of cerebral hemodynamic response to smoking is examined using a mobile NIRS sensor, to determine the effects of naturally administered smoke on oxyhemoglobin (HbO_2) and deoxyhemoglobin (HHb) concentrations. Having the mobile device attached to the test subjects forehead, 15 minute data traces were acquired, including a five-minute baseline period, a five-minute smoking period, and a five-minute recovery period without smoking. Observed baseline changes in HbO_2 and HHb concentrations correspond to normal physiological states that are known[7]. During smoking, sharp changes in HbO_2 concurrent with significant dips in HHb concentrations are observed. This study indicates that portable wireless NIRS devices can be useful in measuring physiological parameters in natural environments.

1. J. Flight, *Canadian Addiction Survey (CAS): A national survey of Canadians' use of alcohol and other drugs: substance use by youths*, Health Canada, 2007.
2 Heath Canada, *Canadian Tobacco Use Monitoring Survey*, Health Canada, 2007.
3. A. Villringer, B. Chance, "Non-invasive optical spectroscopy and imaging of human brain function", *Trends Neuroscience,* **20**, 435-42 (1997).
4 C. Giessing, *et al.*, "The modulatory effects of nicotine on parietal cortex activity in a cued target detection task depend on cue reliability", *Neuroscience,* **137**, 853-64 (2006).
5. A. Siafaka, *et al.*, "Acute effects of smoking on skeletal muscle microcirculation monitored by near-infrared spectroscopy", *Chest Journal,* **131**, 1479-85 (2007).
6. J.R. Thiagarajah, M.C. Papadopoulos, A.S. Verkman, "Noninvasive early detection of brain edema in mice by near-infrared light scattering", *Journal of Neuroscience Research,* **80**, 293-299 (2005).
7. V. Toronov, *et al.*, "Investigation of human brain hemodynamics by simultaneous near-infrared spectroscopy and functional magnetic resonance imaging", *Medical Physics,* **28**, 521-27 (2001).

* This work is being supported by Ryerson University Internal Fund

MO-A2-6 11h30 (G*)

Planification inverse pour la radiothérapie du cancer du poumon utilisant l'imagerie de perfusion SPECT et la modulation d'intensité*, **Jason St-Hilaire** [1], Caroline Lavoie [2], Frédéric Beaulieu [2], Anne Dagnault [2], Francis Morin [2], Luc Gingras [1], Daniel Tremblay [1], Luc Beaulieu [1], [1] *Centre Hospitalier Universitaire de Québec et Université Laval*, [2] Centre Hospitalier Universitaire de Québec — L'imagerie fonctionnelle est utilisée pour caractériser les hétérogénéités biologiques d'un volume tumoral ou d'un organe. Pour le poumon, la scintigraphie de perfusion SPECT permet d'identifier les régions qui contribuent davantage à la capacité pulmonaire du patient. Treize plans de traitement de cancers du poumon ont été rétrospectivement optimisés en utilisant notre système de planification inverse basée sur des champs anatomiques, Ballista. Pour chaque patient, les images CT et SPECT ont été obtenues séparément et fusionnées. Des plans à quatre incidences ont été générés par le système. Dans un premier temps, seule l'information anatomique a été prise en compte. Ensuite, l'information fonctionnelle a été ajoutée pour limiter la dose dans les régions bien perfusées. Les meilleurs plans de ces deux catégories ont été comparés aux plans cliniques pour chaque patient. La couverture moyenne du volume cible (PTV) par l'isodose 95% a été améliorée avec les plans anatomiques (96.5±2.2%) par rapport aux plans cliniques (93.5±5.1%). Le volume de poumon recevant 20 Gy a augmenté pour les plans anatomiques (31.0±3.8%) comparativement aux plans cliniques (25.4±6.9%) mais est resté dans les limites acceptables. L'ajout de l'information SPECT a permis d'éviter les régions bien perfusées, ce qui a diminué la dose moyenne perfusée de 15.4±3.1 Gy à 13.9±2.7 Gy. L'utilisation de champs anatomiques améliore la couverture du PTV tout en préservant le poumon dans les limites cliniquement acceptables. L'ajout de la fonction biologique au processus d'optimisation numérique permet la diminution des indices fonctionnels.

* This work is being supported by Conseil de Recherches en Sciences Naturelles et en Génie du Canada (CRSNG)

11h45 Session Ends / *Fin de la session*

[MO-A3] Curriculum Revitalization / *Rafraîchissement des programmes*

(DPE / *DEP*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

10h00 - 12h00

ROOM / SALLE ***VCH 2840*** **(cap. 98)** ***Chair: R. Hawkes, Mt. Allison University***

MO-A3-1 **10h00**

MARINA MILNER-BOLOTIN, Ryerson University

Physics for Architects: Design, Implementation and Evaluation of Innovative Physics Curricula *

Although the majority of students in the introductory physics courses are not future physicists or engineers, a significant number of physics courses are still designed having future physicists in mind. Too often the range of topics and employed pedagogy, do not reflect students' interests and aspirations. What if an introductory physics course is designed having real students (specifically future architects and building science students) in mind? The Physics for Architects course at Ryerson University is just that. The course had four goals: (a) helping future architects and building science students to understand basic physics principles relevant to architecture; (b) learning how to communicate these principles to scientists, engineers as well as the general public; (c) gaining confidence in their ability to understand physics concepts, and (d) learning to appreciate the beauty of physics and its applications to everyday life and architecture. Course topics included elements of structural loads, vibrations and resonance, heat transfer, moisture in the air, water propagation through various media, optics and acoustics as applied to architectural design. The course culminated with a semester long project: a physics demonstration exhibit (PARADE – Physics at Ryerson Architecture Demo Exhibit) presented to the entire faculty of Engineering, Architecture and Science and general public. Photographs from the PARADE can be found at: http://ryerson.facebook.com/album.php?aid=19863&l=0e64d&id=643353361; http://ryerson.facebook.com/album.php?aid=19976&l=9455d&id=643353361; http://ryerson.facebook.com/album.php?aid=19662&l=33a23&id=643353361

MO-A3-2 **10h30**

A New Way of Teaching Physics 100: Transportation, Earth Energy Balance and Global Warming. **Andrzej Kotlicki**, Georg Rieger, Fei Zhou, Mathew Martinuk, Joss Ives, Melanie Gendre, *University of British Columbia* — In 2007, we implemented fundamental changes into the curriculum and course structure of Phys 100, a large introductory course for non-physics majors at UBC. These changes were made as a consequence of the realization that students often don't make connections between the physics concepts taught in class and real-world phenomena. In addition, we want our students, as citizens and potential future leaders, to use their scientific knowledge to critically think about real world problems such as transportation and climate change. The course is now taught with strong connections to applications in the real world. For example, after introducing the generalized concept of conservation of energy, we apply it to problems based on home heating and the Earth's energy balance. We introduce the concepts of dynamic equilibrium and feedback, which are necessary to understand the basic physics of the Earth's climate. Kinematics is discussed in the context of transportation, energy consumption, and fuel efficiency, drawing connections to earlier ideas of energy and environmental impact. Basic concepts in electricity such as voltage, current, and resistance are applied to examples of home wiring, transmission lines and electrical energy savings. We introduce sources of electrical energy and methods of power generation. By using many examples of everyday physics we hope to increase the students' ability to see physics happening in the real world, and to encourage them to use their knowledge outside of the classroom. This presentation will discuss the curriculum and organizational changes in the course, including changes to labs and tutorials.

10h45 **Coffee Break / *Pause café***

MO-A3-3 **11h15**

A "Skills for Physicists" Core in Undergraduate Curricula. **Robert I. Thompson**, David Feder, Rachid Ouyed, Michael E. Wieser, *University of Calgary* — Undergraduate physics program curricula across the country tend to feature common theoretical physics core topics (e.g. Classical Mechanics, Electromagnetism, Quantum Mechanics, Statistical Physics & Thermodynamics), in which the relevant physical concepts are introduced and then developed over a series of required courses. The new physics B.Sc. curriculum currently being implemented at the University of Calgary broadens its definition of core topical streams by adding, not additional theoretical topics, but additional practical topical cores. Specifically, the new curriculum includes separate computational and experimental physics topical streams, each featuring coherent sets of required courses in each of the 2nd, 3rd, and 4th years of the program. This talk will outline the motivations, content, implementations, and goals associated with introducing these new core topics to our curriculum, examining their planned impact on our majors and honours programs and students.

MO-A3-4 **11h30**

Factors affecting the student drop-out rate in the introductory physics course. **Alan Slavin**, *Trent University* — The drop-out rate (percentage of students per year) in Trent University's introductory physics course showed a gradual increase from about 7% in the early 1980's to 16% in 1999, followed by an abrupt rise in recent years to about 30% now, with one remarkable exception. The rate fell back to 9% during the Ontario "double-cohort" years when the reduction of high school from 5 to 4 years resulted in a doubling of the number of students entering university over these two years, 2003-04. Potential causes for these changes in the drop-out rate will be discussed, including student academic preparation from high-school, gender representation, high-school grade inflation, and student work habits and motivation [1]. One likely cause of the recent rise is that, in Ontario, the fraction of 17-19 year olds attending university doubled between 2000-01 and 2004-05, whereas this ratio showed much less variation in the rest of Canada [2]. This dramatic increase coincided with changes in Ministry policies from 2003 designed to graduate a larger percentage of high-school students. The specifics of these policies and how they reflect on the ability of students entering university will be discussed. In addition, the results of a class survey will be presented that indicate other reasons why students remain in or drop the introductory physics course.

1. A.J. Slavin, *Canadian Journal of Physics* (in press).
2. D. Hango and P. de Broucker, Statistics Canada, 2007. Catalogue no. 81-595-MIE No. 058.

MO-A3-5 **11h45**

Ryerson's Outreach to the High School Community in the GTA*, **Tetyana Antimirova**, Pedro Goldman, *Ryerson University* — The challenges of the transition from high school to the first year of University are well known and much discussed. Numerous research data show that the experience with physics that students have at the high school level and even before, has a great impact on their degree of success in the introductory physics courses at the University level. Closing the gap between high school and university teaching and learning is the key to smooth transition, students' success and satisfaction. The outreach initiative to create and strengthen the ties between the university faculty and the local schools physics teachers' community has been developed by the Department of Physics at Ryerson University. The initiative is aimed first

and foremost at high school physics teachers in GTA. We will describe our joint activities up to date that are aimed towards a common goal to provide a consistent high-quality education in Physics at all levels.

* This work is being supported by Department of Physics, FEAS, Ryerson University

12h00 Session Ends / *Fin de la session*

[MO-A4] Optical Switching/Fiber / *Commutation optique/fibre*

(DOP / *DOP*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

10h00 - 12h30

ROOM / SALLE ***VCH 3830*** **(cap. 110)** ***Chair: N. Beaudoin, Université de Moncton***

MO-A4-1 10h00 (G)

Cationic effect in polymer light-emitting electrochemical cells*, **Yufeng Hu**, Yanguang Zhang, Jun Gao, *Queen's University* — Polymer Light-emitting electrochemical cells (LECs) are solid-state devices operating on the principle of *in situ* electrochemical doping and the formation of a light-emitting p-n junction. LECs usually consist of three components: a luminescent polymer, an ion-solvating polymer, and a molecular salt. As a result of doping, the LEC operation is generally insensitive to the choice of electrode materials and the thickness of active layer. However, the emission zone in an LEC is often off-centered, which increases the probability of exciton quenching by metal electrodes. Here we demonstrate that the emission zone position of LECs can be dramatically shifted toward the centre of the device by increasing size of monovalent cations used in the polymer electrolyte. A more-centered emission zone has been obtained in planar LECs with rubidium or cesium perchlorate as molecular salt, compared to devices made with other alkali perchlorates. LECs with a more centrered emission zone exhibit higher electroluminescence efficiency and better current stability. The more centered emission zone has been explained by better match of mobility of counterions, which determine the doping propagation speed and thus the position of the light emitting junction. .

* This work is being supported by NSERC

MO-A4-2 10h15

KIMBERLEY HALL, Dalhousie University

Ultrafast Control of Spin Dynamics *

The field of semiconductor spintronics has undergone explosive growth over the past few years due to the promise of applications in areas such as semiconductor logic and memory. For example, the incorporation of ferromagnetic materials into traditional transistors may lead to nonvolatile reprogrammable logic devices, and low power spin-based switching is predicted to dramatically enhance device scalability[1]. In addition to incoherent spin devices, which rely on control of a net spin population for enhanced functionality, one may also envision devices that rely on spin coherence, in which coherent operations and controllable entanglement are the basis for quantum logic[2]. Our research group is using ultrafast optical techniques to explore spin dynamics and spin control in a variety of semiconductor materials of interest for applications in spintronics. Our recent results in the area of ultrafast control of ferromagnetic order in GaMnAs and in the study of electron spin dynamics in InAs quantum dots will be highlighted.

1. S. Datta and B. Das, *Appl. Phys. Lett.* **56**, 665 (1990); M.E. Flatte and G. Vignale, *Appl. Phys. Lett.* **78**, 1273 (2001); M.E. Flatte *et al.*, *Appl. Phys. Lett.* **82** 4740 (2003); K.C. Hall *et al.*, *Appl. Phys. Lett.* **83**, 2937 (2003); K.C. Hall *et al. Appl. Phys. Lett.* **88**, 162503 (2006).
2. D. Loss and D.P. DiVincenzo, *Phys. Rev.* **A 57**,120 (1998); P Chen, C. Piermarocchi, and L.J. Sham, *Phys. Rev. Lett.* **87**, 067401 (2001).

* This work supported by NSERC, CFI, NSF, and DARPA.

MO-A4-3 10h45

A tunable high power fiber laser*, **Gautam Das**, *Lakehead University* — A fiber ring laser is developed to produce a high power (100s of mW) widely tunable stable single-wavelength laser at room temperature. A tunable fiber Bragg grating was used to obtain a desired lasing wavelength. An erbium-ytterbium-doped double-clad fiber was used inside the cavity as the gain medium to produce high output power. The ytterbium ion has larger optical absorption cross section and broader absorption band, which increased the spontaneous emission power of the laser oscillation and resulted in high output power. The laser output characteristics such as linewidth, stability, efficiency etc. were studied. The longer cavity of the resonator, corresponding to a smaller longitudinal mode spacing (~MHz), makes the laser to oscillate with multiple-longitudinal-modes. It was found that the laser can be made to oscillate at single-longitudinal-mode by using an unpumped polarization-maintaining erbium-doped fiber inside the cavity as a saturable absorber. The counter propagating light wave inside the saturable absorber creates a transient Bragg reflection grating which acts as a narrow band tracking filter and suppresses mode hopping. Single-mode oscillation was verified by a combination of optical spectrum analyzer of resolution 1.25 GHz and a scanning Fabry-Perot spectrum analyzer of resolution 7 MHz. The stability of the transient Bragg grating with respect to the input pump power, erbium concentration and length of the erbium-doped fiber will be presented.

* This work is being supported by NSERC and Prof. M. Robertson, Department of Physics, Acadia University.

MO-A4-4 11h00

Fiber Bragg grating bending measurement using a high-resolution reflectometer*, **Ping Lu**, Qiying Chen, *Memorial University of Newfoundland* — Optical low coherence reflectometry (OLCR) is an interferometric technique that allows measurements of both the amplitude and the phase of the light reflected from a device under test (DUT). In this talk, bending measurement using a high-resolution reflectometer and a fiber Bragg grating (FBG) cantilever is discussed. A FBG with a grating length of 10 mm was inscribed on a hydrogen-loaded single-mode fiber (SMF-28) using an ArF excimer laser and a phase mask. The FBG was attached to a stainless steel cantilever using epoxy glue. The convex bending of the stainless steel FBG cantilever was generated with a translation stage controlled by a computer. This bending effect resulted in a shift in the Bragg resonance wavelength due to the increase in fiber length. The reflectometry measurement provides information of the exact grating position, grating length, fiber end face position as well as reflection intensity. It has been found that the stainless steel FBG cantilever can determine the bending deflection by measuring the fiber length and change in the reflection intensity. A shift in the grating tip position of 0.47 mm and an increase in the fiber length of 0.194 mm were observed at a convex bending deflection of 15 mm. Details on the design and performance of our sensor system will be discussed.

* This work is being supported by NSERC, Canada Research Chairs, CFI, Province of Newfoundland and Labrador, Memorial University of Newfoundland

11h15 Coffee Break / *Pause café*

MO-A4-5 11h30

JAMES M. FRASER, Queen`s University

Ultrafast Dynamics of a Single-Walled Carbon Nanotube †,*

Single-walled carbon nanotubes (SWCNT) are seamless cylinders of graphene 'rolled up' along a particular chiral vector (n,m) in the hexagonal carbon lattice [1]. Up to millimetres long while only 1 nm wide, SWCNT are a quasi-1D system with interesting spatial confinement and screening effects, and the potential to play a role in future photonic applications [2]. To determine the properties intrinsic to a SWCNT, we avoid the ambiguities of ensemble studies and environmental effects by examining SWCNT (typical length ~ 1 ìm) suspended across photo-lithographically etched trenches. Low density growth ensures only one tube is in our excitation spot size [3]. Identification of the SWCNT's chiral vector is determined by mapping its optical absorption and emission features (via photoluminescence excitation spectroscopy). We observe a saturation of photoluminescence for incident pulse excitation (100 fs duration) at excitation levels estimated to be on the order of one exciton per diffusion length. This is consistent with models in which exciton-exciton annihilation plays a dominant role in carrier dynamics. We exploit this saturation effect to time-resolve energy relaxation in a single tube through femtosecond excitation correlation (FEC) spectroscopy [4]. Decay times of 50 ps for (9,8) nanotubes are measured with some variation from tube to tube. Work is ongoing to quantify important nanotube parameters such as absorption coefficient, exciton diffusion length, and optical quantum efficiency.

1. R. Saito, G. Dresselhaus, and M.S. Dresselhaus, Physical Properties of Carbon Nanotubes (Imperial College Press, London, 1998).
2. R.B. Weisman, The Industrial Physicist **10**, 24 (2004).
3. J. Lefebvre, J.M. Fraser, P. Finnie, and Y. Homma, *Phys Rev. B* **69**, 075403 (2004).
4. H. Hirori, K. Matsuda, Y. Miyauchi, S. Maruyama and Y. Kanemitsu, *Phys. Rev. Lett.* **97**, 257401 (2006).

† In collaboration with Y.-F. Xiao, T.Q. Nhan , M.W.B. Wilson, Queen`s University
* This work is being supported by Natural Sciences and Engineering Research Council, Canadian Foundation for Innovation, Ontario Ministry of Research and Innovation

MO-A4-6 12h00

A comparative study of thermochromic VO_2 thin films deposited by sputtering and sol-gel techniques*, **Balu Ramamoorthy**, A. Nait Ajjou, P.V. Ashrit, *Université de Moncton* — The ultrafast Metal-Insulator Transition (MIT) occurring at 67 °C in thermochromic Vanadium dioxide (VO_2) thin films is very well known. During this transition the material transforms itself from low temperature monoclinic phase to high temperature tetragonal phase bringing about abrupt changes in its electrical and optical properties. Five to six orders of variation in resistivity and optical transmission showing very high contrast ratios have been observed. These optical changes are of great interest from energy efficiency point of view with applications such as smart windows, if the transition is tailored to happen at or near room temperature. Different physical and chemical methods have been used in the fabrication of VO_2 thin films by various research groups. In this presentation we discuss and compare films deposited by two different techniques namely RF magnetron sputtering and sol-gel methods. In sputtering, VO_2 films with substoichiometric composition were deposited first and later were oxidised to achieve the stoichiometry. In the case of the sol-gel method, films with higher oxygen content were prepared first and were reduced in nitrogen ambient to achieve the stoichiometry. Films with three different thicknesses (100nm, 200nm and 300nm) were deposited and were characterised for their optical, electrical and structural properties. Higher thickness films show higher IR transmission at room temperature and a high contrast ratio upon switching. In addition, in the switched state they show a near-zero IR transmission. As the thickness decreases, the inherent switched state transmission is observed to be increasing and this trend is observed both in sputtered and solgel deposited films. For the 300nm thickness, the sputtered film shows a transmission contrast of 74% at 2500nm and solgel deposited film shows a transmission contrast of 50%. Structural observations by XRD and Raman spectroscopy indicate a complete switching during the transition. Efforts are underway to fabricate the films in a single step approach and also to tailor the switching temperature.

* This work is being supported by Atlantic Innovation Funds

MO-A4-7 12h15

Chromogenic Properties of Periodically and Non-periodically Nanostructured Transition Metal Oxide Thin Films*, **Pandurang Ashrit**, Abdelaziz Nait Ajjou, *Universite de Moncton* — The study of the ability of certain materials to reversibly change their optical and electrical properties under the influence of various external stimuli is termed chromogenics. This includes the phenomena of photochromics, thermochromics, electrochromics and more. Transition metal oxide (TMO) thin films which exhibit a wide range of these interesting properties have become important due their important application possibilities. A wide range of variation of these properties can be brought about by working with nanostructured TMO thin films. In our laboratory, we have been studying the various techniques by which such nanostructured thin films can be fabricated. Work related to periodic and non-periodic nanostructuring of some TMO thin films using templating method will be presented. Work pertaining to Tungsten trioxide (WO_3) and Molybdenum trioxide (MoO_3) thin films, prepared by physical and chemical methods on patterned substrates to achieve their nanostructure, is presented. Polystyrene based periodic and non-periodic templates are used in this work. The chromogenic properties, in particular the photochromic and electrochromic properties, of these films are followed. Non-periodic structures are of interest from optical and chromogenic point of view. Periodic structures show promising photonic properties including reversible photonic bandgap tuning.

* This work is being supported by NSERC, AIF, CSJ

12h30 Session Ends / *Fin de la session*

[MO-A5] Nuclear Structure and Astrophysics / *Structure nucléaire et astrophysique*

(DNP / *DPN*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

10h00 - 12h15

ROOM / SALLE VCH 3840 (cap. 106)

Chair: P. Garrett, University of Guelph

MO-A5-1 10h00

ROBERT JANSSENS, Argonne National Laboratory

Hunt for new shell structure in neutron-rich nuclei *

One of the main motivations for the development of ever more powerful exotic beam facilities is the search for phenomena that are either absent or difficult to observe in nuclei close to stability. Changes in shell structure figure prominently among these phenomena. For decades the cornerstone of nuclear structure has been the concept of

single-particle motion in a well-defined potential leading to shell structure and magic numbers. There is now growing evidence that the magic numbers are not immutable: they appear to depend on the neutron-to-proton asymmetry and the binding energy. This aspect of exotic beam physics will be discussed in this presentation through the example of the appearance of new shell structure in neutron-rich nuclei just above ^{48}Ca. To obtain the results that will be presented, a large number of different experiments and techniques had to be used. In other words, this research is a true experimentalist's dream: for each specific issue the best available technique is required.

* This work is being supported by U.S. Department of Energy, Office of Nuclear Physics, under contract No. DE-AC02-06CH11357

MO-A5-2 **10h30**

RITUPARNA KANUNGO, Saint Mary's University

Nuclear halos : A new era in nuclear physics

The nuclear halo, is the most exotic form of the nucleus that was revealed two decades ago, where one or two weakly bound nucleons have an unusually large spatial extent. This occurs by quantum mechanical tunneling and forms a low-density extended halo around the rest of the nucleus, called core. The existence of halo indicates fundamental changes to our concept of nuclear structure. The talk will discuss the basic concept of nuclear halo and its consequences. Recent experiments at TRIUMF will be reported and some future possibilities mentioned.

MO-A5-3 **11h00**

CARLA FROHLICH, University of Chicago

Nuclear Physics Aspects of an Astrophysical Nucleosynthesis Process

I will discuss various aspects of a new nucleosynthesis process, the neutrino p-process, occurring in the proton-rich ejecta of core collapse supernovae and possibly gamma-ray bursts. The relevant nuclear physics and the necessary astrophysical conditions for the nu p-process will be summarized and put into the context of understanding the origin of the elements. I will conclude by illuminating the impact of a new astrophysical process on new avenues for nuclear physics and astrophysics.

MO-A5-4 **11h30**

GOTZ RUPRECHT, TRIUMF

TACTIC - a tracking detector for ions from nuclear reactions

TACTIC (TRIUMF Annular Chamber for Tracking and Identification of Charged Particles), a time projection chamber (TPC), has been developed in the past few years at TRIUMF and the University of York, U.K. to detect ions from nuclear reactions. Contrary to other TPCs where the beam enters directly the drift region, the cylindrical shape of TACTIC allows the separation of the target from the drift region and therefore makes the application of much higher beam currents possible. The use of electron-multiplier (GEM) foils for the amplification of the weak electron-drift signals allows the detection of low energy particles and therefore TACTIC will be ideal for investigations of nuclear processes pertinent to nuclear astrophysics. First beam tests at ISAC/TRIUMF have been performed in autumn 2007 and we will report about the results here.

MO-A5-5 **12h00**

Recent mass measurements among proton and neutron rich nuclei with the Canadian Penning Trap Mass Spectrometer*, **Kumar Satish Sharma** [1], J. Fallis [1], J.A. Clark [2], G. Savard [2], F. Buchinger [3], S. Caldwell [4], J.E. Crawford [3], S. Gulick [3], D. Lascar [5], H. Sharma [1], G. Li [3], A.F. Levand [2], [1] *University of Manitoba*, [2] Argonne National Laboratory, [3] McGill University, [4] University of Chicago, [5] Northwestern University — The masses of nuclei removed from stability are an important parameter for models attempting to explain the origin of elemental abundances. In particular, network calculations of the production of elements through explosive stellar processes critically depend on the masses of nuclei near the proton and neutron drip lines. The Canadian Penning Trap Mass Spectrometer (CPT) online to the ATLAS facility at the Argonne National Laboratory has been involved in measurements among nuclei in both of these regions. A summary of our recent results among proton-rich nuclei near the p- and ip-process paths and among neutron rich nuclei produced in the fission of ^{252}Cf will be given.

* This work is being supported by NSERC and US DOE contract W-31-109-ENG-38

12h15 **Session Ends / *Fin de la session***

[MO-A6] History of Physics / *Histoire de la physique*

(DHP / *DHP*)

MONDAY, JUNE 9
LUNDI, 9 JUIN
10h00 - 12h30

ROOM / SALLE ***VCH 2880*** **(cap. 200)** ***Chair: W.F. Davidson, National Research Council Canada***

MO-A6-1 **10h00**

JEAN BARRETTE, McGill University

Ernest Rutherford at McGill

This year marks the 100th anniversary of Sir Ernest Rutherford's Nobel Prize in Chemistry that he received "for his investigations into the disintegration of the elements, and the chemistry of radioactive substances". Ernest Rutherford was Professor of Experimental Physics at McGill from 1898 to 1907 where he performed most of the work that led to this recognition. The McGill Rutherford Museum contains a unique collection of the actual apparatus used by Ernest Rutherford in his research. The simplicity in design and construction of these apparatus are a strong testimony to why Rutherford is recognized as one of the most outstanding experimentalists of the twentieth century. This talk will describe some of the seminal experiments performed by Rutherford at McGill using these apparatus and that are at the basis of his Nobel Prize.

MO-A6-2 10h30

ROBERT PYWELL, University of Saskatchewan

A Scrapbook History of Physics at the University of Saskatchewan

Balfour Currie, former head of the Department of Physics at the University of Saskatchewan and founder of the Institute of Space and Atmospheric Studies, kept wonderfully detailed scrap books of newspaper clippings, magazine articles, photographs and other memorabilia of the Department. He also compiled materials collected by the earlier head Dr. E.L. Harrington and later wrote a history the Department's early years. These collections provide a unique perspective on the research, teaching and outreach activities of the Department. This talk will summarize the history of physics on the Saskatchewan prairie as revealed by the scrapbooks and writings of Dr. Currie.

MO-A6-3 11h00

JOHN ROOT, National Research Council Canada

The National Research Universal (NRU) Reactor - Fifty years of Excellence *

November 2, 2007, marked the 50th anniversary for the operation of the National Research Universal (NRU) reactor at Chalk River Laboratories. This unique component of Canada's infrastructure for science and industry has consistently made world-class impacts. From the time of the visionary pioneers who designed the most powerful (by far) multipurpose nuclear research platform, and subsequently through decades of good stewardship, the NRU reactor has provided Canada with three major contributions: (1) neutron beams for research on materials – recognized by the 1994 Nobel Prize in Physics, shared by Canadian Bertram Brockhouse and American Cliff Shull; (2) in-core facilities to test nuclear materials and components – supporting Canada's knowledge-intensive nuclear industry that involves 30,000 jobs and generates $5B per year of economic activity; and (3) production of medical isotopes that enable more than 20 million diagnoses and treatments around the world each year. This presentation will review some of the history surrounding Canada's decision to invest in the NRU reactor, a decision that launched us to the forefront of the nuclear age and enabled us to maintain our respected stature in the international community of nuclear S&T to the present day. We shall also consider the historic moment in which we now find ourselves, pondering whether or not to invest in a replacement for this marvellous scientific facility, to achieve the next 50 years of excellence from discovery to innovation and beyond.

* This work is being supported by National Research Council

MO-A6-4 11h30

ALLAN GRIFFIN, University of Toronto

100 years of Liquid Helium: Highlights of Canadian Research

We first review the liquefaction of Helium in 1908 in Leiden by Kamerlingh Onnes and his students, the end result of decades of research trying to reach absolute zero. We then turn to Canadian research, which has played a major role in unraveling the mysteries of liquid Helium. This started with the first production of liquid Helium (after Leiden) at Toronto in 1923 by Shrum and McLennan, with advice from Kamerlingh Onnes. It took until 1938 before the dramatic discovery of zero viscosity and superfluidity at 2.18K at Cambridge by Allen and Misener (both from Toronto). This quickly led to the realization (by London, Tisza and Landau) that superfluid Helium was a "quantum liquid", which exhibited macroscopic quantum effects. Using the new technique of neutron scattering, pioneering measurements were later made by Canadians at AECL in Chalk River: the static structure factor by Hurst and Henshaw in 1953-55; the phonon-roton dispersion curve by Henshaw and Woods in 1961(conjectured by Landau in 1947); and the Bose-Einstein condensate fraction by Cowley and Woods in 1968.

MO-A6-5 12h00

MICHAEL OTTO STEINITZ, St. Francis Xavier University

In Defense of Peter J. W. Debye †

A brief review of the career of Peter Debye will be given, concentrating on his position during the Nazi regime in Germany and his relationship to it before and after his emigration to the United States. This great physicist, who, like so many other physicists, won his Nobel Prize in chemistry, voted with his feet.

† In collaboration with Norwig Debye-Saxinger

MO-A6-6 12h15

The Russian Space Program: The Things You Know and Things You Never Heard About. **Svetlana Barkanova**, *Acadia University* — In the entire history of the space exploration, only three countries have launched their own manned space mission: USSR (1961), the United States (1962), and finally, in 2003, China. Having lived within the former U.S.S.R., the speaker brings a special perspective to her subject. The talk will outline the history of the Russian space program underlining such well-known defining moments as the launch of the first artificial satellite, the first human in space, the first group flight, the first planet landing, the first space tourist, and so on, as well as some of the other intriguing details not widely known to the general public.

12h30 Session Ends / *Fin de la session*

[MO-A7] DIAP/DIMP Joint Session / *Session conjointe DPIA/DPIM*

(DIAP-DIMP / *DPIA-DPIM*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

10h00 - 12h30

ROOM / SALLE VCH 2830 (cap. 106) ***Chair: A. Kotlicki, University of British Columbia***

MO-A7-1 10h00

MICHEL MEUNIER, Ecole Polytechnique de Montréal

Ultrafast laser processing of nanomaterials for biomedical applications

An overview of our recent developments on ultrafast laser processing of nanomaterials ant their applications in biomedical will be presented. The new process consists of performing femtosecond (fs) laser ablation of a target immersed into a biocompatible liquid to produce finely controlled nanomaterials. We will first present results related to the nanofabrication of gold in aqueous solutions for bio-imaging and biosensing applications. The method makes possible the production of stable biofunctionalized gold nanoparticle colloids with extremely small size (down to 2-2.5 nm) and size dispersion (down to 1-1.5 nm). Furthermore, a new fs laser-based method to control the size characteristics of colloidal nanoparticles has been developed. The method uses the supercontinuum generation produced through a strong nonlinear-optical interaction of the femtosecond radiation with a liquid to fragment relatively large colloids and reduce their agglomeration. The fragmented species then re-coalesce to form smaller, less dispersed and much more stable nanoparticles in the solution. Finaly, silicon nanocrystals were prepared by fs laser ablation in water of a silicon wafer target. This technique has the advantage of producing pure nanocrystals that are stable in solution using only biocompatible materials. The silicon nanocrystals generate singlet oxygen under 523 and 266 nm irradiation making them potential photosensitizer candidates for photodynamic therapy.

MO-A7-2 10h30

DEAN CHAPMAN, University of Saskatchewan

The Biomedical Imaging and Therapy Beamline at the Canadian Light Source

A synchrotron biomedical research facility is being constructed at the Canadian Light Source in Saskatoon, Saskatchewan. The Biomedical Imaging and Therapy (BMIT) facility will provide high intensity, high x-ray energy light for a wide variety of imaging and therapy programs. This facility is now in the construction phase with some initial operations in the summer of this year (2008). The BMIT facility will have two beamline complexes; an insertion device source beamline at which the bulk of the imaging and therapy research on humans, animals, and plants will be carried out, and an ancillary bend magnet source beamline which will serve as a proof-of-principle facility and research tool for new methods of imaging and therapy. Several imaging methods (absorption-edge subtraction imaging, diffraction enhanced imaging, phase contrast imaging, and absorption imaging) in projection and computed tomography modes as well as monochromatic beam and filtered white beam therapy methods will be available. The layout of the facility will be presented along with examples of the types of research that can be carried out at BMIT with emphasis on new imaging methods and applications being developed.

11h00 Coffee Break / *Pause café*

MO-A7-3 11h15

Advanced Acoustic Imaging and IR approaches in Nondestructive Investigations and Diagnostics of Cultural and Environmental Heritage. **Roman Gr. Maev**, *Daimler Chrysler/NSERC Industrial Research Chair, University of Windsor* — Continuous innovations in advanced High Resolution Imaging Technologies and Methods have caused unique applications for non-destructive investigations of surface and subsurface microstructures in the conservation of cultural and environmental heritage. It became a preferred approach even in cases where microanalysis sampling is permitted. The synergy between experts in science and culture will lead to continuous development and adjustments of new innovative scientific methods, their applications in the field of preservation, reconstruction and diagnostics of museum, and archeological objects. Acoustical imaging techniques, in particular, are powerful and significant methods that can bring a revolution in the usual study and conservation of art-objects. There is an ancient saying that "A picture is worth a thousand words". Never this is truer than when it is applied to nondestructive characterization of materials of various natures. It is also true that it was the very first nondestructive test when after God created the universe he stopped and "saw that it was good". It may be difficult for modern research scientists and engineers to believe, but visual inspection is still the nondestructive testing technique most often used in practical applications. The goal of this invited talk is to introduce advanced acoustic imaging technique and IR approaches, which have been developed by our group and successfully applied in the industrial sector. In that presentation we will demonstrate our results in the new field of Nondestructive Investigations and Diagnostics of Cultural and Environmental Heritage. We strongly believe that this new technical approaches will benefit art collection community as a whole, and further emphasize scientist's contribution to the world heritage as well.

MO-A7-4 11h30 (G*)

Investigation of the Structure of New Biofiber Composite Materials with Advanced Ultrasonic Imaging Methods. **Ina Seviaryna**, Ghazal Ghodsi, Elena Maeva, *University of Windsor* — Development of new materials always request the necessity for a thorough study of their structure, properties and mechanical performance. Recently, composite materials containing biofibers become more popular materials in many industries: automotive, marine, construction. Acoustic methods are proved to be effective and reliable techniques for nondestructive evaluation of the materials' mechanical and elastic properties which are essential for the design of the new materials and structures. Scanning acoustic microscopy combines visualization of the surface, subsurface and bulk microstructure with quantitative evaluation of its elastic properties of materials. Mechanical properties of biocomposites containing fibers from agricultural sources (wheat, corn, soybean and canola) were investigated with advanced acoustic techniques. Acoustic attenuation, sound velocity, density and elastic moduli of the biofiber composite materials as well as its anisotropy were investigated. Acoustic images of the microstructure were quantitatively evaluated and some subsurface microstructural defects were visualized. A fiber/matrix interface was also investigated by high resolution acoustic microscopy in acoustic frequency range of 50-400 MHz. Capability of the acoustic microscopy to nondestructively detect internal microstructure and defects of the new materials were demonstrated. The acoustic data demonstrate correlation with microhardness parameters and destructive testing results.

MO-A7-5 11h45

Wavefront Energy and Environment*, **T.J.T. Spanos**, *University of Alberta* — Industrial applications of dynamic fluid injection technologies have been developed by Wavefront Energy and Environment based on theoretical developments constructed over a period of 30 years [1]. The associated non-linear classical field theory predicts that porosity-pressure waves and solitons may be generated in the earth and these waves may control the motion of fluids. These predictions were applied in several heavy oil fields in east-central Alberta [2] with reasonable success. This led to the building of a publicly traded company and world wide commercial applications of its patented

technologies. At present Wavefront has commercialized it's technologies world wide and licensed the oil field applications to Haliburton. In the environmental industry commercial applications involve the placement of chemicals for the purpose of neutralizing a contaminant or the use of surfactants to mobilize LNAPL's or DNAPL's. Clients range from NASA to the NY DEC, to major defence contracts, U.S. government sites and private industry contaminants such as service stations and dry cleaning plants.

1. T.J.T. Spanos, *The Thermophysics of Porous Media*, 2002, Chapman & Hall/CRC Press, Monographs and Surveys in Pure and Applied Mathematics series.
2. T.J.T. Spanos, M.B. Dusseault, B. Davidson D. Shand and M. Samaroo, "Pressure Pulsing at the Reservoir Scale a New IOR approach", *Journal of Canadian Petroleum Technology* February 2003, **Volume 42**, 1-13.

* This work is being supported by NSERC and Wavefront Energy and Environment

MO-A7-6 **12h00**

Forensic electron paramagnetic resonance (EPR) dosimetry of drywall. **Jeroen Thompson**, Ibrahim Abu Atiya, Douglas Boreham, *McMaster University* — Concern regarding the possibility of criminal or terrorist use of nuclear materials has led to an interest in developing the capability to measure radiation dose in a variety of natural and man-made materials. Measurement of radiation dose in "fortuitous" dosimeters is intended to aid in law enforcement, screening of affected populations (triage), and possibly even weapons inspections. Electron paramagnetic resonance (EPR) may be used to perform radiation dosimetry on suitable materials. Historically, this field has linked radiation physics with archaeology and geology; at McMaster University, we are extending EPR dosimetry to materials that are of use in forensic dosimetry. One such novel EPR dosimeter is drywall, a common construction material composed largely of gypsum (calcium sulphate dihydrate). A radiosensitive EPR signal in drywall has been identified, and suitable dose measurement protocols have been developed. As a proof-of-concept, a drywall slab was irradiated with a ^{60}Co source, and the absorbed dose was measured across the slab. The resulting two-dimensional dose map illustrates the possibility that one can determine the unambiguous former presence and even location of an illicit radioactive source. Possible applications in counter-terrorism and criminal investigations will be discussed.

MO-A7-7 **12h15** **(G)**

Development of silicon nanowires for applications in small-dimension transistors and field emission devices*, **Han-Jen Yang**, Ishiang Shih, *McGill University* — Silicon nanowire has many potential applications, one of which is to fabricate small dimension transistors. For example, silicon nanowire can form the channel region for the vertical surround-gated field effect transistor. Silicon nanowire can also be used as the sharp, small dimension emission tip for the field emission device. One of the issues facing the field emitter array (FEA) is the device uniformity across the array and uniformly fabricated silicon nanowires can possibly be a solution to such issue. Various silicon nanowires are fabricated using different fabrication methods such as crystal orientation dependent etching process with photolithography and also the self-aligning silica colloids as etching mask combining with metal induced etching process. The fabrication uniformity of the nanowires is examined and the silicon nanowire based transistors and field emission devices are fabricated and characterized.

* This work is being supported by McGill University

12h30 **Session Ends** / ***Fin de la session***

[MO-A8] Particle Physics Instrumentation / *Instrumentation en physique des particules*

(PPD / *PPD*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

10h00 - 12h30

ROOM / SALLE ***VCH 3860*** **(cap. 148)** ***Chair: John F. Martin, University of Toronto***

MO-A8-1 **10h00**

KARL KRUSHELNICK, University of Michigan

Compact laser-plasma based accelerators

Recent developments in femtosecond laser technology have enabled the proliferation of relatively compact high power laser systems in university laboratories around the world. One potentially important application of this technology is the generation of relativistic electron beams having energies of hundreds of MeV to a GeV using the plasmas produced by such lasers. I will discuss recent results and future prospects for this technology.

MO-A8-2 **10h30**

STEVEN ROBERTSON, McGill University

SuperB: New Physics Opportunities at a High Luminosity Flavour Factory *

Flavour will play a crucial role in understanding physics beyond the Standard Model. Progress in developing a future programme to investigate this central area of particle physics has recently passed a milestone, with the completion of the conceptual design report for SuperB — a novel technological solution for colliding electrons and positions at centre-of-mass energies around the Y(4S) (~10.6 GeV) with extremely high luminosities (>O(10^{36}cm^{-2}s^{-1}) in a low background environment. Such a research tool, opens the exciting possibility of a programme of high statistics heavy flavour physics (B and D mesons and tau leptons) that has sensitivity to physics beyond the Standard Model by measuring subtle effects in CP-violating asymmetries and in rare decay branching fractions and kinematic distributions affected by new heavy particles in the loops of second order diagrams. It will provide unique and complementary data for interpreting results from the LHC and indirect access to energy scales beyond those directly probed at the LHC. The time scale for this effort has first collisions occurring in 2014 with the physics programme completed before an ILC is expected to begin collecting data.

* This work is being supported by NSERC

MO-A8-3 **11h00**

International RD collaboration for the development of micro pattern gaseous detectors. **Alain Bellerive**, *Carleton University* — Micro pattern gaseous detectors (MPGD) were designed to give excellent response for very high particle flux experiments. The versatility of MPGD leads the way for many different applications in various fields of research. The RD51 collaboration at CERN aims to push forward technological and system aspects of MPGD. Current trends in MPDG technology, together with new fabrication processes that lead to improvement in performance for detectors of various sizes and shapes, will be reviewed. Basic experimental studies and evaluation for high energy physics, particle astrophysics, nuclear physics, industrial and medical imaging, as well as development of radiation hard technology, detector simulation, and fast electronics, will be summarized.

MO-A8-4 11h15

The T2K Fine-Grained Detector: design and performances*, **Fabrice Retiere** , *TRIUMF* — The Fine-Grained Detector (FGD) is an element of T2K's near detector. Its purpose is to provide target mass where neutrinos interact and track the particles produced in the interactions. It is constructed from 0.96x0.96x184 cm^3 scintillator bars extruded with a hole down the center and coated by a thin layer of titanium dioxide. A wavelength shifting fiber is inserted in the central hole. One end of the fiber is coupled to a Multi-Pixel Photon Counter (MPPC) and the other end is mirrored. The fast MPPC pulses (< 1 ns rise time, 9 ns fall time) are stretched into slower pulses (120 ns rise time, 240 ns fall time) and sampled at 50 MHz during 10 microseconds by the AFTER ASIC. The 10 microsecond sampling time is chosen to encompass the beam spill plus two muon decay constants, in order to detect Michel electrons from pions stopping in scintillator bars. We report on the performance of the FGD detector elements. Beam test measurements show that minimum ionizing particles produce at least 15 photo-electrons. Despite the slow sampling frequency, a timing resolution better than 3 ns has been achieved for MIPs by fitting the rise time of the pulse, which fulfills the detector requirements.

* This work is being supported by NSERC

MO-A8-5 11h30 (G)

Performance of the prototype module of the GlueX electromagnetic barrel calorimeter*, **B.D. Leverington**[1], G.J. Lolos [1], Z. Papandreou [1], A.R. Dzierba [2], E. Scott [2], M. Shepherd [2], D. Lawrence [3], E. Smith [3], S. Taylor [3], E. Wolin [3], F. Klein [4], [1] *University of Regina*, [2] Indiana University, [3] TJNAF, [4] The Catholic University of America — A photon beam test of the prototype module for the GlueX electromagnetic barrel calorimeter was carried out in Hall B at the Thomas Jefferson National Accelerator Facility with the objective of measuring the energy and timing resolutions of the module as well as the number of photoelectrons. The data were collected in September 2006; the results are $\sigma_{\Delta T} = 74\ ps / \sqrt{E} \oplus 33\ ps$, $\sigma_E / E = 5.54\% / \sqrt{E} \oplus 1.64\%$ and 650-750 photoelectrons at 1 GeV. Details of the beam test and analysis will be shown during the talk with a brief overview of the GlueX experiment.

* This work is being supported by NSERC and the US Department of Energy

MO-A8-6 11h45 (G)

Geant4 Studies of the ATLAS Liquid Argon Forward Calorimeter. **John Paul Archambault**, ATLAS FCal Group, *Carleton University* — The Large Hadron Collider will collide 7 TeV proton beams with the intent of studying the Standard Model of Particle Physics and searching for physics beyond. The Liquid Argon Forward Calorimeter (FCal) of the ATLAS detector is an important component in the studies mentioned above. The FCal contains both electromagnetic and hadronic modules and in 2003, a beam test was conducted to obtain the energy calibration. Using the H6 beam line at CERN, the beam test was performed to investigate the response of the FCal to both electrons and pions in the energy range of (10-200) GeV. A simulation of the beam test was incorporated into the ATLAS software framework to study the beam test data. Results of the Geant4 simulation are compared to the data for the linearity and the resolution of the FCal, over the above mentioned energy range.

MO-A8-7 12h00 (G*)

Using Boosted Decision Trees for Tau Identification in ATLAS*, **Jennifer Godfrey**, Dugan O'Neil, *Simon Fraser University* — The production of Tau leptons at the LHC is a key signature of the decay of both the standard model Higgs (via H-> $\tau\tau$) and SUSY particles. Taus have a short lifetime of $c*\tau = 87\mu m$ and can decay hadronically. Because backgrounds have cross-sections about 1 billion times larger than tau production, multivariate techniques are often used. Boosted Decision Trees (BDTs) have recently gained more attention in HEP. Decision Trees optimize the signal and background separation by combining many simple cuts into a multivariate discriminate while the boosting method creates subsequent trees that concentrate on events that are harder to separate. I am using BDTs to identify hadronically decaying taus in the ATLAS experiment.

* This work is being supported by NSERC

MO-A8-8 12h15 (G)

Parameter Estimation with a Weighted Monte-Carlo Likelihood Fit.*. **David Asgeirsson** , Thomas Mattison , *University of British Columbia* — We present recent work done to develop software for a novel method of parameter estimation. In a standard likelihood or chi-squared fit, the data is compared to an analytical theoretical prediction. For many models, it becomes quite difficult to write an analytic expression for the convolution of the physics model of interest, and the detector response function. This means many researchers may resort to either using numerical convolution with a great reduction in the speed of calculations and the overall fitting process, or they may choose to use a simplified instrument response function using only functions which allow for easy evaluation of the convolution integrals. This second approach can lead to fit biases which hinder precision measurements. We present a novel method for avoiding the problems associated with analytic convolution. First we use high statistics Monte Carlo simulation to generate a template for the data we wish to fit. The Monte Carlo events contain enough truth information to allow our software to reweight the events correctly as we vary the physical parameters in the fit. This allows one to perform an exact fit when the underlying distributions are understood, even if one cannot easily write an analytical convolution of all of the underlying probability density functions. We will briefly present some results based on feasibility studies of measuring the frequency of neutral B meson oscillations with dilepton decays in the BaBar experiment.

* This work is being supported by NSERC

12h30 Session Ends / *Fin de la session*

[MO-A9] Atomic and Molecular Spectroscopy and Dynamics I / *Spectroscopie et dynamique des atomes et molécules I*

(DAMPhi / *DPAMip*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

10h00 - 12h15

ROOM / SALLE ***VCH 3820*** **(cap. 104)** ***Chair: D.W. Tokaryk, University of New Brunswick***

MO-A9-1 **10h00**

AMANDA ROSS, Université Lyon

Laboratory exploration of gas phase spectra of some transition metal hydrides *

The work presented in this talk has an astrophysical motivation, as high resolution spectroscopy remains an essential probe for remote and hostile environments. Metal hydride spectra have been observed in the atmospheres of cool stars (where temperatures below 3000 K allow these molecules to form). Those with spectra in the regions of atmospheric windows are of particular interest; isotopic composition and response to magnetic fields, are the targets of our investigations. Molecular spectra can distinguish between metal isotopomers quite readily, but the relative intensities of spectral lines cannot be used indiscriminately to deduce relative populations. Laboratory spectra of 'simple' diatomic metal hydride molecules reveal quite irregular intensity patterns, which we try to interpret in terms of the electronic structure of the species in question. Illustrations will be taken primarily from our recent work on resolved fluorescence spectra of the NiH radical recorded by Fourier transform spectrometry. The extension of optical spectroscopy to the study of molecular response to magnetic fields is related to a specific interest in stellar spectropolarimetry, which uses the Zeeman effect to map, for example, the solar magnetic field, and to monitor changes in magnetic activity. The prime molecular candidate for such work is FeH. Recent experimental work related to this project will be outlined.

* This work is being supported by CNRS France

MO-A9-2 **10h30** **(G*)**

Spectroscopy of the A-X transition of SrCCH and SrCCD*, **Ahmad Faridian** [1], Dennis Tokaryk [1], Allan Adam [2], [1] *University of New Brunswick, Physics Department*, [2] University of New Brunswick, Chemistry Department — The family of molecules consisting of an alkaline earth metal atom bonded to an organic ligand has been under intensive investigation recently, since these molecules play a significant role in synthesis of organic compounds, and since some members like MgNC and MgCN have been detected in stellar atmospheres. Our group has previously studied CaCCH, MgCCH, $CaOCH_3$, and $SrOCH_3$, and in this work we consider the $A^2\Pi$–$X^2\Sigma^+$ transition of SrCCH and SrCCD. The molecules were created in a pulsed-jet laser ablation source through reaction of strontium atoms ablated from a solid rod with methane gas entrained in helium. High-resolution spectra were collected through laser-induced fluorescence following excitation of the molecules formed in the jet with a cw ring dye laser. Results of the analysis are compared to those of a previous high-resolution study of SrCCH [1]. The data provide information on the C-H bond length via the isotopic substitution, and the lambda-doubling parameter p allows for an estimate of the position of the $B^2\Sigma^+$state for both isotopes.

1. Dick *et al.*, *J. Mol. Spectrosc.* **vol. 233**, p. 197-202 (2005)

* This work is being supported by NSERC

MO-A9-3 **10h45**

Observation of the Infrared Spectrum of the C-N Stretching Band of Methylamine*, **Zhen-Dong Sun**, Ronald M. Lees, Li-Hong Xu, *University of New Brunswick* — The first Fourier transform and Lamb-dip spectra of the C-N stretching band of CH_3NH_2, a prototype for nonrigid molecules with two large-amplitude CH_3-torsion and NH_2-wagging motions, are observed in the 10-μm region. We show that the densest Q-branch head and the highly blended R and P line multiplets in the (0, Aa/Ea, 0) sequences are clearly resolved, measured and assigned. Term values of excited vibrational levels are thereby obtained and expanded in $J(J+1)$ Taylor-series, and the subband origins are determined. The results provide precise information for fundamental studies and the generation and detection of terahertz emissions of CH_3NH_2.

* This work is being supported by the Natural Sciences and Engineering Research Council of Canada

11h00 **Coffee Break / *Pause café***

MO-A9-4 **11h15**

ADRIANA PREDOI-CROSS, University of Lethbridge

Laboratory spectroscopy for planetary remote sensing *

We will discuss the application of spectral line shapes to atmospheric physics. There is a need in atmospheric research to accurately model absorption profiles over a wide range of pressures and temperatures. Using a correct understanding of the physics of spectral formation, data may be reliably extrapolated from the laboratory case to the atmosphere. In practice, a full understanding of the physics is hard to obtain, particularly when the numbers of parameters are considered. An overview of high-resolution laboratory investigations will be presented for infrared and near infrared spectral bands. The studies include measurements and theoretical analyses of the line parameters needed to improve the spectroscopic databases required for planetary applications.

* This work is being supported by NSERC

MO-A9-5 **11h45** **(G)**

The cyclic CO_2 trimer: Observation of two parallel bands and determination of intermolecular out-of-plane torsional frequencies*, **Mahin Afshari** [1], Mehdi Dehghani [1], Nasser Moazzen-Ahmadi [1], A.R.W. McKellar [2], [1] *University of Calgary*, [2] Steacie Institute for Molecular Science,National Research Council of Canada — Previously, two distinct isomers of the CO_2 trimer have been identified by means of infrared spectroscopy. The first is a symmetric top with a cyclic planar structure and the second is an asymmetric top barrel-shaped structure with C_2 symmetry. We have observed two new parallel ($\Delta K = 0$) bands of the cyclic CO_2 trimer at 2364 and 2370.5 cm^{-1} which are each assigned as a combination of an intramolecular CO_2 monomer ν_3 stretch and an intermolecular out-of-plane torsion, giving the torsional frequencies of 12.3 and 18.8 cm^{-1}, respectively. The band at 2364 cm^{-1} is surprisingly strong and completely unperturbed, providing a rare and near perfect example for a parallel band of a symmetric top molecule with C_{3h} symmetry and zero nuclear spins. The second band at 2370.5 cm^{-1} is somewhat weaker and has not been fully analyzed because of spotty coverage of our diode lasers. However, it is still easily assigned as the second anticipated combination band involving an out-of-plane torsional mode of the cyclic CO_2 trimer. The trimers are generated in a pulsed supersonic expansion from a slit-jet nozzle and probed with a tunable infrared diode laser.

* This work is being supported by NSERC

MO-A9-6 **12h00** **(G*)**

Observation of two combination bands involving torsion and asymmetric bending modes of the non-polar N_2O dimer*, **Mehdi Dehghany** [1], Mahin Afshari [1], Nasser Moazzen-Ahmadi [1], A.R.W. McKellar [2], [1] *University of Calgary*, [2] National Research Council of Canada — The non-polar N_2O dimer has four low frequency intermolecular vibrational modes: van der Waals stretch (A_g symmetry), symmetric and asymmetric in-plane bends (A_g and B_u symmetry, respectively), and out-of-plane torsion (A_u symmetry). There are two possible intramolecular dimer vibrations which correlate with the ν_1 monomer stretch. One of these is an in-phase vibration of the two monomers, which has A_g symmetry and is not infrared active. The other is an out-of-phase vibration, which has B_u symmetry and gives rise to the infrared active dimer band at 2229.48 cm^{-1}. In the present work, we report the observation of an N_2O dimer band with c-type rotational structure, assigned as a combination of the A_g intramolecular N_2O ν_1 stretching vibration and the A_u intermolecular out-of-plane dimer torsional vibration. The vibrational origin for this band is measured to be 2249.360 cm^{-1}, giving an estimated torsional frequency of 21.5 cm^{-1}. A second combination band with *a*- and *b*-type rotational transitions has also been measured and assigned as the combination of the same A_g intramolecular vibration and the B_u asymmetric van der Waals bend. The measured band center is 2264.37 cm^{-1}, giving an asymmetric bending frequency of about 36.5 cm^{-1}. A search for the other two combination bands is currently underway.

* This work is being supported by NSERC

12h15 **Session Ends / *Fin de la session***

[MO-A10] Best Condensed Matter Paper Published in CJP / *Meilleur article de matière condensée publié dans RCP*

(DCMMP / *DPMCM*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

10h00 - 10h30

ROOM / SALLE ***VCH 2860*** **(cap. 142)** ***Chair: T. Tiedje, University of British Columbia***

MO-A10-1 **10h00**

FRANK MARSIGLIO, University of Alberta

Flippin' Spins: a Quantum Mechanical Approach †,*

Much of the computer hard drive memory business relies on the ability to flip magnetic spins quickly. One new approach, often discussed in the past decade, is to use spin currents to perform the flipping. We review the Landau-Lifshitz-Gilbert based approach, a semiclassical formalism that works reasonably well in certain parameter regimes, and report on some quantum mechanical (QM) approaches that we have recently explored. The QM approach will be required as system sizes continue to shrink.

† In collaboration with Wonkee Kim, Fatih Dogan, Cindy Blois, University of Alberta

* This work is being supported by NSERC, ICORE, CIFAR

10h30 **Session Ends / *Fin de la session***

[MO-A11] Condensed Matter Theory / *Théorie de la matière condensée*

(DCMMP-DTP / *DPMCM-DPT*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

10h30 - 12h15

ROOM / SALLE ***VCH 2860*** **(cap. 142)** ***Chair: R. MacKenzie, Université de Montréal***

MO-A11-1 **10h30**

LAURENT LEWIS, Université de Montréal

Laser ablation with short and ultrashort laser pulses: basic mechanisms from MD simulations *

A short, intense burst of light hitting the surface of a solid can lead to the collective ejection of matter, a phenomenon called laser ablation. The chain of events and mechanisms leading to ablation is complex and was not well understood until recently. Experiments only provide indirect information about the process, and relating this to the actual physics taking place is difficult. On the other hand, the complexity of the phenomenon is such that theoretical and numerical approaches are difficult. To address this problem, we have recently developed a simple, yet powerful, hybrid molecular dynamics / Monte Carlo scheme for the interaction of laser pulses with matter in the thermal regime. In addition to providing a systematic rationale for the known ablation mechanisms (phase explosion, spallation, vaporisation, spinodal decomposition), we have discovered a new mechanism – fragmentation – which drives ablation in various conditions of energy. In this talk I will review the problem, present the model and the results we have obtained, including recent ones on ablation in immersed targets and damage to the heat-affected zone.

* This work is being supported by Supported by NSERC and FQRNT; simulations performed on RQCHP computers.

MO-A11-2 **11h00**

Discrete model for a decaying quantum system*, **Donald Sprung** [1], Wytse van Dijk [2], Joan Martorell [3], Chris Kim [1], [1] *McMaster University*, [2] McMaster University and Redeemer College, [3] Universitat Barcelona — Recently S. Longhi [1] used a Fano-Anderson model to explore the decay of a confined quantum state in 1D. The model is analogous to a chain of masses connected by springs. Initially the excitation is confined to site one, weakly coupled $\Delta^2 < 1$ to a semi-infinite array. We will describe the model and its analytic solution, $c_n(t) = \left[\delta_{n1} + \Delta(1-\delta_{n1})\right] i^{n-1} \sum_{s=0}^{\infty} \frac{n+2s}{t} \alpha^{2s} J_{n+2s}(2t)$; $c_n(t=0) = \delta_{n1}$ where $c_n(t)$ is the occupation amplitude at time t for site n, $\alpha^2 = 1 - \Delta^2$, and $Jn(x)$ is the regular Bessel function. There are three distinct epochs of time evolution. A robust approximation which describes the change-over from exponential decay to asymptotic power law t^{-3} decay will be presented.

1. *Phys. Rev. E* **74** (2006) 026602; *Phys. Rev. Lett.* **97** (2006) 110402

* This work is being supported by NSERC and DGES-Spain

MO-A11-3 **11h15** **(G)**

A Fractionalized Quantum Spin Hall Effect*, **Michael Young**, Sung-Sik Lee, Catherine Kallin, *McMaster University* — The Effects of electron correlations on a two dimensional quantum spin Hall (QSH) system are studied. We examine possible phases of a generalized Hubbard model on a bilayer honeycomb lattice with spin-orbit coupling and short range electron-electron repulsions at half filling, based on the slave rotor mean-field theory. Besides the conventional QSH phase and a broken-symmetry insulating phase, we find a new phase, a fractionalized quantum spin Hall (FQSH) phase, where the QSH effect arises for fractionalized spinons which carry only spin but not charge. This novel property of this system is a direct consequence of the electron correlations. This fractionalization of the electron leads to behavior that distinguishes the FQSH phase from the conventional QSH phase. Particularly interesting is its response to an external electromagnetic field, which will be discussed in the talk. Experimental manifestations of the exotic phase and effects of fluctuations beyond the saddle point approximation will be discussed.

* This work is being supported by NSERC, CIFAR

MO-A11-4 **11h30**

Connecting microscopic simulations with kinetically constrained models of glasses*, **Malcolm Kennett** [1], Matthew Downton [2], [1] *Simon Fraser University*, [2] Technicshe Universitat Berlin — Kinetically constrained spin models are known to exhibit dynamical behavior mimicking that of glass forming systems. They are often understood as coarse-grained models of glass formers, in terms of some "mobility" field. The identity of this "mobility" field has remained elusive due to the lack of coarse-graining procedures to obtain these models from a more microscopic point of view. Here we exhibit a scheme to map the dynamics of a two-dimensional soft disc glass former obtained from Molecular Dynamics simulations onto a kinetically constrained spin model, providing an attempt at bridging these two approaches.

* This work is being supported by NSERC

MO-A11-5 **11h45**

The Kinetic activation-relaxation technique (KART): an on-the-fly kinetic Monte-Carlo algorithm*, **Fedwa El-Mellouhi**, Laurent J. Lewis, Normand Mousseau, *Université de Montréal* — We present KART, the kinetic activation-relaxation technique, that combines the activation-relaxation technique (ART nouveau) with a non-lattice KMC method. KART allows on-the-fly identification of barriers and full treatment of lattice deformations by including elastic effects. In the KART implementation, KMC moves are based on a catalog of events constructed on-the-fly using ART. After each KMC move, this catalog is updated to take into account new environments that may appear. Long-range elastic effects are fully included in the procedure with the relaxation of all active low-energy barriers before each KMC move. A topological description of the structure of the system at each moment allows a rapid characterization and classification of these new environments and efficient kinetics. In this talk, we will describe the method and present the case of vacancy aggregates diffusion in Si. Our results are compared with previous molecular-dynamics and on-lattice KMC simulations.

* This work is being supported by FQRNT, NSERC and the Canada Research Chair Program

MO-A11-6 **12h00** **(G)**

Theory of Disk-to-Vesicle Transformation*, **Jianfeng Li**, An-Chang Shi, *McMaster University* — Similar to lipids, block copolymers are able to self-assemble into membranes and vesicles. The transition from disk-like membrane sheet to vesicle is studied theoretically. As a first step, the behavior of a spherical vesicle formed by diblock copolymer bilayer at low area tension is investigated using a combination of SCFT results for diblock monolayers [1] and curvature elasticity theory [2]. It is found that the results from this simple model are in good agreement with calculations of the full SCFT. Furthermore this modified elastic model can be used to predict the bending energies of other shapes of closed bilayer membranes. In order to understand the disk-vesicle transition, the line tension of an open bilayer membrane is computed by evaluating the free energy of disk-like bilayer with different sizes using SCFT. The availability of the bending energy and line tension allows us to estimate the free energies of intermediate states between disks and vesicles. It is found that when the size of the disk is small, the disk turns into a micelle. When the disk is larger than certain critical value, it will close up to be a vesicle spontaneously. The disk is stable only within a very small region, in which disk and spherical vesicle are two metastable states with an energy barrier between them. Finally the results are summarized in a phase diagram.

1. M.W. Matsen, *J. Chem. Phys.* **110**, 4658 (1999).
2. W. Helfrich, Z. Naturforsch. **C 28**, 693 (1973).

* This work is being supported by NSERC

12h15 **Session Ends / *Fin de la session***

[MO-DAMPhi] (DAMPhi / *DPAMip*)

DAMPhi Business Meeting - NSERC GSC-29 report (lunch available)
Réunion d'affaires DPAMip - rapport du GSC-29 du CRSNG (dîner disponible)

MONDAY, JUNE 9 / LUNDI, 9 JUIN
12h30 - 13h30

ROOM / SALLE VCH 3820 **(cap. 104)** ***Chair: D.W. Tokaryk, University of New Brunswick***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[MO-DCMMP] (DCMMP / *DPMCM*)

DCMMP Business Meeting - NSERC GSC-28 report (lunch available)
Réunion d'affaires DPMCM - rapport du GSC-28 du CRSNG (dîner disponible)

MONDAY, JUNE 9 / LUNDI, 9 JUIN
12h30 - 13h30

ROOM / SALLE VCH 2860 **(cap. 142)** ***Chair: A. Moewes, University of Saskatchewan***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[MO-DHP] DHP Business Meeting (lunch available) / *Réunion d'affaires DHP (dîner disponible)*

(DHP / *DHP*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

12h30 - 13h30

ROOM / SALLE ***VCH 2826*** **(cap. 42)** ***Chair: W.F. Davidson, National Research Council Canada***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[MO-DIAP] DIAP Business Meeting (lunch available) / *Réunion d'affaires DPIA (dîner disponible)*

(DIAP / *DPIA*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

12h30 - 13h30

ROOM / SALLE ***VCH 2830*** **(cap. 106)** ***Chair: A. Kotlicki, University of British Columbia***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[MO-DNP] DNP Business Meeting (lunch available) / *Réunion d'affaires DPN (dîner disponible)*

(DNP / *DPN*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

12h30 - 13h30

ROOM / SALLE ***VCH 3840*** **(cap. 106)** ***Chair: M.N. Butler, St. Mary's University***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[MO-Plen3] Plenary Session - Haig Farris : Business and politics / *Session plénière - Haig Farris : Industrie et la politique*

(CAP-CORP / *ACP-CORP*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

13h30 - 14h15

ROOM / SALLE ***POU 1112*** **(cap. 500)** ***Chair: W.F. Davidson, National Research Council Canada***

MO-PLEN3-1 **13h30**

HAIG FARRIS, Fractal Capital Corp.

Help Wanted- physicists needed in business and politics- apply early and often

21st century world business challenges and opportunities are based on solving problems in physics. Physicists should play a leading role in 21st century politics and business in developing, implementing and communicating solutions. Physicists should shift their priorities from publishing in *Nature* and *Science* to taking the lead in creating new businesses, getting elected to major political offices and political institutions and re-educating students and society on the importance of physics in solving everyday problems in every area of society.

14h15 **Session Ends / *Fin de la session***

[MO-CNIP-Gen] Canadian Institute of Nuclear Physics (CNIP) General Meeting / *Assemblée générale de l'Institut canadien de la physique nucléaire (ICPN)*

(DNP / *DPN*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 3840*** **(cap. 106)** ***Chair: G. Huber, University of Regina***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

16h30 **Session Ends / *Fin de la session***

[MO-P1] Correlated Electrons I / *Électrons corrélés I*

(DCMMP / *DPMCM*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 2860*** **(cap. 142)** ***Chair: A. Damascelli, University of British Columbia***

MO-P1-1 **14h15**

WARREN PICKET, University of California Davis

Correlated Electrons I: Applications from DFT through DMFT to Complex Materials

The new materials and unexpected properties that continue to emerge in the study of strongly correlated electron systems (SCES) keep this area of research at the forefront of condensed matter physics. Whereas model studies dominated the theory of SCES through the 80's and 90's, it has been increasingly evident that, to quote Z. Fisk, "the devil is in the details" and material-specific theory and direct comparison with data is required for a microscopic understanding of the behavior, and especially of the small but important distinctions between seemingly closely related materials. This presentation will address the continuing advancement in realism of material-specific theory of SCES, ranging from use of correlated band theories (viz. LDA+U) to methods that incorporate dynamical correlations (LDA+DMFT, either downfolded or all-electron). One example will be the classic Mott insulator MnO, where both methods have recently been applied. While not classified as a "complex material", MnO (and its sister monoxides) provide sufficient complexity to have kept hidden for five decades the microscopic driving force behind the Mott transition under pressure. This transition will be discussed in some detail. Some studies of abrupt (perovskite) oxide interfaces will also be discussed, including possible (that is, predicted) correlated behavior and magnetism in the oxygen 2p states.

MO-P1-2 **14h45**

ILYA ELFIMOV, University of British Columbia

Novel aspects in oxide's physics

Oxides are a fascinating class of materials which continue to surprise condensed matter physicists as well as materials scientists with a wide variety of properties. Recently it was proposed that oxide based diluted magnetic semiconductors form a class of materials with promise for ferromagnetism at temperatures even higher than are currently achieved with III-V semiconductors. Using a model Hamiltonian and ab-initio band structure methods we demonstrate that even large band gap nonmagnetic materials as simple as CaO with a small concentration of Ca vacancies can exhibit extraordinary properties, in particular "local" magnetic moments and a half metallic ferromagnetism without introducing any magnetic elements. A TMO surface also shows unique properties that stand out from those leveraged for the TMO surface's more traditional and technologically oriented roles, such as selective oxidation, dehydration, etc... For example, conventional density functional studies of the polar surfaces in non-magnetic band insulators, such as the (111) surface of MgO predict an insulator-metal transition with very peculiar ferromagnetic properties. Interfaces are another very distinct example where the so-called polar catastrophe plays an important role, and results in a metallic conductivity at the interface between a simple band insulator $SrTiO_3$ and strongly correlated antiferromagnetic insulator $YBa_2Cu_3O_6$.

MO-P1-3 **15h15**

Recent developments in the theory of the $A_2B_2O_7$ magnetic pyrochlore oxide materials*, **Michel Gingras**, *University of Waterloo* — The magnetic pyrochlore oxides, of generic chemical formula $A_2B_2O_7$ (A=Y,Tb,Ho,Dy,Er,Yb; B=Mo,Mn,Ti,Sn), are the hosts of numerous very interesting magnetic and thermodynamic phenomena. Examples include long range order, spin glass freezing, spin ice and spin liquid behavior. In this talk I will first briefly review the general problematic behind the theoretical and experimental interest devoted to the study of magnetic pyrochlore oxides. I will then present some of our recent theoretical work aimed at explaining the puzzling behaviors observed in various magnetic pyrochlore oxides. In particular, I will discuss the problem of emerging cluster-like/composite-spin correlations in the $Dy_2Ti_2O_7$ spin ice materials and the possibility of a quantum spin ice state in $Tb_2Ti_2O_7$. Time permitting, I will discuss our recent work on the magnetic properties of the $Er_2Ti_2O_7$ and $Yb_2Ti_2O_7$ materials which are realization of XY pyrochlore antiferromagnetis and ferromagnets, respectively.

* This work is being supported by NSERC, Canada Research Chair Program, CFI, OIT, CIFAR

MO-P1-4 **15h30** **(G*)**

Analog of the Josephson effect in antiferromagnets*, **Dominique Chassé**, André-Marie Tremblay, *Université de Sherbrooke* — The Josephson effect is generally described as Cooper pair tunneling, but it can also be understood in a more general context. The DC Josephson effect is the pseudo-Goldstone boson of two coupled systems with a broken continuous abelian O(1) symmetry. Hence, an analog should exist for systems with broken continuous non-abelian symmetries [1]. The case of itinerant ferromagnets (broken O(3) symmetry) coupled across a tunnel junction has already been considered [2]. To exhibit the generality of the phenomenon and make predictions from a realistic model, we study itinerant antiferromagnets. Performing a calculation analogous to that of Ambegaokar and Baratoff [3] for the Josephson junction, we find an equilibrium current of the staggered magnetization through the junction that is proportional to $n_L \times n_R$ where n_L and n_R are the Neel vectors on either sides of the junction. The constant of proportionality is related to the resistance of the junction in the normal state. We also find the temperature dependence of the analog of the critical current. Note that the sine function present in the standard Josephson case is replaced in the non-abelian case by a cross product. Microscopically, this effect exists because of the coherent tunneling of spin-one particle-hole pairs. In the presence of a magnetic field, we find an analog of the AC Josephson effect. Berry phases and possible detection schemes will also be discussed.

1. F. Paul Esposito, *et al.*, *Phys. Rev. Lett.* **98**, 241602 (2007).
2. J. Wang *et al. Phys. Rev. B* **74**, 035342 (2006).
3. V. Ambegaokar and A. Baratoff, *Phys. Rev. Lett.* **10**, 486 (1963).

* This work is being supported by FQRNT, NSERC, CRC

MO-P1-5 **15h45**

High Tc Superconductivity: What the Optical Sum Rule Tells Us*, **Frank Marsiglio**, *University of Alberta* — High Temperature Superconductivity is entering its 3rd decade of existence. In this talk I will summarize the experimental and theoretical status of the optical sum rule, as applied to the high Tc cuprates. The implication is that a novel kind of superconductivity exists in thes materials.

* This work is being supported by NSERC, ICORE, CIFAR

MO-P1-6 **16h00** **(G*)**

Interlayer exchange coupling in EuS/Fe bilayer thin films*, **Valentyn Volobuyev** [1], Alexander Stetsenko [2], Alexander Sipatov [2], Johan van Lierop [1], [1] *University of Manitoba*, [2] National Technical University "Kharkiv Polytechnical Institute" — EuS/Fe bilayer thin films with layer thicknesses from 5 to 20 nm have been prepared successfully by means of vacuum condensation. Transmission electron microscopy studies revealed polycrystalline Fe on top of monocrystalline (001) EuS. DC-magnetometry and AC-suseptometry were used to investigate the magnetic properties. At low temperatures, below the bulk EuS Curie point (16.5 K), clear evidence of interlayer exchange coupling was seen. Hysteresis loops displayed a shift in the coercivity as observed in antiferromagnet/ferromagnet exchange biased films. Simultaneously, steps in the magnetization occur, behaviour that is typical for antiferromagnetically coupled multilayers where ferromagnetic layers are separated by a thin spacer of non-magnetic material. The temperature dependence of the low field magnetization showed a strong decrease below the EuS Curie temperature which is also connected with antiferromagnetic coupling where the magnetization of neighboring layers are in opposite directions.

* This work is being supported by NSERC

MO-P1-7 **16h15**

Significant Enhancement in nanoparticle SiC and C doping in the MgB_2 superconductor. **Saied Soltanian** , M.M. Soltanzadeh[2], X.L. Wang[3], S.X. Dou[3] , [1]*University of Kurdistan, Iran/University of Wollongong, Wollongong, Australia* , [2]University of Kurdistan, Iran, [3]University of Wollongong, Wollongong, Australia — Pure and doped MgB_2 have been studied in order to improve the superconducting properties of this superconductor for practical applications. Different materials have been examined to find desirable dopants for enhancing the performance of MgB_2. It is found that samples doped with SiC nano particles show superior performance compared to other samples. A comparative study of pure, SiC, and C doped MgB_2 samples have been performed in order to find the optimum conditions. We also tried to understand the mechanism of improvement. Samples have been examined using transport and magnetic measurements, XRD, SEM, and TEM. It is found that two distinct mechanisms are responsible for enhancement of superconducting properties at different temperature and magnetic field ranges. Enhancement in properties is due to improving the flux pinning as well as H_{c2} as a result of C substitution and nano inclusions.

16h30 **Session Ends / *Fin de la session***

[MO-P2] Soft Materials / *Matériaux mous*

(DCMMP / *DPMCM*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 2830*** **(cap. 106)** ***Chair: J. Dutcher, University of Guelphfa***

MO-P2-1 **14h15**

JOHN PAGE, University of Manitoba

Localization of ultrasound in a three-dimensional elastic network. †,*

Fifty years after Anderson localization was first proposed, there is currently a resurgence of interest in this phenomenon. This interest is fuelled by theoretical and experimental advances, especially for classical waves, where unambiguous experimental evidence for localization in three dimensions has remained elusive until recently. In this talk, I will summarize our progress in demonstrating the localization of ultrasound in a "mesoglass" made by assembling hard spheres (aluminum beads) into a soft elastic network. We study the time-dependent transmission of the ultrasonic intensity, which reveals a non-exponential decay at long times, characteristic of transmission below the mobility edge. We also measure the dynamic transverse confinement of the waves due to localization, an effect that has not been observed previously for any type of wave. We call this effect transverse localization in three dimensions. Our experimental data are well described by a new self-consistent theory of the dynamics of localization, providing an important validation of this theoretical approach and enabling the localization length to be measured. In addition, we show that the transmission exhibits non-Gaussian statistics, consistent with values of the Thouless conductance g less than one. This is the first time that three different fundamental aspects of Anderson localization (time-dependent transmission, transverse confinement of the waves, and statistics) have been studied simultaneously, ending more than 20 years of speculation on whether or not the Anderson localization of sound can be demonstrated unambiguously in three dimensions.

† In collaboration with Hefei Hu[1] , Anatoliy Strybulevych [1], Sergey Skipetrov [2], Bart van Tiggelen [2], [1] University of Manitoba, [2] Universite Joseph Fourier/CNRS

* This work is being supported by NSERC, CNRS

MO-P2-2 **14h45**

BARBARA FRISKEN, Simon Fraser University

Carbopol - Microrheology and Microstructure *

Carbopol, a family of cross-linked acrylic acid-based polymers, is a well-known thickener used in personal care products such as shampoo and toothpaste. Relatively low concentration aqueous dispersions also exhibit the properties of a yield-stress fluid; at low stress, Carbopol dispersions behave as an elastic solid but they will flow when the applied stress exceeds a sample-dependent yield value. Carbopol is often used as a model yield-stress fluid because it is transparent and its rheological properties can be precisely tuned by sample preparation conditions. Other practical examples of yield-stress fluids include mayonnaise and fresh concrete. Both the phenomena involved and the range of potential applications recommend study of the microscopic structure and properties of yield stress fluids as this will lead to a fundamental understanding of this behaviour. In this talk, I'll discuss our recent light scattering experiments investigating Carbopol 2050 that explore both microscopic rheological properties and microscopic structure.

* This work is being supported by NSERC

MO-P2-3 **15h15**

Microstructure and dynamics of a polymer glass subjected to shear strain*, **Bela Joos** , Martin Bertrand, Matthew L. Wallace, *University of Ottawa* — The application of shear deformations on a polymer glass modifies the energy landscape of the glass in non-trivial ways. Using molecular dynamics simulations on a freely-jointed chain model, we investigate the effect of the strain on the heterogeneities in the glassy system. For instantaneous shear, the resulting behaviour can be separated into two regimes: elastic for small deformations, and plastic for large deformations. Dynamic heterogeneity in the system tends to diminish with deformation. This increased

homogenization can be seen, for instance, through changes in the distribution of particle mobilities, both in space and in time, as the glass relaxes following deformation. We are able to directly correlate changes in the overall diffusion in the system to local configurations of mobile and immobile particles. The effect of the deformation on the aging process is addressed, as we present some new insight into the local dynamics of the polymer chains.

* This work is being supported by NSERC

MO-P2-4 15h30 (G)

Crystal nucleation of polyethylene confined to a system of droplets*, **Jessica L. Carvalho**, Kari Dalnoki-Veress, *McMaster University* — We present results on the crystallisation of polyethylene confined to a system of dewetted droplets. The droplet system allows us access to a large ensemble of small, isolated volumes of crystallisable material. We can then make a direct measurement of the nucleation rate independent of the crystal growth rate, which can be otherwise challenging in bulk crystalline samples. In our previous work with dewetted droplets of poly(ethylene oxide), we were able to demonstrate that the nucleation rate scaled with droplet volume [1]. Thus, a crystal nucleus is most probable to form within the volume of a droplet as opposed to at the surface. In our present work, we will address how the nucleation rate scales for the polyethylene droplet system.

1. M.V. Massa *et al.*, *Phys. Rev. Lett.* **92**, 255509 (2004).

* This work is being supported by NSERC

MO-P2-5 15h45 (G*)

Revealing the dynamics of bubbly suspensions through correlations in the phase of multiply scattered ultrasonic waves*, **Kurt Hildebrand** [1], Tomohisa Norisuye [2], Domitille Anache [3], Bart van Tiggelen [3], John Page [1], [1] *Department of Physics and Astronomy, University of Manitoba*, [2] Department of Polymer Science and Engineering, Kyoto Institute of Technology, Kyoto, Japan, [3] Laboratoire de Physique et Modélisation des Milieux Condensés, CNRS/Université Joseph Fourier, France — Because of their excellent sensitivity to change, multiply scattered waves (both acoustic and optical) are frequently used to probe the dynamics of complex materials [1]. However, in such measurements, the phase of multiply scattered waves is often ignored due to its seemingly random nature. In this talk, we show that phase information [2] can provide more insight into the long time behaviour of the system than can the traditional Diffusing Acoustic Wave Spectroscopy (DAWS) method, which is based on the field autocorrelation function. In order to observe these long time effects, the phase must be *unwrapped*, or tracked as it progresses beyond the usual cutoff of $\pm \pi$. We study the correlations of the unwrapped, or *cumulative*, phase by measuring the Cumulative Phase Correlation Function (CPCF) [3]. Interestingly, the CPCF shows a memory effect, which reflects the entire history of the phase evolution since the beginning of the experiment, and it continues to change and provide information about the dynamics of the system after the field autocorrelation function has already decayed to zero. We show how the cumulative phase can expose subtleties about the dynamics of the system that are not shown by the correlations of the field alone. We present a possible physical model for observed phenomena, while discussing some important details about phase unwrapping and analysis in a pulsed DAWS experiment.

1. e.g., see Snieder and Page, *Physics Today*, **May 2007**, pp 49-55 (2007).
2. Cowan *et al.*, *Phys. Rev. Lett.* **99**, 094301 (2007).
3 van Tiggelen *et al.*, *Europhys.Lett.* **74**, 999 (2006).

* This work is being supported by NSERC; Government of Manitoba

MO-P2-6 16h00

Phase Transitions and Liquid Phase Structure of (mono)triglycerides: Minimal models, computer simulation and Raman spectroscopy*, **David Pink**, Ronald MacEachern, Adam MacDonald, Christophe Sandt, Derick Rousseau, Charles Hanna, *St. Francis Xavier University* — Monotriglycerides (monoTGs) are molecules comprising a glycerol core and three equivalent hydrocarbon chains, $(CH_2)_nCH_3$. They are important in the health (blood components) and the food (chocolate) industries. If n is sufficiently large then a discontinuous phase transition from a solid to a liquid phase is manifested at T = T*. Corkery *et al.* (Langmuir, 23(13) 7241-7246, 2007) asserted that, for possibly some restricted temperature range, all experimental data are in accord with the liquid phase of monoTGs containing structures in which the molecules form discoids. These structures are not necessarily long-lived and might involve various numbers, N, of molecules with the only constraint being N>1. We have created a minimal model of the phase transition of trilaurin (n = 11) from which we have calculated, analytically, the transition enthalpy and the temperature dependence of the "1132 cm^{-1}" Raman band. We have also studied an analogous model using dissipative particle dynamics and computer simulation, and calculated various structure functions, S(q), together with pair correlation functions, in order to establish the structure of the model liquid phase. Amongst these structure functions are those pertinent to Xray and neutron scattering. We shall outline the model, present results for the transition enthalpy and the Raman band (above), compare these to results of other models, identify the likely structure of the liquid phase and predict results of X-ray or neutron scattering.

* This work is being supported by NSERC, AFMNet-NCE, Atlantic Innovation Fund

MO-P2-7 16h15 (G)

Probing Relaxation in Glassy Freestanding Diblock Copolymer Thin Films, **Adam Raegen**, Andrew Croll, Kari Dalnoki-Veress, *McMaster University* — We employ an axi-symmetric deformation and modulus test to measure the response of a thin freestanding diblock copolymer film to an external load. The method measures the deformation of a spincast film when an axi-symmetric load is applied by a flat circular punch. The flat punch minimizes uncertainties in the experiment, while the use of spincast films provides a very smooth contact surface. The use of diblock copolymers allows us to change the internal structure of the film from disordered to ordered (lamellar) and surface topography (flat if there are an integer number of lamellae, and islands, bicontinuous or holes for non-integer) by changing the annealing history and thickness of the sample. We discuss our results in terms of the elastic modulus and creep compliance of the films.

16h30 Session Ends / *Fin de la session*

[MO-P3] Green Power / *Le pouvoir vert*

(DIAP / *DPIA*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 2880*** **(cap. 200)** ***Chair: A. Kotlicki, University of British Columbia***

MO-P3-1 **14h15**

GILBERT B. CHAPMAN, DaimlerChrysler Center, University of Windsor

The Greening of Ground Transportation in North America

The greening of ground transportation in North America is being driven by several factors. Significant among them are the concerns for conservation of the environment, reduction in vehicle ownership and operating costs, reduction of the growing trade deficit, and the escalating cost of petroleum-based fuels. When taken as a whole, these factors can be reduced to a concern for current and foreseeable costs. Research and development in physics, as well as related physical and biological sciences, is underway to provide technologies that will support current and planned approaches to addressing these concerns in automotive transportation applications. Some of these emerging technologies will be discussed in the context of technological innovations to reduce cost to the environment, the manufacturer, the owner-operator, the national economy, and costs concomitant with identifiable unintended consequences. An examination of costs vs. benefits for several approaches to the selection of (1) materials and manufacturing processes, (2) production, delivery and packaging of fuels, (3) environmental costs, and (4) costs concomitant with trade deficits and national security will be discussed. Comprehensive evaluations and discussions such as these can lead researchers to a better understanding of the impact that each approach has on global factors, so that an approach that may be attractive in one aspect, but more costly in others, can be avoided in favor of more globally acceptable solutions.

MO-P3-2 **14h45**

RAYMOND GILBERT, Opsun Technologies Inc.

Solar Energy Extraction: A Real Challenge for Physicists / L'Extraction de l'énergie solaire, un défi de taille pour les physiciens

The control of energy, fuels in particular, has powered the development of mankind. Up to now, we have used almost all the available fossil energy. In a few years, fossil fuel will not be sufficient the respond to world demand. What are the alternatives? What energy sources can we foresee? Which ones will replace oil, gas and coal? Among all the energy sources available, solar energy is probably one of the most promising. However, solar energy extraction is not an easy task. How will physicists contribute to reach the required efficiency? Each Physics specialty holds a part of the answer, particularly optic physicists, nanoparticle physicists and material physicists.
La maîtrise de l'énergie et principalement des carburants a propulsé le développement de l'humanité. Jusqu'à présent, nous avons utilisé presque exclusivement de l'énergie fossile. D'ici quelques années, cette ressource ne suffira plus à répondre à la demande énergétique globale du monde. Quelles sont nos alternatives ? Quelles sont les sources énergétiques susceptibles de remplacer le pétrole , le gaz et le charbon? Parmi toutes les options disponibles, l'énergie solaire s'avère être l'une des plus prometteuses. Cependant, extraire de l'énergie du soleil constitue une entreprise difficile. Comment les physiciens peuvent-ils contribuer à l'obtention les résultats attendus ? Que ce soit les physiciens en optique, les physiciens des particules, les physiciens des matériaux, toutes les spécialités de la physique détiennent une part de la solution.

15h15 **Coffee Break / *Pause café***

MO-P3-3 **15h30**

JAMES POND, Lumerical Solutions Inc.

Rigorous electromagnetic simulation of current and next-generation photonic devices: challenges and opportunities †

A wide range of novel photonic devices have appeared in recent years, spanning fields from quantum computing to bio-photonics. Although these devices are used in a broad range of applications, they have several aspects in common: they rely on dramatic improvements in manufacturing technology that allow for sub-wavelength scale structure; they involve hybrid materials such as low and high index dielectrics or metals; and they often have complex or unique physical geometries. Furthermore, devices must be resistant to imperfections introduced by commercially-viable manufacturing technologies and function reliably in demanding operating environments. As a result, these devices have created new challenges and opportunities for anyone trying to develop electromagnetic simulation software required for design and optimization. Indeed, approximate simulation methods often fail as device dimensions drop below the wavelength scale, or as devices rely on complex effects such as surface plasmon resonance. Fortunately, recent advances in computing technology have made it possible to solve Maxwell's equations rigorously, even for relatively large-scale devices. Lumerical Solutions, Inc. is a Canadian company that has taken advantage of modern computing technology to become a leader in providing advanced electromagnetic modeling software to photonics device designers worldwide. By leveraging continued improvements in computational resources, including widely available computer clusters, device designers can simulate larger computation volumes more quickly. We demonstrate how this opportunity can be exploited in the area of photonic integration to rigorously simulate three-dimensional devices by FDTD previously thought to be intractable, including larger multi-component or hybrid devices composed of both dielectrics and metals that are of current interest. We also discuss the future challenges facing designers of next-generation photonics devices, and those who provide them with design software.

† In collaboration with Chris Kopetski, Lumerical Solutions Inc.

MO-P3-4 **16h00**

ELENA MAEVA, University of Windsor

New BioCar Ontario Initiative: Biocomposite materials

Resent research and development in physics, chemistry and biochemistry is underway to provide technologies that will help to develop new generation of bio-based fiber-reinforced composites materials, containing fibers from agricultural sources (wheat, corn, soybean and canola). Such materials have intense application in construction, aerospace, automotive, marine, electronics biomedical and other high-technology areas. Traditionally fillers, glass, carbon or aramid fibers are the most popular, but recently, as a result of growing environmental awareness, bio-composites, which consist of natural fibers as a reinforcing component and a biodegradable polymer matrix, are considered more compatible with the environment. They are renewable, available worldwide and biodegradable. Biocomposites are gaining acceptance in everything from automotive manufacturing to bridge buildings. Natural fibers have several advantages over traditional glass fibers, including low cost, low density and weight, acceptable

specific strength and stiffness, biodegradability and enhanced energy recovery. The BioCar Ontario Initiative is focused on the developing new biofiber composite products with low cost and improved high performance. The Ontario automotive industry represent new large market for agricultural and forestry products. In spite of the growing production of bio-based composite materials, there are some factors which limit wide replacing of the conventional glass-fiber reinforced plastics (GFRP) with biocomposites. The biocomposites mechanical performance limitation and higher cost compared with conventional composites are the main barriers for their widespread acceptance as substitutes for traditional composite materials. For that reason it was very important to establish effective and reliable physics techniques for evaluation of microstructure and the materials' mechanical and elastic properties which are essential for the design of the new materials and structures. With the focus on the replacement of petroleum-based products by bio-fibre composite materials, the outcomes of research will have a significant positive effect on the profitability of Ontario farming, forestry, and create a sustainable, competitive edge for the automotive industry.

16h30 **Session Ends / *Fin de la session***

[MO-P4] Interactive Teaching / *Enseignement interactif*

(DPE / *DEP*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 17h00

ROOM / SALLE ***VCH 2840*** **(cap. 98)** ***Chair: T. Antimirova, Ryerson University***

MO-P4-1 **14h15**

DAVID HARRISON, University of Toronto

Implementing Physics Practicals †

We are combining our tutorial and laboratories into new "Physics Practicals" in our largest 1st Year undergraduate Physics course, with an enrollment of nearly 1,300 students. In our Practicals, students work for two hours in 9 teams of four at hexagon-shaped tables, or "pods", on guided activities and simple experiments, under the supervision of two roaming Teaching Assistants. The pedagogy, materials and room design were largely adapted from the Workshop Physics modules at Dickinson College, the Physics Education Groups at the University of Washington and at the University of Maryland, the SCALE-UP project from North Carolina State, and elsewhere. When complete we will have five dedicated rooms for the Practicals. The first room was completed in January 2008 and we ran a "Pilot" involving 70 students in the Spring Term. We used the Pilot to collect data on the effectiveness of the Practicals. In this talk I will discuss issues of pedagogy, effectiveness, physical space, Teaching Assistant resources, hardware and software, and the costs of implementing the various components of the Practicals.

† In collaboration with Jason Harlow, University of Toronto

MO-P4-2 **14h45**

Peer Instruction: from Harvard to a Canadian Two-year College*, **Nathaniel Lasry** [1], Eric Mazur [2], Jessica Watkins [2], [1] *John Abbott College*, [2] Harvard University — Peer Instruction is a students-centered approach developed in the early 1990s at Harvard. We compare the effectiveness of a first implementation of Peer Instruction (PI) in a Canadian two-year college with the first PI implementation at Harvard. Results concerning the effectiveness of PI in the college setting replicate earlier findings: PI-taught students demonstrate better conceptual learning and similar problem-solving abilities than traditionally taught students. However, not previously reported are the following two findings: First, although students with more background knowledge benefit most from either type of instruction, PI students with less background knowledge gain as much as students with more background knowledge in traditional instruction. Second, PI methodology is found to decrease student attrition in introductory physics courses at both four-year and two-year institutions.

* This work is being supported by Programme d'Aide sur la Recherche en Enseignement et en Apprentissage (PAREA 2005-009) and National Science Foundation grant DUE-0206947

15h00 **Coffee Break / *Pause café***

MO-P4-3 **15h15**

ROBERT HAWKES, Mount Allison University

Guided Collaborative Learning: Not Just for First Year Physics

Studio style collaborative learning, peer instruction, interactive lecture demonstrations and other interactive approaches are increasingly being used in first year physics classes. However, most physics departments still use mainly traditional lecture/lab approaches in the upper year courses. We will provide an overview of first year studio style instruction, and then show how similar approaches can be used in advanced physics courses. The central theme will be that students should learn physics in a way which is congruent with how professional physicists work and interact.

MO-P4-4 **15h45**

Popular Culture - Our Friend or our Enemy? **Svetlana Barkanova**, *Acadia University* — Many people hate math. Physics is considered dry. How do I teach astrophysics to a diverse group of 270 taking my course as a required science elective? Not only do I have to generate some motivation, but also to overcome their math illiteracy. Where do I start? We all try to build on something our students already know. But these students have not taken university physics. They have been studying arts and history. The physics they bring from high school is at least a hundred years old and mainly covers the old boring Newton and the eccentric, incomprehensible Einstein. Almost everybody is familiar with astrology, though. Being part of a popular culture and not science, astrology does not compete with astronomy; thus, I see no reason fighting it. Instead, I use it as my pivot point. I teach my students to identify the Zodiac constellations, then use math to track the stars' motion through the sky. I point to the brightest stars with the romantic names, like Antares, "Heart of the Scorpio", explain their colour, and then talk about thermonuclear fusion burning in the core. A coating of art, mythology, and history makes physics and math less scary. Of course, the astrology is just one of the many examples – I use newspapers, TV, YouTube, etc. – and make our popular culture to serve education.

MO-P4-5 **16h00**

Zukunftswerkstatt Physics Education. **Daria Ahrensmeier**, *Trent University* — I would like to make use of the diverse experience and collective creativity of the participants of the CAP meeting in a special kind of workshop on the improvement of physics education: "Zukunftswerkstatt" is a German term that translates as "workshop for (building) the future". It is a method, developed by Robert Jungk *et al.*, that aims at solving problems by stimulating creativity in three phases: In the first phase (critique), the participants state the problems they see with the current state of physics education, be it at their own institution, elsewhere, or in general. In the second phase (utopia), participants are asked to develop their ideal of physics education, without (and that's the important part!) thinking of practical limitations, coming up with ideas like "wouldn't it be great if ...". In the first two phases, all contributions from the participants are collected and sorted by topic. The third phase (praxis) works with the results from the first and second phase to come up with realistic suggestions. I will serve as a moderator for this process and prepare several statements for the first and second phase in order to get the brainstorming started.

16h15 **Discussion**

17h00 **Session Ends / *Fin de la session***

[MO-P5] Non-Accelerator Particle Physics / *Physique des particules sans accélérateur*

(PPD / *PPD*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 17h45

ROOM / SALLE ***VCH 3860*** **(cap. 148)** ***Chair: A.T. Warburton, McGill University***

MO-P5-1 **14h15**

JOHN F. MARTIN, University of Toronto

The History and Physics Impact of the HERA e-p Collider *

This is the first CAP meeting since the end of the 15-year running period of the electron-proton collider HERA, the world's largest electron microscope. A brief history of the project will be presented, followed by a broad overview of the scientific results and their impact on the development of our understanding of particle physics.

* This work is being supported by NSERC

MO-P5-2 **14h45**

KEN RAGAN, McGill University

Results of the first year of operation of the VERITAS ground-based gamma-ray observatory *

The VERITAS ground-based gamma-ray detector, comprising four 12m telescopes equipped with 499-phototube imaging cameras, has been operational since early 2007. It has achieved its design sensitivity and a comprehensive science program, including observations of active galactic nuclei and supernova remnants, a galactic plane survey, and gamma-ray burst follow-up observations, has started. Here we will report on the status of the instrument and some of the science results from the first year of observations.

* This work is being supported by NSERC

MO-P5-3 **15h15** **(G)**

Camera Health Monitoring for the VERITAS Collaboration at McGill University*, **Michael McCutcheon**, *McGill University* — The Very Energetic Radiation Imaging Telescope Array System (VERITAS) is a very high-energy gamma-ray observatory consisting of four telescopes. Each is equipped with a 499-pixel camera composed of Photo-Multipler tubes (PMTs). PMTs are delicate analogue devices which evolve over time. Thus, to ensure optimum performance of VERITAS, it is critical to monitor the state of individual pixels and the cameras as a whole. I will describe the analysis chain implemented at McGill University to use regular calibration data-taking to characterise the cameras' performance over time.

* This work is being supported by Department of Energy, National Science Foundation and the Smithsonian Institution in the U.S.; NSERC in Canada; PPARC in the U.K.; and Science Foundation Ireland.

MO-P5-4 **15h30**

HALO-A lead supernova neutrino detector for SNOLAB. **Stanley Yen**, *TRIUMF, for the HALO collaboration* — Water Cerenkov and liquid scintillator neutrino detectors are primarily sensitive to electron anti-neutrinos, via charged-current interactions on the hydrogen nuclei in these materials. By contrast, the large neutron excess of a heavy nucleus like Pb acts to Pauli-block p→n transitions induced by electron anti-neutrinos, making it primarily sensitive to electron neutrinos. This channel is expected to show the most interesting effects of flavour-swapping and spectral splitting due to MSW-like collective neutrino-neutrino interactions in the core of the supernova, the only place in the universe where there is a sufficient density of neutrinos for this to occur. The data will provide a test for $\theta_{13} \neq 0$ and an inverted neutrino mass heirarchy, and the ratio of 1-neutron to 2-neutron events will provide a measure of the temperature of the cooling neutron star. HALO is a detector of opportunity proposed for SNOLAB, which will utilize 80 tons of surplus Pb blocks, together with the neutral-current detectors from the SNO experiment and the SNO data acquisition system, to provide a low-cost, low-maintenance, long-lived, high-lifetime detector. A supernova at 10 kpc would result in 43 neutrons in the absence of collective í-í interactions, and many more in their presence. A future upgrade to 1 kiloton would be sensitive to supernova anywhere in our galaxy.

15h45 **Coffee Break / *Pause café***

MO-P5-5 **16h00**

MARK G. BOULAY, Queen's University

Status of DEAP/CLEAN at SNOLAB *

The DEAP/CLEAN experiment will search for dark matter particle interactions on liquid argon at SNOLAB. The first generation detector (DEAP-1) with a 7-kg liquid argon target mass is currently operating underground at SNOLAB and an overview of that experiment, including pulse-shape discrimination (PSD) results for reducing β/γ backgrounds, and the status of data collection at SNOLAB, will be presented. A larger detector (DEAP/CLEAN-3600) containing a total of 3600 kg of liquid argon is cur-

rently being designed, with a target sensitivity to spin-independent scattering on nucleons of 10^{-46} cm^2, several hundred times more sensitive than current dark matter experiments. Initial construction activities are planned for SNOLAB beginning in 2008. The design and construction status of DEAP/CLEAN-3600 will be presented.

* This work is being supported by NSERC, CFI and MEDT

MO-P5-6 16h30 (G*)

Triple Coincident Gamma Calibration in Dark Matter Experiment with Argon and Pulse Shape Discrimination (DEAP)*, **Paradorn Pasuthip**, *Queen's University* — Dark Matter Experiment with Argon and Pulse Shape Discrimination (DEAP) is an experiment, which aims to detect Dark Matter with scintillation light produced by nuclear recoil in liquid argon. DEAP-1 is a detector with 7 kg target volume, currently located in SNOLAB. In this talk, I will be discussing the triple coincident gamma calibration and the discrimination power between neutron-like and electromagnetic events.

* This work is being supported by NSERC

MO-P5-7 16h45

Pulse Shape Discrimination (PSD) in Liquid Argon, **Bei Cai**, *Queen's University* — Dark Matter Experiment using Argon Pulse-shape discrimination (DEAP) plans to search for WIMPs (Weakly Interacting Massive Particles) through elastic scattering on ^{40}Ar. In this single-phase liquid argon (LAr) experiment discrimination of beta and gamma backgrounds from the WIMP-induced nuclear recoil signal is achieved by analyzing the pulse shape of scintillation light. A 7-kg low-background LAr scintillation detector was constructed and run at Queen's University in Canada. A background rejection of 6 x 10^{-8} at 120-240 photo-electrons was achieved.

MO-P5-8 17h00 (G*)

Measurement and Analysis of the Droplet Size Distributions of PICASSO Detectors*, **Patrick Nadeau**, *Laurentian University* — The PICASSO dark matter search experiment employs Special Bubble Detectors (SBD) that consist of superheated liquid freon droplets (active material) dispersed uniformly throughout a water-based gel matrix. The droplet size distribution is related to the method of detector fabrication and can serve as feedback to the fabrication process, allowing quality control. In addition, understanding the distributions of droplet sizes will help in the data analysis by providing a better understanding of the distributions of detector signal amplitudes. This presentation will discuss techniques we have developed at Laurentian University to measure and analyze the droplet size distributions of detector gel samples using microscopy and digital imaging.

* This work is being supported by NSERC

MO-P5-9 17h15 (G*)

Neutron calibration of the PICASSO detector*, **Rachel Faust**, Martin Auger, *Université de Montréal* — PICASSO aims at directly detecting neutralino-induced recoils using superheated droplet detectors. The threshold energies and detection efficiencies vary as a function of temperature and pressure. Calibrations were performed using mono-energetic neutrons of various energies produced at the Tandem accelerator facility at the Université de Montréal. Along with Monte Carlo simulations, these measurements provide a deeper understanding of the neutralino response function of the PICASSO detector. Recent results of this study will be presented.

* This work is being supported by NSERC

MO-P5-10 17h30 (G*)

Towards A Three Phase Analysis At The Sudbury Neutrino Observatory*, **Pierre-Luc Drouin**, *Carleton University* — Since the discovery of the solar neutrino problem by Ray Davis in the late 1960s, different experiments have been designed to understand the discrepancy between measured and predicted fluxes of electron neutrinos coming from the Sun and to verify if this phenomenon can be explained by the oscillation of neutrinos due to a possible mismatch between flavour and mass eigenstates. Among these experiments is the Sudbury Neutrino Observatory (SNO), which provided the first clear evidence of solar neutrino flavour change. The success of SNO resides in its ability to measure with heavy water both the flux of solar electron neutrinos and the total neutrino flux using the charge-current and neutral-current interactions, in addition to the electron-scattering reaction which also occurs in light water Cerenkov detectors. The SNO experiment was divided into three phases, each one using a different method for detecting neutrons produced in the neutral-current interaction, thus providing three different measurements of the total flux of solar neutrinos. The third phase primarily relies on the deployment of proportional counters to measure the events produced via the neutral-current reaction, while statistical techniques are used for the two other phases. This allows a decoupling of the systematic uncertainties that could be used in a combined analysis to reduce the total uncertainty on the measured neutral-current flux. The presence of these counters creates however some asymmetries in the detector that must be considered to avoid a large increase of fiducial volume and energy uncertainties.

* This work is being supported by NSERC

17h45 Session Ends / *Fin de la session*

[MO-P6] DCMMP Best Student Paper Competition II / *Compétition pour les meilleures communications étudiantes DPMCM II*

(DCMMP / *DPMCM*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 16h45

ROOM / SALLE VCH 2870 (cap. 57) ***Chair: A. Moewes, University of Saskatchewan***

MO-P6-1 14h15 (G*)

Transient photoconductivity and low sheet resistance of CdS thin film prepared by chemical bath deposition*, Jeanne-Louise Shih, **Min Zhao**, *McGill University* — Thin films of cadmium sulfide (CdS) is well known to be a good photoconductor, sensitive to light in the visible region. Transient photoconductivity of CBD CdS films deposited on soda lime glass and oxidized Silicon (Si) substrates has been measured before and after annealing in air. An increase in the photoconductivity magnitude from 300 to 400ºC was observed for both types of samples with a decrease in fast time constant by one order of magnitude, a change that is most likely due to an increase in mobility. However, after a subsequent 500ºC anneal in air, the soda lime glass substrate showed a decrease in magnitude with a still further decrease in fast time constant. For the sample deposited on oxidized n-type Si substrate, after a 500ºC anneal in air, the magnitude continued to increase while the fast time constant remained to be about the same as for 400ºC. We believe the causes for the decreases in magnitude and time constant in the CBD CdS on soda lime glass, annealed at 500ºC, are due to elemental inter-diffusion between the substrate and the CdS film. Sheet resistance measurements with a four-point probe technique were also conducted and a set of optimal conditions for depositing CdS thin films with extremely low sheet resistance is proposed. Optimal deposition conditions were established (T = 95ºC, S = 600 rpm, n = 6) to achieve a sheet resistance of 300 Ω /square (photosensitivity ratio = 4 x 10^8).

MO-P6-2 14h30 (G*)

Gelation of a colloidal suspension: comparison of two length scales*, **Felix Oppong**, John R. de Bruyn, *University of Western Ontario* — Particle-tracking microrheology is used to study gelation in a colloidal suspension of Laponite clay particles. We track the motion of small fluorescent polystyrene spheres added to the suspension, and obtain the microscopic viscous and elastic moduli of the material from their mean squared displacement. The fluorescent spheres move subdiffusively due to the microstructure of the suspension, with the diffusive exponent decreasing from close to one at early times to near zero as the material gels. The particle tracking data show that the system becomes more heterogeneous on the microscopic scale as it ages. We also determine the bulk-scale moduli using small-amplitude oscillatory shear rheometry. Both the macroscopic and microscopic moduli increase with age, and on both scales we observe a transition from a primarily viscous fluid to an elastic gel. We find that the gel point, determined as the time at which the viscous and elastic moduli are equal, is length-scale dependent —- gelation occurs earlier on the bulk scale than on the microscopic scale.

* This work is being supported by NSERC

MO-P6-3 14h45 (G*)

Bulk Liquid Crystal Phases of Semiflexible Polymers. **Ian MacKay** [1], Raul Cruz Hidalgo [2], Don E. Sullivan [1], Jeff Z.Y. Chen [3], [1] University of Guelph, [2] Departament de Física Fonamental (Barcelona, Spain), [3] Univeristy of Waterloo — Liquid crystal polymers are long chain molecules and, as their name implies, have properties intermediate between liquids and solids. Due to their unique geometry, they can exhibit orientational order (the nematic phase) and position order (smectic phase). In this theoretical model we examine semiflexible "wormlike" polymers. There has been much previous work on semiflexible polymers that have dealt with the isotropic-nematic and nematic-smectic phase transition for both homogenous [1,2] and diblock copolymers [3]. Previous studies have used a second-virial approximation/excluded volume interaction between two adjacent cylindrical segments. This study adds an additional excluded volume interaction between wormlike cylindrical segments and terminal (or end) segments of the polymer molecules. The free-energy of the system is calculated using self consistent field theory. The nematic-smectic phase boundary is in good agreement with previous analytic calculations using the second-virial approximation. However the values of the volume fraction at the nematic-smectic transition are large compared with computer simulation results, indicating limitation of the second-virial approximation.

1. Hanif Bayat Movahed, Raul Cruz Hidalgo, and D.E. Sullivan "The phase transitions of semiflexible hard sphere chains liquid", *Phys. Rev. E* **73**, 032701 (2006).
2. Z.Y. Chen, "Nematic ordering in semiflexible polymer chains", *Macromolecules* **26**, 3419 (1993).
3. Dominik Düchs and D.E. Sullivan, "Entropy induced smectic phases in rod-coil copolymers", *J. Phys.:Condens. Matter* **14**, 12189 (2002).

MO-P6-4 15h00 (G*)

A Martensitic-like Transition in a Normal Alkane*, **Shailesh Nene** [1], Eric Karhu [2], Jeffrey L. Hutter [1], Roberta Flemming [3], [1] *Dept. of Physics & Astronomy, The University of Western Ontario*, [2] Dept. of Physics & Atmospheric Science, Dalhousie University, [3] Dept. of Earth Sciences, The University of Western Ontario — Normal alkanes, molecular formula C_nH_{2n+2}, are the simplest hydrocarbons, consisting of a single continuous chain. These are an interesting class of material, both in terms of their intrinsic properties and the fact that many biological molecules contain hydrocarbon domains. Normal alkanes exhibit an unusual phase diagram containing several solid phases, some of which—the "rotator phases"—are characterized by positional order without long-range orientational order. We have found a striking pattern of twinned, striped domains that occurs in the monoclinic rotator RV phase of tricosane ($C_{23}H_{48}$). We have studied this structure, and transitions to other phases, by X-ray diffraction, as well as by optical and atomic-force microscopy. Intriguingly, transitions between the RV phase and the RI orthorhombic phase lying at higher temperature appear to be diffusionless, with the same pattern of stripes, and even molecular scale features, appearing at the same location, even after multiple transitions between the phases. These properties are reminiscent of martensitic transformations, which are better-known in metal alloys at higher temperatures. The tricosane system may be a convenient model for such transitions: since tricosane is a weakly-bound van der Waals solid, the transition occurs at convenient temperatures and with slow kinetics.

* This work is being supported by NSERC

MO-P6-5 15h15 (G*)

Block Copolymer Lamella: Simple Experiments and Complex Physics*, **Andrew B. Croll**, An-Chang Shi, Kari Dalnoki-Veress, *BIMR and the Dept. of Physics & Astronomy, McMaster University* — Block copolymers are soft materials created by joining two dissimilar polymers by a covalent bond. This connectivity frustrates the phase separation of A and B, which results in the spontaneous formation of many fascinating nanoscopic patterns. These complex patterns have lead to intensively study in recent years; however, there remain many fundamental challenges. Most notably, there is significant disagreement about the scale of the resultant patterns near the order disorder transition. Lamellar spacing is often described by the scaling law $(\chi N)^m$ where χ is the Flory-Huggins interaction parameter and N is the number of monomers. We present the results of a simple optical experiment of the lamella thickness as a function of χN which we interpret through fitting to self-consistent field theory. This reveals a significant error in the assumption of a simple power law, and allows us to measure χ in a very simple way.

* This work is being supported by NSERC Canadian Graduate Scholarship

MO-P6-6 15h30 (G*)

Controlling the Elastic Modulus of Electrospun Polymer Fibres using Broad-Energy Ion Beam Treatment*, **Kenneth Kar Ho Wong** [1], Jeffrey L. Hutter [2], Martin Zinke-Allmang [2], Wankei Wan [3], [1] Dept. of Medical Biophysics, *University of Western Ontario*, [2] Dept. of Physics & Astronomy, The University of Western Ontario, [3] Dept. of Chemical & Biochemical Engineering, University of Western Ontario — We demonstrate that the elastic modulus of nano-sized electrospun poly(vinyl alcohol) fibres can be modified using a broad-energy ion beam treatment. The results were confirmed using nano-mechanical bending tests via atomic force microscopy on individual fibres before and after treatment. With a nitrogen dose of 8.0 x10^{15} ions/cm^2, we observed a 30% improvement over the original elastic modulus, while at the same time the fibre diameter decreased. Two additional doses of nitrogen ion, and a helium ion treatment at 8.0 x10^{15} ions/cm^2, showed that the effect on elastic modulus was dependent on the dosage and ion species. The surface morphological features of the fibre were preserved during the ion beam treatment, but X-ray Photoelectron Spectroscopy revealed that nitrogen ions introduced amine and amide groups. Such functionalization may be important for applications such as scaffolds for tissue engineering.

* This work is being supported by NSERC

MO-P6-7 15h45 (G*)

Acoustic quasimodes in two-dimensional dispersed random media*, **Jin Ser Lee** [1], John Page [1], Anatoliy Strybulevych [1], Xin Zhang [2], Zhengyou Liu [2], Fugen Wu [3], Youyan Liu [4], [1] *University of Manitoba*, [2] Wuhan University, [3] Guangdong University of Technology, [4] South China University of Technology — The propagation of classical waves through strongly scattering materials continues to attract interest, largely because the nature of wave transport in such materials may be dramatically altered. While much of the recent interest has focused on ordered materials (photonic and phononic crystals), which may exhibit band gaps and unusual refraction effects, random media may show equally intriguing phenomena. In this presentation, we investigate the coherent propagation of ultrasonic waves through a 2D random medium consisting of nylon rods immersed in water, and measure the dispersion relation and transmission coefficient. The samples were constructed by threading 0.46-mm-diameter nylon fishing line between top and bottom support plates, yielding a "forest" of straight rods with nylon volume fractions ranging from 19 to 69%. Near the frequencies at which strong resonant scattering is observed for a single rod, the transmission drops precipitously, indicating the formation of band gaps. The origin of these band gaps is not the

usual Bragg scattering observed in ordered materials, but is the coupling between the scattering resonances and the propagating modes of the dispersion, thereby creating "hybridization gaps". In the lowest frequency gap, the group velocity v_g is found to be negative. Our measurements of the dispersion relation are in good overall agreement with theoretical predictions based on a spectral function approach, which also reveals the presence of a second longitudinally polarized mode; this second mode arises from the coherent coupling of Stoneley wave resonances on adjacent rods to produce a low velocity, small amplitude propagating mode.

* This work is being supported by NSERC

MO-P6-8 **16h00** **(G*)**

Entanglement density variation by dilution of the polymer network*, **Josh McGraw**, Kari Dalnoki-Veress, *McMaster University* — A polymer system in which the chains are much longer than the entanglement molecular weight, $M_+ \gg M_e$ is well entangled; many chains share the same volume. When a thin polymer film composed of such chains is uniaxially strained below its glass transition temperature, crack-like defects called crazes are locally formed throughout the sample. Measurements of the volume fraction of the deformed versus the undeformed regions can give information on the entanglement density of the system [1]. We present results of such deformation experiments, probed using atomic force microscopy, in which well entangled networks have been diluted with chemically identical species of molecular weight, $M_- \leq M_e$ which results in a decrease in the entanglement density. Varying the molecular weight of the diluent chains provides insight into how the length of a polymer chain affects its contribution to the entanglement network.

1. A.C.M. Yang, E.J. Kramer, C.C. Kuo, S.L. Phoenix, *Macromolecules* **19** 2020 (1986).

* This work is being supported by NSERC

MO-P6-9 **16h15** **(G*)**

Defect analysis in ion-implanted crystalline and amorphous silicon using MD simulations*, **Jean-Christophe Pothier**, François Schiettekatte, Laurent J. Lewis, *Université de Montréal* — The characterization and evolution of defects resulting from ion implantation in semiconductors is among the utmost importance for the understanding of physical properties; in particular, these depend strongly on thermal history and mode of preparation so that knowledge of the early moments following implantation is essential. Using molecular dynamics simulations and the Stillinger-Weber interatomic potential, we have studied the early instants of implantation at keV energies in both crystalline (c-) and amorphous (a-) silicon. In c-Si, we find that the defects are compact clusters with an a-Si-like structure, with no solid/liquid/solid transition observed. The relaxation of the material is characterized by recrystallization steps followed by slow changes in the number of defects. For a-Si, we present a new method of defect identification whereby a total probability function taking into into account several physical properties (coordination number, potential energy, bond angle and radial distribution functions) is computed. Defects are found to restructure rapidly; as a consequence, the first relaxation phase is similar to that in c-Si, while defects become undistinguishable form the a-Si disorder after just a few picoseconds. The relevance of these results for understanding experimental data will also be discussed.

* This work is being supported by CRSNG, FQRNT and RQCHP

MO-P6-10 **16h30** **(G*)**

Attempt to deform gold nanoparticles embedded in AlAs by high energy ion irradiation*, **Chahineze Harkati**, Sjoerd Roorda, *Université de Montréal* — Spherical gold nanoparticles embedded in amorphous silica can be deformed into prolate ellipsoid by irradiation with high energy ions. After irradiation, the cigar-shaped particles are aligned in the direction of the ion beam. The mechanism of the deformation is not known but it is suspected that it is a consequence of the irradiation induced "hammering" deformation of the matrix surrounding the particles. Such hammering is known to occur exclusively in amorphous materials, and therefore we attempted to deform gold nanoparticles embedded in a crystalline matrix such as AlAs which resists amorphization. AlAs was implanted with 1.3 MeV Au ions at room temperature to a fluence of $2 \cdot 10^{16}$ cm^{-2}. Rapid thermal annealing (RTA) at 600°C for 1 or 2 minutes was used to grow Au nanoparticles in the matrix. Deformation was attempted by perpendicular 30 MeV Cu^{+5} irradiation at liquid nitrogen temperature. Crystal damage of the matrix was studied using Rutherford backscattering spectrometry in channelling configuration and the morphology of Au nanoparticules was investigated by Transmission Electron Microscopy. It was found that, in spite of some crystal damage, the AlAs remained crystalline throughout the experiment and even after irradiation, spherical Au nanoparticles with size distribution between 2 and 20 nm were observed. Thus, high energy heavy ion beam does not deform spherical Au nanoparticles embedded in AlAs. This supports the suggestion that the deformation of the gold nanoparticles is a consequence of hammering deformation of the matrix surrounding the nanoparticles.

* This work is being supported by CRSNG

16h45 **Session Ends / *Fin de la session***

[MO-P7] Field Theory / *Théorie des champs*

(DTP / *DPT*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 3870*** **(cap. 51)** ***Chair: R. Lewis, York Universty***

MO-P7-1 **14h15**

GEORGE FLEMING, Yale University

Lattice Study of the Conformal Window in QCD-like Theories

Using lattice simulations, we study the extent of the conformal window for an SU(3) gauge theory with N_f Dirac fermions in the fundamental representation. We present evidence that the infrared behavior is conformal for $12 \leq N_f \leq 16$, governed by an infrared fixed point, while confinement and chiral symmetry breaking are present for $N_f \leq 8$.

MO-P7-2 **14h45**

MAX METLITSKI, Harvard University

Duality and Wilson Loops in Non-Compact U(1) Gauge Theories

It has long been known that certain three-dimensional non-compact U(1) gauge theories admit a dual representation in terms of vortex degrees of freedom in the vicinity of a critical point between the Higgs and Coulomb phases. I will discuss how to use this duality to study correlation functions of Wilson loop operators. In particular, I will demonstrate that close to the critical point all correlators are periodic functions of the Wilson loop charge, Q. The period depends on the global symmetry of the theory,

which determines the magnetic flux carried by the dual particles. For single flavour scalar electrodynamics, the emergent period is Q = 1. In the general case of N complex scalars with a U(1) $^{N-1}$ global symmetry, the period is Q = N. Implications of these results for lattice simulations, as well as for physical systems, such as easy plane antiferromagnets and disordered superfluids, will be noted.

15h15 Coffee Break / *Pause café*

MO-P7-3 15h30

DONALD EDWARD SULLIVAN, University of Guelph

Field Theory for Polymeric Materials *

This talk reviews field theory as applied to polymers and other soft condensed matter systems such as liquid crystals and water-lipid mixtures. Mostly, I will describe the theory in its widely used mean-field approximation, usually known as self-consistent field theory (SCFT). The two main ingredients of the theory are the internal statistics of a polymeric chain molecule, here represented by two idealized models (the Gaussian model for flexible chains and the wormlike-chain model for semiflexible chains), and the intra- and inter-molecular interactions. Numerical techniques for solving the theory will be reviewed. Some applications which will be described are the self-assembly of diblock copolymers and water-lipid mixtures, liquid crystal phase transitions of semiflexible polymers, and interfacial phenomena related to the behaviour of flexible diblock copolymers and semiflexible liquid-crystalline polymers in confined geometries.

* This work is being supported by NSERC

MO-P7-4 16:00 (G)

Phase transitions in the spontaneously broken sector of the 2+1 dimensional abelian Maxwell-Chern-Simons Higgs model*, **Faiza Nebia-Rahal** [1], Richard MacKenzie[1], Manu Paranjape [2], [1] *Université de Montréal*, [2] Université de Montréal/Sogang University — We formulate an effective Euclidean lattice description of the 2+1 dimensional Abelian Higgs model with Chern-Simons term and study it in the symmetry broken sector. The relevant low-lying excitations correspond to vortices and anti-vortices. In the lowest approximation, the functional integral can be approximated by a sum over closed loop configurations, and the Euclidean effective action is proportional to the sum of the length of the vortex world line times their mass per unit length μ and the topological linking number of the closed loops. We present a novel fashion to generate non-intersecting closed loops, starting from a tetrahedral tesselation of three space. We perform Monte Carlo simulations to compute the properties of the vacuum. In this talk, I will present our preliminary results.

* This work is being supported by NSERC of Canada and the Center for Quantum Spacetime of Sogang University

MO-P7-5 16h15

Confinement effects on animal movement in fragmented landscapes*, **Sheldon Opps**, Todd Mackenzie, Marina Silva, *University of Prince Edward Island* — In fragmented landscapes that result from agricultural activities, portions of destroyed habitat are often replaced with novel habitats that may or may not be seen as hospitable habitats by animals. The responses of animals to these changes are influenced by their ability to move among patches, the population dynamics in habitat patches of different sizes, and the factors that control whether they remain in or disperse from suitable habitat. We have been conducting field studies to examine the movement properties of several animal species within hedgerows on PEI. To complement these studies, we have been developing a computer simulation model to study the movement of a generic small mammal within spatially heterogeneous corridors of varying width. Corridors are constructed with several habitat components, each generated with a different quality, Q, and characteristic fractal dimension, D. The animal is provided with some basic navigational skills (e.g., field of vision, perceptual range) and an ability to seek out favoured resources depending on their quality, Q. By varying a number of key parameters, such as the aspect ratio of the corridor, the repulsive strength of the bordering agriculture, and the relative composition and complexity of the corridors, we have been systematically studying confinement effects on movement within fragmented landscapes with edge habitat. These simulation studies are compared against theoretical predictions, including correlated random walk (CRW), biased random walk (BRW), and Lévy walk models. Additionally, fractal analysis has been utilized to ascertain scale-dependent shifts in movement in response to changes in habitat structure.

* This work is being supported by NSERC

16h30 Session Ends / *Fin de la session*

[MO-P8] Instrumentation / *Instrumentation*

(DAMPhi-DIMP / *DPAMip-DPIM*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 16h45

ROOM / SALLE VCH 3820* (cap. 104)** ***Chair: K.H. Michaelian, CANMET, Natural Resources Canada

MO-P8-1 14h15

A. ROBERT MCKELLAR, National Research Council

Longer wavelengths, higher resolution, and greater absorption paths with the far infrared beamline at the Canadian Light Source †

There are two infrared beamlines at Canada's synchrotron light source, the CLS, located in Saskatoon at the University of Saskatchewan. One is a mid-infrared facility, mainly for spectromicroscopy, and the second is a far infrared (FIR) facility for ultra-high spectral resolution (0.0009 cm^{-1}) studies of gases in the 50-1000 cm^{-1} range, equipped with a Bruker IFS125 Fourier transform spectrometer. Gas-phase FIR spectroscopy is a new application for synchrotron radiation whose potential is not yet fully realized. The FIR region is challenging because of the weakness of conventional thermal radiation sources. Synchrotron radiation can provide a FIR continuum with up to 2 or 3 orders of magnitude brightness gain. In order to make full use of the spectral resolution capabilities, a large 2 m gas cell has been interfaced with the spectrometer allowing lower sample pressures and reduced pressure broadening. We are using acrolein (CH_2CHCHO) for testing. Interesting in its own right, this molecule is also of importance in astrophysics, combustion chemistry, and human respiration (cigarette smoke, smog). Our initial CLS work on ν_{12}, ν_{17} and ν_{18} is now extended to ν_{13}, $2\nu_{18}$, $3\nu_{18}$, and further vibrational levels. Even greater gains in source intensity at long wavelengths (<100 cm^{-1})) may be possible using coherent synchrotron radiation (CSR), achieved by shortening the electron bunch length in the synchrotron storage ring. Initial testing of CSR at CLS has already yielded a recognizable high-resolution spectrum of N_2O pure rotational transitions in the 10-20 cm^{-1} range.

† In collaboration with Dominique R.T. Appadoo, Canadian Light Source

MO-P8-2 **14h45**

IR Spectroscopy at the Canadian Light Source: The ν_{11} Fundamental and $\nu_{16}+\nu_{18}-\nu_{18}$ Hot Band of Trans-Acrolein*, **Ronald M. Lees** [1], Hongyu Shi [1], Li-Hong Xu [1], Dennis W. Tokaryk [1], A. Robert W. McKellar [2], Dominique R.T. Appadoo [3], [1] *CLAMS, University of New Brunswick*, [2] National Research Council, [3] Canadian Light Source — The ν_{11} fundamental and the $\nu_{16}+\nu_{18}-\nu_{18}$ hot band have been identified in the high-resolution Fourier transform spectrum of trans-acrolein (CH_2=CH-CH=O) recorded in the 10-μm region on the Far-Infrared beamline of the Canadian Light Source synchrotron in Saskatoon. The two bands are centered at 912 cm^{-1} and 957 cm^{-1}, respectively, with the excited ν_{11} state corresponding to the *A'* in-plane CH_2-rocking mode and the $\nu_{16}+\nu_{18}-\nu_{18}$ state to the combination of the *A"* out-of-plane CH_2 rock with the low-frequency (158 cm^{-1}) *A"* C-C torsional mode. This extends our previous work on the ν_{14} and ν_{16} fundamentals centered at 993 and 959 cm^{-1}, leaving only the ν_{15} mode now to be assigned at high resolution in the 10-μm spectral region for this important atmospheric pollutant. The ν_{11} band is type *a/b* and the $\nu_{16}+\nu_{18}-\nu_{18}$ hot band is *c*-type, so that assignments could be confirmed by lower-state combination differences. The assigned transitions have been fitted to a Watson asymmetric rotor Hamiltonian, and molecular parameters for both states will be reported.

* This work is being supported by Natural Sciences and Engineering Research Council

MO-P8-3 **15h00** **(G*)**

High Resolution Infrared Spectrum and Global Analysis of ν_{12}, ν_5 and $\nu_{12}+\nu_6-\nu_6$ Bands in CH_3SiH_3*, **Leila Borvayeh** [1], Irving Ozier [2], A. Bauder [3], Nasser Moazzen-Ahmadi [1], [1] *University of Calgary*, [2] University of British Columbia, [3] Switzerland — The rotation-torsion-vibration spectrum of CH_3SiH_3 has been investigated at the Canadian Light Source from 400 to 750 cm^{-1} with a resolution of 0.0009 cm^{-1}. The spectra were obtained with a Bruker IFS 125HR Fourier transform spectrometer using the synchrotron radiation as the continuum source. Three bands were investigated: the ν_{12} centred near 525 cm^{-1}, its first torsional hot band $\nu_{12}+\nu_6-\nu_6$ near 534 cm^{-1} with and the ν_5 fundamental near 703 cm^{-1}. For the two fundamentals, the spectra are much improved over those in the earlier studies, with many of the torsional triplets now being clearly resolved even for the unperturbed cases. The main interest is in the hot band, here reported for the first time, where the torsional effects are much larger. Using a Fourier transform waveguide spectrometer at E.T.H., the three σ components of the J=1←0 transition in $\nu_{12}+\nu_6$ have been resolved, where σ = 0, +1,-1 labels the torsional sub-levels. In addition, direct *l*-doubling transitions in $\nu_{12}+\nu_6$ have been measured for σ = 0 and 19 ≤ J ≤ 27. In a global fit, all the new data have been analysed along with the frequencies obtained in earlier investigations. The analysis includes all the important interactions among the torsional stacks of levels for the ground state (gs), for ν_{12}, and for ν_5. These include the previously known (gs, ν_5) Fermi and (gs, ν_{12}) Coriolis interactions, along with a higher order (ν_{12}, ν_5) Coriolis coupling introduced here. This last is responsible for the strong perturbation of the hot band series with for -9 ≤ KΔK ≤- 12. A good fit was obtained. The Hamiltonian will be discussed with emphasis on the terms required for treating the hot band.

* This work is being supported by University of Calgary & NSERC

15h15 **Coffee Break / *Pause café***

MO-P8-4 **15h30**

PIERRE TREMBLAY, Université Laval

Work on Fourier-transform spectrometers at Université Laval †

Fourier-transform spectrometers indirectly measure spectra. They provide spectrum estimation through the Fourier transform of interferograms, measured by efficient light modulators, that are Michelson interferometers. This basic characteristic enables powerful resolution capabilities, but it introduces as well many instrumental features that may severely limit the overall quality of the instrument data. Advances in understanding how the physical layout of the interferometer affects the generated interferograms enable to build precise models of the instrument line shape, the wavelength-dependent spectral signature of the instrument. Experiments have been conducted to confirm the validity of these models. Such knowledge becomes the key factor to ensure that the end user extracts most of the information from his measurements, without having to be an expert in such instrumentation, despite of the instrument limitations. Improving standard spectral and radiometric calibrations, detailed calibration schemes are thus derived to enlarge the fields of applications. The recent development of powerful imaging Fourier-transform spectrometers, also called hyperspectral imagers, brings new challenges. In fact each pixel of the imager behaves as a distinct spectrometer, requesting its own characterization and calibration procedure. Calibration now needs efficient algorithms to correct the huge amount of data produced by such instruments in a realistic amount of time. At Université Laval, many projects are on the way ranging from the understanding of peculiar defects in the instrument line shape to practical implementation of calibration algorithms in specific instrument hardware.

† In collaboration with Jérôme Genest

MO-P8-5 **16h00** **(G*)**

Passive Electrostatic Recycling Spectrometer of Desk-Top Size for Charged Particles of Low Kinetic Energy*, **D.R. Tessier** [1], Y. Niu [1], D.P. Seccombe [1], T.J. Reddish [1], A.J. Alderman [2], B. Birdsey [2], P. Hammond [2], F.H. Read [3], [1] *University of Windsor*, [2] University of Western Australia, [3] University of Manchester (UK) — The development of a completely new type of electron spectrometer, an "Electron Recycling Spectrometer" (ERS) is described in which low energy (<~50 eV) electrons are passively stored in a 'desktop' sized ring. The orbital path for the electrons is 0.65 m long with a race-track geometry and is defined through the application of design voltages to two series of cylindrical electrostatic lenses inserted between two identical hemispherical deflector analyzers. The ERS design concept exploits the very low scattering cross sections in electron-molecule collisions, where the majority of electrons do not interact with the gaseous target. Unscattered electrons are collected, passed back through the ERS for another collision opportunity in the interaction region - i.e. they are "recycled" so that each electron generated in the electron source may undertake multiple passes through the interaction region. Initial results will be presented which demonstrate that the electron beam undergoes up to ~1000 orbits in a time of ~250 μs. The design of the system is likely to enable the storage at low kinetic energy of any type of non-relativistic charged particle, including positrons, polarized electrons, and positive & negative ions.

* This work is being supported by Paul Instrument Fund, NSERC, CFI, OIT, ARC, UoW

MO-P8-6 **16h15** **(G*)**

Segmented Linear Radio-Frequency Quadrupole / Laser Ion Source Project at TRIUMF*, **Jean-Philippe Lavoie** [1], Pierre Bricault [2], Jens Lassen [2], [1] *TRIUMF / Université Laval*, [2] TRIUMF — Reactions such as $^{25}Al(p,\gamma)^{26}Si$ are the key to understanding the production of ^{26g}Al and ^{26m}Al in our galaxy. Experimental results could provide important constraints on the modeling of nova nucleosynthesis where ^{26}Al is believed to be produced. To achieve such measurements, high-intensity and high-purity radioactive beams are required. However, production targets at ISOL-type facilities such as ISAC at TRIUMF produce high-intensity alkali beams by surface ionization on hot transfer tubes that hamper the measurement of isotopes of interest. To overcome this issue, an ion source combining a segmented linear radio-frequency quadrupole (RFQ) to a laser ion source is being built. Its main function is to suppress alkali impurities whilst allowing for fast-release of short-lived isotopes. The beam production method, the RFQ/laser ion source and the removal of alkali contaminants will be presented as well as recent developments.

* This work is being supported by TRIUMF/ Université Laval

MO-P8-7 **16h30** **(G*)**

Neutron Multiple Scattering Discrimination Studies In DESCANT - DEuterated SCintillator Array for Neutron Tagging*. **James Wong** , Paul Garrett, Carl Svensson , *University of Guelph* — A novel neutron tagging array is being developed for the study of high-spin states of neutron-rich systems. This ground-breaking design will be based upon an array of liquid deuterated scintillators for neutron detectors and is called the DEuterated SCintillator Array for Neutron Tagging or DESCANT. DESCANT will serve as an auxiliary detector for the TIGRESS spectrometer located at TRIUMF's ISAC radioactive ion beam facility. Neutron spectroscopy is typically performed utilizing time of flight (TOF) techniques. However, the multiple scattering of neutrons between detectors poses a major problem to overcome and is commonly dealt with by vetoing signals collected in adjacent detectors. This results in a much reduced detection efficiency for higher neutron multiplicity events. Fast neutron scattering from deuterium is not isotropic in the centre-of-mass frame and the measured pulse height spectra is forward-peaked. This pulse height information can be correlated with the TOF to over determine the neutron energy, thus rejecting multiple scattering without the need to veto nearest neighbours. Results from early feasibility tests will be presented, along with the status of our GEANT4 simulations of the array performance. The fully close-packed 70 neutron detector DESCANT array subtends an angle of $\theta = 65.5^{o}$ and covers 92.6% of this solid angle or 1.08π sr.

* This work is being supported by CFI, ORF and TRIUMF.

16h45 **Session Ends** / ***Fin de la session***

[MO-P9] Biophotonics / *Biophotonique*

(DOP-DMBP / (*DOP-DPMB*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 3830*** **(cap. 110)** ***Chair: P. Ashrit, Université de Moncton***

MO-P9-1 **14h15**

CAROLINE BOUDOUX, Ecole Polytechnique de Montréal

Confocal endoscopy: in vivo cellular resolution imaging of human organs †,*

Confocal microscopy is an optical imaging technique used to obtain high resolution and contrast images of in specimens that are thicker than the focal plane by using a spatial pinhole to eliminate out-of-focus light. Spectrally encoded confocal microscopy (SECM) enables reflectance confocal microscopy to be conducted within the confines of a small-diameter, flexible probe, thus allowing the technique to be used clinically for cellular evaluation of internal organs. In this work, we present a handheld confocal microscope designed specifically for in vivo imaging of human vocal folds. The SECM instrument consists of a hand piece housing the scanning apparatus – a high density holographic grating mounted on a galvanometer – coupled to a 16-mm diameter stainless tube containing the telescope relaying the laser light to the back aperture of a miniaturized microscope objective with a high numerical aperture (0.75 NA). The probe yields images with a 350x350 micrometer field of view, a transverse resolution of 1.4 micron, and an axial resolution of 6 microns. In vivo images of a pediatric vocal fold were acquired under anesthesia in the operating suite at a rate of 10 frames per second and showed cellular and intracellular features of the superficial vocal fold layered architecture. These promising images are an additional step towards validation of optical microscopy techniques for clinical applications.

† In collaboration with Brett E. Bouma, Dvir Yelin , Milen Shishkov , Christopher J. Hartnick , Harvard Medical School

* This work is being supported by Wellman Center for Photomedicine

MO-P9-2 **14h45**

QIYING CHEN, Memorial University of Newfoundland

Fibre Bragg gratings for optical biosensors †

In-situ monitoring of multiple parameters is of great importance for biomedical applications. Among different parameters, temperature, salinity, and saccharinity are the most important parameters in many applications. Techniques reported so far on the measurement of these parameters usually used bulky transducers and systems. The most restrictive disadvantage of these techniques is that they cannot realize simultaneous measurement of multiple parameters. In this talk, we will discuss a new fiber optic sensor for simultaneous measurement of temperature and salinity/saccharinity with multiplexed polymer-coated fiber Bragg gratings (FBGs). For these FBGs coated with different polymers, the temperature responses in air and solution as well as salinity and saccharinity in water solution have been investigated. Changes in these environmental parameters result in the shift of the Bragg resonance wavelength of the FBGs. It has been found that the polyimide-coated FBG responds to variations of both temperature and salinity/saccharinity while the acrylate-coated FBG is only sensitive to the environmental temperature.

The authors thank Natural Sciences and Engineering Research Council of Canada (NSERC) for the grant support to this research project. One of the authors (Q. Chen) thanks Canada Research Chairs Program, Canada Foundation for Innovation, the Province of Newfoundland and Labrador, and the Memorial University of Newfoundland on the support of research infrastructure.

† In collaboration with Ping Lu, Liqiu Men , Memorial University of Newfoundland

15h15 **Coffee Break** / ***Pause café***

MO-P9-3 **15h45** **(G*)**

Waveguide Evanescent Field Fluorescence Microscopy and its applications for imaging cell-substrate interfaces and ultra-thin solid films*, **Abdollah Hassanzadeh**, Silvia Mittler, *University of Western Ontario* — Evanescent field fluorescence microscopy is a very powerful imaging method for the investigation of interfacial issues in material science and biology. In waveguide evanescent field fluorescence microscopy, fluorescence dyes are excited within the evanescent field of a waveguide only: roughly within one hundred nanometers above the waveguide surface. This will allow imaging surface and interfacial issues of the waveguide and an adjacent material. Total Internal Reflection Fluorescence (TIRF) Microscopy is an example of an established evanescent field fluorescence microscopy. The advantages of this kind of microscopy is a very high axial resolution (in nanometer regime), but it is a very expensive method and not necessarily allows the substrate to be patterned. Waveguide Evanescent Field Fluorescence Microscopy (WEFF) is an inexpensive alternative, in the moment still with diffraction limited lateral resolution, but offers a lot of space above the specimen for additional instrumentation (e.g. patch clamp) and allows the waveguide as the substrate to be surface functionalized and/or patterned, both chemically and physically. In this method a laser beam couples into a waveguide, the basic component of WEFF, via a grating. The evanescent tail of the propagating beam in the waveguide will excite the fluorescence dyes. By utilizing an inverted fluorescence microscope and a DCC camera fluorescence images, fluorescence intensity maps and fluorescence kinet-

ics can be captured, measured and saved to a computer. Our results show WEFF Microscopy is a very fast and easy imaging technique. We have investigated and imaged ultra-thin films of a few nanometer thicknesses, and also immobilized living cells. Besides quality control applications in ultra thin film technology, potential application for WEFF microscopy are drug screening in the form of kinetics of cell death, and cell death studies itself, e.g. how do cancer cells detach when they die.

* This work is being supported by University of Western Ontario, NSERC, CFI, Ontario Innovation Fund , OPC, CRC Program of the Government of Canada

MO-P9-4 **16h00**

Modeling nonlinear optical interactions in the crystalline lens- defining the light required for a presbyopia cure*, **Melanie C.W. Campbell** [1], Ram P. Sharma [2], Donna Strickland [1], [1] *University of Waterloo and GWPI*, [2] Indian Institute of Technology, Delhi — Femtosecond laser pulses are used to micromachine tissue. Micromachining the lens of the eye is a potential method of improving the elasticity of the lens which would provide a potential "cure" for presbyopia, the age related loss of near vision. We wished to investigate the underlying physical mechanisms by studying the role of self-focusing (which is due to the intensity dependence of the refractive index), and multi-photon and avalanche ionization on micro-cavity bubble formation within the crystalline lens. It is important that these bubbles remain small to avoid excessive light scatter. We created a model of nonlinear pulse propagation in the crystalline lens. We developed the paraxial wave equations for Gaussian beams that include both the nonlinear Kerr effect and the gradient refractive index (GRIN) of the crystalline lens. We showed that self-focusing occurs in the GRIN crystalline lens at powers that are three orders of magnitude lower than in homogeneous media. The model predicts the required input beam diameter and radius of curvature for self-focusing within the crystalline lens. The theoretical modeling showed that at powers above the critical power for self-focusing, the focal spot moved resulting in a line array of foci known as filamentation. Filamentation could result in closely spaced microbubbles along the propagation direction that could then coalesce and cause light scatter. We believe that self-focusing within a GRIN structure has not previously been theoretically modeled. A further study of avalanche ionization will define the pulse and beam profiles required for a presbyopia cure.

* This work is being supported by NSERC, OPC

MO-P9-5 **16h15**

Punching holes in E.coli*, **Simon Rainville**, Mathieu Gauthier, Dany Truchon, *Université Laval* — Motility is critical for most living cells. The bacterium *Escherichia coli* (*E. coli*), like many other bacteria, swims in its aqueous environment using long helical filaments driven at their base by a rotary motor called the bacterial flagellar motor. With a diameter of 45 nm, this system is a nanotechnological marvel, remarkably sophisticated, yet of manageable complexity. Much is known about the flagellar motor, but many questions remain open and the study of this system is a very active and exciting area of current research. Because it is imbedded in the multiple layers of the bacterial membrane, it has not been studied *in vitro* like many other linear biological motors. Our goal is therefore to develop an *in vitro* system that will provide the essential control over experimental parameters to achieve the precise study of the flagellar motor's physical and chemical characteristics. Our system consists of a filamentous *E.coli* bacterium partly introduced inside a glass micropipette. Femtosecond laser pulses (60 fs and ~15 nJ/pulse) are then tightly-focused on the part of the bacterium that is located inside the micropipette. This vaporizes a submicrometer-sized hole in the wall of the bacterium. We have demonstrated that this grants us access to the inside of the cell and the control over the proton-motive force which powers the motor. Finally, we are also developing novel approaches to precisely monitor the rotation speed of a working flagellar motor outside the micropipette using nanoparticles.

* This work is being supported by CRSNG, FQRNT

16h30 **Session Ends / *Fin de la session***

[MO-P10] A Physicist's Career in the Banking World / *La carrière d'un physicien dans le monde bancaire*

(CAP-CORP / ACP-CORP)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h15 - 14h45

ROOM / SALLE ***POU 1112*** **(cap. 500)** ***Chair: W.F. Davidson, National Research Council Canada***

MO-P10-1 **14h15**

LEE ANN JANISSEN, TD Securities

A Physicist's Career in the Wholesale Banking World

A talk about the transference of the skills of a physicist to the wholesale banking world. Over the past 15 years I have had 4 distinct jobs with 2 wholesale banks in 2 continents. This talk will give overview of how physicists have added value to the wholesale banking industry, how the business has changed the intervening years due to world events and changes in the regulatory environment, and the types of roles that physicists are currently performing in the wholesale banking industry.

14h45 **Session Ends / *Fin de la session***

[MO-P11] Workshop on Commercalization of Innovation / *Atelier sur la commercialisation de l'innovation*

(CAP-CORP / ACP-CORP)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

14h45 - 17h00

ROOM / SALLE ***POU 1112*** **(cap. 500)** ***Chair: A. Sarkissian, Plasmionique Inc.***

MO-P11-1 **14h45**

TONY RAHILLY, NRC - IRAP

From Physics in the Lab to Products at the Retailer: The Speed of Innovation and the Acceleration of Commercialization

Dr. Tony Rahilly, Director General of the Industrial Research Assistance Program (IRAP) at the National Research Council, will discuss the impact of an accelerated research environment on physicists, and how the compressed time frame is moving research projects into consumer or industrial products at super-charged speeds. He will offer some examples from among the hundreds of IRAP projects across Canada, and he will discuss the National Research Council's role in general – and IRAPs in particular – in fostering innovation across Canada.

MO-P11-2 **15h15**

JEAN-YVES ROY, INO

How INO brings innovation to help companies improve their competitive edge and contributes to their development

INO's approach based on an entrepreneurial client-focused management style makes it possible to orient the technology development program and creation of intellectual property to meet the industry's needs and create tangible opportunities for technology transfers or specialized services.

MO-P11-3 **15h45**

PHILIP LAWRENCE GARDNER, TRIUMF

Commercializing Fundamental Physics Research: The TRIUMF Experience

TRIUMF is Canada's National Laboratory for fundamental research into particle and nuclear physics. It is operated by a consortium of universities from across Canada, with its buildings funded by the Government of British Columbia and its operating funds supplied through a Contribution Agreement administered by the National Research Council. While the primary mandate of TRIUMF has always been the pursuit of fundamental research, today the facility has also become recognized around the world for the application of its expertise to projects with significant commercial and social benefits. Working with collaborators in Africa, Asia, and Europe as well as North America TRIUMF scientists are finding solutions for such diverse problems as a resistant malaria parasite, improved medical imaging techniques and innovative cyclotron designs.

16h00 - 17h00

Panel Discussion. — The speakers from this afternoon's corporate sessions will be joined by representatives from industry and government organizations to host a panel discussion on the commercialization of innovation in Canada. The format will be a set of brief remarks from each of the panel members, followed by an interactive discussion session with the audience.

17h00 **Session Ends / *Fin de la session***

[MO-P12] Student Competitors in Instrumentation and Optics / *Compétiteurs étudiants en instrumentation et optique*

(DIMP-DOP / DPIM-DOP)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

16h00 - 17h30

ROOM / SALLE ***VCH 2826*** **(cap. 42)** ***Chair: B. Southern, University of Manitoba***

MO-P12-1 **16h00** **(G*)**

Multi-wavelength laser diode arrays fabricated by ArF laser induced Quantum Well Intermixing*, **Romain Béal**, Jonathan Genest, Vincent Aimez, Jan J. Dubowski, *Département de Génie Électrique et Génie Informatique, Université de Sherbrooke* — Post-growth fabrication of multi-bandgap wafers is potentially attractive to develop low cost monolithically integrated photonic devices (MIPD). We have investigated UV excimer laser based Quantum Well Intermixing (UV-QWI) for high resolution bandgap engineering [1]. The main goal of the current study is to explore the UV-QWI technique for the fabrication of arrays of blue shifted lasers emitting at a wide range of wavelengths. We used ArF laser (λ=193 nm, τ=15 ns) to irradiate InGaAs/InGaAsP laser heterostructures covered with a 200 nm thick sacrificial layer of InP. The samples were then annealed at 725°C for 120 sec. After removing the sacrificial layer, laser diodes were fabricated from both intermixed and as-grown materials. The intermixed laser diodes showed a Fabry-Perot behaviour with emission wavelength blue shifted up to 120 nm in comparison to a reference sample (1560 nm). Attractive for practical applications is that both threshold current and quantum efficiency of the blue shifted lasers were comparable to those of the reference lasers. Other parameters of the fabricated devices, e.g., laser life time, still remain to be investigated. However, our results have already indicated that the introduction of the sacrificial layer that is irradiated with relatively short wavelength photons allows achieving high-density of blue-shift enhancing point defects, without significant perturbation of the device microstructure. We discuss the potential of this approach for rapid and efficient post growth bandgap engineering of III/V heterostructures that is expected to yield attractive and cost-effective MIPDs.

1. J. Genest *et al.*, *Appl. Phys.* **A89**, 523 (2007)

* This work is being supported by Natural Sciences and Engineering Research Council of Canada and Canada Research Chair in Quantum Semiconductors programs (J.J. Dubowski)

MO-P12-2 **16h15** **(G*)**

Extrinsic Scattering Loss in Planar Photonic Crystal Waveguides*, **Mark Patterson** [1], Stephen Hughes [1], Sylvain Combrié [2], Quynh Vy Tran [2], Alfredo De Rossi [2], [1] *Queen's University*, [2] Thales Research and Technology — Planar photonic crystal waveguides are structures of great interest for achieving fine control of the propagation of light. In particular, bound waveguide modes in photonic crystal slabs existing below the light line are theoretically lossless and can slow down light by an arbitrary amount, which leads to a rich set of applications in nanophotonics. However, it is now well established that unavoidable fabrication imperfections can have a profound influence on device performance manifesting in extrinsic scattering loss of the propagating light. Although theoretical expressions based on rigorous scattering theory now exist in the literature, their explicit form is far from trivial and only a few numerical calculations have actually been attempted. In this work we will present both theory and practical calculations of extrinsic scattering loss using the novel properties of photon Green functions in planar photonic crystal media. We explore the different loss mechanisms of backscattering and radiative scattering (out of slab), and discuss the roles of group velocity and the disorder parameters such as correlation length and RMS surface roughness. Finally, we make a direct connection to recent transmission measurements performed on GaAs photonic crystal waveguides.

* This work is being supported by NSERC and CFI, Canada

MO-P12-3 **16h30** **(G*)**

Slow light in metamaterial waveguide structures*, **Arvin Reza**, Marc Michael Dignam, Stephen Hughes, *Queen's University* — The field of slow light propagation has recently attracted considerable attention due to its potential application in optoelectronics. Recently, a lossless, and dispersionless, metamaterial waveguide structure was theoretically investigated and shown to stop visible light over a broadband frequency range [K.L.Tsakmakidis, A.D.Boardman, O.Hess, Nature 450, 397 (2007)]. However, it is now well established that loss and dispersion are inherent features of negative index materials. Here, we critically investigate the roles of dispersion and loss on the slow-light modes in the proposed structure. It is demonstrated that the effect of loss is highly non-perturbative on the slow-light modes; as a consequence, even when an extremely small amount of loss is introduced into the modal, it is no longer possible to stop the light. For example, when the loss is 100 times less than the lowest-loss

structure achieved to date, the light can only be slowed to, at best, three order of magnitude below the speed of light in vacuum. We conclude that these slow-light modes are so lossy as to be of little or no practical use. More generally, our results indicate that any realistic modal of slow-light propagation in metamaterial waveguides must certainly include loss and dispersion.

* This work is being supported by Natural Sciences and Engineering Research Council of Canada

MO-P12-4 16h45 (G*)

Photonic crystals as a novel structure to generate optical vortices*, **Jeff Wheeldon**, Henry Schriemer, *University of Ottawa* — The study of optical vortices is an emerging research area of great importance because vortices may be used to confine and manipulate nanoparticles in ways not possible with conventional optical tweezers. It has been demonstrated that optical vortices can be generated within higher order Laguerre-Gaussian laser modes. Arrays of optical vortices have been generated using holographic techniques, or by using multiple beam interference to create optical lattices. We report on a novel means of creating optical vortex arrays arising from a subset of electromagnetic Bloch modes of photonic crystals that contain periodic optical vortices. Using the vanishing dielectric contrast limit, which preserves system symmetry, we have extracted tractable analytic forms for the Bloch modes of a two-dimensional photonic crystal. From these analytic forms, we determined their number and location in real and reciprocal space, finding that vortices may only arise for Bloch modes with odd rotational symmetry. We observe vortices of two types: symmetry and accidental. Symmetry vortices arise in Bloch modes of high symmetry and are spatially stable when the dielectric contrast is increased. Accidental vortices arise in Bloch modes of lower symmetry; they vary in number and location as the dielectric contrast is increased. These symmetry insights are used to direct our numerical research, which examines optical vortices in photonic crystal slab structures for future experimental realization.

* This work is being supported by Ontario Graduate Scholarship

MO-P12-5 17h00 (G*)

Novel method of measuring the gain of photomultiplier tubes for VERITAS*, **Audrey MacLeod**, *McGill University* — Photomultiplier tubes (PMTs) are used Cherenkov radiation emitted by gamma-ray-initiated showers in the earth's atmosphere. The gains of the PMTs are key to determining the amount of light detected and, subsequently, the energy of the incoming gamma ray. A novel method of measuring the gain of a PMT has been proposed for use at the The Very Energetic Radiation Imaging Telescope Array System (VERITAS). Unlike current gain calibration methods, this method could be performed without cutting into the time that the telescope could be observing. The proposed method relates the PMT gain to the variance of the PMT signal divided by the average current. I will motivate the method, and compare it to an existing method of measuring the gain.

* This work is being supported by NSERC, McGill University, VERITAS

MO-P12-6 17h15 (G*)

Radio-frequency pulse compression for ultrafast electron diffraction experiments*, **Robert Chatelain**, Chris Godbout, Vance Morrison, Thana Ghunaim, Bradley Siwick, *McGill University* — Is it possible to obtain a real-time view of chemical reactions by fully resolving the elementary atomic motions that accompany the breaking and making of chemical bonds in the transition state region *between* reactant and product states? Or to make direct observations of the collective atomic motions leading to structural phase transitions in material systems *as they take place*? The development of time-resolved diffraction techniques – both x-ray and electron – with ultrafast temporal resolution ($< 10^{-9}$ s) has recently made such experiments a reality. Experiments performed using a femtosecond electron source to study laser-induced solid-to-liquid phase transitions in metals will be discussed. A combination of analytical estimates and state-of-the-art particle tracking simulations show that it is possible to create 100 keV, 0.1 pC, 30 fs electron bunches using relatively well-established electron beam techniques. Specifically, this new source is based on an initial stage of space-charge (Coulomb repulsion) driven pulse expansion – always present in ultrashort photoelectron pulses – that provides the energy-correlated electron bunches required for subsequent radio-frequency pulse compression in a second stage. This method does not try to *circumvent* the space-charge problem, the much discussed bogey-man of the field, but instead *makes use* of these space-charge induced bunch dynamics. In addition to a dramatic increase in time-resolution and pulse fluence, beam collimation is also significantly improved with this approach. I will discuss the limitations of this approach and show that they come from quite an unexpected source; the properties of the photoemission.

* This work is being supported by NSERC, FQRNT

17h30 Session Ends / *Fin de la session*

[MO-CEWIP] Women in Physics (with reception) / *Les femmes en physique (avec réception)*

(CEWIP / *CEFEP*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

16h30 - 18h15

ROOM / SALLE POP 1168 (cap. 150) ***Chair: J.A. McKenna, University of British Columbia***

MO-CEWIP-1 16h30

NADIA GHAZZALI, Université Laval

Perspectives from the NSERC/Industry Chair for Women in Science and Engineering in Quebec *

Professor Ghazzali's objectives for her NSERC Chair are objectives central to CEWIP: enhancing women's leadership role in science and engineering in the public and private sectors and actively promoting this role to young women. increasing the number of young women in science and engineering education programs, with a view toward their pursuing careers in either of these fields. Professor Ghazzali will share her perspective and experience with the audience in her unique role as NSERC / Industry Chair for Women in Science and Engineering in Quebec.

* This work is being supported by NSERC

17h00 Reception for participations, sponsored by CEWIP / *Réception pour les participants, commandité par le CEFEP*

18h15 Session Ends / *Fin de la session*

[CAP-NSERC] CAP-NSERC Liaison Committee Meeting / *Réunion du comité de liaison ACP-CRNSG*

(CAP-NSERC / *ACP*-*CRNSG*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

17h00 - 19h30

ROOM / SALLE ***POP 2165*** **(cap. 28)** ***Chair: B.D. Gaulin, McMaster University***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

19h30 **Session Ends** / ***Fin de la session***

[MO-POS] Monday evening Poster Session, with light supper / *Session d'affiches du lundi soir, avec léger souper*

MONDAY, JUNE 9 / LUNDI, 9 JUIN

17h00 - 19h45

ROOM / SALLE ***VCH Main Hallway (2nd & 3rd floor)***

(See page 139 for abstracts / Voir page 139 pour les résumés)

19h45 **Session Ends** / ***Fin de la session***

[MO-PIC] PIC Editorial Board Meeting / *Réunion du Comité de rédaction de La Physique au Canada*

(CAP / *ACP*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

17h30 - 19h00

ROOM / SALLE ***VCH 1039C*** **(cap. 25)** ***Chair: B. Joos, University of Ottawa***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

19h00 **Session Ends** / ***Fin de la session***

[MO-CJP] CJP Editorial Board Meeting / *Réunion du conseil d'édition de la revue canadianne de la physique*

(CJP / *RCP*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

19h30 - 21h00

ROOM / SALLE ***Les Anciens canadiens (downtown restaurant)*** ***Chair: M..O. Steinitz, St. Francis Xavier University***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

21h00 **Session Ends** / ***Fin de la session***

[MO-PUBLIC] Special Public Lecture (History of Science in Quebec) / *Conférence publique spéciale (histoire des sciences au Québec)*

(CAP / *ACP*)

MONDAY, JUNE 9 / LUNDI, 9 JUIN

20h00 - 21h00

ROOM / SALLE ***PPP - Théâtre de la Cité Universitaire*** ***Chair: R. Roy, Université Laval***

MO-PUBLIC-1 **20h00**

JACQUES LACOURSIÈRE, Beauport Québec

Petite histoire des sciences et de leur enseignement au Québec

Samuel de Champlain possédait un astrolabe. Des missionnaires jésuites ont étudié des éclipses de soleil et de lune, ainsi que le passage de quelques comètes. Louis Hébert a envoyé de nouvelles plantes à Paris. Ce n'était là qu'un début. Par la suite, des Canadiens ont, à leur manière, enrichi les connaissances scientifiques. Quelques-uns ont fait partie de grandes académies européennes. Dans plusieurs collèges classiques, on utilisait, pour l'enseignement de la physique, des instruments modernes. Citons le cas de l'abbé Jérôme Demers, du Séminaire de Québec. La fondation de la Société royale du Canada, en 1882, signifiera une rapide propagation des connaissances scientifiques.

21h00 **Session Ends** / ***Fin de la session***

TUESDAY, JUNE 10 - MARDI, 10 JUIN

[TU-CNILC] CNILC Breakfast meeting
Réunion du Comité national canadien de liaison avec l'UIPPA

(CAP-CNILC / *ACP-CNCLU*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
07h00 - 08h10

ROOM / SALLE ***POP 2165*** **(cap. 28)** ***Chair: G. Drake, University of Windsor***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

08h10 **Session Ends** / ***Fin de la session***

[TU-HS-REGN] HS Teachers' welcoming reception
Réception d'accueil pour les enseignants

(CAP / *ACP*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
07h15 - 08h15

ROOM / SALLE ***VCH 2870*** **(cap. 57)** ***Chair: M. Duguay, Université Laval***

See page 10 for details about workshop / *Voir page 10 pour les détails de l'atelier*

08h15 **Session Ends** / ***Fin de la session***

[TU-Plen1] Plenary Session : Teaching Medal
Session plénière : Médaille d'enseignement

(CAP / *ACP*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
08h15 - 09h00

ROOM / SALLE ***VCH 2850*** **(cap. 404)** ***Chair: M.N. Butler, St. Mary's University***

TU-PLEN1-1 **08h15**

ADAM JAMES SARTY, Saint Mary's University

Physics Education Across the Continuum: Opening Doors at All Levels

In the business of university physics education, I have encountered "doors" (both literal and figurative!) that face students and/or instructors – and the road to enhanced educational opportunities lies in the opening of these doors. In this presentation, I will explore the various doors I have found, and how I've attempted to open them. I hope to illustrate that, although these doors are located all across the educational continuum (from the elementary school student first encountering physics, to the first year university engineering student taking introductory physics, to elementary and high school science teachers, to the physics professors themselves), all of them can play an important role in university physics teaching. When closed, these doors present barriers that limit opportunity - for example (to name a few): a barrier between a narrow focus on teaching and the multidisciplinary, methodical practices conducted in the rest of the academy; a barrier between our students learning styles and how physics content is delivered; a barrier between a student's potential to succeed in university physics and their long-ingrained "fear of physics". While none of the "tools" I will discuss are particularly new - nor am I the first to utilize them - I hope that my linking together of many different tools and techniques (in seemingly disparate arenas), with the focus of enhancing accessibility to physics education through "opening doors", can provide some useful insight to others engaged in physics education pursuits.

09h00 **Session Ends** / ***Fin de la session***

[TU-Plen2] Plenary Session - Eric Mazur : Teaching
Session plénière - Eric Mazur : Enseignement

(CAP-DPE / *ACP-DEP*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
09h00 - 09h45

ROOM / SALLE ***VCH 2850*** **(cap. 404)** ***Chair: R. Thompson, University of Calgary***

TU-PLEN2-1 **09h00**

ERIC MAZUR, Harvard University

Confessions of a converted lecturer

I thought I was a good teacher until I discovered my students were just memorizing information rather than learning to understand the material. Who was to blame? The students? The material? I will explain how I came to the agonizing conclusion that the culprit was neither of these. It was my teaching that caused students to fail! I will show how I have adjusted my approach to teaching and how it has improved my students' performance significantly

09h45 **Session Ends** / ***Fin de la session***

[TU-A1] New Investigators in Condensed Matter and Materials Physics / *Nouveaux chercheurs(ses) en matière condensée et matériaux*

(DCMMP / *DPMCM*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

10h00 - 12h00

ROOM / SALLE ***VCH 3840*** **(cap. 106)** ***Chair: Steve S.N. Patitsas, University of Lethbridge***

TU-A1-1 **10h00**

CAN-MING HU, University of Manitoba

Spin Dynamics in Ferromagnetic and Spintronic Materials *

Understanding spin dynamics in magnetic and spintronic materials has both scientific significance and application importance [1]. The Canadian magnetism community has made significant contributions to this field [2-9]. Within this context, I will review in this talk our recent work [9] performed at the University of Manitoba, which include (I) Generation of electrical current via spin precession. (II) Electrical detection of spin waves in Py microstrips. (III) Direct mapping of spin wave evolution. (IV) Broadband FMR spectroscopy on GaMnAs. (V) Developing a new approach for detecting rf magnetic field vectors. Students looking for research opportunities are invited to come by to learn about this exciting frontier of condensed matter physics.

1. Peter Grünberg, 2007 Nobel Physics Lecture, http://nobelprize.org/
2. J. van Lierop and D.H. Ryan, Phys. Rev. Lett. **86**, 4390 (2001).
3. Z.K. Wang, *et al.*, Phys. Rev. Lett. **89**, 027201 (2002).
4. B. Heinrich, *et al.*, Phys. Rev. Lett. **90**, 187601 (2003); **94**, 197603 (2005).
5. M. Buess, *et al.*, Phys. Rev. Lett. **94**, 127205 (2005).
6. B.C. Choi, *et al.*, Phys. Rev. Lett. **95**, 237211 (2005).
7. K.J. Chau and A.Y. Elezzabi, Phys. Rev. Lett. **98**, 133901 (2007).
8. Zhigang Liu, *et al.*, Phys. Rev. Lett. **98**, 087201 (2007).
9. Y.S. Gui, *et al.*, Phys. Rev. Lett., **98**, 217603 (2007); **98**, 107602 (2007); Phys. Rev. B, **76**, 224430 (2007). Appl. Phys. Lett. **91**, 082503 (2007); Physics in Canada, **63**, No. 2, 67 (2007).

* This work is being supported by NSERC, CFI, URGP

TU-A1-2 **10h30**

SEAN CADOGAN, University of Manitoba

Magnetism, Valence and the Magnetocaloric Effect in $R_5(Si,Ge)_4$ compounds (R =rare-earth) †

The crystallography of the intermetallic compounds R_5M_4 (where R =rare-earth and M = Si, Ge, Sn) has been studied since the 1960's but these compounds are enjoying renewed interest due to their magnetocaloric properties, with $Gd_5Si_2Ge_2$ becoming established as a major component of the next generation of refrigeration materials. We have been studying the magnetic order in the R_5M_4 compounds using a combination of neutron diffraction and Mossbauer spectroscopy. In this talk, we will present results on the determination of the magnetic structures of various compounds, as well as the mixed-valence behaviour of Yb in the $Yb_5(Si,Ge)_4$ compounds.

† In collaboration with D.H. Ryan, McGill University

TU-A1-3 **11h00**

KEVIN BEACH, University of Alberta

Simulating frustrated spin systems using valence bonds

In addition to states with ordered local moments, quantum magnets can support a variety of paramagnetic ground states that have no classical analogue. The most natural description of these exotic states is in terms of so-called valence bonds (singlet pairs), which exhibit liquid ("resonating") or crystalline behaviour. The valence bond basis, which consists of all possible bond tilings of the spin lattice, is quite unusual. It is maximally overcomplete, with every two of its states having nonzero overlap. This property make the basis inappropriate for use with conventional algorithms that depend on orthonormality, but it does open the door to new algorithms that exploit the overcompleteness. For example, frustrated quantum magnets are not amenable to simulation using conventional quantum Monte Carlo because of the infamous sign problem. In the overcomplete basis of singlet product states, however, updates have a many-to-one property that allows for grouping of updates around plaquettes in such a way that the negative sampling weights are almost entirely eliminated.

TU-A1-4 **11h30**

ROGER MELKO, University of Waterloo

Quantum Phase Transitions via Large-Scale Computing

Quantum phase transitions occurring between different ordered states, driven by quantum instead of thermal fluctuations at zero (or near-zero) temperature, exist in a plethora of electronic systems, quantum magnets, and atomic matter. Exploring quantum phase transitions in microscopic Hamiltonians is a challenging theoretical task, made feasible by new computational techniques devised to simulate quantum models on classical computers. The continuing advancement of simulation technology, coupled with modern high-performance computing infrastructure, has allowed for the discovery new physical phenomena in a variety of microscopic models. I will discuss some of the most exciting recent advances, in particular the possibility of new paradigms in quantum criticality that lie outside of the standard Landau-Ginzburg-Wilson framework. Associated with this new class of quantum criticality may be novel and exotic emergent phenomena, such as topological order and quantum number fractionalization. Because of the concept of universality, it may be possible to observe such exotic physics outside the microscopic models, in real experimental systems. The calculation and classification of universal properties such as critical exponents is therefore an important, if expensive, computational task.

12h00 **Session Ends / *Fin de la session***

[TU-A2] Theoretical Biophysics / *Biophysique théorique*

(DMBP / *DPMB*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
10h00 - 12h30

ROOM / SALLE ***VCH 3830*** **(cap. 110)** ***Chair: M. Karttunen, University of Western Ontario***

TU-A2-1 **10h00**

JOERG ROTTLER, University of British Columbia

Deformation, flow and aging in glassy materials *

The slow dynamics found in most disordered solids such as glassy polymers, amorphous metals or colloidal glasses presents great challenges to theory and simulation of materials. The inability to reach equilibrium on experimental timescales is due to the many geometric constraints that the molecules experience in dense, "jammed" configurations. In addition, our understanding of how such amorphous materials yield and flow under the application of stress or strain is much less developed than in crystals, where well-defined defects such as dislocations are the carriers of plastic deformation. This talk will demonstrate how molecular simulations provide new insight into the complex, microscopic origins of the elastoplastic behavior of amorphous matter. The intrinsic relaxation (aging) dynamics of the glasses can lead to intriguing phenomena: aging modifies the mechanical properties, and deformation modifies aging. We investigate this interplay in coarse-grained models for polymer and metallic glasses. Molecular dynamics simulations are used to determine the macroscopic shear yield stress as well as the compliance of the model glasses for different loading conditions, temperatures, strain rates and aging times, and we identify the relationship to the underlying microscopic distribution of relaxation times. As in experiments, we find that large stresses decrease the relaxation times and cause mechanical rejuvenation. Furthermore, we find new behavior when the aging glass undergoes more involved thermal protocols such as a temperature step. Phenomenological models will be developed that describe the data over a wide range of temperature, stress and strain rates. We also discuss how continuum models such as energy landscape pictures and the recently formulated shear transformation zone (STZ) theory of amorphous plasticity can account for the aging effects observed in the molecular simulations.

* This work is being supported by NSERC, CFI

TU-A2-2 **10h30**

P.B. SUNIL KUMAR, Indian Institute of Technology, Madras

Strain hardening, avalanches and strain softening in dense cross-linked actin networks

Biological cells have an amazing capacity to change their shape and to adjust to a variety of external conditions. The dynamical structural organization needed for this is believed to be facilitated by a mesh-like structure formed of protein filaments, active and passive cross-linkers and a chemical network that is able to control the amount of cross-linking. Actin filaments are one of the major constituents of this network. Actin filament networks enable the cytoskeleton to adjust to internal and external forcing. These active networks can adapt to changes by dynamically adjusting their cross-links. Here, we model actin filaments as elastic fibers of finite dimensions. We employ a full three-dimensional model to study the elastic properties of actin networks by computer simulations. We model a dense actin network with the cross-links being approximately lμm apart. The results show compelling evidence that dense actin networks, are characterized by (a) strain hardening without entropic elasticity, (b) avalanches of cross-link slippage leading to strain softening in the case of breakable cross-links, and (c)spontaneous formation of stress fibers in the case of dynamic cross-link formation and destruction.

TU-A2-3 **11h00**

Protein Folding Simulation of Mutant Go Models of the Trp-cage Protein*, **Apichart Linhananta**, *Lakehead University* — For the past three decades, Go models of protein folding have played important roles in the understanding of how proteins fold from random conformations to their unique native structures. Unfortunately Go models reliance on known NMR or x-ray structures to construct interaction potentials severely limit their predictive powers. In this work, we introduce a novel method for constructing Go interaction potentials of mutant proteins based on Go interaction potentials of wild type proteins. As a template we employ the all-atom Go model of the 20-residue Trp-cage protein [1] as the wild type Go model. Trp-cage mutants are constructed by replacing a Trp-cage residue with a different residue. In particular the Pro-12 residue of the Trp-cage is substituted by Trp-12 to produce the Trp^2-cage mutant, whose native structure is not yet known. Monte Carlo simulations, using CHARMM force fields, are performed to determine the ground-state structure of the mutant, which is used to construct the Go interaction potential of the Trp^2-cage mutant Go model. Folding simulations of the Trp^2-cage mutant Go model find a significant increase in folding rate compare to the Trp-cage Go model. Comparisons will be made with a recent experiment on the Trp^2-cage mutant.

1. A. Linhananta, J. Boer and I. MacKay, *J. Chem. Phys.*, 2005, **122**, 114901)

* This work is being supported by NSERC

TU-A2-4 **11h15**

Membrane-Charge Selectivity of Cationic Antimicrobial Peptides*, **Bae-Yeun Ha**, Sattar Taheri-Araghi, *University of Waterloo* — Antimicrobial peptides are known to selectively disrupt microbial membranes through hydrophobic insertion into the outer layers, which carry a large fraction of anionic lipids. Here, we present a physical basis for membrane-charge selectivity of cationic antimicrobial peptides. In particular, we provide a clear picture of how peptide charge Q influences the selectivity — one salient feature is the existence of an optimal peptide charge, at which selective insertion is optimized. Our results suggest that large Q is required for antimicrobial selectivity, consistent with experiments.

* This work is being supported by NSERC

TU-A2-5 **11h30**

Origin of contractile force during cell division of bacteria*, **Anirban Sain**, Biplab Ghosh, *Indian Institute of Technology, Bombay (INDIA)* — During the last phase of cell division in bacteria, the physical guillotining of the cylindrical shaped cell into two halves occurs via the contraction of a polymeric ring. This ring, made of intracellular proteins named FtsZ, anchors to the cell wall and starts to contract. That initiates a dividing septum to close in, like the shutter of a camera. All through, the ring remains at the leading edge of the septum and seems to power its closure. It is not understood why the ring contracts or how it generates the required contractile force. We propose a novel mechanism and simulate it to show that the ring generates force by exploiting the natural curvature of its FtsZ filaments. This new force generation mechanism is likely to be valid across a wide class of organisms, namely prokaryotes and even in some plant cells. It is worth mentioning that a similar contraction phenomenon occurs for the actin ring in Eukaryotes, but there it is due to motor proteins, which however, are absent in bacteria.

* This work is being supported by Dept. of Science & Technology (INDIA)

TU-A2-6 **11h45**

The energetics of G.A mispairs and their recognition in DNA*, **Julia Berashevich**, Tapash Chakraborty, *University of Manitoba* — The efficient recognition of DNA mispair is the most important step in DNA repair which is essential for genome stability and survival of the species. However, a proper understanding of the recognition process is still unavailable. It remains a collection of hypotheses based on some experimental studies. The reason for this is that the characteristic parameters of the base pair opening and nucleoside flipping can not be measured directly. The mispairs are the most frequent source of damage of DNA, while the G-A mispair is known to be poorly recognized by the mismatch repair system. In this work we investigate the efficacy of one of the mismatch recognition hypotheses - the efficiency of recognition is defined by the base pair opening dynamics. We found that the experimentally observed local perturbation of the phosphate backbone induced by the G-A/A-G tandem and stabilization of the DNA chain is a result of the structural/energetic compensation effect within tandem. We calculated the stability of a duplex containing the G-A mispairs or G-A/A-G tandem during the DNA melting and opening dynamics of the canonical base pairs and G-A mispairs adopted three different conformations in vacuum and within the DNA duplex. The duplex stability is found to be dependent on both DNA sequences and the conformation of the G-A mispairs. If the G-A/A-G tandem adopts the G(anti)-A(anti), G(anti)-A(syn) conformations the behavior of duplex stability on the DNA sequence is found to be opposite to that for the G-A sheared conformation. These results are supported by experimental observations, where dependence of the duplex stability on the DNA sequences often has been contradictory. Finally, it has been found that the thermodynamics of single pair opening within DNA duplex for the poorly recognized mispairs correlates with that of the canonical base pairs while for the easily recognized mispairs a significant difference is observed. We propose that the thermodynamics of pair opening is essential for the recognition process. Our findings indicate that the energetics of a mispair should be the main focus of experimental investigations of DNA mismatch recognition process.

* This work is being supported by the Canada Research Chairs Program and NSERC Discovery Grant

TU-A2-7 **12h00**

Controlling crystal growth using peptides. **Mikko Karttunen**, Jason O'Young, Bernd Grohe, Harvey Goldberg, Graeme Hunter, *University of Western Ontario* — Controlling mineralization, or crystal growth, in biological systems is essential for engineering new materials, understaning plaque formation in atherosclerosis as well as preventing the growth of kidney stones. Here, we focus on the physical mechanisms of peptide-crystal interactions to understand how the growth of calcium oxalate surfaces can be inhibited by using phosphorylated ostepontin peptides. We have performed atomistic molecular dynamics simulations which we correlate with experiments and have found how the phophorylated osteponting inhibits growth of calcium oxalate {100} surface through a mediated mechanism [1] not previously discovered.

1. "Control of calcium oxalate crystal growth by face-specific adsorption of an osteopontin phosphopeptide", B. Grohe, J. O'Young, A. Ionescu, G. Lajoie, K.A. Rogers, M. Karttunen, H.A. Goldberg and, G.K. Hunter *J. Am. Chem. Soc.* **129**, 14946-14951, 2007

TU-A2-8 **12h15**

Catching the cold: Can computational modeling explain the physical mechanisms behind cold denaturation?. **Cristiano Dias**, *University of Western Ontario* — Proteins assume a unique three-dimensional structure under physiological conditions. This structure becomes gradually unstable as temperature is raised or lowered. At about 60°C the ordered structure of proteins becomes unstable. This phenomenon is called denaturation and is also observed at low temperatures, around -20°C. While denaturation at high temperature is well understood, the mechanism behind denaturation at low temperature, i.e. cold denaturation, is still controversial. In this talk, I will discuss a microscopic mechanism, that we have recently proposed in the literature (*Phys. Rev. Lett.* **100**, 118101 (2008)), for cold denaturation.

12h30 **Session Ends / *Fin de la session***

[TU-A3] Precision Frontier I / *Les limites de la précision I*

(PPD / *PPD*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
10h00 - 12h15

ROOM / SALLE ***VCH 2830*** **(cap. 106)** ***Chair: S. Robertson, McGill U.***

TU-A3-1 **10h00**

STEVEN ROBERTSON, Institute for Particle Physics / McGill University

Recent results from the BABAR experiment

The BABAR experiment at the SLAC B-Factory possesses an extremely broad physics program which spans not only CKM and CP-violation studies in B meson decays, but also rare decay physics in the beauty, charm and tau lepton sectors and searches for new meson and baryon states. BABAR recently finished data taking at the Upsilon(4S) resonance and began collecting data in the region of the Upsilon(2S) and Upsilon(1S) bottomonium resonances in anticipation of the termination of the B-Factory program during the spring of 2008. With the completion of the data-taking phase, the focus of the experiment has shifted to the analysis of the full and final BABAR data set. This talk will describe recent operational activities, present some recent physics highlights and discuss the prospects for the remainder of the BABAR physics program.

TU-A3-2 **10h30** **(G*)**

Search For The Rare Decay $B\to l\nu\gamma$ at BaBar. **Dana Lindemann**, Steven Robertson, *McGill University* — We present the search for the radiative leptonic decay modes $B^+\to e^+\nu_e\gamma$ and $B^+\to \mu^+\nu_\mu\gamma$ using data collected by the BaBar detector at SLAC. This analysis uses a novel technique in which the accompanying B is exclusively reconstructed, providing cleaner kinematic information on the signal's missing energy and high momentum photon and lepton. With the approximately 465 million B meson pairs produced by this B-factory (corresponding to an integrated luminosity of ~ 423 fb^{-1}), the predicted Standard Model branching fraction of these rare decay modes may finally be within reach to produce a measurable signal. The combination of this unprecedented large data set and this promising new technique will allow a tighter measurement of the $B\to l\nu\gamma$ branching fraction in a model-independent way.

TU-A3-3 **10h45** **(G*)**

Measurement of the $B\to\eta^{(\prime)}l\nu$ Form-Factor Shapes and Branching Fractions*. **Martin Simard**, Joel-Etienne Myre, Paul Taras, Benoit Viaud, *BaBar - Universite de Montreal* — We report the results of a study of the exclusive charmless semileptonic decay, $B\to\pi l\nu$ and $B\to\eta^{(\prime)}l\nu$, undertaken with approximately 464 million BB pairs collected at the $\psi(4S)$ resonance with the BaBar detector. The analysis uses events in which the signal B decays are reconstructed with a loose neutrino reconstruction technique. We obtain partial branching fractions for B in four bins of q^2, the momentum transfer squared, from which we extract the $f_+(q^2)$ form-factor shapes and total branching fractions.

* This work is being supported by CRSNG

TU-A3-4 **11h00** **(G)**

Measurement of the $\tau^- \to \eta\pi^-\pi^+\pi^-\nu_\tau$ Branching Fraction and a Search for a Second-Class Current in the $\tau^- \to \eta'(958)\,\pi^-\nu_\tau$ Decay*, **Mateusz Lewczuk**, Randall Sobie, *University of Victoria* — The $\tau^- \to \eta\pi^-\pi^+\pi^-\nu_\tau$ decay with the $\eta \to \gamma\gamma$ mode is studied using 384 fb^{-1} of data collected by the BABAR detector at the PEP-II asymmetric-energy e+e$^-$ storage rings operated at the Stanford Linear Accelerator Center. The branching fraction is measured to be $(1.60 \pm 0.05 \pm 0.11) \times 10^{-4}$. It is found that $\tau^- \to f_1(1285)\,\pi^-\nu_\tau \to \eta\pi^-\pi^+\pi^-\nu_\tau$ is the dominant decay mode with a branching fraction of $(1.11 \pm 0.06 \pm 0.05) \times 10^{-4}$. The first error on the branching fractions is statistical and the second systematic. In addition, a 90% confidence level upper limit on the branching fraction of the $\tau^- \to \eta'(958)\,\pi^-\nu_\tau$ decay is measured to be 7.2×10^{-6}.

* This work is being supported by BaBar

TU-A3-5 **11h15** **(G*)**

A Muon Decay Spectrum Measurement from TWIST*, **Ryan Bayes**, *University of Victoria* — The TWIST experiment measures the momentum and angle of positrons from muon decay to determine the details of the Lorentz structure of the weak interaction to high precision. Results for the measurement of the parameters characterizing the decay spectrum, ρ, Δ, and $P_\mu\xi$ have been published by the TWIST collaboration with at least a factor of two improvement over pre-TWIST results. I will present a new measurement of ρ and Δ that further improves upon first TWIST results. I will discuss its impact on the weak Lorentz structure and describe the current efforts of the TWIST collaboration to achieve its final goal of a full order of magnitude over pre-TWIST measurements.

* This work is being supported by NSERC

TU-A3-6 **11h30** **(G*)**

Towards the First Direct Measurement of the Longitudinal Structure Function at the ZEUS Experiment*, **Jason Schwartz**, *McGill University* — The Longitudinal Structure Function (FL) is the most difficult component to measure of the Deep Inelastic Scattering (DIS) Cross Section. The ZEUS experiment at HERA is making the first direct measurement of this elusive function. Once extracted, FL will give insight into the Gluon Parton Distribution Function (PDF) in the Proton, which would be a valuable asset to all experiments dealing with deeply inelastic parton interactions. This contributed talk will discuss the experimental method used by the ZEUS collaboration to extract FL and will include the latest results.

* This work is being supported by McGill University

TU-A3-7 **11h45** **(G*)**

Cross section measurement of single top quark in tau+jets channel by decision trees, **Zhiyi Liu**, Dugan O'Neil, *Simon Fraser University* — The D0 experiment at Fermilab published significant evidence for the existence of single top quarks using electron+jets and muon+jets channels in proton-antiproton collisions with the energy 1.96 GeV. In this talk we will present a study on cross section measurement of single top quark production in the tau+jets channel. The tau identification, event selections, background modelling and signal discrimination approach used in the study will be discussed with special emphasis. One multivariate technique, which is employed for discriminating signal events from background, is decision trees. The current state of the decision tree analysis in the tau+jets channel is presented.

TU-A3-8 **12h00** **(G*)**

Barium tagging for the Enriched Xenon Observatory*, **Etienne Rollin**, *Carleton University* — The Enriched Xenon Observatory (EXO) proposes to measure the effective neutrino mass by observing neutrinoless double beta decay of xenon 136 into barium 136 in a large time projection chamber (TPC). An original way to possibly eliminate the number of background events from natural radioactivity in EXO would be to use lasers and the current knowledge of the barium ion spectroscopy to optically observe the daughter nucleus. Such technique would be a unique advantage over other neutrinoless double beta decay experiments and possibly the only way to convince every members of the scientific community of the existence of the decay. The talk will concentrate on the procedure to perform barium tagging and on the current apparatus used to observe a cloud of barium ions in gas.

* This work is being supported by Carleton University

12h15 **Session Ends / *Fin de la session***

[TU-A4] Quantum Information and Computing I / *Informatique et calcul quantiques I*

(DAMPhi-DOP / *DPAMip-DOP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

10h00 - 12h15

ROOM / SALLE VCH 3820 **(cap. 104)** ***Chair: A. Lvovsky, University of Calgary***

TU-A4-1 **10h00**

LUMING DUAN, University of Michigan, Ann Arbor

Controlling interaction of ultracold atoms in an optical superlattice *

First, I will briefly review the methods to control spin-exchange interaction for ultracold atoms in an optical lattice [1], and the recent experimental techniques to demonstrate the second-order tunneling and the spin exchange interaction with a superlattice [2]. Then, I will discuss the interaction for strongly interacting atoms in a lattice near a wide Feshbach resonance. The strong interaction brings in a number of new features such as multi-band populations and direct neighboring interaction. Under certain circumstances, this complicated system can be described by an effective single-band model (the general Hubbard model) which has particle assisted tunneling for the atoms [3]. The particle assisted tunneling means that the effective atomic tunneling rate from the site i to j depends on whether there is another atom on these two sites. The particle assisted tunneling brings in new feature for quantum many-body physics. I will describe an experimental scheme to test the prediction of the particle assisted tunneling for strongly interacting atoms based on the use of the optical superlattice technique [4]. Work supported by the MURI quantum simulation program and the DARPA OLE Program.

1. L.-M. Duan, E. Demler, M.D. Lukin, Controlling Spin Exchange Interactions of Ultracold Atoms in Optical Lattices, *Phys. Rev. Lett.* **91**, 090402 (2003).
2. S. Fölling, S. Trotzky, P. Cheinet, M. Feld, R. Saers, A. Widera, T. Müller, I. Bloch, Direct Observation of Second Order Atom Tunnelling, *Nature* **448**, 1029 (2007); M. Anderlini, P.J. Lee, B.L. Brown, J. Sebby-Strabley, W.D. Phillips, J.V. Porto, *Nature* **448**, 452 (2007).
3. L.-M. Duan, Effective Hamiltonian for fermions in an optical lattice across a Feshbach resonance, cond-mat/0508745, *Phys. Rev. Lett.* **95**, 243202 (2005); L.-M. Duan General Hubbard model for strongly interacting fermions in an optical lattice and its phase detection, arXiv:0706.2161, *Europhys. Lett.* **81**, 20001 (2008).
4. T. Goodman, L.-M. Duan, Test of particle assisted tunneling with strongly interacting atoms in an opticla superlattice, in preparation.

* This work is being supported by MURI and DARPA

TU-A4-2 **10h30**

Escaping decoherence*, **Barry Sanders** [1], Raisa Karasik [2], Karl-Peter Marzlin [1], K. Birgitta Whaley [2], [1] *University of Calgary*, [2] University of California at Berkeley — Decoherence is the bane of quantum information, and putting states into decoherence-free subspaces is one strategy to avoid this destruction of quantum information. The bad news is that we have found that decoherence free subspaces do not exist for extended systems in more than one dimension for a broad class of realistic reservoirs, but the good news is that we have discovered that in some cases the environment protects certain states by disallowing them from decohering via a nudging process from the unitary part of the open system dynamics. Examples are given from cavity quantum electrodynamics and squeezed light.

* This work is being supported by CIFAR, iCORE, QuantumWorks, NSF, DARPA, USAF, NSERC

TU-A4-3 **10h45** **(G*)**

Towards unambiguous quantum state discrimination in an optical memory*, **Ahdiyeh Delfan Abazari**, Erhan Saglamyurek, Cecilia La Mela, Wolfgang Tittel, *University of Calgary* — The possibility to store and recall information encoded into quantum states of light is at the heart of many applications of quantum information processing, including a quantum repeater [1]. A recently proposed approach to such a quantum memory employs controlled reversible inhomogeneous broadening (CRIB) [2,3,4]. Beyond storage, a modified version of CRIB allows quantum state manipulations [5]. CRIB is currently still challenging, however, it is possible to study closely related atom light interaction via stimulated photon echoes [6]. Nonorthogonal state discrimination based on POVMs (positive operator valued measure) has become an interesting problem in quantum information processing from a fundamental [7] as well as applied [8] point of view. In this kind of measurement a set of nonorthogonal states is mapped onto a set of orthogonal ones by a non unitary transformation. We propose a novel, robust implementation of POVMs that combines quantum state storage with state rotations and is based on stimulated photon echoes. We will present simulations based on numerically solving Maxwell Bloch equations in an inhomogenously broadened medium, and discuss the experimental results.

1. H.J. Briegel, *Phys. Rev. Lett.* **81**, 5932(1998)
2. A.L. Alexander *et al*, *Phys. Rev.Lett.* **96**, 043602(2006)
3. B. Kraus *et al*, *Phys. Rev. A* **73**, 020302(2006)
4. M. Nilsson *et al*, *Opt. Comm.* **247**, 393 (2005)
5.M. Underwood *et al*, in preparation.
6.M.U. Staudt *et al*, *Phys. Rev. Lett.* **98**, 113601 (2007)
7.Y Sun *et al*, *Phys. Rev A* **64**, 022311(2001)
8.V. Scarani *et al*, *Phys. Rev. Lett.* **92**, 057901(2004)

* This work is being supported by iCore,NSERC,CFI,General Dynamics,AAET

11h00 **Coffee Break / *Pause café***

TU-A4-4 **11h15** **(G*)**

A simple method to characterize a synchronous heralded single photon source*, **Joshua Slater**, Félix Bussières, Yasaman Soudagar, Suzanne Lacroix, Nicolas Godbout, Wolfgang Tittel, *University of Calgary* — As quantum cryptography and communication continue to develop, the need for true single photon sources is continuously growing. The production of photon pairs through 2nd and 3rd order non-linear processes in crystals and optical fibre are simple methods for constructing a high quality heralded single photon source (HSPS). The ability to employ such sources for quantum communication depends on the multi-pair statistics of the source, which is conventionally characterized by measuring the second order autocorrelation function, $g_2(0)$, with a Hanbury Brown and Twiss (HBT) experimental setup. In practice, a HBT experiment can be difficult to realize, especially when the source is of high quality. We will present a fast and simple method to predict the $g_2(0)$ of a HSPS based on nonlinear crystals or optical fibre and show agreement with results from a standard HBT experiment using a PPLN crystal. We will also report on our progress towards repeating the experiment using a microstructured fibre that has nonlinear properties tailored to create a HSPS at telecom wavelengths.

* This work is being supported by NSERC, General Dynamics Canada, iCORE, AAET, CFI, NATEQ, AIF.

TU-A4-5 **11h30** **(G*)**

Benchmarking single and multi-qubit control in liquid state NMR quantum information processing*. **Martin Laforest**, Colm Ryan, Raymond Laflamme, *Institute for Quantum Computing* — Being able to quantify the level of coherent control in a proposed quantum information processing (QIP) device is an important task for both comparing different implementations and assessing a device's prospects with regards to achieving fault tolerant quantum control. We implement in a liquid state nuclear magnetic resonance QIP the randomized benchmarking protocol presented by Knill *et al* (Phys. Rev. A 77, 012307 (2008)). Generalization to multi-qubit benchmarking is also under investigation. The protocol consists of applying a sequence of randomly chosen computational gates to a fiducial initial state and for an increasing number of gates. By averaging over multiple gate sequences, the noise introduced while performing the gates becomes depolarized with a depolarizing strength related to the original noise strength. This depolarized noise strength is obtained from the average attenuated correlation between the measured and the expected outcome state (known as the state fidelity). We report an error per randomized $\pi/2$ pulse of $3\pm0.5 \cdot\times 10^{-4}$ for a single qubit QIP and a three qubit processor is currently under investigation. We estimate that this error is still not decoherence limited and thus can be improved with modifications to the control hardware and software. The advantage with this protocol is that it requires only a polynomial amount of experiments in the number of qubits, unlike other noise characterization protocols (e.g. quantum process tomography), which scale exponentially. It is also fairly robust to state preparation and readout.

* This work is being supported by NSERC, FQRNT

TU-A4-6 **11h45** **(G*)**

Quantum optics in superconducting circuits : The side-effects of measurement*, **Maxime Boissonneault**[1], Jay Gambetta [2], Alexandre Blais [1], [1] *Université de Sherbrooke*, [2] Institute for Quantum Computing and Department of Physics and Astronomy, University of Waterloo — To study quantum optics in superconducting circuits, a superconducting charge qubit is fabricated inside a high quality superconducting coplanar resonator. The qubit then plays the role of an atom in a cavity realized by the coplanar resonator. This is the circuit equivalent of cavity QED [1], however, due to the 1D configuration, it has a much stronger qubit-cavity interaction, thereby allowing us to probe new quantum effects. In the dispersive regime, where the detuning between the qubit and the resonator frequency is large with respect to their coupling, the qubit-resonator interaction can be treated perturbatively. The physics is then understood in terms of Lamb and Stark shifts, and the qubit state can be read through the state-dependent pull of the cavity frequency. However, as the coupling strength or the number of photons in the resonator increases, this description breaks down. In this talk, we will explain that, when taking into account higher order corrections, measurement photons act as a heat bath inducing incoherent relaxation and excitation of the qubit. Moreover, due to non-linear terms in the perturbation theory, we show that the pull of the cavity frequency decreases with increasing number of photons, therefore reducing the amount of information about the qubit state per photon. We will discuss how this can decrease achievable signal-to-noise ratio and may reduce the quantum non-demolition (QND) aspect of the measurement.

1. A. Wallraff, *et al*., *Nature* **431**, 162 (2004)

* This work is being supported by NSERC, FQRNT, CIFAR, MITACS, ORDCF

TU-A4-7 **12h00** **(G*)**

Entangled Free-Space Quantum Key Distribution*, **Chris Erven**, Raymond Laflamme, Gregor Weihs, *Institute for Quantum Computing - University of Waterloo* — While the origins of quantum physics are more than one hundred years old, we have only recently begun to understand its power in information processing. Feynman was among the first to suggest that quantum systems may go beyond those based on classical physics in a way that fundamentally changes the representation of information. While full-scale quantum computers are still out of reach, secure communication based on quantum physical laws is starting to become a commercial product. Yet, such ground-based quantum key distribution (QKD) systems will not be able to go any further than 200km because of the intrinsic propagation loss in optical fibers. We have designed and built an entanglement based QKD system that uses free-space optical (FSO) transmission to connect three buildings on the University of Waterloo campus. The system implements the BBM92 protocol, which uses entangled photon pairs distributed across two free-space links to establish a secure, secret, random key between two receivers. We have implemented a full QKD system including all error correction and privacy amplification procedures. Currently, we have performed QKD experiments across one 450m free-space link whereas the second photon in each pair was detected locally. In this configuration we saw total detected pair rates of 4.2kbits/s which yielded a final key rate of 1.1kbits/s. Initial experiments with the second 1.3km link have seen total detected pair rates of between 150bits/s and 1.0kbits/s depending on atmospheric conditions.

* This work is being supported by NSERC, CFI, CIAR, OPC, QuantumWorks

12h15 **Session Ends / *Fin de la session***

[TU-A5] Biomedical Instrumentation / *Instrumentation biomédicale*

(DIMP-DMBP / *DPIM-DPMB*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
10h00 - 12h30

ROOM / SALLE ***VCH 2840*** **(cap. 98)** ***Chair: K.H. Michaelian, CANMET, Natural Resources***

TU-A5-1 **10h00**

ANDREAS MANDELIS, Center for Advanced Diffusion Wave Technologies; Quantum Dental Technologies

Investigation of Demineralization and Remineralization of Human Teeth Using Infrared Photothermal Radiometry and Modulated Luminescence †

Photothermal radiometry (PTR) and modulated luminescence (LUM) were applied to detect artificially created demineralized and remineralized lesions on the root and enamel of human teeth. The experimental set-up consisted of a semiconductor laser (659 nm, 120 mW), a mercury-cadmium-telluride IR detector for PTR, a photodiode for LUM, and two lock-in amplifiers. A lesion was created on a 1-mm X 4-mm rectangular window, spanning root to enamel surface, using an acidified gel to demineralize the tooth surface. The samples were subsequently immersed in a remineralization solution. Each sample was examined with PTR/LUM on root and enamel before and after treatment at times from 1 to 10 days of demineralization and 2 to 10 days of remineralization. PTR/LUM signals showed gradual and consistent changes with treatment time. After completing all the experiments, transverse micro-radiography (TMR) and micro-computed tomography (μ–CT) analyses were performed to correlate the PTR/LUM signals to depth of lesions and mineral losses. In this study, TMR showed good correlation coefficients (0.6-0.8) with PTR/LUM, while μ–CT showed poor correlation. It was also found that treatment duration did not correlate well to any technique, PTR/LUM, TMR or μ–CT, which is indicative of significant variations in demineralization - remineralization rates among different teeth. Preliminary theoretical interpretation of the data in terms of coupled diffuse photon density and thermal-wave fields will be presented.

† In collaboration with Raymond Jeon [1], Adam Hellen [1], Anna Matvienko [1], Stephen Abrams [2], Bennett Amaechi [3], [1] Center for Advanced Diffusion Wave Technologies; Quantum Dental Technologies, [2] Quantum Dental Technologies, [3] Department of Community Dentistry, University of Texas Health Science Center at San Antonio

* This work was supported by the Ontario Centres of Excellence and NSERC Discovery Grants

TU-A5-2 **10h30**

SERGEY TELENKOV, CADIFT, Dept. of Mechanical Engineering, University of Toronto

Photothermoacoustic (PTA) imaging of breast tissue: numerical simulation and detection analysis †

The photothermoacoustic (PTA) imaging modality is analyzed using numerical simulation of diffuse photon propagation and acoustic wave generation in breast tissue. Our numerical analysis employs the real shape of human breast and the finite element method (FEM) to solve the three-dimensional problem of diffuse photon transport. Optical heterogeneities simulating breast tumors were synthesized numerically to evaluate capabilities of the PTA modality to image breast cancer. Photothermoacoustic signal detection is analyzed assuming short-pulse and frequency-modulated optical excitation of tissue. Advantages and limitations of both detection techniques are discussed.

† In collaboration with Andreas Mandelis, CADIFT, Dept. of Mechanical Engineering, University of Toronto

* This work was supported by the 2007 Ontario Premier's Discovery Award in Science and Engineering (AM)

TU-A5-3 **11h00**

YUAN XU, Ryerson University

Magneto-Acousto-Electrical Tomography: a Potential Imaging Modality for Electrical Impedance †,*

We report our theoretical and experimental investigations on a potential imaging modality for the electrical impedance of biological tissues, Magneto-Acousto-Electrical Tomography (MAET). In MAET, an ultrasound beam is focused into the sample located in a static magnetic field. The vibration of ions in the sample caused by the ultrasound can induce electric current through the mechanism of Lorentz force. Consequently, a voltage can be measured at the boundary of the sample. This voltage is proportional to the current density that exists at the ultrasound focal point when a unit current is injected into the sample through the measurement electrodes. If the ultrasound beam is scanned throughout the samples, the current density distribution in the sample can be mapped. After that, the electrical impedance of the sample may be reconstructed from the current density distribution. MAET combines the good contrast of electrical impedance tomography with the good spatial resolution of sonography. In the theoretical part, we provide the formulas for both the forward and inverse problems of MAET. In the experimental part, the experiment setup and methods are introduced and the current density images of gelatin objects by means of MAET are presented.

† In collaboration with Vitaliy Ivantsiv, Elena Renzhiglova, Syed Haider, Andrew Hrbek, Department of Physics, Ryerson University

* This work is being supported by NSERC discovery

TU-A5-4 **11h30**

Diffusion Weighted Imaging of Optic Chiasm in Experimental Autoimmune Encephalomyelitis Mice*, **Melanie Martin** [1], Annie Kim [2], Jonathan Thiessen [2], Angela Schellenberg [2], Blair Cardigan Smith [1], Marc Del Bigio [2], Richard Buist [2], [1] *University of Winnipeg*, [2] University of Manitoba — Multiple Sclerosis (MS) is an autoimmune disease of the central nervous system. While magnetic resonance imaging (MRI) is used to diagnose MS, little is known about the relationship between lesions and signs of the disease. Since MS often first presents with compromised vision, our studies focussed on detecting and understanding lesions in the optic chiasm. Myelin oligodendrocyte glycoprotein (MOG)-induced experimental autoimmune encephalomyelitis (EAE) is a good murine model resembling human MS disease with optic neuritis. MOG-EAE mice can develop lesions by demyelination and inflammation. *In vivo* brain diffusion-weighted imaging (DWI) of axial slices including regions of the optic chiasm, anterior commissure and the third ventricle were imaged before the onset and at several stages of EAE. Most affected animals displayed enlarged ventricles and increased diffusivities in the optic chiasm suggesting inflammation. Just after peak of the disease, animals were sacrificed and their brains examined with histology. Haemotoxylin & Eosin Y stains showed blue nuclei aggregation superficially within the optic chiasm, which is indicative of an inflammatory response. The intensity of Solochrome Cyanine myelin staining is reduced within the optic chiasm, possibly indicating demyelination. Thus DWI can successfully detect inflammation in the optic chiasm. Since the course of disease and lesions detected differed among animals, this study confirms the need to study *in vivo* MOG-EAE mice.

* This work is being supported by Natural Sciences and Engineering Research Council of Canada and University of Winnipeg

TU-A5-5 **11h45** **(G)**

Magneto-Acousto-Electrical-Tomography: A novel imaging modality for current density and electrical impedance*, **Syed Haider**, Andrew Hrbek, Yuan Xu, *Ryerson University* — Quantitative measurement of the distribution of electrical impedance inside a biological tissue is useful for many applications, such as cancer detection and monitoring of physiological functions. This paper outlines our investigation on utilizing Magneto-Acousto-Electrical Tomography (MAET) to image lead field current density. It can be mathematically shown, that the lead field current density may further be utilized to reconstruct the electrical impedance distribution in a piecewise smooth object. A lead field current density distribution is obtained when a current/voltage is applied to a biological sample via pair of electrodes. In order to image the lead field current density, rather than applying current/voltage to the sample directly, we place it in a static magnetic field and focus an ultrasonic pulse on it, to simulate a point like current dipole source at the focal point. Then by using electrodes we measure the voltage/current signal which, based on the reciprocity theorem, is proportional to a component of the lead field current density. High spatial resolution image of current density in 2D and 3D are shown for the first time using MAET. Possible improvements in the process are discussed in the end.

* This work is being supported by Ryerson start up fund and NSERC discovery grant

TU-A5-6 **12h00**

Determination of the Least Significant Change in Bone Densitometry*, **Jeff Frimeth** [1], Eduardo Galiano [1], Dave Webster [2], [1] *Laurentian University*, [2] St. Joseph's Hospital-Sudbury — Bone mineral density (BMD) measurements are important in the diagnosis of bone diseases such as osteoporosis. BMD is typically measured with a Dual Energy X-ray Absoprtiometer (DXA) and compared to reference databases to quantify the risk of a fracture. The International Society of Clinical Densitometry (ISCD) recommends that a precision study be implemented at all clinical sites performing BMD measurements. The goal of a precision study is to determine the precision error involved in measuring the BMD of a patient between serial measurements. Factors associated with the DEXA, the patient, and the operator, can all affect BMD measurement precision for sequential scans on a given patient under identical conditions. Once the precision error is calculated, it is used to compute the Least Significant Change (LSC), which determines whether the difference between two sequential BMD measurements on a given patient is due to a physiological change, or a random statistical fluctuation. The precision error has been calculated for the Lunar Prodigy™ DEXA at St. Joseph's Hospital in Sudbury, ON. The computed value correlates well with results reported by other investigators at different sites. The methodology to calculate precision error and the corresponding LSC, as well as comparison to other published results will be discussed.

* This work is being supported by Laurentian University-St. Joseph's Hospital Sudbury

TU-A5-7 **12h15** **(G*)**

Nonlinear effect in Magneto-Acousto-Electrical Tomography to improve the imaging modality*, **Elena Renzhiglova**, Vitaly Ivantsiv, Yuan Xu, *Ryerson University* — Electrical impedance Tomography (EIT) of tissues is of some clinical interest today, but its application is limited due to its low spatial resolution. We propose Magneto-Acousto-Electrical Tomography (MAET) to measure lead field current density and electrical impedance with higher spatial resolution. In our studies, sample is put in a static magnetic field and a focused ultrasound field. The focused ultrasonic field induces movement of ions in a focal range inside the sample, which causes a local voltage source by means of Lorentz force. A voltage/current can then be measured through the measurement electrodes attached on the surface of the sample. Due to the Helmholtz reciprocity theorem, electrode signal is proportional to one component of lead field of the sample. With our method, it is possible to measure lead field current density with the resolution of diameter of the ultrasound beam. However, due to velocity oscillations, signal inside a homogenous part of the sample appears to be cancelled out, and only signal from interfaces in the sample can be obtained. We will discuss the possibility to overcome this cancellation by using nonlinear low-frequency MAET signals.

* This work is being supported by NSERC; Ryerson start-up fund

12h30 **Session Ends / *Fin de la session***

[TU-A6] Heavy Ion / *Ions lourds*

(DNP / *DPN*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
10h00 - 12h00

ROOM / SALLE ***VCH 2826*** **(cap. 42)** ***Chair: R.A.E. Austin, St. Mary's University***

TU-A6-1 **10h00**

ABDELOUAHAD CHBIHI, GANIL

Exploring the symmetry energy with isospin effects in heavy-ion collisions

In this contribution we will describe an experiment performed at GANIL, in order to measure the isotopic distributions of the fragments produced in $^{40,48}Ca+^{40,48}Ca$ collisions at E/A=35 MeV using the multi detector INDRA coupled to the VAMOS Spectrometer. We will show a study of these distributions, in order to estimate the relative contribution of surface and volume terms to the symmetry energy in the nuclear EOS. The knowledge of these relative contributions and, especially, the relevance of the surface term are key to explore to what extent one can learn about the density dependence of the symmetry energy in infinite nuclear matter from multi fragmentation of finite nuclei and from nuclear reaction dynamics.

TU-A6-2 **10h30** **(G*)**

Design and implementation of a gain control system for the Héraclès multidetector. **Marc Olivier Frégeau**, *Université Laval, Groupe de recherche sur les ions lourds* — The Héracles multidetector is an assembly of many different detectors used for the study of heavy ions collisions. Different scintillators like BaF_2, CsI and plastic scintillators are used to achieve this objective. Light emitted by scintillators is gathered and transformed in electric current by photomultipliers (PMT). These devices transform light with a photocathode and then 10 dynodes amplify the photocathode current by a factor that may reach 1,1 X 10^6 (Hamamatsu R580). During its last experience in Texas A&M the Groupe de recherche sur les ions lourds de l'université Laval encountered important PMT's gain variations which seriously affected experimental results. In order to follow gain variations and to correct data a posteriori a system has been designed. It generates a light signal that is injected with fibre optics in every scintilator of Héracles. Final design and first results will be shown.

TU-A6-3 **10h45** **(G*)**

New HERACLES setup and further experiments with ISAC-II. **Jérôme Gauthier**, René Roy, *Université Laval* — The Heavy Ions Team of Université Laval has worked for many years with the HERACLES multi-detector to study heavy ions reactions at intermediate energies (20 to 100 MeV/nucleon). The next experiment will use the ISAC-II beam at TRIUMF to study projectile-like fragments from reactions involving a large variety of Na exotic beams at 8 and 15 MeV/nucleon on Carbon and Magnesium targets. The low energies and the necessity to resolve the mass of fragments at low angles constrained us to change the setup of the detectors. The former 3 lower phoswich rings have been replaced by BaF2 scintillators and Si-CsI telescopes. The overall phoswich delta-E thickness (energy threshold) has also been lowered. The facility is practically ready to perform experiments which will this year.

TU-A6-4 **11h00** **(G*)**

BUU calculations with isospin and momentum dependence for mid rapidity emission in heavy-ion collisions*, **Martin Larivière Bastien**, *Université Laval* — While experimental results have shown neutron enrichment at mid rapidity in heavy ion collisions, there is still much speculation about its origin : some have attributed it to isovectorial gradient while others have come up with different explanations like the early formation of alpha particles which, in the case of system with N/Z ratio greater than one, leave the neck enriched in neutron. It could also be due to dipole or momentum dependent potential effects. The relative importance of those effects is studied with numerical simulations based on a BUU model with momentum and isospin dependence. Additionally a de-excitation program has been used and an automatic numerical method for isolating the mid rapidity has been developed.

* This work is being supported by CRSNG

TU-A6-5 **11h15** **(G*)**

Heavy residues produced in Xe+Sn collisions*, **Josiane Moisan** [1], Abdelouahad Chbihi [2], John D. Frankland [2], René Roy [1], [1] *Université Laval*, [2] GANIL — Previous experiments with the INDRA multidetector showed the survival of unexpected heavy residues in Xe+Sn reactions at 25 AMeV. One could suppose that they come from an excited compound nucleus formed in central collisions, which decays by emitting neutrons, light charged particles and intermediate mass fragments. This heavy nucleus could be formed in asymmetric fissions, from fluctuations in a deep-inelastic process or fusion. To better understand the process which produces these heavy residues, the fifth INDRA campaign included measurements at lower energy, from 8 to 25 AMeV. Charge, velocity and angular distributions of the residues from these new data tend to show that they come from the evaporation of a heavy nucleus formed in a fusion-like process. Evolution of the characteristics of the residues with the incident energy, as well as the particles and fragments characteristics, will be shown.

* This work is being supported by CNRS

TU-A6-6 **11h30** **(G)**

Fragments recognition at finite temperature. **Alexandre Vallée** [1], René Roy [1], Francesca Gulminelli [2], [1] *Université Laval*, [2] LPC Caen — The theoretical approach of heavy ion collision dynamics essentially goes through numerical simulations. Many models can be used, however they all require an additional and crucial step before comparing theoretical predictions and experimental observations: clusterization. Usually, this is a static picture of the simulation at freeze-out. This project proposes to build clusters all along with the dynamical simulation, driven by antisymmetrized molecular dynamics, by minimizing free energy of the statistical ensemble through a Monte Carlo calculation. It will then be possible to make correlations between fragments formation and temperature conditions.

TU-A6-7 **11h45**

Coulomb energy differences and Coulomb displacement energies from a coupled-channel scattering theory*, **Juris Svenne** [1], Kenneth Amos [2], Paul Fraser [2], Dirk van der Knijff [2], Luciano Canton [3], Gualtiero Pisent [3], Steven Karataglidis [4], [1] *University of Manitoba*, [2] University of Melbourne, Australia, [3] Istituto di Fisica Nucleare, sezione di Padova, Italy, [4] Rhodes University, South Africa — Coulomb energy differences and Coulomb displacement energies of low-lying states in light mirror nuclei have been determined using a multichannel algebraic scattering (MCAS) approach to nucleon-nucleus scattering. This MCAS theory yields a good description of both sub-threshold and resonance states of the compound system, when taking proper care that the Pauli principle is not violated. The Coulomb interaction is obtained from a prolate or oblate spheroidal charge distribution, and the results are compared with previous work where a simple spherical description of the Coulomb interaction was used.

* This work is being supported by NSERC; MIUR-PRIN Project, Italy; National Research Foundation, South Africa

12h00 **Session Ends / *Fin de la session***

[TU-A7] String Theory / *Théorie des cordes*

(DTP / *DPT*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
10h00 - 12h15

ROOM / SALLE ***VCH 2870*** **(cap. 57)** ***Chair: K. Dasgupta, McGill University***

TU-A7-1 **10h00**

JAMES CLINE, McGill University

Nongaussianity in the Cosmic Microwave Background from Nonlocal Inflation Models

String theory is nonlocal at energies above the string scale. It is possible to make sense of inflation at a Hubble rate exceeding the string scale in p-adic string theory, with novel features such as slow roll despite having a steep potential, and domination by kinetic energy of the inflaton. A distinctive observational feature in this regime is

observably large nongaussian fluctuations in the CMB, which are too small to be detected in conventional single-field inflation models, and for which there are recent claims of detection.

TU-A7-2 **10h30**

ALEXANDER MALONEY, McGill University

Partition Functions of Three Dimensional Quantum Gravity *

We consider pure three-dimensional quantum gravity with a negative cosmological constant. The sum of known contributions to the partition function from classical geometries can be computed exactly, including quantum corrections. However, the result is not physically sensible, and if the model does exist, there are some additional contributions. One possibility is that complex geometries need to be included, leading to a holomorphically factorized partition function. We analyze the subleading corrections to the Bekenstein-Hawking entropy and show that these can be correctly reproduced in such a holomorphically factorized theory. We also consider the Hawking-Page phase transition between a thermal gas and a black hole and show that it is a phase transition of Lee-Yang type, associated with a condensation of zeros in the complex temperature plane. Finally, we analyze pure three-dimensional supergravity, with similar results.

* This work is being supported by NSERC

11h00 **Coffee Break / *Pause café***

TU-A7-3 **11h15**

ROBERT BRANDENBERGER, McGill University

Progress in String Gas Cosmology

String gas cosmology is a model of early universe cosmology which makes use of new symmetries and new degrees of freedom of string theory. I will review how string gas cosmology provides a mechanism to explain the fact that only three spatial dimensions are large, and that the moduli corresponding to the sizes and shapes of the extra dimensions are stabilized. I will argue that string gas cosmology can lead to a new mechanism for providing the origin of primordial cosmological fluctuations, a mechanism which does not require a period of inflation.

TU-A7-4 **11h45**

JAUME GOMIS, Perimeter Institute

Progress in String Gas Cosmology

In this talk we will describe our recent progress in the understanding of new non-local operators in gauge theory and the role they play in ads/cft correspondence.

12h15 **Session Ends / *Fin de la session***

[TU-A8] CAP/HPCS Numerical Physics / *Physique numérique ACP/HPCS*

(CAP / *ACP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

10h00 - 12h30

ROOM / SALLE ***VCH 3860*** **(cap. 148)** ***Chair: D. Sénéchal, Université de Sherbrooke***

TU-A8-1 **10h00**

HUGH COUCHMAN, McMaster University

Computational Astrophysics

Large-scale computation has achieved a pivotal role in many areas of astrophysics and cosmology. Not only does increasing computational power allow us to better model the huge range of spatial and temporal scales in the universe, but simulations provide in many cases the only laboratory in which we may actively experiment on cosmic phenomena. The talk will highlight some of the significant achievements in numerical astrophysics and cosmology over the past decade and describe some of the key challenges that we must face in the future. It will focus, in particular, on some recent state-of-the-art models of dwarf galaxies and illustrate the subtle interplay between gravitational and astrophysical processes in these systems.

TU-A8-2 **10h30**

MIKE VETTERLI, Simon Fraser University/TRIUMF

ATLAS Computing: Dealing with PetaBytes of Data per Year

ATLAS is a particle physics experiment at CERN in Geneva, which will study proton-proton collisions at the highest energy ever achieved in the laboratory. The main goal of the experiment is to discover the Higgs particle, which is central to the current theory of how subatomic particles attain mass. ATLAS will also search for a variety of phenomena "beyond the Standard Model" of particle physics. In order to carry out this research program, ATLAS will collect data from millions of collisions per second, recording 200Hz to tape. This will result in 3.5 PetaBytes (10^{15} bytes) of data per year, which could double when secondary data sets are produced. This talk will describe the international computing network (WLCG) that has been set up using Grid tools to deal with this avalanche of data. Emphasis will be given to Canada's contributions to WLCG.

TU-A8-3 **11h00**

HOWARD TROTTIER, Simon Fraser University

Quantum Chromodynamics on a space-time lattice [*]

Quantum Chromodynamics has been accepted as the theory of the strong interactions for more than thirty years, ever since the discovery of asymptotic freedom by Gross, Politzer and Wilczek, whose work was recognized with the 2004 Nobel Prize. Despite many successful quantitative predictions for high-energy processes, applications of QCD to strongly-coupled, low-energy hadronic physics, including such basic quantities as the proton mass, have historically been much less successful. A space-time lattice discretization of QCD (proposed by Ken Wilson the year after asymptotic freedom) lends itself to direct numerical simulation, but the enormous computational burden of lattice QCD has, until recently, precluded accurate simulations of the full theory. Happily, dramatic improvements in the predictive power of lattice QCD have occurred in the past few years, due to major theoretical progress in our understanding of lattice quantum field theories. These developments are having a significant impact, including the use of lattice QCD to constrain the search for physics beyond the so-called standard model. This talk will give a conceptual review of the theory of QCD at high and low energies and the new developments in lattice QCD.

[*] This work is being supported by NSERC

TU-A8-4 **11h30**

MATTHIAS TROYER, ETH Zurich

Simulating exotic quantum states of matter

Strong quantum effects in correlated materials can give rise to unusual and exotic quantum states of matter. Examples are the so-called supersolid phase (which combines the seemingly contradictory properties of being solid and at the same time superfluid), high-temperature superconductors with exotic superconductivity driven by strong quantum fluctuations fluctuations, or anyonic quantum liquids. Numerical methods are essential for our understanding of these exotic phases since the strong quantum fluctuations make approximate analytical treatments such as mean-field or weak-coupling approximations unreliable. In this talk I will review the tremendous progress in quantum Monte Carlo algorithms in the past decade, allowing the simulation of millions of quantum spins or bosons with high accuracy and the accurate understanding of phenomena such as supersolidity. I will also explain the origin of the infamous 'negative sign problem' which prevents simulations of similar accuracy for electronic system and will show that this problem is NP-hard. The simulation of electronic systems will thus remain a big challenge for the foreseeable future.

TU-A8-5 **12h00**

NORMAND MOUSSEAU, Université de Montréal

Simuler la dynamique des protéines [†,*]

L'étude de la dynamique des protéines a connu un essor considérable depuis une dizaine d'années, avec la disponibilité accrue des super-ordinateurs parallèles. Mais l'augmentation des ressources informatiques n'est pas suffisante et il faut développer de nouvelles approches numériques qui permettent d'échantillonner plus efficacement l'espace des configurations. Dans cette présentation, je discuterai de certaines avancées récentes du côté des méthodes de simulation —-dont la méthode des répliques et la technique d'activation et de relaxation—- et des potentiels —- représentation en coordonnées internes et champ de force à gros grains. Je présenterai également quelques applications de ces méthodes au repliement de la protéine A, une chaîne de 60 acides aminés utilisée comme problème modèle, ainsi qu'à l'aggrégation amyloïde. Comme on le verra, en dépit des progrès récents, les défis qui restent à relever sont encore très nombreux.

[†] En collaboration avec Philippe Derreumaux, Wei Chen, Xiao Dong, Lilianne Dupuis, Rozita Laghaei, Jean-François St-Pierre et Guanghong Wei.

[*] This work is being supported by CRSNG et Fondation des chaires de recherche du Canada

12h30 **Session Ends / *Fin de la session***

[TU-A9] (DCMMP / *DPMCM*) DCMMP Best Student Paper Competition III / *Compétition pour les meilleures communications étudiantes DPMCM III*

TUESDAY, JUNE 10 / MARDI, 10 JUIN

10h00 - 12h30

ROOM / SALLE ***VCH 3870*** **(cap. 51)** ***Chair: A. Moewes, University of Saskatchewan***

TU-A9-1 **10h00** **(G*)**

3,4,9,10-Perelynetetracarboxylic Diimide on NaCl: Dynamics of Dewetting[*], **Jessica Topple**, Sarah Burke, Shawn Fostner, Peter Grutter, *McGill University* — The interesting optical and electronic properties of some organic molecules advocate their employment as the building blocks of organic optoelectronic circuits. If a single molecule may be trapped between two metal electrodes and produces desirable current-voltage characteristics, the resulting device is expected to have many advantages, particularly in size over today's silicon chip technology. Insulating substrates such as alkali-halides provide the ability to electrically isolate molecules from the underlying surfaces, facilitating characterization of their electronic properties. However, the surface science of insulators is not well understood, and therefore we require a more complete understanding of the interaction between organic molecules and substrates. 3,4,9,10-Perelynetetracarboxylic diimide is a candidate molecule which has been deposited in sub-monolayer coverages onto atomically flat NaCl. The resulting morphology is initially comprised of two coexisting growth structures: square shaped, single monolayer islands as well as needle-like multilayer islands. Molecular/atomic resolution images achieved using non-contact atomic force microscopy under ultra high vacuum enabled the determination of the epitaxy of each island type. The monolayer islands disappear within a few days of deposition, while the multilayer islands become larger. This has been characterized as a dewetting transition, similar to that reported for other molecular systems, in which molecules from the edges of monolayer islands diffuse away and join the more favorable multilayer islands over time. The dynamics of this transition have been described for the first time and fit to the monomolecular growth model, a model typically applied to biological growth.

[*] This work is being supported by NSERC

TU-A9-2 **10h15** **(G*)**

Effect of sodium in $CuInSe_2$ ingots grown by the Bridgman method. **Hadley Myers**, Clifford Champness, Ishiang Shih, *McGill University* — The incorporation of a small amount of sodium into the fabrication of $CuInSe_2$-based thin-film polycrystalline solar cells has been shown to increase the performance of the devices. In this, it has been suggested that the migration of Na_2Se to the grain boundaries plays a significant role. Accordingly, studies have been made in this laboratory using monocrystals of

$CuInSe_2$, which ideally would have no grain boundaries. Ingots containing monocrystals of this chalcopyrite were grown from the melt by the Bridgman method, starting with either stoichiometric (i.e. $CuInSe_2$) or excess selenium (i.e. $CuInSe_{2.2}$) atomic proportions of the elements Cu, In and Se in a quartz ampoule. To these, before sealing, were also added 0 to 3 at % Na_2Se or elemental sodium Na^0. The resulting ingots were p-type in the 3 cases of $CuInSe_2 + Na_2Se$, $CuInSe_{2.2} + Na_2Se$ and $CuInSe_{2.2} + Na^0$, but were n-type in the case of $CuInSe_2 + Na^0$, except for the last zone to freeze. The cohesiveness of the ingots generally decreased with increase of sodium addition. Deposits on the inner wall of the quartz ampoule after ingot growth were found to contain Cu_3Se_2, a Cu-like material and, in the case of runs with $CuInSe_{2.2}$, Se dots. A white substance was also found, where XPS indicated the presence of SiO_2, carbon and small amounts of Na, In, Cu, and Se. Thermoelectric power (α) measurements made on slices cut from the ingots generally showed a decrease in á with increase of Na_2Se addition, corresponding to an increase in hole concentration.

TU-A9-3 10h30 (G*)

Nitrogen Under Extreme Conditions*, **Brian Boates**, Stanimir Bonev, *Dalhousie University* — There has been a lot of interest in the properties of nitrogen under pressure following the prediction [PRB 46, 14419] and observation [Nature Materials 3, 558] of polymeric phases of dense nitrogen. Most recently, measurements [PRL 99, 225701] suggested the existence of a first-order phase transition in liquid nitrogen, characterized with dramatic changes in bonding properties. We have investigated the structural properties of nitrogen over a large part of its phase diagram using first principles theory. The focus of the study is to understand the changes of bonding properties with pressure and temperature and to provide verification and explanation of experimental observations.

* This work is being supported by NSERC, Ace-net, Westgrid, Sharcnet, IRM

TU-A9-4 10h45 (G*)

Characterization of coherently controlled ballistic charge currents in semiconductors and carbon nanotubes via the emitted THz radiation*, **Jean-Michel Ménard**, Christian Sames, Markus Betz, Ryan Newson, Henry van Driel, *University of Toronto* — In the past our group has shown how one can use the interference of different optical absorption pathways to generate both electrical and spin currents in semiconductors. When electrical currents are generated with ultrashort laser pulses the transient charge displacement leads to the emission of THz radiation, which can therefore be used as a diagnostic of current dynamics. Here we illustrate the use of this technique to examine the role of many-body effects in the case of current generation in CdTe and CdSe and apply all-optical coherent control to generate electrical currents in graphite and carbon nanotubes. Experimentally, we use phase-related ~1400 nm fundamental and ~700 nm second harmonic pulses of 150 fs duration to generate the electrical currents via the interference of single photon and two photon absorption. The emitted THz radiation is collected in the far field and detected using transient electro-optic sampling. For currents generated with photon energies near the band gaps of CdSe and CdTe we demonstrate the role of excitonic effects in altering the phase properties of current generation. We also demonstrate for the first time coherently controlled currents in graphite and carbon nanotubes. The efficiency of current generation in the carbon nanotubes is indicative of peak currents as large as 1 nA per nanotube. It thereby greatly exceeds the efficiency in graphite and is comparable to that observed in high quality bulk semiconductors.

* This work is being supported by NSERC

TU-A9-5 11h00 (G*)

Novel Structure Formation via Thermal Patterning of Diblock Copolymer Films*, **Joseph Parete**, Andrew Croll, John Preston, Kari Dalnoki-Veress, *McMaster University* — We have developed a surface tension driven lithography technique that enables the patterning of microscopic features into thin polymer films through the application of a highly localized thermal gradient. When diblock copolymers (polymers of different chemistry covalently bonded to each other) are manipulated using this technique, their anisotropic nature causes them to form a novel microstructure. The morphology of these structures as observed via optical and atomic force microscopy reveals the complex, dynamical interplay of different physical scales.

* This work is being supported by NSERC and OGS

TU-A9-6 11h15 (G*)

Electric field requirements for the suppression of short channel effects of organic thin film transistors. **Yi Chen**, Ishiang Shih, *McGill University* — Scaling down of Organic Thin Film Transistors(OTFTs) to sub-micron channel lengths ($L \leq 1\mu m$) often leads to a sever short channel behavior of the devices: devices cannot get into saturation operation and drain current increases quadratically with drain voltage (i.e. gate loses control of the transistor) as well as a large decrease of the field effect mobility. In this work, OTFTs with channel lengths from 0.3 μm to 20 μm and gate oxide thicknesses from 15 nm to 250 nm has been successfully fabricated on Si substrates with P3HT (poly~3-hexylthiophene) as organic active layer. The measurement results show that even the channel length is reduced to 0.3 μm, transistors can still show good long channel behavior with excellent saturation operation under the condition that the channel length over oxide thickness ratio is greater than 10. In other words, the vertical electric field should be at least 10 times higher than the lateral electric filed to suppress the short channel effect of the transistors. Furthermore, the field effect mobility of long channel devices ($L \geq 5$ μm) is about an order of magnitude larger than small channel devices (L from 0.3 μm to 2.5 μm), which could be attributed to the more severe contact resistance effects between organic materials and metal contacts for devices with smaller dimensions.

TU-A9-7 11h30 (G)

Tunable terahertz amplification in optically-excited biased semiconductor superlattices*, **Dawei Wang** [1], Aizhen Zhang [1], Lijun Yang [2], Marc Dignam [1], [1] *Queen's University*, [2] University of California, Irvine — The development of a compact, tunable terahertz (THz) laser has been an area of intense research for over a decade. One of the first THz lasers was a quantum cascade laser (QCL). Although the QCL is a compact THz source, it only has very limited tunability due to the fact that its gain spectrum is largely fixed by its structure. In our research, we simulate the coherent carrier dynamics and thereby the THz gain of an optically-excited, updoped AlGaAs superlattice (BSSL) in the presence of a THz pulse. We use an excitonic formalism that includes 1*s* excitonic states as well as higher in-plane excited states and allows for dephasing and population decay. Our results show that due to the symmetry breaking introduced by electron-hole interaction, tunable THz gain arises, even in the presence of large numbers of unbound excitons. The gain mechanism arises from transitions between the different excitonic Wannier-Stark ladder (WSL) states, tunability is provided by the applied DC bias and depopulation of lower lasing levels is provided via coherent cascading of excitons down the excitonic WSL. We find that gain coefficients greater than 20 cm^{-1} can be achieved over a tuning range of 3 to 11 THz and that due to the *coherent* cascading of the carriers down the excitonic Wannier-Stark ladder, the gain coefficients have much higher gain saturation fields than comparable two-level systems. Thus, we find that the BSSL is a potentially promising tunable gain medium for THz radiation.

* This work is being supported by Natural Sciences and Engineering Research Council of Canada

TU-A9-8 11h45 (U*)

Acoustic wave propagation in a bubbly liquid*, **Mitchell Anderson** [1], Kurt Hildebrand [1], Anatoliy Strybulevych [1], Valentin Leroy [2], John Page [1], [1] *University of Manitoba*, [2] University of Manitoba/LOA, ESPCI, Paris — Bubbles in liquids are not at all uncommon, and yet many interesting phenomena can be observed through the interactions of bubbles with themselves, with their environment and with external probes. One example of such phenomena is the interaction of a bubble with an ultrasonic wave: a bubble is a rare example of a monopole resonator, and the associated effects of this resonance include anomalous dispersion, leading to negative group velocities. While there has been extensive theoretical work on describing the frequency dependence of the attenuation, phase velocity, and group velocity of ultrasonic waves traveling

through a bubbly liquid, relatively few experiments have been successfully performed. In addition to experimental difficulties associated with the very large attenuation near resonance, one of the challenges in comparing experiment and theory is accurate knowledge of the bubble size distribution. We describe experiments in which we measure the bubble sizes optically at the same time that the ultrasonic experiments are performed, and capitalize on the continuous evolution of the bubble positions to measure true ensemble averaged properties. We also use a new image calibration technique to improve the accuracy with which the bubble size distribution can be determined. This approach will allow us to obtain unambiguous evidence of the anomalous dispersion of ultrasonic waves associated with bubble resonance, and to test the theoretical models over a wide range of bubble concentrations.

* This work is being supported by NSERC

TU-A9-9 12h00 (G*)

Theoretical and Experimental Study of the Radiation Induced Decomposition of Glycine. **R. Wilks** [1], J.B. MacNaughton [2], A. Moewes [1], [1] *University of Saskatchewan*, [2] Stanford Synchrotron Radiation Research Center — The radiation-induced decomposition of glycine is studied using a combination of soft X-ray absorption spectroscopy (XAS) and density functional theory calculations. The measured spectra show strong dose- or time-dependent effects consistent with a complex, multistep reaction. The emerging absorption features are assigned to various product molecules through comparison with simulated spectra of several model compounds. It is clear from the experiment that the initial effect of soft X-ray irradiation is the deprotonation of the C_a site of neutral or zwitterionic glycine. The radicals that are produced then decompose to form numerous other products. This study utilizes a unique and novel approach to the study of radiation damage that can occur during measurements, and suggests that the simulation of model spectra may possibly be used to correct for these effects in measured spectra.

TU-A9-10 12h15 (G*)

Terahertz Radiation from $YBa_2Cu_3O_7$ Thin Film on Sapphire Substrate*, **Stéphane Savard** [1], Jean-François Allard [1], Jesse Petersen [2], Denis Morris [1], Patrick Fournier [1], Steven J. Dodge [2], [1] *Université de Sherbrooke*, [2] Simon-Fraser University — During the past decade, new laser-based methods for generating and detecting pulses at terahertz frequencies (0.1 to 10 THz) have been developed. These techniques enable investigation of rich physical and chemical processes in condensed or gas state. New terahertz spectroscopy and imaging techniques are presently used to identify atmospheric pollutants, to assess skin cancer, or to obtain fingerprints of a specific drug. Sources of intense terahertz pulses are still needed for several applications and high-temperature superconductor–based device might be used for such purpose. In order to apply adequately high-temperature superconductors with laser-based methods, their photoconductive mechanisms have to be clarified. The emitter device consists of a dipole antenna made of a $YBa_2Cu_3O_7$ thin film excited by a visible beam (1.55 eV). The characteristics of this emitter have been measured using a time-domain terahertz spectroscopy setup that uses a semiconductor photoconductive antenna as the detector. Using a model in frequency domain, a relaxation time of 1.5 ± 0.1 picosecond has been determined at 20 K. This value gradually increases as the sample approaches the critical temperature at 85 K. The relaxation time and the temperature dependence are in very close agreement to the ones obtained using a pump-probe technique that utilizes a terahertz probe beam. The reproducible values obtained using both techniques with the same sample reinforce the basic assumptions of the model used. A better understanding of the relaxation mechanisms of high energy excited particles in $YBa_2Cu_3O_7$ or other high-temperature superconductor will open avenues to optimize emitter characteristics.

* This work is being supported by CIFAR - NSERC - FCI - FQRNT - RQMP

12h30 Session Ends / *Fin de la session*

[TU-A10] Teaching with Technology / *Enseigner avec la technologie*

(DPE / *DEP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

10h00 - 12h00

ROOM / SALLE VCH 2860* (cap. 142)** ***Chair: R.I. Thompson, University of Calgary

TU-A10-1 10h00

PHILIP P. LANGILL, University of Calgary

Hands-on Physics at an Observatory? (or, Is 'Physics' the better half of 'Astrophysics'?) †,*

The Dept of Physics and Astronomy at the University of Calgary operates one of the largest astronomical observatories in Canada, the Rothney Astrophysical Observatory (RAO). With its suite of 5 telescopes (3 optical, 1 optical + IR, 1 radio), its array of modern detectors (CCD imagers, spectrometers and photometers), and its wireless microwave internet, the U of C offers its undergraduate and graduate students unique and valuable learning opportunities. In recent times a new Interpretive Center (IC) was built, and an Education and Public Outreach (EPO) program was established at the RAO. In just two short years the EPO efforts of the RAO have grown remarkably. Teachers and students at the Jr. High and Sr. High school levels, and special interest groups of all kinds visit the RAO regularly. The IC is also equipped with video conferencing equipment, and several schools from Calgary and from Central Alberta have taken 'virtual tours' of the RAO and interacted 'live' with U of C astronomers over the internet. When an interesting celestial event occurs, we have the ability to webcast it live to the world. In this talk I will describe some of the unique teaching aspects of the RAO as they pertain to our astrophysics students, and briefly describe our efforts to educate and excite the general public about astronomy and science.

† In collaboration with Michael Williams, Jennifer Howse , Russ Taylor , University of Calgary

* This work is being supported by Faculty of Science, UofC and PromoScience, NSERC

TU-A10-2 10h30

Teaching Physics with Visual Arts*, **Tetyana Antimirova**, *Ryerson University* — Although the community of physics educators has come a long way in developing and implementing effective strategies for teaching physics, it still stands out among other sciences as the subject particularly difficult to learn and to teach effectively. Part of it is because the students still do not see physics as related to our everyday life and lack motivation. Visual arts such as photography, paintings, movies and cartoons seem to have no relevance to physics whatsoever, and yet, they all can become powerful tools for bringing excitement in class while teaching physics. Nature photography and realistic paintings sometimes reveal (intentionally or not) striking manifestations of various physical phenomena. Today we can capitalize on the widespread use of digital photography to attract the students' attention to the physics in our everyday life. I will present several such examples of professional and amateur visual art works.

* This work is being supported by Department of Physics, FEAS, Ryerson University

10h45 Coffee Break / *Pause café*

TU-A10-3 **11h15**

ERIC MAZUR, Harvard University

The interactive learning toolkit: technology and the classroom

It has been suggested the lack of interaction in large lecture courses is to blame for the many problems facing these courses: declining enrollments, low attendance, poor evaluations, and disappointing retention. We offer a way of redesigning the classroom so interaction is introduced in many aspects of the course. This approach has shown to be effective by many instructors in a broad variety of environments. I will demonstrate some of the tools we have developed to foster this interaction.

TU-A10-4 **11h45**

Music in the physics classroom*, **Diane de Kerckhove**, *University of Guelph* — Music is ubiquitous, and most students, by the time they reach the undergraduate level, have listened to tens of thousands of hours of it. They therefore have a certain level of 'expert knowledge' of music. Many students have also played an instrument or sung in a choir at some point in life. Anyone who has taught first year physics courses knows that it can be difficult for students to understand concepts of wave phase, amplitude, interference, etc. Even at higher levels, Fourier analysis is not always easy for students to grasp. In this presentation, we demonstrate several experiments involving music, some physical, some computer-based, which can enhance learning in first year college physics courses, as well as higher-level courses on waves and acoustics.

* This work is being supported by NSERC

12h00 **Session Ends / *Fin de la session***

[TU-HS-1] High School Teachers' Workshop - A.M. / *Atelier des enseignant(e)s de la physique - avant-midi*

(CAP-DPE / *ACP-DEP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

10h15 - 12h30

ROOM / SALLE ***VCH 2880*** **(cap. 200)** ***Chair: M.A. Duguay, Université Laval***

09h45 **Coffee Break / *Pause café***

TU-HS-1-1 **10h15**

RAYMOND LAFLAMME, IQC/University of Waterloo

Quantum Information Processing

Information processing devices are pervasive in our society; from the 5 dollar watches to multi-billions satellite network. These devices have allowed the information revolution which is developing around us. It has transformed not only the way we communicate or entertain ourselves but also the way we do science and even the way we think. All this information is manipulated using the classical approximation to the laws of physics, but we know that there is a better approximation: the quantum mechanical laws. Would using quantum mechanics for information processing be an impediment or could it be an advantage? This is the fundamental question at the heart of quantum information processing (QIP). QIP is a young field with an incredible potential impact reaching fundamental physics to technological applications such as quantum computers and cryptography. In my presentation I will give an overview of the properties of quantum mechanics that are used on these technologies and explain how they are used.

TU-HS-1-2 **11h00**

JEAN-MICHEL POUTISSOU, TRIUMF

L'étude des phénomènes stellaires en laboratoire à TRIUMF

Tous les élements dans notre univers proviennent de synthèses rèalisées dans les étoiles durant, et surtout, à la fin de leur évolution. Les réactions nucléaires générées dans ces phénomènes impliquent un grand nombre de noyaux, pour beaucoup très instables. Le développement d'accélérateurs de faisceaux éxotiques radioactifs tel que ISAC à TRIUMF a ouvert un nouveau champ d'études de ces réactions nucléaires, élement par élement, qui nous permet de mieux comprendre l'origine des élements que nous "voyons" dans notre univers. Je présenterai quelques exemples de travaux en cours à TRIUMF.

TU-HS-1-3 **11h45**

DANIEL CÔTÉ, Université Laval / Robert Giffard

Photonique appliquée à la recherche sur les neurones

Le conférencier décrira plusieurs techniques photoniques et biophotoniques appliquées à l'étude de petits réseaux de neurones.

12h30 **Session Ends / *Fin de la session***

[TU-DIMP] DIMP Business Meeting (lunch available) / *Réunion d'affaires DPIM (dîner disponible)*

(DIMP / *DPIM*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

12h30 - 13h30

ROOM / SALLE ***VCH 2840*** **(cap. 98)** ***Chair: K.H. Michaelian, CANMET, Natural Resources***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[TU-DMBP] DMBP Business Meeting (lunch available)
(DMBP / *DPMB*)
Réunion d'affaires DPMB (dîner disponible)

TUESDAY, JUNE 10
MARDI, 10 JUIN
12h30 - 13h30

ROOM / SALLE ***VCH 3830*** **(cap. 110)** ***Chair: A. Linhananta, Lakehead University***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[TU-DOP] DOP Business Meeting (lunch available)
(DOP / *DOP*)
Réunion d'affaires DOP (dîner disponible)

TUESDAY, JUNE 10
MARDI, 10 JUIN
12h30 - 13h30

ROOM / SALLE ***VCH 3820*** **(cap. 104)** ***Chair: P. Ashrit, Universite de Moncton***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[TU-DTP] DTP Business Meeting (lunch available)
(DTP / *DPT*)
Réunion d'affaires DPT (dîner disponible)

TUESDAY, JUNE 10
MARDI, 10 JUIN
12h30 - 13h30

ROOM / SALLE ***VCH 2870*** **(cap. 57)** ***Chair: R. MacKenzie, Université de Montréal***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[TU-HS-LUNCH] HS Workshop Luncheon
(CAP-DPE / *ACP-DEP*)
Atelier des enseignant(e)s de la physique - dîner

TUESDAY, JUNE 10
MARDI, 10 JUIN
12h30 - 14h00

ROOM / SALLE ***POP 1168*** **(cap. 150)** ***Chair: M.A. Duguay, Université Laval***

TU-HS-LUNCH-1 **13h15**

MICHEL TÊTU, Université Laval

The Photonics within the ALMA Radiotelescope / La photonique dans le radio-télescope ALMA (Atacama Large Millimeter-Wave Array)

The ALMA radiotelescope is an array of up to 64, 12-meter parabolic antennas spread over variable configurations of up to 15 kilometer range in the Atacama desert at 5000 km altitude in the Chilian Andes. At millimeter and sub-millimeter wavelengths (31 GHz to 950 GHz), the radio telescope array will be able to reveal the structure of the cold regions of the universe with unprecedented sensitivity and resolution. The cost of this project is estimated to more than 1 Billion dollars and is financed by North America, European Community, Japan and Chili. The first observations are due in 2010 and the system will be fully operational in 2012. Photonics is playing a very important role in the deployment and operation of this radiotelescope. Since the RF local oscillator reference signal has to be distributed to every antenna with great phase stability, this is achieved by sending the beat note between two highly phase correlated optical signals to every receiver. The distribution of these laser signals is done through a buried optical fiber network with precisely controlled length. A brief description of the ALMA project and a discussion on TeraXion's contributions will be presented.

Le radio télescope ALMA est constitué d'un ensemble de 64 antennes paraboliques de 12 m de diamètre, distribuées suivant des configurations variables s'étalant sur des distances aussi grandes que 15 kilomètres, à plus de 5000 m d'altitude dans le désert Atacama, au sommet des Andes chiliennes. Aux longueurs d'ondes millimétriques et sub-millimétriques (31 GHz à 950 GHz) ce radio télescope permettra de révéler la structure des régions froides de l'Univers avec une sensibilité et une résolution inégalée. Il s'agit d'un projet de plus d'un milliard de dollars, financé conjointement par l'Amérique du nord, la Communauté européenne, le Japon et le Chili. Les premières observations sont attendues en 2010 et le système sera pleinement opérationnel en 2012. La photonique joue un rôle très important dans le déploiement et l'opération de ce radiotélescope puisque le signal de l'oscillateur local RF de référence requis au récepteur de chaque antenne est généré par le battement entre deux signaux lasers à phase corrélée. De plus la distribution de ces signaux lasers est assurée par un réseau de fibres enfouies dont les longueurs doivent être contrôlées précisément. Une brève revue du projet ALMA et une discussion des contributions de TeraXion seront présentées.

14h00 **Session Ends / *Fin de la session***

[TU-PPD] PPD Business Meeting (lunch available) / *Réunion d'affaires PPD (dîner disponible)*

(PPD / *PPD*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

12h30 - 13h30

ROOM / SALLE ***VCH 2830*** **(cap. 106)** ***Chair: R.W. Moore, University of Alberta***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

13h30 **Session Ends / *Fin de la session***

[TU-Plen3] Plenary Session: Achievement Medal in Physics / *Session plénière : La médaille pour contributions exceptionnelles à la physique*

(CAP / *ACP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

13h30 - 14h15

ROOM / SALLE ***VCH 2850*** **(cap. 404)** ***Chair: Louis Marchildon, Université du Québec à Trois-Rivières***

TU-PLEN3-1 **13h30**

LOUIS TAILLEFER, Universite de Sherbrooke

*The Fermi Surface of high-Tc superconductors**

The recent observation of quantum oscillations in the resistance of high-Tc superconductors [1] has opened up a new pathway to investigate the baffling behavior of electrons in these materials*. I will describe recent experiments along that pathway, which may lead us, after two decades, to the fundamental organizing principles of high-Tc superconductivity.

1. N. Doiron-Leyraud *et al.*, Nature 447, 565 (2007).

* In collaboration with D.A. Bonn, W.N. Hardy and R. Liang at UBC, and Cyril Proust at the LNCMP in Toulouse, France.

14h15 **Session Ends / *Fin de la session***

[TU-HS-2] High School Workshop P.M. / *Atelier des enseignant(e)s de la physique - après-midi*

(CAP-DPE / *ACP-DEP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

14h15 - 16h00

ROOM / SALLE ***VCH 2880*** **(cap. 200)** ***Chair: M.A. Duguay, Université Laval***

TU-HS-2-1 **14h15**

SIMON RAINVILLE, Université Laval

Very high precision mass measurements: does $E = mc^2$?

The concept of mass is of primary importance in all branches of physics. Precise mass measurements play important roles in several fundamental tests of physics and have diverse and interesting applications. By simultaneously trapping two different ions and comparing their cyclotron motions (while precisely controlling their relative positions), mass comparisons with a relative accuracy of about $10^{(-11)}$ can be achieved. This has opened the door to the most precise direct test to date of Einstein's famous mass-energy relationship $E=mc^2$.

TU-HS-2-2 **14h45**

CHRISTIAN HÉON, Cégep de Victoriaville

L'apprentissage par projet en physique

La construction d'un véhicule, la mesure de sa performance et sa modélisation servent de structurants pédagogiques très stimulants autant pour l'étudiant que pour l'étudiante. Nous exposerons les résultats d'un projet de fusée et d'un projet de véhicule électrique ainsi que les étapes de la mise en œuvre de ces projets.

TU-HS-2-3 **15h30**

JANIS MCKENNA, University of British Columbia

Symmetries and broken symmetries

Symmetry not only adds beauty to nature, but it plays an important role in nature. We'll explore symmetry in nature and in the laws of physics, and examine the work of mathematician Emmy Noether, who discovered the connection between symmetries and conservation laws. Many of the fundamental symmetries in nature are not perfect, but are broken or imperfect symmetries — for example: time-reversal symmetry, chiral symmetry (left/right-handedness), charge and parity symmetries, and matter-antimatter symmetry... which adds to the richness of both the laws of physics and the world of nature.

16h00 **Session Ends / *Fin de la session***

[TU-P1] Materials: semiconductors / *Matériaux: semiconducteurs*

(DCMMP / *DPMCM*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
14h15 - 16h30

ROOM / SALLE ***VCH 3840*** **(cap. 106)** ***Chair: G.S. Chang, University of Saskatchewan***

TU-P1-1 **14h15**

RICHARD LEONELLI, Université de Montréal

Ga(In)AsN: an unusual semiconductor alloy *

The large bandgap bowing observed in III-V dilute nitride semiconductors opens the way to better optoelectronic devices such as photovoltaic cells and quantum-well lasers operating in the coveted 1,3-1,5 μm range. However, these novel materials exhibit unusual properties when compared to common III-V semiconductors as the small nitrogen ionic radius induces symmetry breaking that leads to conduction band hybridization. In this presentation, I will review our recent findings concerning the optical properties of GaAsN and GaInAsN alloys. Using spectroscopic ellipsometry and modulated photoreflectance in a correlated way, we have determined the contributions of near-gap optical transitions to the dielectric function. Our results strongly suggest that not only the conduction bands, but also the valence bands are modified by the presence of nitrogen. Furthermore, we have determined the absorption coefficient at threshold of the same materials. We find that, contrary to other III-V semiconductor alloys, the absorption coefficient increases with decreasing band gap. These results will be discussed in terms of several theoretical models.

* This work is being supported by NSERC and FQRNT

TU-P1-2 **14h45**

IAN HILL, Dalhousie University

The Importance of Interfaces in Organic Electronic Devices †,*

During the past ten years, organic electronic devices have made the transition from laboratory demonstrations to commercial products. Small displays based on organic light emitting devices (OLEDs) can now be found in may cell phones, digital cameras, MP3 players and car stereos. Sony has just announced an 11" OLED television that will be available in late 2007. Although OLEDs have now reached the early stages of commercialization, there are several up-and-coming technologies, including organic thin film transistors (OTFTs) and organic photovoltaic (OPV) devices that are still in the early stages of research and development. Much of the recent success of organic electronic devices has been due to the close synergy between applied electronic device researchers, organic chemists, and those studying the fundamental electronic properties of organic thin films and the interfaces formed between these films and metal contacts. Within the organic electronic materials and devices group at Dalhousie University, we are currently studying new electronic and dielectric materials based on self-assembled mononlayers (SAMs) for use in OLEDs, OTFTs, and OPVs. Our progress in these areas, including both the fabrication of novel electronic devices and fundamental studies of the interfaces present in these devices, using photoelectron spectroscopies, will be discussed.

† In collaboration with Matthew McDowell [1], Joseph McDermott [2], Jeffrey Schwartz [2], [1] Dalhousie University, [2] Princeton University

* This work is being supported by NSERC, CFI, Aculon Inc.

TU-P1-3 **15h15**

General Approach for the Design of Semiconductor Heterostructures via Direct and Inverse Methods*. **A.E. Botha**, S.A. Sofianos, A. Thomas, *University of South Africa* — Semiconductor devices can be defined mathematically in terms of their dimensions, material compositions, and other relevant physical information. Device simulation, which is the process of using computers to calculate the behaviour of semiconductor devices, e.g. the current-voltage (I-V) curves of a transistor, has traditionally followed a so-called direct approach, which has several disadvantages. Alternative simulation techniques, called inverse methods, have been shown to be more useful in many cases for which solutions of the inverse problem are realisable. Such inverse scattering approaches have for example been developed for the single band constant [1] and variable [2] effective mass models of semiconductor heterostructures. Recently there have also been multiband extensions of the aforementioned inverse approaches [3]. In the present work, previously developed direct and inverse methods have been combined into a holistic model which can offer new insights for the design of promising heterostructure configurations. A graphical user interface has been created using *python*, a versatile scripting language, as a front end to state-of-the-art FORTRAN subroutines which handle the numerically intensive parts of the calculations. This new design approach allows the user to view and modify, interactively using a mouse, both the structural and compositional data for the direct calculation as well as the functional data (such as the electron reflection coefficient) for the inverse calculation.

1. S.A. Sofianos, G.J. Rampho, H. Azemtsa-Donfack, I.E. Lagaris and H. Leeb, *Microelectronics J.* **38**, 235 (2007).
2. D. Bessis and G.A. Mezincescu, *Microelectronics Journal* **30**, 953 (1999).
3. Conference proceedings, contributed by L.J. Allen and A.E. Botha respectively, of the 2nd International Conference on Inverse Quantum Scattering Theory held in Siófok, Hungary, 27-31 August 2007. The proceedings will appear in the second half of 2008 as a special volume of *Modern Physics Letters B*

TU-P1-4 **15h30**

Strain-induced Electronic Level Splitting in CdSe/$Cd_xZn_{(1-x)}$S Colloidal Quantum Dots*, **Claudine Allen** [1], Benoit Mahler [2], Benoit Dubertret [2], [1]*Centre d'optique, photonique et lasers, Université Laval*, [2] École supérieure de physique et de chimie industrielles — A series of colloidal quantum dot (cQDs) samples has been prepared with a CdSe core and $Cd_xZn_{1-x}S$ shell varying the relative alloy concentration of Cd : Zn between x = 0 and x = 1. According to the Successive Ion Layer Adhesion and Reaction shell deposition method, half-monolayers were successively grown on the cores by alternating the injection of cation and anion precursors in the reaction flask. Enough material was injected to grow a 7 monolayer shell on the cQD cores in each sample, however transmission electron microscopy (TEM) images shows that a higher percentage of Zn yields smaller cQDs. Matching this decrease in radius, the cQD absorption spectra and the emission wavelength of the lowest energy exciton ($1S_e$-$1S_{3/2}$ transition) were progressively blueshifted on the order of 50 nm with increasing Zn concentration. This behaviour can be expected from the lattice mismatch between core and shell increasing from 3.9% to 12% with the Zn/Cd ratio. The strain resulting from this mismatch also creates more defects in the cQDs and large surface roughness becomes visible on TEM images of cQDs with high Zn content in their shell. The structural stress and accompanying strain is also expected to perturb the electronic configuration of the cQDs. We observed a progressive splitting of the $1S_e$-$1S_{3/2}$ transition in the PL excitation spectra up to ~25nm when the shell Zn content reaches 100% and attributed this behaviour to the strain perturbation.

* This work is being supported by Natural Sciences and Engineering Research Council of Canada

TU-P1-5 **15h45**

Preparation of ZnO nanoparticles and particle size estimation by PL spectra. **Xuewen Wang**, Ishiang Shih [2], Yali Yang [3], Steven Xiao [3], [1] *McGill University, Northwest University*, [2] McGill University, [3]Organic Vision Inc. — Zinc oxide (ZnO) nanomaterials, with unique electrical and optical properties, have potential to offer a new perspective towards green environment and have attracted considerable research attention in recent years. At present, many techniques including conventional and advanced methods such as CVD, sputter deposition, MBE, MOCVD, PLD, physical and chemical processes are used to grow ZnO. We have employed a simple solution method to synthesize ZnO nanoparticles. Under different conditions, ZnO powder with various particle sizes was prepared with $Zn(CH_3COO)_2 \cdot 2H_2O$, KOH and methanol. In the synthesis process, we have observed improved dissolution of raw materials with the addition of a small quantity of water to the solution. A magnetic stirrer was used when the methanol solution of KOH is mixed into the solution of $Zn(CH_3COO)_2$. The as-prepared powder is analyzed respectively by XRD, photoluminescence (PL) spectra. The results of XRD show that the powder is ZnO nanoparticles with a hexagonal structure and the dimensions can be affected by the preparation conditions. PL results measured suggest that the sizes of these nanoparticles are changed by the stirring speed. Using a model describing the relation between optical gap E_g, the cluster size R and the PL absorption information, we have calculated the dimensions of the as-grown ZnO particles by choosing suitable parameters. The calculated data will be compared with the average diameter obtained from XRD. We anticipate that the more detailed study can improve the batch applications of ZnO nanoparticles in various fields.

TU-P1-6 **16h00**

Reconstructions of the Au(111) and GaAs(001) surfaces driven by the thiol-thiol interactions*, **Oleksandr Voznyy**, Jan Dubowski, *Université de Sherbrooke* — Formation of organic self-assembled monolayers (SAMs) on solid substrates is of great technological importance. Alkanethiol SAMs on Au(111) surface serve as a prototypical example due to the ease of their preparation and are the most studied SAMs to date. On GaAs surfaces, thiol SAMs are promising for passivation and other applications, such as chemical and bio-sensing, molecular electronics, nanolithography, etc. However, despite more than two decades of extensive studies of these material systems, the exact structure of the SAMs and their interface with the substrate remains unclear. Here we report the use of the thiol dense packing structures as a starting point for SAM modeling in order to deduce the surface structure commensurate with the SAM. This is in contrast to a conventional approach, where thiols are fitted on a predefined (usually atomically flat) surface. For gold surface this allows for the first time to take into account the thiol-thiol interactions and, using the deduced packing structures as a geometrical constraint, combine them with the already known driving forces for surface reconstruction (maximization of thiol-surface adsorption energy) to find the details of the c(4x2) SAM structure. For GaAs(001), our approach allows to find the SAM and interface structure, resolve the issue of Ga-S vs. As-S bonding, better understand the process of SAM formation, and suggests the ways to improve the SAM passivating properties and stability.

* This work is being supported by Canada Research Chair in Quantum Semiconductors Program

TU-P1-7 **16h15**

Atomistic Basis for Continuum Growth Equation in GaAs Molecular Beam Epitaxy*, **Tom Tiedje** [1], Anders Ballestad [2], Aleksy Jones [1], Tian Li [3], Joerg Rottler [1], Michael B. Whitwick [1], [1] *University of British Columbia*, [2] BC Cancer Agency, [3] University of Illinois — Experimental measurements of surface shape evolution during epitaxial growth of GaAs are compared with kinetic Monte Carlo (kMC) simulations and numerical solutions of a continuum growth equation derived from an adatom transport equation [1]. We show that the experimental data can be described by a stable growth equation that is mixed-order in the spatial derivatives, with an Edwards-Wilkinson type linear term, together with a conservative nonlinear term. The stable growth equation is derived from coupled rate equations, one that describes the transport of adatoms on the surface and another that describes the rate of change of surface height due to adatom incorporation at step edges. We assume there is an Ehrlich-Schwoebel barrier and/or an incorporation barrier at step edges that favor a net downhill migration of adatoms across step edges, favouring stable growth, meaning that undulations in the surface tend to smooth. The predicted dependence of the coefficient of the linear term in the growth equation on the growth rate and step density, is found to be consistent with experiment. The continuum description of the morphological evolution is tested by comparison with kMC simulations. In both experiment and kMC simulations of growth on patterned surfaces we observe a "kinetic facet" near the special slope where the growth process changes from island nucleation to step flow growth.

1. T. Tiedje, A. Ballestad, Thin Solid Films (to be published 2008)

* This work is being supported by NSERC

16h30 **Session Ends / *Fin de la session***

[TU-P2] General Condensed Matter and Materials Physics / *Physique générale de la matière condensée et des matériaux*

(DCMMP / *DPMCM*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 3870*** **(cap. 51)** ***Chair: Y. Zahra, National Research Council***

TU-P2-1 **14h15**

The effect of volatile bubble growth on the periodic dynamics of volcanic eruptions*, **Ivan L'Heureux**, *Universite d'Ottawa* — It is well known that many volcanic eruptions exhibit some periodic behavior. For instance, periodic inflations and deflations of the ground in proximity to a volcano reflect periodic overpressure in the magma channel with a corresponding periodic magma flow rate. The period varies from a few hours to many years, depending on the volcano parameters. On the other hand, volatile components exsolve from an ascending magma, thus forming bubbles. The strong dependence of the magma viscosity with the volatile concentration generates a positive feedback on the magma flow. In this contribution, I consider the effect of the growth of volatile bubbles on the dynamics of a magmatic flow in a volcanic channel. Various expressions for the bubble growth rate will be treated, thus generalizing previous work. It is seen that, for a limited range of flow rate values at the basis of the magma channel, the system undergoes a Hopf bifurcation and generates periodic solutions. The numerical results are in agreement with the measurements performed on some typical volcanoes.

* This work is being supported by NSERC

TU-P2-2 **14h30**

NMR and QENS Study of Phase Transition in Supercooled Confined Water*, **Firas Mansour** [1], Timothy Jenkins [2], Hartwig Peemoeller [1], [1] *University of Waterloo*, [2] NIST — Water in confinement exhibits molecular properties similar to those of protein-surface water and supercooled water. Hydrophobic confinement of water is believed to cause changes to the molecular structure and dynamics of water that are different from those caused by hydrophilic confinement. Water molecules in contact with hydrophobic surfaces are expected to experience a reduction in entropy. Furthermore, the decreased water density near the confining surface results in a tightening of the water molecule network away from the surface. This is expected to produce potentially significant changes to the enthalpy of the hydrogen bond network. Inelastic neutron scattering

results are presented along with NMR results on water confined in the hydrophobic pores of carbon nanohorns. Carbon nanohorns are highly hydrophobic, yet their pores readily absorb water, which makes them an ideal candidate for the study of hydrophobic "wetting". From the NMR point of view carbon nanohorns are practically impurity free. Furthermore, carbon is a weak scatterer of neutrons which makes nanohorns exceptionally attractive as a confining medium for study with neutron scattering. Both Techniques show a transition in liquid water which lends support to the possibility of the existence of a glass phase in water at "elevated" temperatures. The impact of the results and the nature and significance of the observed transition are presented and discussed.

* This work is being supported by NSERC

TU-P2-3 14h45

Electron spin modulation using local strain fields*, **James Stotz** [1], Paulo Santos [2], Rudolph Hey [2], Klaus Ploog [2], [1] *Queen's University*, [2] Paul Drude Institute — For quantum information processing schemes to be successful, the ability to manipulate the information forms the basis for computation. In semiconductor systems, the coherent manipulation of electron spins is often discussed via the Rashba spin-orbit interaction, with which the orientation of a spin travelling in an electrostatic field can be controlled. An alternate method that has been examined is the use of strain fields, which can manipulation electron spins in a manner similar to using an electrostatic field. We will discuss the effect that local strain fields generated by surface acoustic waves (SAWs) have on travelling electron spins. The electron transport is enabled by a system of moving quantum dots that are formed by the superposition of piezoelectric potentials from SAW beams propagating along orthogonal directions on a GaAs/(Al,Ga)As (001) quantum well sample. The SAW system is particularly interesting because the SAWs act as both the "carrier wave" of the signal as well as the logic gate. In particular, we will show that the orientation of the spins can undergo a ð-rotation within their coherence time by varying the strength of the SAW beams.

* This work is being supported by NSERC, BMBF (Germany)

TU-P2-4 15h00

Extensions of the Momentum Average approximation. **Lucian Covaci**, Mona Berciu, *University of British Columbia* — We consider a well studied problem, the formation of polarons. Even for the simplest electron-phonon interaction (the Holstein model), an exact solution is only known in the asymptotic limits of zero coupling or zero electron bandwidth. A simple analytical approximation that turns out to be accurate for all coupling strengths (the Momentum Average approximation) has only been found recently in our group. I will discuss the extension of this method to various other situations in which polaron physics might be important. I will show how the Momentum Average approximation can be used in answering questions regarding coupling of electrons to multiple phonon branches, formation of polarons in the presence of spin-orbit interactions and the existence of multiple electron bands.

TU-P2-5 15h15

Dynamics of structural arrest in nanocolloidal suspensions undergoing gelation and aging*, **James Harden** [1], Hongyu Guo [2], Subramanian Ramakrishnan [3], Brian Chung [2], Charles Zukoski [4], Robert Leheny [2], [1] *University of Ottawa*, [2] Johns Hopkins University, [3] Florida State University, [4] University of Illinois Urbana-Champaign — We report a combined x-ray photon correlation spectroscopy (XPCS) and rheometry study of the dynamical evolution of concentrated suspensions of nanometer-scale silica colloids (sterically stabilized in decalin by grafted octadecyl hydrocarbon chains) undergoing gelation and aging. At high temperatures the chains form a solvated brush that stabilizes the colloids, resulting in a fluid suspension. At sufficiently low temperatures, the brush layer is partially collapsed, leading to a weak, short-range attraction between the colloids that drives a reversible ergodic-to-nonergodic transition in the suspensions. Following a quench through this transition, the shear modulus grows exponentially with a time constant that depends strongly on temperature. The intermediate scattering function measured with XPCS displays two features, a plateau value that provides information about constrained local dynamics in the suspensions and a terminal relaxation time that provides information about relaxation of residual stress. Both the plateau value and the terminal relaxation time increase exponentially following the quench with a characteristic time that closely matches the value for the growing shear modulus measured by rheometry. The comparison between XPCS and rheometry indicates how the arrest of the particle-scale dynamics correlates with the growth in elasticity. Further, a comparison of intermediate scattering functions for suspensions with colloidal volume fractions ranging from 0.20 and 0.43 shows a qualitative variation in the temporal evolution that indicates a crossover from gel-like to glass-like dynamical arrest with increasing volume fraction.

* This work is being supported by DOE, NSERC, NSF

TU-P2-6 15h30

First-principles study of the high pressure phases of alkaline-earth metals*, **Amanuel Teweldeberhan**, Sergei Bonev, *Dalhousie University* — The structural, vibrational, and electronic properties of alkaline-earth metals under pressure have been studied using first-principles density functional theory. We calculate the free energies as a function of volume to determine finite temperature phase boundaries. The mechanism driving the computed phase transitions has been investigated. Comparisons are made with available experimental data.

WITHDRAWN

* This work is being supported by NSERC and Acenet/Sun Microsystems

TU-P2-7 15h45

Atomistic simulations of the microstructural evolution of TiSiN nanocomposites. **Jiri Houska**, Ludvik Martinu, Jolanta Klemberg-Sapieha, *Ecole Polytechnique de Montreal* — In this contribution, we report classical molecular dynamics simulations of thermodynamically preferred structures of $Ti_{(50-x)}Si_xN_{50}$ nanocomposites of various compositions, containing up to a quarter of a million of atoms. Interatomic interactions in the system were described by two-body empirical potentials fitted using energies from ab-initio calculations. Thermodynamically-preferred structures of materials of various compositions were sought by slowly cooling the system down from a melt. We examine the effect of different parameters of the simulation protocol (target temperature, cooling rate and time-step) on the structures obtained. We then focus on the formation and growth of TiN nanocrystals, and investigate how the Si content affects their number, size distribution, and quality in terms of deformation and Si impurities, as well as the thickness of the amorphous phase between them. All calculated characteristics are of high importance for the properties of the experimentally prepared materials. We observe 3 important cases, namely formation of monocrystals at zero or small Si contents, formation of fine nanocrystalline structures (3-6 nm size TiN crystals separated by up to 2 silicon-rich amorphous monolayers) around 7 % of Si, and amorphization at and above 15 % of Si. The results suggest that idealized phenomena such as a formation of a single uniform monolayer of Si all around pure TiN crystals are not necessary for the formation of the experimentally observed nanostructures.

TU-P2-8 16h00

Morphology of Comb-Shaped Proton Exchange Membrane (PEM) Copolymers Using Small Angle Neutron Scattering*, **Mu-Ping Nieh** [1], Michael D. Guiver [1], Dae Sik Kim [1], Tyler Norsten [2], [1] *National Research Council Canada*, [2] Xerox Research Center of Canada — Comb-shaped copolymer films made by solution casting have shown high proton conductivity and low dimensional swelling after wetting, which demonstrate their great potential as materials for proton exchange membranes (PEM) for fuel cells (FC). We have conducted small angle neutron scattering (SANS) study on the copolymers to resolve their morphological structures. Two peaks were found in the SANS curves. A low-q peak presumably results from the strong interaction among the self-aggregating hydrophilic and hydrophobic domains, whereas the high-q peak is

commonly known as the "ionomer peak". We propose a new structural model to fit the SANS data in the q-range covering 0.005 and 0.4 $Å^{-1}$. This model combines a form factor of flexible worm-like aggregates with an ellipsoidal cross-section and a structure factor of hard-disk interaction accounting for the low-q scattering as well as the Teubner –Strey model for the high-q "ionomer peak". Water uptakes can be derived from the best-fitting results of the current model and are consistent with the measured values, confirming the validity of the current model.

* This work is being supported by National Research Council, Canada

TU-P2-9 **16h15**

Microscopic surface deformation of Si(111) due to low energy ion bombardment. **Peter Piercy**, Daniel Pohl, *University of Ottawa* — Low energy ion bombardment of a solid may cause a variety of subsurface defects, accompanied by localized strain fields in the near-surface region. We characterize the defect-induced deformation of the Si(111) surface after argon ion bombardment at energies below 1 keV, at temperatures in the range 600–800 K for which the surface remains crystalline. Using a low energy electron diffraction spot profile analysis, we measure a continuous distribution in surface height spanning several tenths of an Angstrom, correlated laterally over tens of Angstroms, in addition to the atomic-step-and-terrace structure created by the sputtering process at these temperatures. The measured interface width (standard deviation) of the height deformation varies from 0.04 to 0.2 D with increasing ion dose in the range 10^{15} to 10^{17} cm^{-2}, depending on ion beam energy and sample temperature. The evolution of the surface distortion may be correlated with conditions for subsurface defect formation reported elsewhere by other techniques. After ion bombardment at temperatures up to 800 K, the height deformation is attributed to the effects of sub-surface defects involving interstitials and depends quite differently on sample preparation conditions, compared to the surface step density. The deformation is substantially removed by annealing above 870 K.

16h30 **Session Ends / *Fin de la session***

[TU-P3] Experimental Biophysics / *Biophysique expérimentale*

(DMBP / *DPMB*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 3830*** **(cap. 110)** ***Chair: A. Linhananta, Lakehead University***

TU-P3-1 **14h15**

MARIA KILFOIL, McGill University

Single cell fast spindle dynamics probed by automated phenotyping

Spindle dynamics - positioning, assembly, and chromosome segregation - take place over much of the cell cycle, from the time of spindle assembly to the completion of anaphase at the end of mitosis. These dynamical processes require complex spatiotemporal organization of cytoskeletal components and their regulators: spindle positioning itself is characterized by highly regulated coupling between microtubules (MTs) and cortical F-actin. Unbiased tracking of multiple components at high temporal and spatial resolution would greatly facilitate the analysis of these complex processes. Here, I will describe automated, high-resolution image analysis algorithms that find point-like, line-like and surface features in a time-series of confocal image stacks and link the point-like features into trajectories. They may be applied in tandem to labeled components in living cells. We demonstrate the application of these techniques to the tracking of spindles in asynchronous cell populations of budding yeast. Using these methods in data collected at a timescale of 5 sec resolution, we show that spindles can be separated into pre- and post-anaphase populations, and that they fluctuate in length and orientation in a temporally correlated manner. This is a novel observation arising from the analysis that was enabled by the methods developed. These findings have implications for checkpoint processes in cell division.

TU-P3-2 **14h45**

ANDREW PELLING, University College London

Mechanics in the Moment

Mechanical properties of cells are becoming recognized as key indicators and control mechanisms during physiological processes such as mitosis, malignant transformations and differentiation. In addition, these properties are also highly responsive and time dependent. In this talk I will describe recent work utilizing simultaneous atomic force microscopy and laser scanning confocal microscopy to investigate dynamic and timescale dependent cell mechanics. In combination with modern molecular biology (RNAi and fluorescent fusion proteins) and physical/computational approaches we examined several important processes, including: The transmission of force through the cell to organelles and the substrate; 2) the mechanical role of ERM proteins (specifically Moesin) in governing spindle morphogenesis and mitotic progression; and 3) cytoskeletal control of short (<1sec) and long (>1min) term elastic and viscous deformations during early apoptosis (programmed cell death). These results show that the application of force to a cell causes a variety of instantaneous and long term deformations and dissipation pathways which are unlikely to be universally described by a single mechanical model or physical picture. Moreover, cell mechanics is distinctly controlled by time and cell-type dependent molecular mechanisms which, in turn, are governed by the physiological and mechanical environment. This complexity and interesting physics is not merely a side-product of biology but is a key component of a biological feedback loop governing the life of a cell. The mysterious link between the gene and the physical properties of the cell is now being uncovered, revealing many exciting opportunities for the collaboration of biology and physics.

TU-P3-3 **15h15**

Detection of Lipid Rafts by Neutron Scattering*, **Norbert Kucerka** [1], Jeremy Pencer [2], Vinicius Anghel [2], Mu-Ping Nieh [1], John Katsaras [1], [1]*National Research Council of Canada*, [2] Atomic Energy of Canada Ltd. — The detection and characterization of lateral heterogeneities, or domains, in lipid mixtures, commonly referred-to as rafts, has attracted considerable interest because of their role in biological function. Studies of both model and cell membranes demonstrate that domains can be formed over a wide range of length scales, from nanometers to microns. Of the various techniques, small angle scattering is the least used because of the complexity in data analysis and interpretation. Nevertheless, small angle neutron scattering (SANS) has inherent advantage in probing nanometer length scales and yielding ensemble averaged information. We have demonstrated that, through the appropriate use of selective deuteration it is possible to use SANS to detect and characterize lateral heterogeneities in model membrane systems. We devised a quantitative model-independent method for detecting lateral segregation in model membranes as well as a complete treatment of the laterally heterogeneous vesicle form factors. This recently developed state-of-the-art approach was applied to binary and ternary lipid mixtures. We have addressed the ongoing controversy regarding the size and stability of domains in unilamellar vesicles, where none were observed in giant unilamellar vesicles. We have found, that this apparent inconsistency may be merely an artifact of differences in vesicle size, as increased membrane curvature increases demixing of lipids.

* This work is being supported by NRC, NSERC, NIST

TU-P3-4 **15h30**

Effect of Cations on the Structure of Lipopolysaccharide Bilayers Isolated from P. aeruginosa PAO1*, **John Katsaras** [1], Norbert Kucerka [1], Mu-Ping Nieh [1], Thad Harroun [2], Sarah Schooling [3], Erzsebet Papp-Szabo [3], Jeremy Pencer [4], Eric Nicholson [1], Terry Beveridge [3], [1] *National Research Council*, [2] Brock University, [3] University of Guelph, [4] Atomic Energy of Canada Limited — The asymmetric outer membrane of Gram-negative bacteria contains lipopolysaccharides (LPSs), which contribute significantly to the bacterium's surface properties and play a crucial role in regulating membrane permeability. We report on neutron diffraction studies performed on aligned, self-assembled bilayers of Na-, Ca- and Mg-salt forms of LPS, isolated from *Pseudomonas aeruginosa* PAO1. From the one-dimensional neutron scattering length density profiles we find that Ca^{2+}-LPS bilayers are less permeable to water than either Na^{+}- or Mg^{2+}-LPS. This differential permeability to water could have implications as to how small molecules penetrate the outer membrane of Gram-negative bacteria and possibly, how non-lamellar phases are formed.

* This work is being supported by Advanced Foods and Materials Network

TU-P3-5 **15h45**

Probing Protein Conformations at the Oil-Water Interface Using Single Molecule Force Spectroscopy*, **John Dutcher**, Ahmed Touhami, Marcela Alexander, Milena Corredig, *University of Guelph* — Beta-lactoglobulin (BLG), a globular protein that is abundant in the milk of several mammals, adsorbs to the interface of oil-in-water emulsions, forming a protective coating that stabilizes the oil droplets against flocculation and/or coalescence. The present work aims at a deeper understanding of the conformational changes in BLG adsorbed onto the emulsion interfaces due to variations in pH. Mechanical unfolding of BLG using atomic force microscopy-single molecule force spectroscopy (AFM-SMFS) was performed on single oil droplets that were mechanically trapped in a polycarbonate filter. The changes in the contour length upon each unfolding event were determined by fitting the WLC model of polymer elasticity to each of the BLG peaks. Our results show clearly that at pH 2.5, BLG exists as a dimer in which each monomer is similar to two immunoglobulin domains with contour lengths of 32 nm. At neutral pH (6.8), BLG on the oil droplets adopts a conformation that is different from that in its native state consisting of domains with a contour length of 11 nm. Furthermore, at pH 9, the interactions between the AFM tip and the BLG layer on the oil droplet surface are dominated by a large repulsion due to the highly negatively charged BLG layer. This study demonstrates a novel application of AFM-SMFS to investigate the underlying mechanisms by which proteins can be used to stabilize food products.

* This work is being supported by AFMnet, NSERC, CRC

TU-P3-6 **16h00**

High Resolution Structure of Bacterial Cell Sacculi*, **John Dutcher** [1], Ahmed Touhami [1], Valerio Matias [1], Anthony Clarke [1], Manfred Jericho [2], Terry Beveridge [1], [1] *University of Guelph*, [2] Dalhousie University — The major structural component of bacterial cell walls is the peptidoglycan sacculus, which is one of nature's strongest and largest macromolecules that allows the cell to maintain a large internal pressure while allowing the transport of molecules into and out of the cell and cell growth. The three-dimensional structure of this unique biopolymer is controversial, and two models have been proposed: the planar model, in which the glycan strands lie in the plane of the cell surface, and the scaffold model, in which the glycan strands lie perpendicular to the cell surface. In this study we have used atomic force microscopy (AFM) to investigate the high resolution structure of isolated, intact sacculi of both Gram-positive and Gram-negative bacterial cells. We have observed a sponge-like structure for both types of sacculi with pore diameters between 5 to 15 nm. Our data for Gram-positive sacculi provide evidence for the validity of the scaffold model, whereas our data for Gram-negative sacculi indicate an orientation along the short axis of the cell which is consistent with the planar model. To further elucidate the structure, we have exposed sacculi to the tAmiB enzyme which cleaves peptide-peptide bonds.

* This work is being supported by AFMnet, NSERC, CRC

TU-P3-7 **16h15**

Effect of palmitoylation on perturbation of model lung surfactant by the N-terminal segment of surfactant protein SP-C*, **Michael R. Morrow** [1], Azucena Gonzalez-Horta [2], David Andreu [3], Jesús Perez-Gil [2], [1] *Memorial University of Newfoundland*, [2] Universidad Complutense, Madrid, [3] Universidad Pompeu Fabra, Barcelona — Acyl chains bound to the surfactant protein SP-C may help maintain association of pulmonary surfactant complexes with interfacial films compressed to high pressures, at the end of expiration. We have used ^{2}H-NMR to study surfactant membrane models containing palmitoylated and non-palmitoylated synthetic peptides, based on the N-terminal SP-C sequence in dipalmitoylphosphatidylcholine (DPPC)/egg phosphatidylglycerol (PG) (7:3, w/w). Perturbations of lipid properties by the peptide versions were compared in samples containing chain- and headgroup-deuterated lipid (DPPC-d_{62} and DPPC-d_4 respectively). Furthermore, deuterated peptide palmitate chains were compared with those of DPPC in otherwise identical lipid-protein mixtures. The palmitoylated peptide raised lipid chain order slightly over the gel-liquid crystal coexistence temperature range. The non-palmitoylated peptide had a small and opposite effect. Both peptide versions perturbed DPPC-d_4 headgroup orientation similarly, suggesting little effect of palmitoylation on the largely electrostatic peptide-headgroup interaction. Deuterated acyl chains attached to the SP-C N-terminal segment displayed a qualitatively different distribution of chain order, and lower average order, than DPPC-d_{62} in the same membranes. This likely reflects local perturbation of lipid headgroup spacing by peptide residues interacting with the bilayer near the peptide palmitate chains. This work suggests how SP-C-attached acyl chains may help to couple lipid and protein motions in surfactant bilayers and monolayers, especially in the context of ordered phospholipid structures such as those potentially formed during exhalation, when stabilization of the respiratory surface by surfactant is the most crucial.

* This work is being supported by NSERC (MRM) and Spanish Ministry of Science and Community of Madrid (J. P.–G.)

16h30 **Session Ends / *Fin de la session***

[TU-P4] (DNP / *DPN*) New Physics - Electroweak Tests / *Nouvelle physique* - tests électrofaibles

TUESDAY, JUNE 10 / MARDI, 10 JUIN

14h15 - 15h45

ROOM / SALLE ***VCH 2840*** **(cap. 98)** ***Chair: M.N. Butler, St. Mary's University***

TU-P4-1 **14h15**

GERALD GWINNER, University of Manitoba

Test of relativistic time dilation with fast optical atomic clocks at different velocities

Time dilation is one of the most fascinating aspects of special relativity as it abolishes the notion of absolute time. It was first observed experimentally by Ives and Stilwell in 1938 using the Doppler effect. Here we report on a method, based on fast optical atomic clocks with large, but different Lorentz boosts, that tests relativistic time dilation with unprecedented precision. The approach combines ion storage and cooling with optical frequency counting using a frequency comb. $^{7}Li^{+}$ ions are prepared at 6.4%

and 3.0% of the speed of light in a storage ring, and their time is read with an accuracy of using laser saturation spectroscopy. The comparison of the Doppler shifts yields a time dilation measurement represented by a Mansouri–Sexl parameter , consistent with special relativity. This constrains the existence of a preferred cosmological reference frame and CPT- and Lorentz-violating 'new' physics beyond the standard model.

TU-P4-2 **14h45**

JOHN BEHR, TRIUMF

Standard Model tests by measurement of the daughter nucleus momentum from laser-trapped radioactives *

Laser-cooling and trapping of atoms of radioactive isotopes is useful for a variety of decay experiments sensitive to non-Standard Model physics. Recently we have concentrated on measuring the momentum of the daughter nucleus, which leads to several new observables. The angular distribution of the daughter nucleus with respect to the nuclear spin in pure Gamow-Teller decay vanishes in the Standard Model to lowest order, making it a sensitive probe of 4-Fermi effective tensor interactions. The dependence of the spin asymmetry on momentum help distinguish the effect of a new tensor from higher-order standard model corrections. The results from the first version of this experiment are complementary to the best limits from other beta-decay experiments. Forseeable improvements could provide useful sensitivity to left-right sfermion mixing in SUSY models [S. Profumo *et al.* Phys Rev D75 075017 (2007)]. The momentum of the daughter nucleus in two-body gamma decay of nuclear isomers is uniquely defined, so lower momenta would signal emission of exotic massive particles. Progress will be shown towards an experiment sensitive to light scalars proposed to explain the excess of 511 keV annihilation near the galactic center.

* This work is being supported by NSERC, NRC through TRIUMF, WestGrid, the Israel Science Foundation

TU-P4-3 **15h15**

Relativistic shifts of μ^- g-factors: finite nuclear size effects*, **Jess H. Brewer**, *University of British Columbia* — High precision measurements of μ^- spin precession frequencies at 2.4~T in high-Z muonic atoms reveal large relativistic shifts of the bound muon's magnetogyric ratio. New results on muonic tungsten and lead suggest that the relativistic shift is nearly independent of Z in heavy elements where the muon's ground state wave function is mostly inside the nucleus.

* This work is being supported by NSERC

TU-P4-4 **15h30**

Computational models for the physics of electroweak and hadronic interactions*, **Svetlana Barkanova** [1], Aleksandrs Aleksejevs [2], [1] *Acadia University*, [2] Memorial University — The Standard Model of fundamental particles and their interactions has been under rigorous experimental tests for several decades, and so far is considered as one of the most successful theories in particle physics. It is only recently that experiments have reached the level of precision and energy scale where we can see the Standard Model limitations and probe new physics (Qweak, G0, etc.). Electroweak properties of the nucleon can be studied by parity-violating electron-nucleon scattering at the low to medium-energies. An excellent place to search for new physics, the deviation of the weak charge of the nucleon from its Standard Model prediction also requires considerable experimental and theoretical input. Here, the theoretical uncertainty in calculations of cross-sections or asymmetries is primarily induced by the hadronic degrees of freedom, and hence to reduce it substantially, we have to operate with the extensive set of one-loop graphs. We completed this task in part by specifically constructing the hadronic computational model using the dipole approximation for nucleon coupling. In the presented talk, we will outline the results obtained in the dipole approximation relevant to the current parity-violating experiments, as well as discuss some of the details on the computational model we developed for symbolic and numerical calculations.

* This work is being supported by NSERC

15h45 **Session Ends / *Fin de la session***

[TU-P5] New Phenomena / *Phénomènes nouveaux*

(DTP-PPD / *DPT-PPD*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 2830*** **(cap. 106)** ***Chair: R.W. Moore, University of Alberta***

TU-P5-1 **14h15**

HEATHER LOGAN, Carleton University

What's new at the energy frontier *

With the long-anticipated turn-on of the LHC this summer, particle physics enters a new era of discovery which promises to shed light on electroweak symmetry breaking, dark matter, and what lies beyond the Standard Model. This talk will survey recent developments in phenomenology at the energy frontier.

* This work is being supported by NSERC

TU-P5-2 **14h45** **(G*)**

Searches for New Physics in the Exclusive Dijet + Missing E_T Signature at the CDF-II Experiment*, **Daniel M. MacQueen** [1], Pierre-Hugues Beauchemin [2], Kevin Burkett [3], Pier-Olivier Deviveiros [1], Eric James [3], Robert S. Orr [1], Pierre Savard [1], [1] *University of Toronto*, [2] University of Oxford/University of Toronto, [3] Fermi National Accelerator Laboratory — We present the results of a signature-based search for new physics using a dijet + missing transverse energy (ME_T) data sample from 2 fb^{-1} of proton-antiproton collisions at sqrt(s) = 1.96 TeV collected with the Collider Detector at Fermilab. Using data-driven techniques, the expected Standard Model background for the dijet +ME_T signature is measured in two kinematic regions. The "low" region requires the ME_T to be above 80 GeV and the scalar sum of the transverse energy of both jets (H_T) to be above 125 GeV. The "high" region requires ME_T > 100 GeV and H_T > 225 GeV. For both regions, the expected background is within 1.3 standard deviations of the observed results, allowing us to set limits on new physics. We therefore present updated limits on the masses of first, second, and third generation leptoquarks, as well as limits on squark and gluino masses in the non-mSUGRA MSSM case.

* This work is being supported by NSERC

TU-P5-3 **15h00**

Cosmic rays through the Higgs portal*, **Rainer Dick** [1], Robert Mann [2], Kai Wunderle [1], [1] *University of Saskatchewan*, [2] University of Waterloo — Electroweak singlets may couple only through Higgs exchange to Standard Model particles. Models with electroweak singlets therefore provide interesting minimal dark matter models. We discuss possible signatures of these models in cosmic gamma rays.

* This work is being supported by NSERC

TU-P5-4 **15h15** **(G*)**

Search for Higgs Bosons Produced in association with W bosons at CDF*, **Adrian Buzatu**, *McGill University* — The Higgs boson is an elementary particle predicted by the mechanism that allows elementary particles to acquire mass in the Standard Model. The Collider Detector at Fermilab experiment has performed a search for Higgs bosons decaying to $b\bar{b}$ pairs and produced in association with a W boson in a dataset of 1.9fb^{-1} of integrated luminosity of proton-antiproton collisions at a center-of-mass energy of 1.96 TeV. We selected events consistent with having a high transverse momentum electron or muon, large missing transverse energy and two jets. We improved the purity of our sample by using advanced techniques to identify jets from b quarks. We improved our discrimination between the Higgs signal and the W+jets background by using an artificial neural network. We set a 95% confidence level upper limit on the production cross section times branching ratio.

* This work is being supported by NSERC and other international institutions who finance the CDF experiment at Fermilab.

TU-P5-5 **15h30**

CÉLINE LEBEL, Université de Montréal

The ATLAS detector at LHC *

The Large Hadron Collider (LHC) located at CERN near Geneva will begin operating before the end of 2008 at low luminosity. With a design luminosity of 10^{34}/cm^2/sec and a center-of-mass energy of 14 TeV for proton-proton collisions, this collider will allow the exploration of particle physics at the electroweak symmetry breaking scale. One of the detectors which will study the collision products is ATLAS, A Toroidal LHC ApparatuS. With the ATLAS detector, it will be possible to investigate the validity of the Standard Model of particle physics and other models beyond. Canadian physicists have been actively participating in this international project. Their participation includes simulations of exotic physics, detector construction, radiation hardness studies, beam conditions monitoring, real-time radiation field monitoring and development of the high-level trigger.

* This work is being supported by NSERC

TU-P5-6 **16h00**

Diffractive Z and Upsilon production at the LHC*, **Ruben Sandapen** [1], Jeffrey R. Forshaw [2], Brian E. Cox [3], Thorsten Wengler [3], [1] *Université de Moncton*, [2] University of Manchester, [3] University of Manchester & CERN — We compute the rate for the Upsilon meson and Z boson production in the reaction $p + p \to p + V + p$ where V, the Upsilon or Z, is produced diffractively via the sub process $\gamma + p \to V + p$ and the initial photon is radiated off an incoming proton. The rate for Upsilon production is high enough for the process to be of interest at the LHC. Moreover, there is a rather small uncertainty on the predicted cross-section. This could be a very useful calibration process for central exclusive production at the LHC.

* This work is being supported by Royal Society and PPARC

TU-P5-7 **16h15**

Testing explanations of the Polarization Puzzle. **Alakabha Datta**, *University of Mississippi* — I will discuss how the various explanations for the large transverse polarization in certain rare B decays can be tested.

16h30 **Session Ends / *Fin de la session***

[TU-P6] Surface Science of Environmental Processes / *Science des surfaces et processus environnementaux*

(DSS / *DSS*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
14h15 - 16h15

ROOM / SALLE ***VCH 2870*** **(cap. 57)** ***Chair: H. Al-Abadleh, Wilfrid Laurier University***

TU-P6-1 **14h15**

ALLAN BERTRAM, University of British Columbia

Heterogeneous atmospheric chemistry at night †

Laboratory, fieldwork, and modeling studies have conclusively shown that interactions between gas-phase species and atmospheric aerosol particles (termed heterogeneous atmospheric chemistry) can significantly influence the chemistry of the atmosphere. Although a significant amount of research has focused on heterogeneous atmospheric chemistry during the last two decades, this field is still in its infancy, especially in comparison with gas-phase atmospheric chemistry. This talk will focus on heterogeneous atmospheric chemistry that can occur during the night. First, N_2O_5 hydrolysis on aqueous particles coated with organic monolayers will be discussed. Surface-active organic molecules (organic molecules that have both a hydrophobic group and a hydrophilic group) are common constituents of aqueous particles in the atmosphere. Several researchers have suggested that these organic molecules form organic monolayers on the surface of atmospheric aqueous particles. Using a newly constructed flow cell, we have investigated the effect of these organic monolayers on N_2O_5 hydrolysis. Reactions between NO_3 radicals and organic particles will also be discussed. This research shows that NO_3 heterogeneous reactions are efficient and may be more important than previously thought.

† In collaboration with Lori M. Cosman, Simone Gross , Jackson Mak , Daniel A. Knopf

TU-P6-2 **14h45** **(G*)**

Hygroscopic Properties and Reactivity of Multicomponent Aerosol Proxies Studied using Diffuse Reflectance Fourier Transform Infrared Spectroscopy*, **Scott Cowen** [1], Hind Al-Abadleh [2], [1] *University of Guelph*, [2] Wilfrid Laurier University — It is now recognized that atmospheric aerosols modify the chemical and radiative balance of the atmosphere. Due to their chemical complexity, organic aerosols contribution to climate change is still poorly understood. We have studied the hygroscopic properties and reactivity of model multicomponent aerosols that include self-assembled monolayers (SAMs) on silica particles and tannic acid. Silica particles functionalized with SAMs terminated with methyl, vinyl and phenyl groups serve as a model for inorganic particles containing organic matter. Tannic acid serves as a model for atmospheric humic-like substances. Preliminary water uptake experiments and heterogeneous reactions with NO_2 on the above model aerosol proxies were conducted using diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS) at 298 K. The implications of the above studies on our understanding of the chemical aging and change in hygroscopic properties of atmospheric aerosols will be discussed.

* This work is being supported by NSERC and the Canadian Foundation of Innovation

15h00 **Coffee Break / *Pause café***

TU-P6-3 **15h15**

DEREK PEAK, University of Saskatchewan

Mineral structure, surface complexation, and the solid/water interface: Insights on general aqueous surface chemistry from ATR-FTIR and XAS studies of S and Se oxyanion adsorption *

The fate and mobility of many environmentally-relevant oxyanions is determined by reactions at the solid/water interface in soils and sediments. Additionally, one may think of oxyanions reactants as molecular probes into the surface chemistry of important minerals. In this presentation, the authors will present a variety of spectroscopic investigations of sulfate, selenate, and selenite reactivity on different aluminum and iron oxides with Me_2O_3, MeOOH, and $Me(OH)_3$ structures. From these studies, we will support the overall conclusion that the surface structure of metal oxide minerals has a rather dramatic effect on bonding mechanisms of oxyanions for these systems.

* This work is being supported by NSERC, CFI, Saskatchewan Synchrotron Institute

TU-P6-4 **15h45**

Adsorption of Organoarsenicals on Iron (oxyhydr)oxides: In situ ATR-FTIR Studies*, **Hind Al-Abadleh** [1], Scott Cowen [2], Megha Duggal [1], Tuan Hoang [1], [1] *Wilfrid Laurier University*, [2] University of Guelph — Organoarsenicals are found in the environment from the biomethylation of inorganic arsenic compounds and from anthropogenic sources. Anthropogenic sources of arsenic include industrial effluents of the petrochemical and coal industries, the application of organoarsenical pesticides (monomehtylarsonic acid and dimethylarsinic acid), and poultry litter contaminated with arsenic feed additives (p-arsanilic acid and roxarsone) on agricultural lands. It is clear that organoarsenicals pose a health and an environmental risk due to their potential cycling to the most toxic forms of arsenic. The environmental impact of arsenic compounds is usually quantified through the determination of properties such as mobility, bioavailability and speciation, which depend to a large extent on the surface interactions with geosorbents, mainly minerals and organic matter. We have utilized the surface sensitive attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR) to investigate the adsorption of p-arsanilic acid and dimethylarsinic acid on iron (oxyhydr)oxide particles in situ at 298 K. The broad band assigned to ν(As-O) in the spectral range 650 – 950 cm^{-1} was analyzed to quantify adsorption thermodynamics and obtain information about the geometry of adsorbed complexes. We have also quantified the maximum adsorption capacities of these model geosorbents to both organoarsenicals using ATR-FTIR and ICP-MS. Our results suggest that p-arsanilic acid is more mobile than methylated and inorganic forms of arsenic and that transport of nanoparticles with p-AsA(ads) might play a role in its mobility in geochemical environments.

* This work is being supported by Wilfrid Laurier University, Research Corporation Cottrell College Award, and the Canadian Foundation for Innovation

TU-P6-5 **16h00** **(G*)**

Phenol Interactions with Iron Oxide Colloids and Aluminum Oxide Colloids by Chemical Force Microscopy*, **Peiling Sun**, J. Hugh Horton, *Queen's University* — Iron oxide colloids and aluminum oxide colloids are important components in soil systems and efficient coagulants in common use in wastewater treatment processes. Organic compounds containing functional groups such as phenol, benzoic acid and phosphates have specific absorption interactions with the binding sites on the surfaces of iron oxide colloids and aluminum oxide colloids. Since the phenol group within humic-based organic compounds is usually present in naturally occurring soil and water systems, we focus here on interactions between phenol and variously modified iron oxide colloids and aluminum oxide colloids using atomic force microscopy (AFM) at the molecular level to model naturally occurring systems. Iron oxide colloids and aluminum oxide colloids are modified with phosphate, gallic acid and tannic acid by post-precipitation or co-precipitation methods. X-ray photoelectron spectroscopy is used to quantitatively and qualitatively analyze the different elements and functional groups present on the surface. Other surface characterization methods such as ATR-FTIR and AES also are used to confirm successful surface modification. Chemical force titrations are used to probe interactions between a phenol terminated AFM tip and various colloidal substrates as a function of pH.

* This work is being supported by NSERC

16h15 **Session Ends / *Fin de la session***

[TU-P7] Quantum Optics - Laser Cooling and Trapping / *Optique quantique - refroidissement au laser et piégeage*

(DAMPhi-DOP / *DPAMip-DOP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

14h15 - 16h45

ROOM / SALLE ***VCH 3820*** **(cap. 104)** ***Chair: D.W. Tokaryk, University of New Brunswick***

TU-P7-1 **14h15**

MICHEL PICHÉ, Université Laval

Acceleration of charged particles using ultrafast transverse magnetic laser beams of multiterawatt power †,*

Basic theories of particle physics are commonly tested with RF-based particle accelerators whose cost and size have become prohibitive nowadays. In parallel, new medical treatments would benefit from the availability of compact and low cost particle accelerators. Since the discovery of the laser, many accelerator schemes based on intense laser beams have been proposed as alternatives to RF accelerators; however, no consensus has yet been reached as to which scheme would be optimized for particle physics and/or medical treatment. Laser beams propagating in free space pose two fundamental challenges for the acceleration of charged particles: their accelerating fields

produce a force transverse to their propagation axis, and their phase velocity exceeds the speed of light. In this paper, we will describe how ultrafast and ultraintense transverse magnetic (TM) laser beams allow to circumvent these problems. The main idea is to exploit the full vectorial structure of TM laser beams which have a longitudinal electric field with a peak at beam center, where the transverse field components are null. We will show that few-cycle TM laser beams would allow for the acceleration of electrons from rest to relativistic energies using laser powers in the tens of terawatts (10^{12} W). Such powers are now available at major laser facilities throughout the world. One benefit of the approach is that the accelerated particles form a pulse whose duration can be much shorter than a single cycle of the accelerating laser field. The electron beams so produced would have a low divergence and a duration of a few attoseconds (10^{-18} s). With future petawatt (10^{15} W) laser sources, the duration of the electron pulses could be well below one attosecond.

† In collaboration with Charles Varin [1], Pierre-Louis Fortin [2], Alexandre April [2], [1] Université d'Ottawa, [2] Université Laval

* This work is being supported by NSERC, CIPI, FQRNT

TU-P7-2 14h45 (G)

Spectroscopic characterization of a filament induced by a femtosecond laser pulse in a gaseous medium*, **Jens Bernhardt** [1], Weiwei Liu [2], Huailiang Xu [3], Francis Théberge [4], Jean-François Daigle [1], Patrick Tremblay Simard [1], Ali Azarm [1], Marc Châteauneuf [4], Jacques Dubois [4], See Leang Chin [1], [1] *Centre d'Optique, Photonique et Laser (COPL) et le Département de Physique, de Génie Physique et d'Optique, Université Laval*, [2] Institute of Modern Optics, Nankai University, China, [3] The University of Tokyo, Japan, [4] Defence Research and Development Canada - Valcartier — When a high-power (>10GW), ultra-short (<1ps) laser pulse propagates in a gaseous medium, filaments form. These filaments are induced by a dynamic equilibrium between Kerr self-focussing and defocussing by the self-generated plasma. As a result, the laser intensity inside a filament is clamped ("intensity clamping") [1,2]. The clamped intensity is high enough (~5×10^{13}W/cm^2, in air [1,3]) to ionize or dissociate the gas species into fragments. This produces "clean" fluorescence, which is practically free from plasma continuum [4,5]. The phenomenon of filamentation is relevant to many practical applications such as the detection and identification of gaseous pollutants, lightning/discharge control or, ultimately, the generation of powerful few-cycle pulses [6]. In this work, we present a spectroscopic characterization of a filament induced by a femtosecond laser pulse in air and helium. In air, the Stark broadened atomic oxygen triplet centered at 777.4nm was observed and utilized for evaluating a plasma density of ~10^{16}cm^{-3}. In helium, using the Stark broadening of the atomic line He I 587.56nm, the intensity clamping of the filamentation process was confirmed, which sets in at a critical power of about 268GW.

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* This work is being supported by NSERC, DRDC Valcartier, FQRNT, Canada Research Chairs, CFI, CIPI

TU-P7-3 15h00 (G*)

Mean-field Stationary State of a Bose Gas at a Feshbach Resonance*, **Andrew Carmichael**, *University of Connecticut* — We study the steady state behaviour of a zero-temperature Bose gas close to a Feshbach resonance using a simple mean field model which allows for atomic and molecular condensates as well as correlated zero-momentum "BCS" pairs whose provenance would be dissociated zero momentum molecules. Beginning with a second quantized Hamiltonian and equations conserving total (free and bound) atom number and enforcing an assumption that atoms only appear either in the condensates or pairs and the usual Bogoliubov approximation, the system is numerically (and in certain limits, analytically) soluble in the steady state and exhibits a first order phase transition to a pure atomic condensate when the controllable parameters of the coupling and detuning are varied across an (analytically determined) transition line. Analysis of the thermodynamics of the zero-entropy system shows a negative pressure and hence mechanical instability on both sides of the resonance. A mathematical difficulty arising from an ultra-violet divergence due to the assumption of a zero range interaction is resolved with the help of a simpler, exactly analytically soluble two atom version of the problem.

* This work is being supported by NSF (PHY-0354599, PHY-0750668) and NASA (NAG3- 2880)

15h15 Coffee Break / *Pause café*

TU-P7-4 15h30

Effect of Spontaneous Emission on Matter Wave Interference*, **S. Beattie** [1], B. Barrett [1], M. Weel [1], I. Chan [1], C. Mok [1], S.B. Cahn [2], A. Kumarakrishnan [1], [1] *York University*, [2] Yale University — We have studied the effects of spontaneous emission (SE) on a single state time domain atom interferometer (AI) that uses trapped Rb atoms. The AI uses two standing waves pulses separated by time T to diffract and recombine a superposition of momentum states corresponding to the same internal state. The traveling wave components of the standing wave pulses are off-resonant with respect to the excited state. Interference of momentum states produces a ground state density modulation in the sample in the vicinity of t=2T, which can be detected as an echo signal by backscattering an off-resonant readout pulse. The echo amplitude is periodic in T at the atomic recoil frequency. We find that SE influences both the shape of the echo signal and its periodic T dependent amplitude in a manner consistent with theoretical predictions. The effective radiative decay rate of the excited state can be extracted from the T dependant echo amplitude. This rate asymptotically approaches the radiative rate of a single atom in the long pulse limit. We also present results that test theoretical predictions for several properties of the echo formation. These studies are important for realizing precision measurements of the atomic fine structure constant and gravity using this interferometer. The details of this work are described in PRA 77 013610 (2008).

* This work is being supported by CFI, OIT, NSERC, OCE and York University

TU-P7-5 15h45

Improving the Precision Measurement of the Atomic Recoil Frequency using a Single-State Time-Domain Atom Interferometer*, **Brynle Barrett** [1], Scott Beattie [1], Itay Yavin [2], Carson Mok [1], Iain Chan [1], A. Kumarakrishnan [1], [1] *York University*, [2] Princeton University — We use a single state atom interferometer to measure the atomic recoil frequency in laser cooled Rb atoms. A short, off-resonant standing wave laser field is turned on at t = 0, creating a superposition of momentum states. A density grating with period $\lambda/2$, which is formed a short time after the standing wave interaction, dephases due to the velocity distribution of the sample. A second standing wave pulse applied at t = T diffracts the momentum states again. As a result, the density grating is rephased (grating echo) in the vicinity of t = 2T due to the interference of momentum states. The echo signal is a measure of the contrast of the grating and is detected by coherently backscattering a traveling wave readout pulse from the grating. The signal amplitude is periodic at the atomic recoil frequency. A precision measurement of the recoil frequency can be obtained by measuring the period the signal on an extended timescale. We discuss efforts to improve the precision by extending the timescale of the experiment and by modeling the signal shape more accurately.

* This work is being supported by CFI, OIT, NSERC, OCE and York University

TU-P7-6 **16h00**

Progress on Measurements of Gravitational Acceleration Using a Single State Atom Interferometer*, **Carson Mok**, Scott Beattie, Brynle Barrett, Iain Chan, A. Kumarakrishnan, *York University* — We review the development of a gravimeter using a single state atom interferometer. Two standing wave pulses separated by T are applied to a sample of laser cooled rubidium atoms. The traveling wave components of the excitation pulses are far detuned from the excited state. The atoms evolve into a superposition of momentum states separated by $2\hbar k$ and produce a density grating in the sample. The grating dephases due to the velocity distribution and is rephased by the second standing wave pulse near t = 2T. The rephased grating has a period of $\lambda/2$, where λ is the optical wavelength. It is detected by coherently back scattering a traveling wave readout pulse. The backscattered signal, known as an echo, is detected using a balanced heterodyne detector. The phase of the signal is measured relative to an optical local oscillator and is sensitive to the motion of the inertial reference frame. The accumulation of phase as a function of T can be used to find g. We have measured g to a precision of ~10ppm on a time scale of 20ms by acquiring data over ten minutes. We discuss improvements related to increasing the time scale, shielding the experiment from vibrations and actively correcting the RF phase (used to generate the optical pulses) to compensate for the motion of the inertial reference frame. The echo exhibits temporal oscillations consistent with theoretical predictions (PRA **73** 063624), which can be detected as a Doppler shift and used to infer g.

* This work is being supported by CFI, OIT, NSERC, OCE and York University

TU-P7-7 **16h15**

Evolution of Magnetic Coherences in Magnetic Fields*, **Iain Chan**, A. Kumarakrishnan, *York University* — We have studied the evolution of a coherent superposition of magnetic sublevels of the ground states of rubidium gas. Two traveling wave pulses detuned from the excited state by ~40 MHz are used to create such a superposition. The pulses have orthogonal linear or circular polarizations so that magnetic sublevels differing by $\Delta m = 1$ or $\Delta m = 2$ can be excited. The superposition is spatially periodic and dephases because of the velocity distribution. It can be detected by applying a traveling wave read out pulse along one of the excitation directions, and detecting the coherently scattered light along the other excitation direction. We have developed a theoretical description of the evolution of these coherences in arbitrary magnetic fields. The effect of the magnetic field can be described as a time dependent rotation of the atomic system about the quantization axis using a rotation matrix approach. We show that predictions are in agreement with data from laser cooled atoms and room temperature vapour. By using rate equations to model atomic coherences, it is also possible to predict the evolution of coherence grating echoes. Echoes are realized by rephasing the coherences using a second set of traveling wave pulses applied at t = T after the first excitation. The effect of Doppler dephasing is eliminated at t = 2T resulting in the formation of an echo. We have studied the echo in magnetic fields and discuss applications relating to precision measurements of atomic g factor ratios.

* This work is being supported by CFI, OIT, NSERC, OCE and York University

TU-P7-8 **16h30**

Observation of Superfluorescent Emissions from Laser-Cooled Atoms*, **E. Paradis** [1], B. Barrett [1], A. Kumarakrishnan [1], R. Zhang [2], G. Raithel [2], [1] *York University*, [2] University of Michigan — We study superfluorescence (SF) from spherical and cigar-shaped clouds of laser-cooled rubidium atoms from the $5D_{5/2}$ level through the $6P_{3/2}$ level to the $5S_{1/2}$ ground level. The atomic system is excited to the $5D_{5/2}$ level from the ground state via two-photon excitation through the intermediate $5P_{3/2}$ level. The fluorescence on the 6P – 5S transition at 420 nm is recorded using time-resolved measurements. The time delays of the SF peaks typically scale as $< N^{-1}$, where N is the atom number, and are much smaller than the time delay expected for uncorrelated cascade fluorescence. Since N is significantly smaller than the threshold number for SF on the 420 nm transition, and larger than the threshold number for the 5D – 6P transition at 5.2 μm, our observations suggest that the 420 nm SF emission is triggered by rapid de-excitation of the 5D to the 6P level via SF at 5.2 μm. The measured SF time delays for 420 nm emission agree with SF time-delay estimates for the 5.2 μm transition. For spherical clouds, the SF is isotropic, whereas, for cigar-shaped clouds, it is highly anisotropic. Along the long axis of cigar-shaped atom clouds, SF and incoherent cascade fluorescence produce temporally resolved peaks. In this case, the SF component of the signal is highly concentrated along a direction in between the directions of the two almost parallel excitation beams. The SF intensities scale as N suggesting that the 5D-level is regeneratively pumped during SF decay. Details of this work are described in PRA 77, 043419 (2008)

* This work is being supported by CFI, OIT, NSERC, OCE, York University, NSF, FOCUS, and University of Michigan

16h45 **Session Ends / *Fin de la session***

[TU-P8] Industrial Applications of Plasmas / *Applications industrielles des plasmas*

(DPP / *DPP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

14h15 - 16h15

ROOM / SALLE ***VCH 2860*** **(cap. 142)** ***Chair: A. Sarkissian, Plasmionique Inc.***

TU-P8-1 **14h15**

JOËLLE MARGOT, Université de Montréal

Plasma-Québec : a unique strategic network in Plasma Science and Applications *

Plasma-Québec is a unique strategic research network putting together 50 researchers sharing various expertises enabling to pursue advanced research on plasma science and applications. Plasma-Québec R&D activities cover various domains in which plasmas constitute state-of-the art tools. These include materials and nanomaterials synthesis, modification and analysis, fabrication of electronic and photonic micro- and nanostructures, development of advanced instrumentation for elemental analysis, X-ray imaging systems, and treatment of biocompatible materials and biological tissues. Capitalizing on its exceptional infrastructure that represents an investment of about 80 M$, Plasma-Québec has built a coherent research program that integrates 3 complementary axis : (i) plasma science, with focus on laser-induced plasmas, high-frequency plasmas and internal electrodes plasmas, (ii) plasma processes (thin films and nanomaterials synthesis, functional coatings, micro- and nanometer plasma etching, photon sources, elemental analysis) and (iii) process integration in strategic sectors (information and communication technologies, biomedical engineering and environmental preservation technologies). In this presentation, we will briefly review the scientific and technological achievements and objectives activities of Plasma-Québec and we will present a few recent examples of research projects.

* This work is being supported by Fonds Québécois de Recherche sur la Nature et les Technologies

TU-P8-2 **14h45**

LUC STAFFORD, Université de Montréal

Studies of plasma reactions on dynamic surfaces using a novel rotating substrate technique

Over the last three decades, semiconductor device features have been aggressively scaled down from micron sized features to 45 nm. For the upcoming 32 nm technology node, the total variation of the gate electrode width from all sources is expected to be less than 2 nm. Therefore, precise control of definition of the gate electrode in a low pressure (<100 mTorr) plasma etching process is essential. Wall reactions are the dominant loss pathway for reactive neutrals under such low-pressure conditions, and hence have a major influence on the etching rates and quality of etched profiles. Thus, the control of chamber wall conditions is crucial for minimizing process drifts and achieving optimum etching characteristics. However, the dynamic nature of reactor walls with simultaneous bombardment by positive ions, electrons, and UV photons makes measurements of kinetic parameters at the plasma-wall boundary a difficult task. A new "spinning-wall" method was recently demonstrated for studying such complex plasma-wall interactions, bringing the established ultra-high-vacuum techniques of desorption mass spectrometry and Auger electron spectroscopy to the high-pressure, high charge density plasma environment. A small, cylindrical section of the wall is rapidly rotated through skimmers, allowing portions of the surface to be periodically exposed to the plasma and then to be analyzed in near real-time by surface diagnostics in separate, differentially-pumped chambers. In this talk, I will present applications of this new method to systematic investigations of the interactions of O, O_2, Cl, and Cl_2 with dynamic anodized aluminum and stainless steel surfaces.

TU-P8-3 **15h15**

DILIP SARKAR, DSA, University of Quebec

Superhydrophobic and icephobic coating by plasma process †,*

After presenting the current status of ice phobic coatings and its application, our results on superhydrophobic and icephobic coating by plasma process will be discussed. Two different approaches were undertaken to produce low surface energy nanostructured superhydrophobic surfaces. In the first approach, chemically produced metallic or oxide nanoparticles are deposited on various substrates to achieve nanopatterns and these nanopatterned surfaces are then coated with ultra-thin rf-sputtered Teflon films using plasma reactor to obtain low surface energy. In the second approach, fluorine doped hydrocarbon films are coated by plasma enhanced chemical vapor deposition (PECVD) process to achieve low surface energy coatings. These films, prepared by both the processes, were characterized using scanning electron microscopy (SEM), atomic force microscopy (AFM) and x-ray photoelectron microscopy (XPS) both for surface morphological and chemical compositions. Further these films were tested for their superhydrophobic and icephobic properties. The significant ice adhesion reductions are observed when the films are superhydrophobic with very low contact angle hysteresis.

† In collaboration with Masoud Farzaneh, DSA, University of Quebec

* This work is being supported by NSERC/Hydro-Quebec

TU-P8-4 **15h45**

VINCENT BLANCHARD, FPInnovations-FORINTEK

Plasma technology for the wood product industry †

Canadian wood product industry has hard time. This industry has to face competition from emerging industry. Its natural market, USA, has a slowing down economy which also decreases the demand for wood products. High value of Canadian dollar against American dollar also contributes to decrease export to USA. In this context, wood product industry should be innovative and develop a next generation of wood product. Plasma technology could be used to improve its properties as it is an organic living material, which is sensitive to its environment (moisture, water, temperature, UV light). For this reason, wood properties could change significantly between species, or even amongst different samples of the same species. Over the last years, plastic and textile industries have begun experimenting with plasma technology to activate surfaces, mainly to improve coating/substrate adhesion. However, there is very little literature on studies of potential applications of plasma to the treatment of wood surfaces. In our presentation we report the preliminary results of the effect of interactions of sugar maple wood board surface and plasma from different gases and mixes (N_2, H_2, O_2 and Ar). The influence on the surface energy and adhesion between surface and waterborne Polyurethane coating were studied. Moreover, different inorganic (SiO^2, Al_2O_3, ZnO, TiO_2) and organic components (PMMA, PU and PVA) were deposited using plasma-based techniques to obtain nanolayer thick coatings in order to engineer the surface hydrophobicity, increase capacity to absorb/reflect UV light and improve its mechanical properties. The results of these experiments will be presented briefly.

† In collaboration with P. Blanchet [1], P. Jedrzejowski [2], B. Riedl [3], [1] FPInnovations, [2] Plasmionique Inc, [3] Université Laval

16h15 **Session Ends / *Fin de la session***

[TU-P9] Special Topics in Optics / *Sujets spéciaux en optique*

(DOP / *DOP*)

TUESDAY, JUNE 10
MARDI, 10 JUIN
14h15 - 16h15

ROOM / SALLE ***VCH 3860*** **(cap. 148)** ***Chair: P. Ashrit, Université de Moncton***

TU-P9-1 **14h15** **(G*)**

Les faisceaux Bessel courbés et leurs applications*, **Mathieu Fortin** [1], Michel Piché [1], Réal Tremblay [2], [1] *COPL / Université Laval*, [2] Université Laval — Nous proposons une méthode d'inscription de guides d'ondes courbés dans le verre à l'aide de faisceaux Bessel également courbés. L'inscription de ces guides est possible grâce à l'utilisation de lasers à impulsions brèves. Le caractère non-diffractant et la finesse de pic central des faisceaux Bessel font de ceux-ci un choix indiqué pour inscrire des guides de l'ordre du micromètre dans le verre. Les faisceaux Bessel courbés sont générés à partir d'un axicon en transmission et d'une lame de phase qui déforme localement la phase du front d'onde du faisceau et le fait dévier hors de l'axe de propagation. Les simulations numériques effectuées nous montrent qu'il est possible d'inscrire profondément dans la silice de longs guides courbés et des jonctions en forme de Y. Les profils spatiaux des guides produits seraient circulaires, introduisant moins de biréfringence que les méthodes actuelles.

* This work is being supported by ICIP / CRSNG

TU-P9-2 14h30 (G*)

Using Telescope and Adaptive Optics to the Generation and Locally Control of Filament for Filament-Induced Fluorescence Spectra to Remote Sensing of Hydrocarbon Pollutants*, **Yousef Kamali**, Jean-François Daigle, Ali Azarm, Jens Bernhardt, Zhen-Dong Sun, Huailiang Xu, Weiwei Liu, See Leang Chin, *Laval University* — Filamentation is one of the ideal candidates in remote sensing because of its extraordinary properties such as intensity clamping, white light generation and kilometer long plasma channels [1]. The intensity (5×10^{13} W/cm^2) inside the filament core is high enough to dissociate hydrocarbon molecules into small fragments like CH and C_2, which fluoresce [2]. Using a LIDAR system in the laboratory for remote sensing of 2% hydrocarbon (methane, ethylene and acetylene) balanced with air, the fluorescence emitted from the filament–induced CH and C_2 fragments in a 25 m distance are detected and distinguished. In addition, the filament is generated and can be locally controlled via an improved telescope system, where a deformable mirror has been used to vary the aberrations of wavefronts within a closed feedback loop system with a wavefront sensor. Using this setup at energy of 40 mJ per laser pulse, we are able to generate very strong nitrogen signals at a far distance of 85 m. Comparing to the chirp-based filament control technique, we believe that an appropriate control of the reservoir of a filament as what we have achieved here, will reduce the energy of the required laser pulses and save the cost of the required laser system.

1. S.L. Chin *et al.*, *Can. J. Phys.* **83**, 863 (2005).
2. H.L. Xu *et al.*, *Appl. Phys. Lett.* **90**, 101106 (2007).

* This work is being supported by NSERC, Canada Research Chairs, CIPI, DRDC-Valcartier, FQRNT, and the University of Mohaghegh Ardabili

TU-P9-3 14h45

High-resolution scanning X-ray diffraction microscopy*, **Pierre Thibault**, Franz Pfeiffer, Martin Dierolf, Andreas Menzel, Oliver Bunk, Christian David, *Paul Scherrer Institut* — Coherent diffractive imaging (CDI) techniques use coherent sources of radiation — such as X-rays from high-brilliance synchrotrons and free-electron laser sources to extract information on a specimen from its diffraction pattern [1,2]. This approach can produce high-resolution 2D or 3D maps of both the absorption and the phase shift within the specimen. However, replacing lenses with a reconstruction algorithm involves solving the notoriously hard phase problem and imposes strong constraints on specimen preparation. Scanning transmission X-ray microscopy (STXM) is an alternative imaging method that can yield high-resolution images through the raster scan of a focused X-ray beam on the specimen. STXM is fast, efficient and does not require sophisticated data analysis. However, its resolution is limited by the spot size at the specimen plane. Up to now both techniques have evolved separately. We will present a method, called scanning X-ray diffraction microscopy (SXDM), that bridges the gap between coherent imaging and scanning techniques. We will review the method, based on the principles of ptychography [3,4], and describe the recent theoretical developments in algorithms used for the image reconstruction. We will also show first experimental results using a focused hard X-ray beam [5]. The resolution of the reconstructed image is improved by a factor of more than five beyond the size of the focal spot. Our approach can be combined with other X-ray scanning probe techniques such as X-ray fluorescence mapping or microspectroscopy. In addition to providing the full complex-valued transmission function of the specimen, the new analysis procedure retrieves the complete structure of the wavefront incident on it. We expect that SXDM will become a unique tool for the characterization of the fully coherent wavefields produced by projected next-generation X-ray sources.

1. D. Shapiro, *et al. Proc. Natl. Acad. Sci. USA* **102**, 15343-15346 (2005).
2. H.N. Chapman, *et al. J. Opt. Soc. Am. A* **23**, 1179-1200 (2006).
3. R. Hegerl and W. Hoppe. *Ber. Bunsen-Ges. Phys. Chem.* **74**, 1148–1154 (1970).
4. J.M. Rodenburg and R.H.T. Bates. *Phil. Trans. R. Soc. Lond. A* **339**, 521–553 (1992).
5. P. Thibault, *et al.* submitted (2008).

* This work is being supported by FQRNT

TU-P9-4 15h00 (G*)

Evolution and termination of a femtosecond laser filament in air*, **Yanping Chen** [1], Francis Théberge [2], Olga Kosareva [3], Nikolay Panov [3], Valerii P. Kandidov [3], See Leang Chin [1], [1] *Centre d'Optique, Photonique et Laser (COPL) and Département de physique, de génie physique et d'optique, Université Laval*, [2] Defence Research and Development Canada-Valcartier, [3] International Laser Center, Physics Department, M.V. Lomonosov Moscow State University, — Filamentation has sparked considerable interest owing to its novel properties such as intensity clamping, self-spatial filtering, self-stabilization and self-steepening [1-3]. The definition of a filament, however, is still puzzling. Liu *et al.* [4] found that multiple filamentation terminates prematurely due to diffraction by the plasma inside the filaments. Méchain *et al.* observed stable non-ionizing channels extending over km distance in air [5]. We studied the full evolution of a single filament in air both experimentally and numerically. The divergence of the filament core is almost constant over a long distance, encompassing a zone with efficient ionization followed by another where ionization is much weaker. At the end, the core diverges out linearly with a low divergence due to self-spatial filtering [6].

1. S.L. Chin, S.A. Hosseini, W. Liu, Q. Luo, F. Théberge, N. Aközbek, A. Becker, V.P. Kandidov, O.G. Kosareva, and H. Schroeder, *Can. J. Phys.* **83**, 863 (2005).
2. A. Couairon, and A. Mysyrowicz, *Phys. Rep.* **441**, 47 (2007).
3. L. Bergé, S. Skupin, R. Nuter, J. Kasparian, and J-P. Wolf, *Rep. Prog. Phys.* **70**, 1633 (2007).
4. W. Liu, Q. Luo, F. Théberge, H.L. Xu, S.A. Hosseini, S.M. Sarifi, and S.L. Chin, *Appl. Phys.* **B 82**, 373 (2006).
5. G. Méchain, A. Couairon, Y.-B. Andre, C. D'Amico, M. Franco, B. Prade, S. Tzortzakis, A. Mysyrowicz, and R. Sauerbrey, *Appl. Phys.* **B 79**, 379 (2004).
6. S.L. Chin, F. Théberge, and W. Liu, *Appl. Phys.* **B 86**, 477 (2007).

* This work is being supported by the Natural Sciences and Engineering Research Council of Canada, Defence Research and Development Canada in Valcartier, Canada Research Chair, Canada Foundation for Innovation

15h15 Coffee Break / *Pause café*

TU-P9-5 15h30

High contrast fs laser driven intense Ar K-shell x-ray source and its imaging application. **Liming Chen** [1], M. Kando [1], J. Ma [2], Y.T. Li [1,3], S.V. Bulanov [1], T. Tajima [1], Y. Kato [2], Z.M. Sheng [4], J. Zhang [4], [1] *Advanced Photon Research Center, Japan Atomic Energy Agency*, [2] Beijing National Laboratory for Condensed Matter Physics, China/Advanced Photon Research Center, Japan Atomic Energy Agency, Japan, [3] Beijing National Laboratory for Condensed Matter Physics, China — Femtosecond (fs) laser-driven hard x-ray sources have a number of interesting applications in the dynamic probing of matter and in medical imaging. Unfortunately, typically the x-ray continuum in spectrum for solid target is strong and usually contains 90% of total x-ray energy. The energetic x-ray tail will greatly reduce the subject contrast of in-line radiography. We present the result of hard x-ray spectroscopy from an Ar nanoplasma irradiated by a fs laser pulse at 10^{17} *W/cm*^{2}. The spectrum shows a high contrast characteristic K-shell emission, a compressed continuum and the elimination of the energetic x-ray tail which is typically observed with solid target. This Ar K-shell x-ray possesses the measured flux of 1.2×10^3 *photons/mrad*^{2}*/pulse*. In experiment, the high contrast laser is the key factor to stimulating this source. This compact quasi-monochromatic x-ray source has been applied to x-ray radiographic imaging of a biological specimen, resulting in high-resolution phase-contrast images. Correlation between this intense K-shell emission with the laser channeling in the Ar gas is addressed. Recently, the peak brightness of the Ar K-shell radiation is estimated to be ~1.2×10^{21} *photons/s/mm*^{2}*/mrad*^{2} by using longer plasma channel, which is comparable to the peak brightness of the third generation synchrotron radiation sources.

TU-P9-6 15h45 (G*)

Génération expérimentale de faisceaux Bessel-Gauss spatiotemporels*, **Michaël Dallaire**, Nathalie McCarthy, Michel Piché, *Université Laval/COPL* — On sait que les faisceaux Bessel transversaux sont caractérisés par une propagation non diffractante. On a récemment proposé une nouvelle forme de paquets d'onde invariants, dont la forme spatiale et temporelle correspond à une fonction de Bessel, appelés faisceaux Bessel spatiotemporels [1]. Dans cette distribution de champ, les anneaux de la fonction de Bessel se retrouvent dans le plan espace-temps, contrairement au plan *x-y* des faisceaux Bessel transversaux communs. La nature invariante de ce faisceau provient de la balance entre la diffraction et la dispersion (anomale) qui affecte ce dernier au cours de la propagation. La génération expérimentale des faisceaux spatiotemporels ayant une énergie finie due à une enveloppe gaussienne (appelés faisceaux Bessel-Gauss spatiotemporels) nécessite de modeler adéquatement le faisceau dans l'espace et dans le temps simultanément. Pour ce faire, on utilise un modeleur spatiotemporel qui sélectionne spatialement certaines fréquences optiques qui composent une impulsion brève de départ. Les premiers tests ont été réalisés avec des impulsions femtosecondes à 800nm afin de valider la méthode de modelage. Même si le faisceau requière une dispersion anomale afin de se propager de façon quasi-invariante, il est néanmoins possible de vérifier la théorie en analysant sa propagation dans l'air. En faisant l'intégration du profil spatial avec une camera CCD, on peut observer l'évolution du faisceau le long de l'axe de propagation. Le profil temporel est quand à lui obtenu à l'aide d'un autocorrélateur de fabrication maison. Les résultats expérimentaux ainsi obtenus démontrent un bon accord avec le modèle analytique et les simulations numériques.

1. M. Dallaire, M. Piché, and N. McCarthy, "Analysis and Generation of Spatiotemporal Bessel Beams," Frontiers in Optics, OSA Technical Digest, Optical Society of America, paper FWC2 (2007).

* This work is being supported by ICIP, CRSNG et FQRNT

TU-P9-7 **16h00** **(G*)**

Proposal for a solid state carrier-envelope-offset phase (CEP) detector*, **Cole Van Vlack**, Stephen Hughes, *Queen's University* — Ultrashort pulse light-matter interactions in a thin film GaAs are theoretically investigated within the regime of resonant optical rectification. By solving the microscopic semiconductor Bloch equations self-consistently with the classical electromagnetic field equations, a single-shot dependence on carrier-envelope-offset phase (CEP) is demonstrated for 5 fs pulse durations using pulse envelope areas of only 2-4π. We subsequently suggest a possible technique to extract the CEP, in both sign and amplitude, using a solid state detector. The role of exciton effects, sample thickness, and multibands is discussed.

* This work is being supported by Natural Sciences and Engineering Reseach Council of Canada

16h15 **Session Ends** / ***Fin de la session***

[TU-AGM] CAP Annual General Meeting / *Assemblée générale de l'ACP*

(CAP / *ACP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

16h30 - 18h00

ROOM / SALLE ***VCH 2850*** **(cap. 404)** ***Chair: L. Marchildon, UQTR***

TU-AGM-1 **16h30**

LOUIS MARCHILDON, Université du Québec à Trois-Rivières

Promouvoir la physique canadienne: réalisations et défis / Achievements and challenges in promoting Canadian physics †

Nous faisons un survol des réalisations de l'ACP au cours de la dernière année, tant dans la promotion de la physique et des physiciens canadiens que dans l'amélioration de l'efficacité de l'Association. Plusieurs défis se profilent, mais notre conscience collective et notre motivation sont nos plus grands atouts pour y faire face.

We will outline CAP's accomplishments over the last year, both in promoting Canadian physics and physicists and in improving the Association's efficiency. There are challenges ahead, but our strong sense of community and purpose is our biggest asset in meeting them.

† In collaboration with Shelley Page, University of Manitoba

18h00 **Session Ends** / ***Fin de la session***

[TU-Banq] CAP Reception and Banquet / *Réception et banquet de l'ACP*

(CAP / *ACP*)

TUESDAY, JUNE 10 / MARDI, 10 JUIN

19h00 - 22h30

ROOM / SALLE ***PAD "Le Grand Salon" (2nd floor)*** ***Chair: L. Marchildon, UQTR***

19h00 **Reception** / ***Réception***

19h30 **Banquet** / ***Banquet***

22h30 **Session Ends** / ***Fin de la session***

WEDNESDAY, JUNE 11 - MERCREDI, 11 JUIN

[WE-Plen1] Plenary Session: CAP-INO Medal / *Session plénière: Médaille de l'ACP-INO*

(CAP-INO / *ACP-INO*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
08h15 - 09h00

ROOM / SALLE ***VCH 2850*** **(cap. 404)** ***Chair: R. Corriveau, CIPI/ICIP***

WE-PLEN1-1 **08h15**

JACQUES BEAULIEU, Beaulieu Consultant Inc.

From Optics to Photonics in 50 Years

After reviewing the impact of the discoveries of geometrical Optics, the evolution of Quantum Optics since the late 50's and that of associated data processing electronics led to the concept of Photonics. A variety of applications of this technology will be outlined, and some potential future applications will be discussed. Débutant par une revue de l'impact des découvertes de l'Optique géométrique, puis celle de l'évolution de l'Optique Quantique depuis les années 50 et associée au développement du traitement électronique des données ont mené au concept de la Photonique. Une grande variété des applications de cette technologie sera soulignée et le potentiel de futures applications sera présenté.

9h00 **Session Ends / *Fin de la session***

[WE-Plen2] Plenary Session: CAP Herzberg Medal / *Session plénière: Médaille Herzberg de l'ACP*

(CAP / *ACP*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
09h00 - 09h45

ROOM / SALLE ***VCH 2850*** **(cap. 404)** ***Chair: L. Marchildon, UQTR***

WE-PLEN2-1 **09h00**

CARL SVENSSON, University of Guelph

Gamma-Ray Spectroscopy with Radioactive Ion Beams at TRIUMF-ISAC

Over the past decade, the world's premier online isotope separator and accelerator facility, ISAC, has been developed at TRIUMF, Canada's national laboratory for nuclear and particle physics research. ISAC produces high-quality, high-intensity beams of radioactive ions that greatly expand the selection of isotopes available to both subatomic physics and material science researchers. The evolution of the complex nuclear many-body system far from the stable combinations of neutrons and protons that form the isotopes of everyday experience is probed and its implications for the synthesis of the heavy chemical elements in explosive astrophysical environments explored. Particular isotopes with desirable properties are selected and exploited in applications as diverse as studies of surface magnetization in thin films to tests of the electroweak Standard Model and searches for new fundamental interactions through high-precision measurements. Gamma-ray spectroscopy with large arrays of high-resolution gamma-ray detectors provides a particularly powerful, and versatile, technique for the study and exploitation of these unique beams of radioactive ions and this presentation will provide an overview of recent progress and highlights in the gamma-ray spectroscopy programs with the Canadian 8π Gamma-Ray Spectrometer and the newly-commissioned TRIUMF-ISAC Gamma-Ray Escape Suppressed Spectrometer (TIGRESS) at ISAC.

9h45 **Session Ends / *Fin de la session***

[WE-A1] CAP Best Student Presentations Final Competition / *Compétition finale de l'ACP pour les meilleures communications étudiantes*

(CAP / *ACP*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
10h00 - 12h30

ROOM / SALLE ***VCH 2860*** **(cap. 142)** ***Chair: M.C.W. Campbell, University of Waterloo***

WE-A1-1 **10h00** **(G*)**

The list of students participating in this competition will be announced at the Annual General Meeting on Tuesday, June 10th.

Les participants seront annoncés pendant l'assemblée générale mardi, le 10 juin.

12h30 **Session Ends / *Fin de la session***

[WE-A2] Hadron Structure, QCD / *Structure hadronique, CDQ*

(DNP / *DPN*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
10h00 - 12h30

ROOM / SALLE ***VCH 3820*** **(cap. 104)** ***Chair: R. Lewis, York University***

WE-A2-1 **10h00**

GARTH HUBER, University of Regina

Physics Potential of the Jefferson Lab 12 GeV Upgrade *

The 12 GeV Upgrade at Jefferson Lab will offer electron beams with a unique combination of high intensity, duty factor, polarization, and kinematic reach, opening new opportunities for advances in hadron physics. The combination of these beams with greatly enhanced detectors will provide critically needed data for the investigation of a broad range of QCD phenomena that have simply not been experimentally accessible. This will make possible new explorations of the valence structure of hadrons and nuclei, and of the existence and properties of possible new states of matter, the exotic mesons. I will review the status and plans for experiments in the first five years of operation of the upgraded Jefferson Lab, with particular emphasis on those experiments which are expected to have noteworthy Canadian contributions, and their possible impacts upon theory.

* This work is being supported by NSERC

WE-A2-2 **10h30**

ADAM JAMES SARTY, Saint Mary's University

Upcoming Proton Form Factor Ratio Measurements at Extreme Momentum Transfers: from 0.015 to 15.0 GeV^2 †,*

Over the past decade, a series of elastic electron scattering measurements off the proton in Jefferson Lab's Hall A has generated renewed interest in the structure information revealed by the proton's electric and magnetic form factors (G_E and G_M). Prior to this series of measurements, the form factors were empirically observed to exhibit dipole forms, such that $\mu_p G_E/G_M \approx 1$ over all regions of momentum transfer studied. With the Hall A results confirming that the ratio $\mu_p G_E/G_M$ shows a steady decrease below unity as a function of Q^2, beginning at least around $Q^2 = 1$ GeV^2, discussions revolving around the implication of this deviation from dipole behaviour for proton structure have been accompanied by renewed experimental interest in these elastic form factors. This talk will outline the latest two Hall A experimental proposals in this field, which will probe the form factor ratio at the opposite extremes of momentum transfer. Experiment 08-007 (spokespersons: Ron, Arrington, Day, Gilman, Higinbotham, Sarty) will investigate the lowest end of momentum transfer, using recoil proton polarimetry to span $Q^2 \approx 0.25 - 0.70$ GeV^2, and using a polarized target technique to reach down to $Q^2 \approx 0.015$ GeV^2. Experiment 12-07-109 (spokespersons: Pentchev, Cisbani, Perdrisat, Punjabi, Wojtsekhowski) will push the proton recoil polarization technique to the highest momentum transfer values of $Q^2 \approx 13 - 15$ GeV^2 by using an 11 GeV beam (to be available following the lab's energy upgrade), a lead glass calorimeter for scattered electron detection, and Gas Electron Multiplier (GEM) detectors for the recoil proton to define the kinematics. The experimental techniques, and the physics opportunities, offered by each of these "extreme" upcoming experiments will be discussed.

† In collaboration with Hall A Collaboration, Jefferson Lab

* This work is being supported by NSERC

WE-A2-3 **11h00**

ROBERT PETRY, University of Regina

Lattice methods for light-quark mesons

Determination of the meson mass spectrum from lattice QCD requires a large set of operators with appropriate quantum numbers and an unbiased analysis method. A specific class of operators has been studied with the twisted-mass lattice action. An analysis algorithm based on genetic evolution has been proposed and implemented. Numerical results obtained in the quenched approximation, for standard mesons and hybrid mesons, will be discussed.

WE-A2-4 **11h30**

Measurement of the Photon Asymmetry in Neutral Pion Production from the Proton near Threshold*, **David Hornidge**, *Mount Allison University* — A precise measurement of $p\ (\gamma,\pi^0)\ p$ close to threshold was undertaken at the Mainz Microtron in order to test Chiral Perturbation Theory. The *S*-wave and all three *P*-wave amplitudes, along with their energy dependence, will be extracted from the differential cross section and photon asymmetry. Preliminary results will be presented.

* This work is being supported by NSERC, DOE, NSF, DFG, SFB 443

WE-A2-5 **11h45**

The Compton polarimeter for Qweak*, Anna Micherdzinska [1], **Charles Davis** [2], [1] *University of Winnipeg,* [2] *TRIUMF*, for the Qweak Collaboration — Compton polarimetry is theoretically clean, a noninvasive technique of determining the polarization of the electron beams. Compton polarimeters have been used in experiments needing continuous monitoring of the beam polarization where the highest possible precision on polarization is required. In Compton polarimetry, the electron polarization is determined by the measurement of counting rates of the polarized electrons scattered off circularly polarized photons as a function of scattered photon energy. The rate asymmetry is equal to the product of laser and electron beam polarizations and the theoretical cross section asymmetry (calculated from QED). This technique will be applied in the Q_{weak} experiment, which will be conducted at the Jefferson Lab in 2010. The Q_{weak} experiment will measure the parity-violating asymmetry in elastic electron-proton scattering at very small momentum transfer $Q^2 = 0.03$ (GeV/c) ^{2}. This will result the first ever extraction of the proton's weak charge (Q^p_W) and the most precise extraction of $\sin^2 \theta_W$ below the Z-pole. The precision goal is 4% for the determination of Q^p_W, which corresponds to 0.3% for the determination of $\sin^2 \theta_W$. The dominant experimental uncertainty results from the determination of the electron beam polarization, which needs to be known to 1%. Progress on the Compton polarimeter for Q_{weak} will be presented. This talk is followed by Peiqing Wang's talk presenting details on the electron detector for this polarimeter, a device that we are constructing.

* This work is being supported by Natural Sciencies and Engineering Research Council of Canada and Canada Foundation for Innovation

WE-A2-6 **12h00** **(G)**

Diamond Detectors for Compton Polarimetry*, **Peiqing Wang**, *University of Manitoba (for the Qweak collaboration)* — Compton polarimetry will be used to measure the longitudinal polarization of the electron beam for the upcoming Qweak experiment at Jefferson Lab. The polarization is measured by scattering polarized laser light from the polarized electron beam, and extracting the Compton scattering cross-section asymmetry. The recoil electrons are momentum-analyzed using a dipole magnet which separates them spatially from the main beam. A bulk semiconductor detector, fabricated from synthetic diamond is used to sense the recoil electrons. The diamond detector will be a multi-strip device. The strips will be oriented perpendicular to the bend plane of the magnet, so that each strip will be sensitive to the recoil electron momentum. The shape of the Compton asymmetry in recoil momentum allows a systematically clean determination of the incident electron polarization with high confidence. First prototypes of the detector have been fabricated at the University of Manitoba Nanosystems Fabrication Laboratory. Tests of prototypes using minimum-ionizing electrons are ongoing at the University of Winnipeg. Prototyping progress and results of these tests will be reported.

* This work is being supported by NSERC and CFI

WE-A2-7 **12h15** **(G)**

The G0 experiment, parity violation of Delta photoproduction*, **Alexandre Coppens** [1], [1] *University of Manitoba*, [2] The G0 collaboration — The G0 experiment is a nuclear physics experiment done at the Jefferson Laboratory and allows the measurement of the parity violating asymmetry of the process $\gamma + n \rightarrow \Delta^0 p + \pi^-$. This measurement aims at the extraction of d_Δ, a low energy constant characterizing the Parity-violating $\gamma N\Delta$ coupling. In practice, the very intense electron beam from the JLab accelerator produces a secondary beam of collinear photons within the G0 deuterium target. This Bremsstrahlung beam can be used to study of the interaction between this photon beam and the neutrons inside the target via the process described above. In this case, the parity violating asymmetry of the pion (π^-) production is directly proportional to d_Δ. This low energy constant is of great interest as it has never been measured before. It also provides an additional test of the resonance saturation model which solves several puzzles in hyperon decay, and which predicts a potentially suprisingly large value for d_Δ. The analysis status of the data, taken in backward angle mode between September 2006 and March 2007, will be discussed.

* This work is being supported by University of Manitoba

12h30 **Session Ends / *Fin de la session***

[WE-A3] Medical Physics / *Physique médicale*

(DMBP / *DPMB*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
10h00 - 12h15

ROOM / SALLE ***VCH 3840*** **(cap. 106)** ***Chair: D.E.B. Fleming, Mount Allison University***

WE-A3-1 **10h00**

ANDREW JIRASEK, University of Victoria

Polymer gel dosimetry for 3D dose verification in radiation therapy

Polymer gel dosimeters are tissue equivalent, dose integrating, high spatial resolution, anthropomorphic dosimeters which show promise for use in three dimensional measurement and verification of complex radiation treatments in cancer therapy. Currently largely in the developmental phase, this class of dosimeters has not been used widely in clinical settings due to a number of scientific and technological challenges. This talk will review some of the basic science behind polymer gel dosimeters, the imaging of gel dosimeters for dose information extraction, and applications of polymer gel dosimetry in radiation therapy. The talk will also highlight some of the work our group has been involved with in the area of polymer gel dosimetry.

WE-A3-2 **10h30**

TAMIE POEPPING, University of Western Ontario

Vascular Modeling and Hemodynamics Research Using Ultrasound and Particle Imaging *

Ischemic stroke is typically due to large-artery emboli, for example as can result from atherosclerotic plaque build-up in the carotid artery bifurcation. Hemodynamics can play a critical role in the plaque ulceration and rupture or the activation of blood-clotting mechanisms through shear stress, turbulence and recirculation. While stroke risk has been shown to be associated with stenosis severity (degree of constriction), only a fraction of stenosed carotids proceed to cause stroke, and yet this is the primary diagnostic metric that determines subsequent treatment. Clearly there is an association with hemodynamics, but it is unclear as to what aspects (or combinations) of the hemodynamics and plaque physiology are the real troublemakers. A better understanding of large-artery hemodynamics, and techniques to characterize the hemodynamics in vivo, will enable longitudinal patient studies, which may lead to improved diagnosis and treatment. A unique in-vitro facility has been developed which is comprised of life-sized carotid bifurcation models, enabling the in vitro study of shear stress and turbulence resulting from varying degrees of atherosclerotic disease in the carotid bifurcation. Flow modeling using digital particle imaging (DPI), Doppler ultrasound (DUS), and computational fluid dynamics (CFD) demonstrates flow pattern changes for different levels of disease severity and plaque geometry. DPI and CFD offer high-resolution standards for comparisons, but ultimately Doppler ultrasound provides the crucial opportunity for transferring new techniques to in vivo hemodynamics studies. The development of the in vitro facility and recent results using DPI and DUS will be discussed.

* This work is being supported by NSERC, Heart & Stroke Foundation

WE-A3-3 **11h00**

STEVEN BEYEA, National Research Council of Canada

Novel Acquisition Techniques for High Field Functional MRI (fMRI) †,*

Functional Magnetic Resonance Imaging (fMRI) is well established as a tool to study brain activity, via the Bold Oxygen Level Dependent (BOLD) contrast mechanism. The use of strong magnetic fields (e.g. 4-Tesla) is known to increase the sensitivity and specificity of BOLD; however, high field fMRI also brings its own challenges

which must be addressed using novel MR physics methodologies. One example of this is the susceptibility induced field gradients (SFG) which scale with applied magnetic field, and consequently lead to signal loss and image distortion in regions of the brain that are close to air-tissue interfaces (e.g. orbital-frontal cortex). At our lab, an array of complimentary methods have been developed which attempt to address these challenges by utilizing an understanding of the underlying physics. Results demonstrating the advantages and challenges of BOLD fMRI in a 4-Tesla whole-body MRI will therefore be shown, with a focus on the development and characterization of new techniques designed to provide optimal fMRI at high field.

† In collaboration with Kim Brewer [1], Steve Patterson [1], Chris Bowen [2], [1] Dalhousie University, [2] National Research Council of Canada

* This work is being supported by NSERC Discovery Program, Nova Scotia Health Research Foundation, Radiology Research Foundation

WE-A3-4 11h30

K-shell X-ray fluorescence measurements using the fundamental parameter method*, **Mihai Gherase**, Marc Vallee, David Fleming, *Mount Allison University* — Traditionally, X-ray fluorescence (XRF) spectroscopy measurements of elemental concentration in a matrix make use of a calibration line. The calibration line is produced by plotting the fluorescence signal extracted from the XRF spectrum against a "prepared" concentration in a matrix with identical or similar elemental composition. An underlying assumption of this technique is that the concentration distribution in the "prepared" sample is similar to the one in the sample to be measured. Often, homogeneous concentration is assumed in both cases. In practice, this condition may not always be satisfied. The inhomogeneous depth distribution is particularly important in cases where the spatial extent of this distribution is comparable with or greater than the attenuation path length of the fluorescent photon. An example is the XRF measurement of arsenic in skin [1]. In this presentation, an XRF signal equation based on the Fundamental Parameter (FP) method [2], which explicitly takes into account the depth dependence of the elemental concentration, will be developed. The formalism is experimentally verified for two-disc polyester resin stacks with different arsenic concentrations.

1. R.C.N. Studinski, F.E. McNeill, D.R. Chettle, J.M. O'Meara, Estimation of a method detection limit for an *in vivo* XRF arsenic detection system. *Phys. Med. Biol.* **50**:521-530, 2005.
2. D.K.G. De Boer, Calculation of x-ray fluorescence intensities from bulk and multilayer samples. *X-ray Spectrom.* **19**: 145-154, 1990.

* This work is being supported by CRC, CIHR, NSERC

WE-A3-5 11h45

Near-infrared optoacoustic imaging of tissue mimicking phantoms*, **William Whelan** [1], Robin Castelino [2], Michael Kolios [2], [1] *University of Prince Edward Island*, [2] Ryerson University — Clinical ultrasound imaging is the most frequently used imaging modality in the world accounting for almost 25% of all imaging procedures. Ultrasound imaging has the advantage of low cost, rapid imaging speed, portability and high resolution but suffers from relatively poor image contrast. Optoacoustic imaging combines high tissue contrast achievable using optical interrogation with the high spatial resolution associated with ultrasound. Tissues are illuminated with nanosecond pulses of near infrared laser energy, yielding a local temperature rise followed by thermal expansion and the production of pressure waves. These pressure (ultrasound) waves, typically 150 kHz to 1.5 MHz, can propagate through the tissue with minimal attenuation (scattering), delivering high resolution information to wide-band transducers at the surface of the tissue. Recent work demonstrates that optoacoustic signals are sensitive to structural, compositional and vascular changes that occur in tissues as cancers grow and respond to therapy. Minimally invasive thermal therapy, which involves heating tissues to above 55 C, is currently being investigated for the treatment of small solid tumours. In this presentation, the potential of optoacoustic detection of thermal damage is demonstrated in tissue-equivalent albumen phantoms exposed to varying thermal doses. In addition, multi-wavelength selective optoacoustic imaging is demonstrated for different chromophore based targets embedded in albumen phantoms. The results of this study indicate that optoacoustic signals are sensitive to changes in delivered thermal dose and, hence, optoacouctic imaging has potential as a non-invasive monitoring tool for thermal therapy.

* This work is being supported by NSERC (CHRP and Discovery Programs) and CIHR

WE-A3-6 12h00

Can tissue aging and transformation be detected optically?, **Lothar Lilge** [1], Pryianga Ranjan [1], Kristina Blackmore [2], Samantha Dick [1], [1] *Division of Biophysics and Bioimaging, Ontario Cancer Institute,* [2] Prosserman Centre for Health Research, Joseph and Wolf Lebovic Centre Mount Sinai Hospital, Toronto, Ontario — The visual appearance of aging is visible to us in particular on the skin. However, microscopic changes precede visual clues, with the latter mostly related to morphological changes mainly relating to the collagen structure. The microscopic changes are associated with a modification of the metabolism; the rate of the metabolic changes accelerates as rapidly aging tissue undergoes transformation. This is consistent with the multiple genetic hits required for tissue transformation from normal via dysplasia to carcinoma *in situ* according to the model by Kelloff *et al.* In an ongoing longitudinal optical breast transillumination study in a cohort of young women (23-49 years) we observed time-dependent changes in the spectra over a 3 year period, which are suggestive of tissue aging in this cohort. The rate of change for the cohort is statistically different from zero, where the rate of change for an individual can either be positive or negative. Within this group of pre-menopausal women the rate of change was not statistically different between young and older women. These tissue aging rates will be discussed in relationship with the Pike model associating rates of breast tissue maturation and aging with the relative lifetime risk of developing breast cancer. 1. Kelloff GJ. Perspectives on cancer chemoprevention research and drug development. Adv Cancer Res. 78:199-334, 2000. Review. 2. Pike MC, Krailo MD, Henderson BE, Casagrande JT, Hoel DG. 'Hormonal risk factors', 'breast tissue age', and the age-incidence of breast cancer. Nature 303:767-70, 1983.

12h15 Session Ends / *Fin de la session*

[WE-A4] Advanced Materials and Photonic Crystals / *Matériaux avancés et cristaux photoniques*

(DOP / *DOP*)

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

10h00 - 12h45

ROOM / SALLE VCH 2830* (cap. 106)** ***Chair: S. Gauvin, Université de Moncton

WE-A4-1 10h00

JEAN-CLAUDE KIEFFER, Université du Québec, INRS

The 200TW laser at the Advanced Laser Light Source facility: Progress, first experiments and perspectives of high power femtosecond technology †

The first laser system in the world delivering simultaneously high peak (200TW) and high average (50W) power is now operational at the Advanced Laser Light Source (ALLS) facility. I will describe the performances of this laser system and present the first experiments realized in order to qualify the system. This laser, which is at the

forefront of the femtosecond technology, is opening new avenues in laser-matter interaction. I will discuss perspectives towards societal applications and more specifically the development of ultrafast μCT for in vivo imaging of small animals. Finally I will present the technical roadmap to increase the average power, while keeping the high peak power, to the limits of this technology.

† In collaboration with Stephane Payeur, Sylvain Fourmaux

WE-A4-2 10h30 (G)

Polymer homo-junction photovoltaic cells*, **Yanguang Zhang**, Yufeng Hu, Jun Gao, *Queen's Univeristy* — Conjugated polymers have great potential for photovoltaic (PV) applications due to the intrinsic low cost of polymer semiconductors. Current "bulk hetero-junction" polymer PV cells typically exhibit open circuit voltage (V_{oc}) in the range of 0.5 → 1.3V, which are much smaller than polymer bandgaps. Polymer homo-junction PV cells offer the possibility in theory to achieve high V_{oc} approaching polymer bandgaps, since photovoltaic effect in these cells mainly arise from the difference in chemical potential of p and n-doped polymers. Here, we report high V_{oc} very close to polymer bandgaps, 2.25V and 1.90V for a green and red-emitting polymer (with bandgaps 2.38 and 2.11eV), respectively. In addition, these polymer homo-junction PV cells exhibit short circuit current density (I_{sc}) of 2.0mA/cm^2 (green) and 4.72mA/cm^2 (red) at 180K without the addition of fullerene materials and/or conjugated polymers which can be used to form donor/acceptor system and therefore largely facilitate charge separation. Even larger I_{sc} of 13.45mA/cm^2 (green) and 7.90mA/cm^2 (red) have been achieved simply by enhancing the test temperature to 250 and 220K respectively.

* This work is being supported by NSERC

WE-A4-3 10h45

JACQUES ALBERT, Carleton University

Multiparameter sensing mechanisms from gratings in optical fibers

Over the past two years, our group has developed a novel class of fiber grating sensors that can provide several orthogonal quantitative measurements simultaneously. In particular, I will present experimental results on gold-coated optical fibers for plasmon resonance based sensing of bio-molecules, as well as sensors made from endlessly single mode photonic crystal fibers.

11h15 Coffee Break / *Pause café*

WE-A4-4 11h30

MAKSIM SKOROBOGATIY, École Polytechnique de Montréal

Photonic textiles and their applications

In my talk I will overview photonic textiles – a novel composite that merges optical fibers and clothes. Various uses of such textiles in illumination, fashion and adaptive coloration will be discusses. I will conclude with a progress report on developing photonic crystal fiber-based textiles in our research group.

WE-A4-5 12h00

Effect of film thickness and filling ratio on ΓL photonic pseudogap in WO_3 inverse opal thin films*, **Julia Khalack**, Pandurang Ashrit, *GCMP, Université de Moncton* — Due to a relative simplicity of its fabrication, the inverse opal has become one of the most popular kinds of photonic crystals. The close-packed FCC structures of air spheres in the matrix material with the refractive index n>2.8 are known to develop a complete bandgap between the 8th and the 9th photonic bands. Using a photonic crystal made from an electrochromic material, one can reversibly change the bandgap position by controlling the external parameters. Unfortunately, all electrochromic materials have quite low refractive index, so one has to operate with a partial bandgap in the ΓL direction between the 2nd and 3rd photonic bands. On the other hand, the inverse opals are usually produced in the form of thin films with the close-packed (111) plane parallel to the surface, so that the ΓL direction is normal to the surface and the partial bandgap effects the light coming at normal incidence. To investigate the influence of the finite film thickness on the photonic bandgap, we perform Finite-Differences Time-Domain simulations (with the help of FullWAVE simulation package) of the transmission and reflection spectra of a WO_3 inverse opal film with a variable number of air sphere layers. The possibility of non-complete infiltration of the top layer by the matrix material is considered as well.

* This work is being supported by AIF-FIA

WE-A4-6 12h15 (G)

Fabrication of Gold Nanoparticles Based Optical Sensors Using Focused Ion Beam Lithography*, **Asad Rezaee**, A.K.A. Aliganga, Silvia Mittler, *University of Western Ontario* — Metallic nanostructures and their applications is a rapidly expanding field. Surface plasmon, localized near the boundary between a metal nanostructure and the surrounding material, produces an enhanced electromagnetic field at the interface. This enhanced field can be used for optical interactions that form a powerful basis for optical sensing. Nobel metals such as silver and gold historically have been used to demonstrate plasmon effects because their resonances are the strongest and occur in the visible part of the electromagnetic spectrum. As a result, there has been much experimental interest in the optical properties of noble metal and particularly gold nanoparticles recently. Gold nanoparticles show plasmon absorbance peaks when they are illuminated by light. The location and width of the peak depends on the size, shape, and average spacing between the particles. For sensor application, it is important to find the optimum condition in which the best size, shape, and average spacing can be reached. A sensor depicts its highest sensitivity with optimized parameters and usually operates by investigating plasmon band shifts. The absorbance peak of randomly positioned gold nanoparticles is mostly broad. As a result, a sensor made from these structures shows absorbance peak shifts which might not be very clear. This presentation introduces a new method to deposit precisely positioned gold nanoparticles on glass and silicon substrates, FIB-lithography and OMCVD grown nanoparticles fabrication technique. The proposed structure is aimed to yield a very sensitive nanoparticle system for the detection of minute amounts of biological and chemical materials.

* This work is being supported by OCE, NSERC, CFI, OIT

WE-A4-7 12h30 (G)

Photoluminescence of colloidal CdSe/ZnS quantum dots coupled to whispering gallery modes of a microsphere for label-free biodetection*, **Guillaume Cyr**, Claudine Allen, *Centre d'optique photonique et laser, Université Laval* — Semiconductor quantum dot nanocrystals (QDs) have unique optical properties such as size-tunable photoluminescence (PL) wavelength and a chemically functionalizable surface. Combined to optical microcavities, these properties could eventually be used for label free biodetection experiments. Our CdSe/ZnS QD nanocrystals were first made water-soluble by encapsulation in a micelle of positively charged amphiphilic copolymers. They were then adsorbed on micrometer–sized silica beads having a negative surface charge which was sometimes enhanced by successive deposition of cationic poly-

ethylenimine followed by anionic polyacrylic acid sodium salt. Single beads were characterized with a flow circulating system enabling fast recording of several measurements to obtain good statistical sampling. The visible PL spectra between 500 nm and 580 nm from QDs on a single bead were modulated by whispering gallery mode resonances since the bead acts as an optical microcavity. Depending on the microsphere quality factor (Q), it could also be possible to detect perturbations caused by sufficient adsorption of biomolecules on a bead's surface by observing spectral shifts of the resonances. To study this optical phenomenon, we tested the predictions of the Lorentz-Mie model by calculating the resonance wavelengths and by characterizing their spectral shifts when the permittivity of the external medium was changed. We recorded single bead PL spectra for various media of different refractive indexes (n), such as isopropanol in aqueous solution with n = 1.33 to n = 1.37, and compared them with the calculated spectra. In addition, we also observed that the wavelength shift is inversely proportional to the sphere radius as predicted by the model. We measured a Q factor of 500 for our microspheres and compared it with to the Q factor of commercially available microspheres.

* This work is being supported by National Sciences and Engineering Research Council of Canada

12h45 Session Ends / *Fin de la session*

[WE-A5] Synchrotron Science / *Science des synchrotrons*

(DCMMP-DIMP / *DPMCM-DPIM*)

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

10h00 - 12h00

ROOM / SALLE ***VCH 2840*** **(cap. 98)** ***Chair: A. Moewes, University of Saskatchewan***

WE-A5-1 10h00

ANDREA DAMASCELLI, University of British Columbia

The Legacy of Einstein's Photoelectric Effect: From Light Quanta to Quantum Phenomena in Solids

The photoelectric effect, discovered by Hertz in 1887 and explained by Einstein in 1905 on the basis of the revolutionary hypothesis of light quanta, marked the beginning of photoelectric spectroscopy, one of the most active fields in modern science and technology. Owing to recent technical progress, in particular to the development of third-generation synchrotron sources, the last decade witnessed a renaissance in this technique and its applications. To this end, angle-resolved photoemission spectroscopy (ARPES) has emerged as the most powerful method to study the momentum-resolved low-energy electronic structure of solids. Nowadays ARPES enables the detailed mapping of electronic band structures and Fermi surfaces as well the study of many-body quantum phenomena in solids. In this talk I will review the present state of the technique and, by presenting our recent experimental results on unconventional superconductors, I will illustrate that state-of-the-art ARPES is a unique tool for momentum-space microscopy on novel quantum materials.

WE-A5-2 10h30

SERGE DESGRENIERS, Université d'Ottawa

X-ray Micro-Diffraction: A Remarkable Tool for the Study of Condensed Matter Under Extreme Conditions *

Recent advances in high pressure techniques and the availability of synchrotron radiation beam lines dedicated to research on materials submitted to extreme conditions have led to an outstanding impulse to the study of the condensed state at very high density. In this talk, I will present and discuss the latest instrumentation advances and recent results regarding the dense phases of a simple molecular system, namely, solid oxygen. The physical properties of the ε- and ζ-oxygen phases, which exist at room temperature over a large pressure range, extending from 10.4 to 96 GPa and 96 GPa to as least 140 GPa for ε- and ζ-oxygen, respectively, have been of extensive interest. As shown from synchrotron x-ray micro-diffraction, the ε-oxygen phase reveals a remarkable crystalline structure formed by the clustering of oxygen molecules into $(O_2)_4$ lattice sub-units. Compression of ε-oxygen leads to a transition to a metallic yet molecular phase (ζ-oxygen). Recent results, obtained from x-ray diffraction and Raman spectroscopy experiments, carried out at room temperature up to 140 GPa on single crystals imbedded and oriented differently in solid helium, indicate that the ζ- phase comprise chains of oxygen molecules leading to electrical conduction. The crystalline structure found experimentally compares favourably with that proposed from *ab-initio* computations. I will conclude with a brief presentation of the on-going "science at extreme conditions" program running at the Canadian Light Source.

* This work is being supported by NSERC and CEA (France)

11h00 Coffee Break / *Pause café*

WE-A5-3 11h15

High multipole transitions in NIXS: Valence and hybridization in 4f systems*, **Robert Gordon** [1], Gerald T. Seidler [2], Timothy T. Fister [3], Maurits W. Havekort [4], George A. Sawatzky [5], Arata Tanaka [6], Tsun-Kong Sham [7], [1] *PNC-CAT/Simon Fraser University*, [2] University of Washington, [3] University of Washington/MSD, Argonne National Laboratories, [4] Max Planck Institute for Solid State Research, [5] University of British Columbia, [6] Hiroshima University, [7] University of Western Ontario — We have used momentum-transfer (q) dependent non-resonant inelastic x-ray scattering (NIXS) to gain a new perspective on 4f interactions in rare earth-containing materials [1]. In studying the 4d initial states ($N_{4,5}$ resonance), new spectroscopic features emerge in the pre-threshold region as the dipole transition diminish in strength with increasing q. For ionic $4f^0$ and $4f^1$ compounds, the pre-threshold features have been modeled using a local many-body approach [2] with good agreement for the two distinct q-dependences observed. For cerium compounds in particular, these high-q features are strong indicators of occupation and hybridization of the 4f orbitals in the initial state. Results for a number of valence-fluctuation cerium materials will be presented.

1. R.A. Gordon, G.T. Seidler, T.T. Fister, M.W. Haverkort, G.A. Sawatzky, A. Tanaka and T.K. Sham, *Europhysics Letters* **81** (2008) 26004.
2. L.H. Tjeng, M.W. Haverkort, A. Tanaka and G.A. Sawatzky, *Physical Review Letters* **99** (2007) 257401.

* This work is being supported by NSERC, CIAR, DOE-BES, Bosack and Kruger Found., Deutsche Forschungsgemeinschaft

WE-A5-4 11h30

Monitoring the Glass Transition in Vitreous Silica with Temperature-Scanning Small Angle X–Ray Scattering*, **Ralf Brüning** [1], Claire Levelut [2], Rozenn Le Parc [2], Annelise Faivre [2], Lynne Semple [1], Marc Vallee [1], [1] *Mount Allison University*, [2] Université Montpellier II — Observing the glass transition in vitreous silica and related glasses is difficult due to the high temperatures involved. Synchrotron-based temperature-scanning small angle x–ray scattering measurements (ts-SAXS) has been used to overcome these difficulties. This technique allows one to probe the kinetics in detail, and observe the changes of the glass *in situ* during annealing. In general there is a

feedback between the thermal history of the glass and its kinetics. However, in vitreous silica with about 800 wt. ppm of dissolved hydroxyl groups we found that this is feedback negligible, resulting in a case of unusually simple glass kinetics that depend on temperature alone. The use of SAXS in glasses and liquids, including our recent results obtained with different types of vitreous silica, will be reviewed. Key improvements of certain aspects of the experimental technique are discussed.

* This work is being supported by NSERC

WE-A5-5 11h45

Nanosecond Domain Wall Dynamics in Ferroelectric $PbZrTiO_3$ Thin Films*, **Eric Dufresne** [1], Alexei Grigoriev [2], Paul Evans [2], [1] *Argonne National Laboratory*, [2] University of Wisconsin — Domain wall motion during polarization switching in ferroelectric thin films is fundamentally important and poses challenges for both experiments and modeling. We have visualized the switching of a $Pb(Zr,Ti)O_3$ capacitor using time-resolved x-ray microdiffraction. The structural signatures of switching include a reversal in the sign of the piezoelectric coefficient and a change in the intensity of x-ray reflections. The propagation of polarization domain walls is highly reproducible from cycle to cycle of the electric field. Domain wall velocities of 40 m s^{-1} are consistent with the results of other methods, but are far less than saturation values expected at high electric fields. In a more recent study, we have also studied the structural response of these films to large electric fields. Nonlinear effects in the coupling of polarization with elastic strain have been predicted to occur in ferroelectric materials subjected to high electric fields. Such predictions are tested here for a $PbZr0:2Ti0:8O_3$ ferroelectric thin film at electric fields in the range of several hundred MV/m and strains reaching up to 2.7%. The piezoelectric strain exceeds predictions based on constant piezoelectric coefficients at electric fields from approximately 200 to 400 MV/m, which is consistent with a nonlinear effect predicted to occur at corresponding piezoelectric distortions.

* This work is being supported by US Department of Energy

12h00 Session Ends / *Fin de la session*

[WE-A6] Precision Frontier II / *Les limites de la précision II*

(PPD-DNP / *PPD-DPN*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
10h00 - 12h30

ROOM / SALLE ***VCH 3830*** **(cap. 110)** ***Chair: R.W. Moore, University of Alberta***

WE-A6-1 10h00

ANNA DAVOUR, Queen's University

The PICASSO Dark Matter Search Project *

PICASSO is an array of bubble detectors constructed to search for spin dependent interactions of dark matter in the form of weakly interacting massive particles (WIMPs). The bubble detectors are similar to those used in neutron dosimetry: superheated droplets of fluorocarbon (C_4F_{10}) are suspended in a polymerized gel. A nucleus recoiling from the elastic scattering of a WIMP triggers the boiling of the superheated liquid. The explosive expansion of a droplet to a bubble will induce an acoustic wave in the gel which is picked up with piezoelectric sensors. The PICASSO collaboration has developed large volume bubble detectors of 4.5 litres. The performance of these detectors has been evaluated with several methods. The detectors are installed at SNOLAB, located at a depth of 2070 meters in the Creighton mine in Sudbury. In its present configuration the setup accomodates 32 detectors with a combined active mass of 2.6 kg. Preliminary exclusion limits on the cross section of the dark matter particles have been calculated using data from the first of the large detectors.

* This work is being supported by NSERC

WE-A6-2 10h30 (G)

Status of PICASSO Detector for direct dark matter detection *, **Marie-Cécile Piro**, *Université de Montréal* — "The direct search for evidence of Weakly Interacting Massive Particle (WIMP) dark matter continues among the forefront activities of experimental physics". The PICASSO project is one of these experiments that use Superheated Droplet Detector (SDD) for direct search in the spin dependent channel. I will present the status of detector fabrication and R&D including the necessary (background and calibration measurements) before their installation for direct dark matter detection.

* This work is being supported by NSERC

WE-A6-3 10h45 (G)

Data analysis of the ongoing PICASSO 3kg-phase*, **Guillaume Giroux**, *Université de Montréal* — The PICASSO project is using superheated droplet detectors in order to achieve the direct detection of the neutralino, a cold non-baryonic dark matter particle. The 3 kg-phase at SNOLAB is currently taking data that is already being analysed in Montreal. The different steps leading to reliable results will be discussed, including data acquisition, selection of good events and ultimately, production of a preliminary neutralino exclusion curve.

* This work is being supported by NSERC

WE-A6-4 11h00

Calibration for the PICASSO dark matter search project. **Cecilia Levy**, *Queen's University* — PICASSO consists of several bubble detectors looking for weekly interacting massive particles (WIMP) which are thought to be the main component of the 20% of dark matter present in the universe. Because of the very small probability of interaction and detection we need to know the shape of our backgrounds very precisely. In this presentation I will talk about the ongoing progress on the neutron, gamma and alpha calibrations necessary to understand these backgrounds.

WE-A6-5 11h15

News from Direct Dark Matter Search with CDMS*, **Wolfgang Rau**, Queen's Universtiy — The Existence of Dark Matter is well established by a large number of observations. But even though it makes up roughly 85 % of the matter in the universe its nature has not been revealed so far. Weakly Interacting Massive Particles (WIMPs) are among the best motivated particle candidates to account for the Dark Matter. The Cryogenic Dark Matter Search experiment (CDMS II) employs low temperature (~40 mK) solid state detectors with excellent background discrimination potential to search for WIMP-nucleon interactions. We have started to analyse our first data taken with the

full complement of 30 detectors between October 2006 and June 2007 and could improve our sensitivity compared to earlier publications by a factor of about 3. No WIMP candidate events have been identified giving the most stringent upper limit on the WIMP-nucleon cross-section for spin-independent interaction reported so far for WIMP masses above about 40 GeV/c^2. The best sensitivity is reached for a WIMP mass of 60 GeV/c^2 and corresponds to a cross-section limit of $< 4.6 \times 10^{-44}$ cm^2 (90 % C.L.).

* This work is being supported by NSERC Canada, NSF and DOE (USA), SNF (Swiss)

WE-A6-6 11h30

New Results from ALPHA Antihydrogen Project at CERN*, **Makoto C. Fujiwara** [1], David Gill [1], Leonid Kurchaninov [1], Konstantin Olchanki [1], Art Olin [1], James Storey [1], Walter Hardy [2], Sarah Seif El Nasr [2], Richard Hydomako [3], Robert Thompson [3], Mike Hayden [4], Scott Menary [5], [1] *TRIUMF*, [2] University of British Columbia, [3] University of Calgary, [4] Simon Fraser University, [5] York University — ALPHA is an international collaboration based at CERN's Antiproton Decelerator. Our long-term goal is to test the symmetry between matter and antimatter via a precision comparison of the well-studied hydrogen atom with its antimatter counter-part, antihydrogen. Since the start of the construction of the experiment in 2006, rapid progress has been made towards stable trapping of antihydrogen atoms. In this talk, we will discuss the details of our trapping techniques, including recent physics results on the containment of charged particles in a combined trap [1], production of antihydrogen in a reduced magnetic field [2], and radial compression [3] and diagnosis [4] of antiproton plasmas.

1. *Phys. Rev. Lett* **98**, 023402 (2007)
2. *J. Phys. B* **41**, 011001 (2008)
3. Submitted to Phys. Rev. Lett
4. Accepted for Phys. Plasmas (2008).

* This work is being supported by NSERC

WE-A6-7 11h45

Ultracold Neutrons at TRIUMF*, **Jeffery Martin**, *University of Winnipeg* — We are proposing to construct the world's highest density source of ultracold neutrons at TRIUMF. Ultracold neutrons are neutrons which are moving so slowly that they are totally reflected from surfaces. This property makes them useful for a variety of fundamental neutron physics and applied physics experiments. A search for a non-zero neutron electric dipole moment, a measurement of the neutron lifetime, and a measurement of quantized energy levels of neutrons confined in the Earth's gravitational field are examples of experiments that are being considered for TRIUMF. Additionally, an apparatus to use ultracold neutrons to study surface physics is being designed. The physics motivations behind these experiments, and the new technology being developed to produce the ultracold neutrons, will be discussed.

* This work is being supported by NSERC and CFI

WE-A6-8 12h00

KEVIN GRAHAM, Carleton University

Measuring Neutrino Mass with EXO

Recent experiments, including SNO and SuperK, have definitively shown that neutrinos have mass. Measuring neutrino oscillations, these experiments are only senstive to difference in mass squared and not directly to the neutrino mass scale. Neutrinoless double beta decay, a process in which two neutrons simultaneously decay to protons and electrons, is directly sensitive to neutrino mass. The EXO collaboration aims to carry out a sensitive search for the neutrinoless double beta decay of 136Xe. Time projection chamber technology, with measurement of both ionization and scintillation signals and coupled with a spectroscopic laser tag, is being developed to optimize the ability to reject backgrounds and maximize sensitivity to signal events. The current status of the EXO experiment efforts will be provided with emphasis on the research and development towards a gas-phase detector.

12h30 Session Ends / *Fin de la session*

[WE-A7] Relativity / *Relativité*

(DTP / *DPT*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
10h00 - 12h15

ROOM / SALLE ***VCH 2870*** **(cap. 57)** ***Chair: D.M. Witt, University of British Columbia***

WE-A7-1 10h00

ROBERT MANN, University of Waterloo

Boundaries Unbound *

Holography has been shown to be a remarkably fruitful concept in gravitational theory. In the context of gravity it has been shown that boundary terms make important contributions both quantitatively and qualitatively to our understanding of conserved charges, variational principles, and the behaviour of spacetime at infinity. Here I shall discuss recent advances in the boundary-counterterm technique as applied to asymptotically flat spacetimes, and to spacetimes with non-trivial dilatonic behaviour at infinity.

* This work is being supported by NSERC

WE-A7-2 10h30

ERIC POISSON, University of Guelph

Black holes in tidal environments *

A nonrotating black hole placed in a tidal environment (that is, subjected to gravitational interactions produced by other nearby bodies) is not described by the Schwarzschild solution to the Einstein field equations. Instead, its metric is given by a perturbed version of this exact solution, and the spacetime is no longer stationary nor spherically symmetric. The description of the tidal distortion involves: (i) a specification of the tidal environment, which is given in all generality by the spacetime's

Weyl tensor far away from the black hole; (ii) the determination of the metric perturbation associated with this tidal environment, which must be expressed in a meaningful coordinate system; and (iii) the extraction of physical consequences, such as the tidal heating of the black hole. In this talk I will give an overview of these issues, and describe an application in which the black hole is part of a post-Newtonian system of N bodies (which move slowly under their weak mutual gravity). In this case the tidal fields acting on the black hole can be determined by matching the post-Newtonian N-body metric to the distorted black-hole metric.

* This work is being supported by NSERC

11h00 Coffee Break / *Pause café*

WE-A7-3 11h15

Predictions of the Generalized Uncertainty Principle*, **Saurya Das**, *University of Lethbridge* — We examine various predictions of the Generalized Uncertainty Principle, which is believed to replace the Heisenberg uncertainty principle at energies close to, or above the Planck scale, and comment on whether some of these predictions can be verified in the laboratory.

* This work is being supported by NSERC

WE-A7-4 11h30

Do black holes accreting phantom energy violate Cosmic Censorship?, **Valerio Faraoni**, *Bishop's University* — Using new exact solutions describing black holes in a cosmological background, we find that the physical mass of a black hole embedded in a universe driven by phantom energy may increase due to the accretion of phantom fluid, contrary to previous claims. The black hole apparent horizon grows while the cosmic horizon shrinks until the two eventually coincide and disappear,leaving behind a naked singularity before the Big Rip occurs, and violating Cosmic Censorship.

WE-A7-5 11h45

A Complex Universe, **Arundhati Dasgupta**, *University of New Brunswick* — I shall describe a search for the wavefunction of the universe in complex chaotic systems.

WE-A7-6 12h00

Potential Evidence for Noncommutative Geometry in Muon Decay, **Dinesh Singh**, Nader Mobed, *University of Regina* — The properties of the Pauli-Lubanski vector are explored for a spin-1/2 particle propagating in curved space-time described by Fermi normal co-ordinates, where the spatial components are expressed in terms of curvilinear co-ordinates to accommodate for any symmetries of the particle's motion in space. This analysis leads to two distinct conclusions. First, when applying the Pauli-Lubanski vector to calculate gravitational corrections to the muon decay rate, it is possible to identify the existence of non-trivial terms in the matrix element that survive only if space-time geometry is somehow noncommutative at some undetermined length scale. Second, building upon results from a previous investigation, it is shown that the Casimir invariant associated with spin possesses both gravitational and frame-dependent contributions, where the latter violates Lorentz invariance at a possibly different length scale, also with the appearance of contributions due to noncommutative geometry.

12h15 Session Ends / *Fin de la session*

[WE-A8] Atomic and Molecular Spectroscopy and Dynamics II / *Spectroscopie et dynamique des atomes et molécules II*

(DAMPhi / *DPAMip*)

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

10h00 - 12h15

ROOM / SALLE ***VCH 3860*** **(cap. 148)** ***Chair: A. Ross, Université de Lyon***

WE-A8-1 10h00

RICHARD HOLT, University of Western Ontario

Recent progress in fast-ion-beam laser measurements of atomic data for astrophysics †,*

Atomic oscillator strengths, lifetimes, wavelengths, hyperfine structure and isotope shifts are important atomic data that find application in astrophysical measurements of chemical abundances. These can be used to infer the history of nucleosynthesis in the Universe and to obtain indirect information about stellar interiors from observations of photospheric abundances. Our group has been measuring these data with a variety of fast-ion-beam laser-induced-fluorescence techniques. Recently we published oscillator strengths for 608 transitions in Sm II, 260 transitions in Pr II, and 430 transitions in Nd II, all with a typical uncertainty of 10% or better. The accuracy was limited by the need to measure the relative detection sensitivity over a very wide wavelength range (300-900 nm). We have implemented a detector-substitution calibration procedure that promises to improve this greatly. As well, we have replaced our surface-ionization source with a Penning source in order to study doubly-ionized species, and replaced a trialkali photomultiplier with a GaAs(Cs) type for greater spectral coverage. We also plan to incorporate an echelle spectrograph to obtain the multiplex advantage. Recent progress and results will be presented.

† In collaboration with Ruohong Li [1], Timothy J. Scholl [1], Steven J. Rehse [2], S. David Rosner [1], [1] University of Western Ontario, [2] Wayne State University

* This work is being supported by Natural Sciences and Engineering Council of Canada

WE-A8-2 10h30

QED and Isotope Shifts in Li and Be^{+} *, **Gordon Drake**, Zong-Chao Yan, *University of Windsor* — Recent years have seen dramatic advances in the accuracy that can be achieved for three-electron atoms such as Li and Be^{+}. Results that are essentially exact for all practical purposes can be obtained by use of correlated variational wave functions in Hylleraas coordinates. This opens the way to the study of higher-order quantum electrodynamic (QED) corrections, and other applications such as the determination of nuclear charge radii from measured isotope shifts. Studies of nuclei with excess neutrons forming a halo, such as ^{11}Li and ^{11}Be have been of particular recent interest, both experimentally and theoretically. As one example of accuracy, our value for the $2\,^2S_{1/2} - 3\,^2S_{1/2}$ transition frequency is 88,231.918(6) cm^{-1}, as compared with the experimental value 88,231.915 cm^{-1} [1]. This tests the calculated QED shift for the three-electron system of -1.169(6) cm^{-1} to an accuracy of 0.3%. Other comparisons between theory and experiment will be reviewed.

1. Y. Ralchenko *et al.*, NIST Atomic Spectra Database available at http://physics.nist.gov/asd3.

* This work is supported by SHARCNET and NSERC

WE-A8-3 10h45

Atomic data for magnetic fusion diagnostics*, **P. Beiersdorfer** [1], J. Clementson [1], M. Gu [1], H. McLean [1], R. Wood [1], M. Bitter [2], K. Hill [2], [1] *Lawrence Livermore National Laboratory*, [2] Princeton Plasma Physics Laboratory — Progress in magnetic fusion depends on being able to accurately diagnose the spatial and temporal variation of the plasma parameters. Measurements based on spectral diagnostics play a major role in current devices, and they are expected to be an important source of data on the upcoming ITER tokamak in Cadarache, France. Tungsten is likely to be present in ITER plasmas because of various plasma facing components made of the metal, and it probably will be the element of choice for many spectroscopic measurements. For example, we are developing x-ray crystal spectrometers for ITER [1] that will provide spatial profiles of the ion and electron temperatures based on the emission of neonlike tungsten ($W64^+$). Atomic data needed include accurate line positions and collisional excitation rates as well as dielectronic satellite strengths. Moreover, line identification of tungsten transitions in the EUV are needed for assessing impurity concentrations in the divertor region. We will present our laboratory measurements that address some of these atomic data needs and describe our efforts to develop the appropriate diagnostics for ITER.

1. Bitter *et al.*, *Rev. Sci. Instrum.* **74**, 1977 (2003).

* This work is being supported by Work at LLNL was performed under auspices of the DOE under contract DE-AC52-07NA2344.

11h00 Coffee Break / *Pause café*

WE-A8-4 11h15

STEPHEN ROSS, University of New Brunswick

Selected Aspects of Large Amplitude Motion in Molecules †,*

Large-amplitude vibrational motion can result in the standard "harmonic oscillator + rigid rotor" approximation becoming inadequate. This is especially true when the vibrational motion carries the molecule between different potential energy minima or when the coupling between the rotational motion and the vibrational motion is strong. Skew-chain molecules of the type HSOH have both these features and as a result exhibit energy splitting patterns that have unusual dependence on mass and axial rotational quantum number. Interpretation and understanding of the energy level structure of these molecules continues to pose a challenge. Quasilinear molecules also present interesting behaviour. Recently it has been realised that quasilinear molecules exhibit Quantum Monodromy – a dislocation in the energy level structure due to the topology of the potential energy surface. Special theoretical treatment is needed to study the coupling of the large-amplitude motion and rotation in both skew-chain and quasilinear molecules. For triatomic molecules the SemiRigid Bender treatment ("SRB", P. R. Bunker and B. M. Landsberg, J. Mol. Spectrosc. **67,** 374 (1977)) explicitly allows for a single large-amplitude bending vibration coupled with rotation. The Generalised SRB (GSRB) does the same but is not restricted to triatomic molecules or to bending vibrations. A basic introduction to the theory will be given and recent progress on these systems will be reported.

† This work has been done in collaboration with Dr. Koichi Yamada (for HSOH, a skew-chain molecule) and with Drs. B.P. and M. Winnewisser (for NCNCS - a quasilinear molecule).

* This work is being supported by NSERC

WE-A8-5 11h45

Nitrogen-broadened lineshapes in the oxygen A-band: experimental results and theoretical calculations*, **Adriana Predoi-Cross** [1], Christopher Holladay [1], Chad Povey [1], Jean-Pierre Bouanich [2], Georg Mellau [3], Reimund Keller [3], Daniel Hurtmans [4], [1] *University of Lethbridge*, [2] Université de Paris-Sud, France, [3] Justus-Liebig-University, Germany, [4] Université Libre de Bruxelles, Belgium — We report measurements for N_2-broadening, pressure-shift and line mixing coefficients for 55 oxygen transitions in the A-band retrieved using a multispectrum fitting technique. Nineteen laboratory absorption spectra were recorded using a multi-pass absorption cell and the IFS 120 Fourier transform spectrometer located at Justus-Liebig-University in Giessen, Germany. An Exponential Power Gap (EPG) scaling law was used to calculate the N_2-broadening and N_2-line mixing coefficients. The line broadening and shift coefficients for the A-band of oxygen self-perturbed and perturbed by N_2 are modeled using semi-classical calculations based on the Robert-Bonamy formalism and two intermolecular potentials.

* This work is being supported by NSERC, University of Lethbridge, German Academic Exchange (DAAD) RISE program

WE-A8-6 12h00

Interplay between Electronic and Nuclear Motion in the Photodouble Ionization of H_2 *, **T.J. Reddish** [1], J J. Colgan [2], P. Bolognesi [3], L. Avaldi [3], M. Gisselbrecht [4], M. Lavollée [4], M.S. Pindzola [5], A. Huetz [4], [1] *University of Windsor*, [2] Los Alamos National Laboratory (USA), [3] CNR-IMIP, Rome (Italy), [4] LIXAM, CNRS-Université Paris Sud (France), [5] Auburn University (USA) — Photodouble ionisation (PDI) of molecular hydrogen results in a "Coulomb explosion", as the two protons rapidly separate in opposite directions. The internuclear distance, *R,* between the two nuclei at the instant of photodouble ionisation can be accessed through the kinetic energies of the emitted protons. We present fully differential cross sections (FDCSs) measurements for PDI in H_2 obtained at a photon energy of 76.09 eV, ~25 eV above the nominal PDI threshold at the equilibrium internuclear separation (1.4 a_0) and near the peak maximum of the total PDI cross section. The results were obtained with the CIEL momentum imaging apparatus using 100% linearly polarized light from the Elettra Synchrotron (Italy). A systematic analysis of the variation with *R* of the FDCS for this process is presented for a geometry where the 4-body interaction is completely probed. Excellent agreement is found between experiment and Time-Dependent Close-Coupling (TDCC) theory after convolution of the latter over the relevant solid angles. We show that the observed variations are purely due to the component of the polarization vector along the molecular axis and a physical interpretation is proposed by analogy with single ionization of H_2^+.

* This work is being supported by NSERC, UoW, EU, DOE, NSF, NERSC

12h15 Session Ends / *Fin de la session*

[WE-Plen3] Plenary Session: CAP-CRM Prize / Session plénière: Prix ACP-CRM

(CAP-CRM / ACP-CRM)

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

13h30 - 14h15

ROOM / SALLE VCH 2850 (cap. 404) Chair: R. MacKenzie, Université de Montréal

WE-PLEN3-1 **13h30**

RICHARD CLEVE, University of Waterloo

Quantum Information, Computation and Communication *

In the past fifteen years, a number of interesting algorithms for hypothetical quantum computers have been discovered. These algorithms are fundamentally different from any algorithms for existing "classical computers". They harness the strange power of quantum mechanics to solve certain computational problems much faster than classical algorithms can. I will give an overview of this subject, including a broader perspective of quantum information.

* This work is being supported by NSERC, MITACS, CIFAR, QuantumWorks, ARO/DTO

14h15 **Session Ends / *Fin de la session***

[WE-P1] Thin Films / Couches minces

(DCMMP / DPMCM)

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

14h15 - 16h30

ROOM / SALLE VCH 2840 (cap. 98) Chair: D.E. Venus, McMaster University

WE-P1-1 **14h15**

DAVID VENUS, McMaster University

Measurements of static and dynamic susceptibility exponents of an ultrathin ferromagnetic film †,*

Given that the dynamics, or time-evolution, of the ferromagnetic properties of thin films has generated an enormous literature, it is perhaps surprising that critical slowing down, a fundamental dynamical property of a magnetic system near a phase transition, has hardly been addressed in thin films. In the context of ferromagnetism, critical slowing down refers to the prediction that the relaxation of the magnetization toward equilibrium occurs more and more slowly as the temperature, Tc, of a phase transition is approached. The relaxation time is predicted to scale as a power law in (T-Tc)/Tc with dynamic exponent z. The experimental measurement of the dynamic critical exponent has proven to be very difficult, even for a conceptually simple system like the two dimensional Ising model. We have recently approached this problem through the first studies of critical slowing down in ultrathin ferromagnetic films. By measuring the magnetic susceptibility of Fe/W(110) films near the Curie transition, we are able to determine the dynamical exponent for the 2D Ising model in an internally consistent manner.

† In collaboration with Michael Dunlavy, St. Mary's University

* This work is being supported by NSERC

WE-P1-2 **14h45**

STEVE S.N. PATITSAS, University of Lethbridge

STM studies of the dissociation of trichloroethylene on silicon surfaces: Possible consequences for thin film growth †,*

The dissociation of trichloroethylene (TCE) molecules on the Si(111)7x7 and Si(100)2x1 surfaces was investigated using STM. Chlorine atoms were identified by using voltage dependent imaging and by observing voltage dependent tip-induced diffusion. On the (111) surface, at low coverage, we identify one chlorine that thermally dissociates and binds to an adatom, leaving a nearby chlorovinyl group as the other product bound to the surface. Chlorine atoms show strong site selectivity for corner adatoms and some preference for the faulted half of the unit cell. This result differs significantly from previous studies of chlorine on this surface and a site-selective mobile precursor model is used to explain this discrepancy. The observed site-selectivity is consistent with the high electronegativity value for chlorine. This result could lead to a new approach for chemical vapour deposition delivery of highly reactive atoms. If time permits, studies of TCE dissociation on the Si(100)2x1 surface, also at room temperature, will be presented.

† In collaboration with Pouya Maraghechi [1], Steven Horn [2], [1] University of Alberta, [2] University of Lethbridge

* This work is being supported by NSERC

WE-P1-3 **15h15**

Spin selective Aharonov-Bohm oscillations in a lateral triple quantum dot*, **F. Delgado**, Yun-Pil Shim, M. Korkusinski, L. Gaudreau, S. Studeninkin, A.S. Sachrajda, P. Hawrylak, *National Research Council of Canada/University of Ottawa* — Spin dependent Aharonov-Bohm (AB) oscillations in equilateral triple quantum dot (TQD) molecule in the presence of a perpendicular magnetic field are analyzed using a Hubbard model. The magnetic field is accounted for by magnetic flux dependent phases in the off-diagonal tunnelling matrix elements of the Hamiltonian. The voltages on the three dots are set so that one of the dots, number 2, contains a single electron (hole), and this (0,1,0) configuration is resonant with three two-electron (two-hole) configurations (1,1,0),(0,2,0) and (0,1,1). The two-electron configurations of the isolated TQD, calculated using exact diagonalization technique, depend on whether total spin is singlet or triplet. The triplet configurations (1,1,0) and (0,1,1) involve additional electron either in dot 1 or dot 3. By contrast, the three singlet configurations (1,1,0),(0,2,0) and (0,1,1) involve a second electron tunnelling along the closed loop of a TQD, leading to AB oscillations of the singlet ground state energy. At low magnetic fields, the singlet state has the lowest energy. With increasing magnetic field the Zeeman energy lowers the energy of the triplet, leading to single- triplet transitions, followed by the quenching of the AB oscillations in high magnetic fields. These spin transitions affect transport through the TQD, calculated using master equation for the populations within the sequential tunnelling and lowest order in TQD-leads coupling approximation. The predicted oscillations of the current as a function of the magnetic field for electrons and holes are compared with transport experiments.

* This work is being supported by the Canadian Institute for Advanced Research and QuantumWorks

WE-P1-4 **15h30**

Observation of Chiral Heat Transport in the Quantum Hall Regime*, **G. Granger** [1], J.P. Eisenstein [1], J.L. Reno [2], L.N. Pfeiffer [3], K.W. West [3], [1] *California Institute of Technology*, [2] Sandia National Laboratories, [3] Bell Labs — The nature and properties of heat transport at the edge of a quantum Hall state are investigated using three adjacent quantum point contacts (QPCs) separated by 20 micrometers fabricated along the edge of a GaAs/AlGaAs two-dimensional electron gas (2DEG). With the bulk of the device at filling factor n=1, a thermovoltage signal appears across a detector QPC only on one side of the heater QPC depending on the direction of the magnetic field. This behavior indicates that heat transport is chiral at this filling factor. Raising the temperature decreases the thermovoltage, as the electrons carrying the heat find more ways to cool off at higher temperatures. When the distance between the heater and the detector is doubled, the thermovoltage is reduced, meaning that the electrons cool significantly over distances on the order of tens of micrometers. These experiments illustrate the feasibility of using mesoscopic devices to study heat transport in the QH regime.

* This work is being supported by Microsoft Research Project Q

WE-P1-5 **15h45**

Elemental Contrast in Nanostructures by Low Energy Electron Point Source Holography*, **Lucian Livadaru**, Josh Mutus, Robert Wolkow, *NRC- National Institute for Nanotechnology, Dept. of Physics, University of Alberta* — The high spatial and temporal coherence of recently fabricated ultrasharp nanotips opens up new possibilities in the holographic imaging of nanoscale structures, including graphene, carbon nanotubes, and smaller molecules or atomic clusters. Thus, digital holographic reconstructions of nanostructures can be obtained as both amplitude and phase images, and also offer 3-dimensional rendering of their shape. Furthermore, due to differences in the scattered wave phase shift and amplitude caused by different atom types, the reconstructed images have the potential to render elemental contrast. Here we investigate theoretically the conditions of obtaining phase and amplitude contrast between different atomic species in a chain molecule, and defects or impurities in a 2-dimensional crystalline structure, such as graphene. The influence of various parameters (such as the wavelength) of the holographic setup on the reconstructed contrast is carefully assessed. The relationships between elastic electron scattering cross section (EESCS) and the amplitude contrast from reconstructed holograms is also studied. For a beam energy between 50- 200 eV, we found that, in general, good contrast is only observable between elements with significantly different Z-numbers. For example, contrast between C, N, and O is not practically feasible, while that between C and Cl is easily observable. However, we found exceptions from that general rule, explained by the non-monotonic dependence of the EESCS on the Z-number. Some good sample candidates for elemental contrast are suggested for upcoming holographic experiments.

* This work is being supported by NRC, NSERC, Alberta Ingenuity

WE-P1-6 **16h00**

Azobenzene Polymers for Photo-Reversible Surfaces and Structures*, **Christopher Barrett**, *McGill University* — Polymers containing Azobenzene have received much interest as photo-reversible materials for a variety of optical and photonic applications. Most recently however, Azo Polymers have also been shown to respond physically and mechanically to light, to act as all-optical patterning materials, and photo-mechanical devices. In particular, a photo-induced pressure in soft amorphous thin films of azo polymers can lead to the facile inscription of efficient surface relief gratings (SRGs) upon irradiation with an interference pattern. Irradiation with CW light is also shown to lead to a reversible photo-expansion of these films, of up to a few %, allowing the materials to function as photo-mechanical switches or light-actuators. New azo polymers to optimize this effect with be presented, and some simple macroscopic devices will be demonstrated that take mechanical advantage of this effect for larger scale motion driven by light, such as bending, rolling, and 'walking'. The mechanism for this effect will be discussed from studies using ellipsometry, surface plasmon resonance spectroscopy, and neutron reflectometry.

* This work is being supported by NSERC

WE-P1-7 **16h15**

Effect of nanostructure on the phase and crystallinity of molybdenum oxide films*, **Gisia Beydaghyan**, S. Balaji, Yahia Djaoued, Pandurang Ashrit, *Université de Moncton* — Transition metal oxides such as tungsten trioxide (WO3), molybdenum trioxide (MoO3), and titanium dioxide (TiO2) are known for their electrochromism, defined as reversible coloration with the intercalation/de-intercalation of electrons/ions or atoms. Molybdenum trioxide films exhibit electrochromism, in addition to photochromism and thermochromism. Here, we present our work on the molybdenum trioxide films prepared by the glancing angle deposition (GLAD) technique. We compare morphology, phase, and electrochromic response of the as-deposited films with those annealed under atmospheric pressure. Annealing results in the formation of the mirocrystalline grains (1-5 μm and larger) in the films. We present Raman spectra, showing that the phase of the resulting crystallites is dependent on the film nanostructure, which is in turn determined by the substrate tilt of the film during deposition.

* This work is being supported by AIF-FIA

16h30 **Session Ends / *Fin de la session***

[WE-P2] Energy Frontier / *Frontière énergétique*

(PPD / *PPD*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
14h15 - 16h45

ROOM / SALLE ***VCH 3830*** **(cap. 110)** ***Chair: S. Robertson, McGill University***

WE-P2-1 **14h15**

ANDREAS WARBURTON, McGill University

Recent Results from the Collider Detector at Fermilab (CDF) *

The Tevatron collider at the Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois is providing symmetric collisions of protons on antiprotons at a centre-of-mass energy of 1.96 TeV, making it the highest energy particle accelerator currently in operation. The upgraded Collider Detector at Fermilab (CDF II) is one of two multi-purpose detectors examining the outcome of these high-energy hadronic collisions. The CDF collaboration has been pursuing a broad and exciting scientific program while acquiring physics quality data over the past five years. The talk will provide an update on the key performance aspects of the upgraded collider and CDF II detector, as well as a presentation of recent physics measurements with emphasis on Canadian contributions and analyses important to the imminent physics program at the Large Hadron Collider at CERN.

* This work is being supported by NSERC

WE-P2-2 14h45

ERNEST AGUILO, University of Alberta and York University

Latest Results of the DZero Experiment *

The DØ experiment at the Fermilab Tevatron proton-antiproton collider has recorded an integrated luminosity greater than 3 fb^{-1}. DØ is a multi-purpose detector that probes a wide spectrum of physics topics within the Standard Model, such as top-quark production and properties measurements, QCD, W and Z gauge bosons studies, and b-quark physics. The DØ experiment also allows for searches for the Higgs boson as well as physics beyond the Standard Model, such as super symmetry and extra dimensions. In this talk, I will present some of the recent highlights of the DØ physics program.

* This work is being supported by DZero Collaboration

WE-P2-3 15h15

Measurement of the Top Quark Mass with the template method in the dilepton and lepton+jets decay channels from pp collisions at 1.96 TeV. **Sebastian Carron Montero**, *University of Toronto* — We present the latest results of a measurement of the top quark mass in the combined dilepton and lepton + jets decay channel from pp collisions at 1.96 TeV in the CDF detector at Fermilab with 1.9 fb^{-1} of data. This measurement employs the template method and is the first to combine in the same likelihood fit the dilepton and l + jets channel, resulting in one of the most precise top quark mass measurements. Our measured top quark mass is 171.9 + /-1.7(stat+JES)+/-1(syst) GeV/c^2. We also will present our individual measurements in the dilepton and lepton+jets decay channels.

WE-P2-4 15h30

Search for direct production of a heavy charged Higgs boson decaying to tb final state in proton-antiproton collisions*, **Brigitte Vachon**, Gustavo Kertzscher, Chris Potter, *McGill University* — Many extensions of physics beyond the Standard Model predict the existence of a charged Higgs boson. A new search for the production of charged Higgs boson decaying to a top and a bottom quark in proton-antiproton collisions was performed. Results obtained from the analysis of nearly 1 fb^{-1} of data collected by the DZero experiment at Fermilab will be presented.

* This work is being supported by NSERC, FQRNT, CRC

WE-P2-5 15h45 (G)

Associated production ZH/WH -> photons with the ATLAS detector., **Bertrand Brelier**, *Université de Montreal* — The LEP experiments have excluded a Higgs mass below 115 GeV and the Standard Model suggests a mass below about 200 GeV, and certainly below ~ TeV. The LHC detectors will allow us to search for a Higgs Boson in this mass range. Observation of an excess of events in one the Higgs channels is not sufficient to prove its existence: we will have to measure its spin, CP eigenvalues and its couplings to known Standard Model Particles. In the low mass region, the decay into photons is one of the most important channel : this decay suffers from a very low branching ratio but benefits from a very good mass resolution of the electromagnetic calorimeter of the ATLAS detector. The Higgs boson in association with a Z and W boson would increase the statistical significance of the Higgs discovery and these production modes can be used to measure directly the Higgs couplings to the weak bosons.

WE-P2-6 16h00

MADHU DIXIT, TRIUMF/Carleton University

The International Linear Collider - a precision probe for physics in the post-LHC era

Standard Model is the most comprehensive present day precision theory of electro-weak phenomena. Nonetheless, many key questions in particle physics and cosmology remain unanswered. The measurements at LHC at CERN are expected to provide some of the answers over the next few years, but may also raise new questions. The International electron-positron Linear Collider (ILC) is being planned as the next high-energy world facility for particle physics. Precision experiments at the ILC will be essential in unambiguously interpreting LHC physics discoveries. ILC will also be a discovery machine on its own. ILC physics will require detector performance not achievable by existing technology. The project status and the detector challenges will be described with focus on ILC Canada group R&D activities.

WE-P2-7 16h30

Study of Dark Matter with the International Linear Collider*, **Mauricio Barbi** [1], Blair Jasper [1], Nikolay Kolev [1], Teruki Kamon [2], Bhaskar Dutta [2], [1] *University of Regina*, [2] Texas A&M — Supersymmetric particles called neutralinos are considered as candidates for the unknown dark matter that fills our Universe. If neutralinos do exist, the Large Hadron Collider will likely see their signals. However, it will take the International Linear Collider (ILC) experiment to accurately measure their properties and therefore establish whether they do significantly contribute to the total amount of dark matter needed to explain the dynamics of galaxy clusters and the structure of the Universe. A mSUGRA model to simulate events with neutralino signals is used to study possible scenarios of identification with the ILC at center of masses of 500 GeV and 800 GeV. The events are simulated with PYTHIA interfaced to ISAJET for supersymmetric particle simulations and TAUOLA for tau decays with polarized electron and positron beams and then passed through a full detector simulation based on a compact ILC detector concept. Gamma-gamma and standard model backgrounds are considered in the analysis.

* This work is being supported by NSERC - University of Regina

16h45 Session Ends / *Fin de la session*

[WE-P3] General Instrumentation / *Instrumentation générale*

(DIMP / *DPIM*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
14h15 - 15h30

ROOM / SALLE ***VCH 3840*** **(cap. 106)** ***Chair: K.H. Michaelian, CANMET, Natural Resources***

WE-P3-1 **14h15**

JUN SHEN, National Research Council Canada

Top-hat cw laser induced time-resolved mode-mismatched thermal mirror and thermal lens spectroscopies †,*

Photothermal spectroscopies are powerful techniques for optical and thermal property measurements, which can be applied to not only transparent samples but also opaque ones with little sample preparation. Photothermal spectroscopies are usually induced by a strong gas laser (e.g., an Ar^+ ion laser) of a high-quality TEM_{00} Gaussian intensity profile, which is expensive and also requires regular maintenance services. Solid state lasers are less expensive and are, however, of multi-modes. To use solid state lasers in photothermal spectroscopies, top-hat illumination is a good approach, but the theoretical model and experimental setup are more complex compared with the Gaussian illumination. In this presentation, we report the recent progress in theoretical models of time-resolved mode-mismatched thermal mirror and thermal lens spectroscopies with top-hat solid state laser illumination. Experimental setup and experimental results of transparent and opaque samples are also presented. Good agreement between theoretical models and experimental results exhibit that top-hat cw laser induced thermal mirror and thermal lens can be used for determination of optical and thermal parameters of solid samples. Furthermore, the combined measurements of thermal mirror and thermal lens can measure the mechanical property of solid samples.

† In collaboration with Nelson Astrath [1], Mauro Baesso [2], Francine Astrath [1], James Zhou [1], [1] National Research Council Canada, [2] Unversidade Estadual de Maringa, Brazil

* This work is being supported by National Research Council Canada

WE-P3-2 **14h45** **(G)**

Optimization of rocker measurements with a portable gauge*, **Louis Poirier** [1], Sean Maw [2], Robert I. Thompson [1], Darren Stefanyshyn [1], [1] *University of Calgary*, [2] Mount Royal College — Equipment is a major contributing factor to success in elite winter sports but understanding that equipment has not been made a priority. Our work concentrates on understanding factors influencing ice friction in winter Olympic sports, specifically how the longitudinal curvature or rocker of a blade affects friction in skating (hockey, short and long track). For a given material, the geometry of the runner is the main factor contributing to ice friction so we felt it was important to start with a better understanding of the runner geometry. We are developing a compact measurement method that can be used on tour by the athlete. The work will be compared to automated methods and we will discuss the problems arising between rocker measurement precision and spatial resolution. These measurements are the first step of an equipment survey, which we hope will lead to a better understanding and improved equipment construction for our athletes. We will also extend our discussion to other ice sports such as bobsleigh, skeleton and luge.

* This work is being supported by NSERC

WE-P3-3 **15h00**

Measurements of Turbulent Flow Phenomena with Magnetic Resonance Imaging (MRI)*, **Ben Newling** [1], Zhi Yang [1], Olusegun Adegbite [1], Joshua Varner [1], Andrew Holloway [2], Katy Haralampides [3], [1] *Department of Physics, University of New Brunswick* , [2] Department of Chemical Engineering, University of New Brunswick, [3] Department of Civil Engineering, University of New Brunswick — Magnetic resonance imaging (MRI) can non-invasively measure fluid flow properties. Careful design of the appropriate MRI measurement can quantify in three dimensions time-averaged velocities, turbulent eddy diffusivities and mechanical dispersion coefficients and even place some boundaries on flow correlation times. However, the range of flows in which this powerful technique can be useful has been limited by flow rates and fluid properties because the measurement interval is typically several milliseconds. Our MRI measurement, based on the SPRITE MRI technique [1], has a significantly reduced measurement interval (tens to hundreds of microseconds), which has extended the applicability of MRI flow measurements to higher Reynolds number (250 000) flows, to gaseous flows and to multi-phase flows. We will explain how our measurement developments fit into the pantheon of experimental fluid dynamics techniques by showing examples of measurements in gas flow, in air-water flow and in mechanically dispersed flow.

1. B. Newling, C.C. Poirier, Yang Zhi, J.A. Rioux, A.J. Coristine, D. Roach, and B.J. Balcom, *Phys. Rev. Lett.* **93**, 154503 (2004)

* This work is being supported by NSERC, Harrison McCain Foundation

WE-P3-4 **15h15**

Mid- and far-infrared photoacoustic spectroscopy at the Canadian Light Source*, **Kirk H. Michaelian** [1], Tim E. May [2], [1] *CANMET, Natural Resources Canada*, [2] Canadian Light Source — The use of synchrotron radiation (SR) in the measurement of photoacoustic (PA) infrared spectra of solids at the Canadian Light Source (CLS) is discussed in this presentation. PA spectroscopy was recently commissioned at CLS, providing the capability for analysis of a variety of industrial materials. CLS is thought to be the only third generation synchrotron facility in which the technique is used on a routine basis. Work carried out at the mid-infrared beamline at CLS is reported here. PA spectra have been obtained for aromatic hydrocarbons that are studied as models for asphaltenes, highly aromatic solids that affect the extraction and upgrading of Athabasca bitumen to middle distillate fuels. The beamline was modified to enable acquisition of far-infrared PA spectra through an appropriate choice of optical materials; this enabled acquisition of low-wavenumber SR PA spectra of hydrocarbons. Consistency between a spectrum calculated from the average of a series of interferograms and one obtained by averaging the corresponding individual spectra served as an indicator of band authenticity. Preliminary SR PA experiments involving the use of a microsample accessory are also discussed.

* This work is being supported by Natural Resources Canada

15h30 **Session Ends / *Fin de la session***

[WE-P4] Nuclear Theory / *Théorie nucléaire*

(DNP-DTP / *DPN-DPT*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
14h15 - 15h45

ROOM / SALLE ***VCH 2870*** **(cap. 57)** ***Chair: P.G. Blunden, University of Manitoba***

WE-P4-1 **14h15**

SONIA BACCA, TRIUMF

Ab Initio Reactions of Light Nuclei

The investigation of nuclear reactions using ab initio approaches is fundamental in order to bridge nuclear physics with the underlying QCD regime. Nowadays this valuable information is only accessible for few-particle systems, where the quantum many-body problem of nucleons can be solved exactly both for bound and scattering states. This allows an optimal setting to probe different nuclear potentials models, which are typically fitted to bound state properties of nuclei. Nuclear reactions induced by electromagnetic probes turn out to be very useful as the electromagnetic current is well known and a clean comparison with experimental data can be done. A report on a new calculation of the electron scattering reaction off 4He is presented. The innovative technique of the Lorentz Integral Transform [1] is used to take into account all the possible break-up channels in the final state of the nucleus. Modern interactions are used as solely input. The comparison with the experimental data shows the importance of three-body forces and offers a rich soil to investigate further the structure of three-nucleon interactions.

1. V.D. Efros, W. Leidemann, G. Orlandini, *Phys. Lett. B* **338**, 130 (1994).

WE-P4-2 **14h45**

Inclusive Photoproduction of η Mesons on Nuclei and the in-medium properties of the S_{11} Resonance*, **Helmy S. Sherif** [1], Mohammad Hedayatipour [2], [1] *University of Alberta/Sinai University, Egypt*, [2] University of Alberta — A relativistic non-local model for the inclusive photoproduction of η mesons from complex nuclei is introduced. The model is based on the dominance of the S_{11} (1535) resonance. We compare the results of our calculations with the available data on inclusive cross sections for the nuclei C, Al and Cu. Assuming the resonance propagates freely in the nuclear medium, we find that the calculated angular distribution and energy dependence of the cross sections reproduce the data in a reasonable fashion. The present non-local model allows the inclusion of density dependent mass and width in the calculations. Inclusion of these in the calculations and comparison with presently available data will be discussed.

* This work is supported in part by the Natural Sciences and Engineering Research Council of Canada

WE-P4-3 **15h00**

Leading Order Calculation of Transport Coefficients in Hot Quantum Electrodynamics from Diagrammatic Methods. **Jean-Sebastien Gagnon** [1], Sangyong Jeon [2], [1] *École Polytechnique Fédérale de Lausanne*, [2] McGill University — We compute the electrical conductivity and shear viscosity at leading order in hot Quantum Electrodynamics. Starting from the Kubo relation for electrical conductivity and shear viscosity, we use diagrammatic methods to write down the appropriate integral equations for bosonic and fermionic effective vertices. We also show how Ward identities can be used to put constraints on these integral equations. One of our main results is an equation relating the kernels of the integral equations with functional derivatives of the full self-energy; it is similar to what is obtained with two-particle-irreducible effective action methods. However, since we use Ward identities as our starting point, gauge invariance is preserved. Using these constraints obtained from Ward identities and also power counting arguments, we select the necessary diagrams that must be resummed at leading order. This includes all non-collinear (corresponding to 2 to 2 scatterings) and collinear (corresponding to 1+N to 2+N collinear scatterings) rungs responsible for the Landau-Pomeranchuk-Migdal effect. We also show the equivalence between our integral equations and the linearized Boltzmann equations of Arnold, Moore and Yaffe obtained using effective kinetic theory.

WE-P4-4 **15h15**

The collective model from a Cartan-Weyl perspective*, **Stijn De Baerdemacker**, Kris Heyde [2], Veerle Hellemans [3], [1] *Department of Physics, University of Toronto / Vakgroep subatomaire & stralingsfysica, Universiteit Gent*, [2] Vakgroep subatomaire & stralingsfysica, Universiteit Gent, [3] Département de physique, Université Libre de Bruxelles — The geometrical Bohr-Mottelson model is a macroscopic nuclear structure model in the sense that it considers the atomic nucleus as a charged liquid drop with a definite surface, rather than a many-body system of constituent particles. The quantum mechanical treatment of the surface excitations the lead to the Bohr Hamiltonian, which describes the dynamics of the nuclear surface up to spheroidal deformations. Depending on the choice of the potential, this Hamiltonian is able to explain the low-energy structure of medium and heavy atomic nuclei (away from the shell closures) in terms of rotations, vibrations and a coupling between them. For this purpose, many different techniques to handle general collective potentials have been proposed and profoundly discussed in the literature. These techniques are based on combinations of analytical and algebraic methods, making use either of special function theory or the underlying $SU(1,1)$ x O(5) Lie group structure of the Bohr Hamiltonian. This contribution will discuss a technique which is completely algebraic in the sense that no explicit representations have to be constructed. By means of a rotation to the Cartan-Weyl scheme and an intermediate state method, all necessary ingredients for the matrix representation can be derived within this basis. First test-results find their application in the field of nuclear quantum shape phase transitions.

* This work is being supported by Universiteit Gent, FWO-Vlaanderen and Belgian Interuniversity Atraction Pole (IUAP) under project P5/07

WE-P4-5 **15h30**

Rotational deformations on B=1 and B=2 Skyrmions*, **Jimmy Fortier**, Luc Marleau, *Université Laval* — The Skyrme model admits topological solitons solutions of topological charge B which may be identified with nucleus of baryon number B in its quantized version. We propose to set the parameters of this model F_π and e such that they reproduce the physical masses of the nucleon and the deuteron. Numerical solutions which minimize the total energy for the B=1 nucleon and B=2 deuteron are achieved using an axially symmetric ansatz and a simulated annealing algorithm. Surprisingly we find that axial deformations are responsible for a significant reduction (by about a factor of 4) of the rotational energy. Our results also show that it is not possible to get a common set of parameters F_π and e which would fit both nucleon and deuteron masses simultaneously at least for smaller pion masses m_π = 138 MeV, 345 MeV and 500 MeV. This suggests that either $m_\pi > 500$ MeV or additional terms must be added to the Skyrme Lagrangian.

* This work is being supported by National Science and Engineering Research Council

15h45 **Session Ends / *Fin de la session***

[WE-P5] Quantum Information and Computing II / *Informatique et calcul quantiques II*

(DAMPhi-DOP / *DPAMip-DOP*)

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

14h15 - 16h30

ROOM / SALLE ***VCH 3860*** **(cap. 148)** ***Chair: B.C. Sanders, University of Calgary***

WE-P5-1 **14h15**

ALEXANDER LVOVSKY, University of Calgary

Quantum memory for continuous-variable optical states †

We are reporting on our progress towards universal quantum memory for light: a system that would allow storage and retrieval, with high fidelity, of an arbitrary optical state. Our apparatus employs parametric down-conversion for preparing quantum states of light, electromagnetically-induced transparency for their storage in atomic rubidium vapor and homodyne tomography for measuring the retrieved states. We demonstrate storage and retrieval of squeezed vacuum as a test of our system's capabilities.

† In collaboration with J. Appel, E. Figueroa, D. Korystov, C. Kupchak, M. Lobino

WE-P5-2 **14h45**

Double electromagnetically-induced transparency in rubidium vapor*, **Andrew MacRae**, Geoff Campbell, Peter Marzlin, Alexander Lvovsky, *University of Calgary* — We report demonstration of double electromagnetically-induced transparency in a hot rubidium-87 vapor: two transparency windows appear simultaneously on $|5S_{1/2}, F = 1\rangle \rightarrow |5P_{1/2}, F = 2,\rangle$ and $|5S_{1/2}, F = 2\rangle \rightarrow |5P_{1/2}, F = 2\rangle$ when a single control field is applied. We have been able to simultaneously slow down two optical pulses resonant with these transitions. By switching the control field, we have demonstrated simultaneous storage of these pulses. This scheme can be applied to achieve optical nonlinearities in the pulsed regime at light levels as low as a few photons per atomic cross section.

* This work is being supported by NSERC, AIF, CFI, CIFAR, QuantumWorks

WE-P5-3 **15h00** **(G)**

Towards Quantum Memory*, **Erhan Saglamyurek**, Ahdiyeh Delfan, Neil Sinclair, Cecilia La Mela, Wolfgang Tittel, *Institute for quantum information science, University of Calgary* — The implementation of many applications of quantum communication and computation such as quantum repeaters relies on the possibility to reversibly transfer quantum information between photons and atoms. Key properties for such a quantum memory are high recall efficiency and long storage times, and the capacity to store short photonic wavepackets with high fidelity. Our approach towards quantum state storage is based on rare-earth ion doped solid state material (crystalline and amorphous waveguides) at cryogenic temperature, and "controlled reversible inhomogeneous broadening" (CRIB) of a narrow absorption line [1]. Implementation of CRIB relies on the possibility to prepare such an absorption line out of an inhomogeneously broadened medium by means of optical pumping, and to broaden this line in a controlled and reversible way. After an introduction into CRIB, we will present spectroscopic investigations of Thulium doped Lithium Niobate waveguides and silicate fibers, and analyze these novel material candidates in view of the requirements for quantum memory.

1. M. Nilsson, S. Kroll, *Opt. Commun. Vol.* **247**, No. 4-6. (2005).
2. A.L. Alexander, J.J. Longdell, M.J. Sellars, and N.B. Manson, *Phys. Rev. Lett.* **96**, 043602 (2006)
3. B. Kraus, W. Tittel, N. Gisin, M. Nilsson, S. Kroll, and J.I. Cirac, *Phys. Rev A* **73**, 020302 (2006).

* This work is being supported by AAET, CFI, General Dynamics, iCORE, NSERC

15h15 **Coffee Break / *Pause café***

WE-P5-4 **15h30**

Quantum Walks on Circles in Phase Space via Cavity or Circuit Quantum Electrodynamics*, **Peng Xue** [1], Barry Sanders [1], Alexandre Blais [2], Kevin Lalumiere [2], [1] *Institute for Quantum Information Science, University of Calgary*, [2] Département de Physique, Université de Sherbrooke — We show how a quantum walk in phase space can be implemented via cavity or circuit quantum electrodynamics (CQED) where only the resonator field (i.e. the walker) needs to be driven and measured. The atom or Cooper pair box (i.e. the coin) is controlled indirectly via Jaynes-Cummings coupling. Decoherence can be tuned so that the transition from quantum to classical walk can be controlled, which confirms the quantum nature of the walk. In contrast to previous proposals for CQED realizations, the walker is not confined to one circle in phase space (fixed mean energy) but rather leaps to other circles in phase space. Despite this complication, the quantum enhanced diffusion of walker's phase can be cleanly observed and rigorously explained, thereby enabling the first experimental realization of a single-walker quantum walk.

* This work is being supported by NSERC, MITACS, CIFAR, FQRNT, QuantumWorks and iCORE

WE-P5-5 **15h45** **(G)**

Towards Fast Error Correction for Quantum Key Distribution*, **Philip Chan** [1], Itzel Lucio Martínez [2], Xiaofan Mo [2], Wolfgang Tittel [2], [1] *ATIPS, University of Calgary*, [2] IQIS, University of Calgary — The implementation of the decoy state protocol in Quantum Key Distribution (QKD) can improve the raw key rate of the system. This improvement, when coupled with expected advances in the available technology, particularly in single photon detectors, promise significantly increased raw key rates in the near future. As such, improvements to the classical error correction used in a QKD system are required in order to keep up with the potential increase in key rates [1]. Low-Density Parity-Check (LDPC) codes have recently been shown to provide very desirable properties for error correction under belief propagation decoding. They offer both near Shannon limit performance and the potential for highly efficient decoding algorithms. In particular, the decoding algorithm is parallelizable, allowing for fast hardware implementations [2]. Efficient implementations in hardware, whether it is a custom Application Specific Integrated Circuit (ASIC) or a Field Programmable Gate Array (FPGA), require that computations are performed using fixed-point arithmetic. The performance of a LDPC code is simulated at different error rates around 3% while using various bit lengths to represent the data during decoding and the results are compared with double precision floating-point calculations. It is shown that for an irregular LDPC matrix of size 4000x1200 with check node degree 20 and message node degree between 2 and 8, excellent results are obtained using 20-bit fixed-point arithmetic. References:

1. D. Pearson, *Proc. 7th Int. Conf. Quantum Communication, Measurement and Computing*, **734**, 299-302 (2004)
2. B. Levine *et al.*, *Proc. IEEE Symp. Field-Programmable Custom Computing Machines*, 217-226 (2000).

* This work is being supported by iCORE, NSERC

WE-P5-6 **16h00** **(G)**

Combining Quantum Key Distribution and Internetworking over a 12 km real-world fibre link*, **Itzel Lucio** [1], Mo Xiaofan [2], Philip Chan [3], Steve Hosier [4], Wolfgang Tittel [2], [1] *IQIS,University of Calgary*, [2] IQIS, University of Calgary, [3] ATIPS, University of Calgary, [4] SAIT — Quantum key distribution (QKD) is the only technique currently known that provides cryptographic key exchange over an untrusted public communication channel with information theoretic security [1]. We present the current status of our QKD system, which allows encoding of quantum bits into polarization states of light. The system includes decoy states to remove the threat of eavesdropping attacks based on photon-number-splitting in an efficient way [2], low-density parity-check-matrix based error correction [3], and is implemented on a 12 km fibre link between the University of Calgary and the Southern Alberta Institute of Technology. Two home-made circuits based on FPGAs are used to control the key distribution process and acquire the raw key bits. At the same time they allow the implementation of fast error correction and privacy amplification. Our system also allows sending of classical framing information via sequences of strong laser pulses, inspired by the Ethernet protocol, whose purpose comprise synchronization, sender and receiver identification, and assessment and compensation of time-varying birefringence in the communication channel.

1. N. Gisin, G. Ribordy, W. Tittel and H. Zbinden, "Quantum cryptography" *Rev. Mod. Phys*, **vol. 74**, 145 (2002).
2. B. Huttner, N. Imoto, N. Gisin and T. Mor. *Phys. Rev A*, **51**, 1863 (1995).
3. D.J.C. MacKay and R.M. Neal, "Near Shannon limit performance of low density parity check codes", *Electron. Lett*, **33** (1997).

* This work is being supported by General Dynamics, iCore, NSERC, Canada Foundation for Inovation, Alberta Advanced Education and Technolody, CMC Mycrosystems, CONACyT

WE-P5-7 **16h15** **(G)**

Implementation of Quantum Error Correction in Solid State NMR*, **Osama Moussa**, Jonathan Baugh, Colm Ryan, Raymond Laflamme, *University of Waterloo* — A crucial requirement for large-scale universal quantum computation is the ability to perform quantum error correction. In this talk, we report on the experimental implementation of an active quantum error correction scheme on a 3-qubit system in the solid state NMR implementation of a quantum information processor.

* This work is being supported by NSERC

16h30 **Session Ends / *Fin de la session***

[WE-P6] Astronomy, Atmospheric and Space Physics / *Astronomie, physique de l'atmosphère et de l'espace*

(DASP / *DPAE*)

WEDNESDAY, JUNE 11 / MERCREDI, 11 JUIN

14h15 - 15h30

ROOM / SALLE ***VCH 2860*** **(cap. 142)** ***Chair: R. Roy, Université Laval***

WE-P6-1 **14h15**

LAURENT DRISSEN, Université Laval

The International Year of Astronomy 2009

In 1609, Galileo aimed for the first time a telescope at the heavens. His discoveries profoundly changed our view of the Universe. Four hundred year later, astronomers are using the magnifying properties of warped spacetime around massive clusters of galaxies to observe the formation of the first generation of stars 12 billions years ago and are still, like Galileo, amazed by what they see. The International Year of Astronomy 2009 (IYA2009) will be a global celebration of astronomy and its contributions to society and culture, stimulating worldwide interest not only in astronomy, but in science in general, with a particular slant towards young people. I will present some of the activities planned to commemorate this anniversary in Canada.

WE-P6-2 **14h45**

Extreme CO pollution events measured by the MOPITT instrument*, **Florian Nichitiu**, James Drummond, Jay Kar, Jason Zou, *University of Toronto* — In the fall of 2006, an unprecedented high level of CO over Indonesia was observed by the Measurements Of Pollution In The Troposphere (MOPITT) instrument on the Terra satellite. This is an extreme event caused by a huge fire activity during the recent El Nino event. In the past eight years, MOPITT has observed three high CO events over Indonesia and all during the El Nino warm phase when rainfall decreased (and the fires spread). The fact that fire activity is well correlated with El Nino-Southern Oscillation (ENSO) indices is well known. Further, all the ENSO indices indicate 2002, 2004, 2006 as El Nino years with the 2002 and 2006 events being very similar. What is not clear is why the Indonesian biomass burning of 2006 was almost double that of 2002 (with all the consequences including very high CO pollution levels) when, in fact the 2006 El Nino was similar or even a bit weaker than the 2002 El Nino. We compare the three recent high CO pollution events over the Indonesian region using MOPITT CO data. We shall describe the Oct-2006 extreme CO pollution event and suggest possible correlations which can help in identification of the mechanisms responsible. We discuss the El Nino correlation with fire activity as well as a possible "fire-pollution-lightning feedback loop" mechanism (An increase in intensity of lightning activity was observed during this big biomass burning activity) which can have an important contribution to overall high pollution of the Oct 2006 event over Indonesia.

* This work is being supported by Canadian Space Agency

WE-P6-3 **15h00**

Atomic Data from Magnetic Fusion Devices for Solar and Stellar Physics*, **Jaan K. Lepson** [1], Peter Beiersdorfer [2], Ming Feng Gu [2], Manfred Bitter [3], Norimasa Yamamtoto [4], Takako Kato [5], [1] *University of California Space Sciences Laboratory*, [2] Lawrence Livermore National Laboratory, [3] Princeton Plasma Physics Laboratory, [4] Nagoya University, [5] National Institute for Fusion Science — Magnetic fusion devices have been very useful for providing fundamental data for atomic physics. In recent years, we have been using data from such devices to answer questions arising in solar and astrophysical plasmas. We will present our measurements from the NSTX spherical torus device at Princeton, aimed at calibrating density-dependent line ratios of highly charged argon ions. We will also present spectroscopic data from the LHD stellarator in Toki, used to calibrate intensity ratios of Fe XIII lines observed with the Hinode satellite near 200 Å. The plasma density of these devices is sufficiently high to test atomic theory in the "high"-density limit compared to the solar corona. These measurements have also uncovered several lines not yet included in solar spectral models.

* This work is being supported by Work at LLNL was performed under auspices of the DOE under contract DE-AC52-07NA2344.

WE-P6-4 **15h15**

An empirical determination of the mass to size ratio in modern commercial air transports. **Eduardo Galiano-Riveros**, Stefan Kaluzienski, *Laurentian University* — The ratio of linear dimension to mass in modern aircraft is in general a complicated function which cannot be derived analitically. For uniform geometrical bodies the mass is proportional to a linear dimension (i.e. side or radius) cubed. Since modern aircraft are far from being uniform geometric bodies, this relation does not hold. There is also the issue of adequately defining the linear dimension of an aircraft. In this study, we plot and derive polynomial relations for the mass as a function of the linear dimensions of specific types of aircraft. The linear dimension is defined as the mean of the wingspan and fuselage length, and the mass is taken as the published Maximum Take Off Weight (MTOW). A relation has been derived for commercial transports - including turbofan, turboprop, and piston powered types - using as data points all transport types presently in service around the globe. In the turbofan category, we included regional jets, narrow and wide bodies, and so called "jumbo" transports. The following best fit (by least squares) third degree polynomial relating mass to linear dimensions, has been derived: Mass (kg) = $3.0264x^3 - 273.48x^2 + 12651x - 170321$ ($R^2 = 0.9612$) where x is the aircraft linear dimension. Specific plots and mass to linear dimensions have also been obtained for each aircraft sub type. These relations may be of interest to the designer when considering performance parameters for new or derivative transport types.

15h30 **Session Ends / *Fin de la session***

[WE-P7] Topics in Physics / *Divers sujets en physique*

(CAP / *ACP*)

WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
14h15 - 16h00

ROOM / SALLE ***VCH 2830*** **(cap. 106)** ***Chair: R. Mann, University of Waterloo***

WE-P7-1 **14h15**

Non-linear PDE model for pattern dynamics observed on sun-ablated snow*, **Kevin Mitchell** [1], Tom Tiedje [2], [1] *UBC, dept of Physics & Astronomie*, [2] UBC, dept of Physics & Astronomy/ECE — We present experimental observations of the shape and time-evolution of quasi-periodic ablation hollows (suncups) in sun-melted snow at an elevation of ~2000m in Southern British Columbia. Our observations show that the spontaneous growth in roughness from a flat snow surface occurs over a few days, and the chaotic post-saturation lateral motion of the minima of the ablation hollows exhibits a super-diffusive behaviour. The experimental observations are compared to numerical solutions of the previously derived non-linear PDE $\partial_t h = -(\nabla^2 + \nabla^4) h - a(\nabla h)^2 + b\nabla^2 (\nabla h)^2$. The only free parameter in the equation is the relative strength of the two non-linear terms a/b. The first non-linear term is non-conservative, adding a negative drift to the surface height h, i.e., augmenting the melt rate of the snow surface. The second non-linear term is conservative, adding no such drift. In addition to decreasing ablation rate, reducing the ratio a/b is numerically observed to increase the time and length scales of the post-saturation solutions. By fitting the value of a/b to the experimentally observed initial growth rate and post-saturation dynamics, we are able to determine the ammount that the melting of the snowpack is accelerated by the non-conservative term, thus offering an indirect method for measuring the albedo of the snow surface.

* This work is being supported by NSERC, Tranzeo Wireless Technologies Inc.

T. Tiedje, K.A. Mitchell, B. Lau, A. Ballestad, and E. Nodwell, *Radiation transport model for ablation hollows on snowfields*, (2006)

WE-P7-2 **14h30**

Numerical Simulations of a Single State Atom Interferometer*, **Brynle Barrett**, Carson Mok, Scott Beattie, A. Kumarakrishnan, *York University* — We present simulations to understand a single state atom interferometer used to measure the atomic recoil frequency with laser cooled atoms. In the experiment, a standing wave laser is pulsed on at t = 0 which creates a superposition of momentum states. At t = T, a second standing wave pulse diffracts the momentum states again so that a density grating is formed in the vicinity of t = 2T. This grating is associated with the interference of momentum states separated by $2\hbar k$. A traveling wave readout pulse is applied to the sample at this time and the backscattered light from the grating is detected as the echo signal. The amplitude of the echo signal is periodic at the atomic recoil frequency and the duration of the echo envelope is related to the velocity distribution in the sample. Our goal is to model several aspects of the echo signal, both in the short pulse (Raman-Nath) and long pulse (Bragg) regimes, such as the dependence of the echo amplitude on the Rabi frequency, pulse length and spontaneous emission.

* This work is being supported by CFI, OIT, NSERC, OCE and York University

WE-P7-3 **14h45**

Investigation of Light Scattering and Collisions on an Atom Interferometer*, **S. Beattie**, I. Chan, A. Kumarakrishnan, *York University* — We have measured the effects of light scattering and collisions on the signal from a single state atom interferometer that uses laser cooled ^{85}Rb. Two standing wave pulses separated by time T are used to diffract and rephase momentum states (corresponding to a single internal state) resulting in the formation of a density grating in the vicinity of $t = 2T$. The grating is detected by measuring an echo signal that represents the amplitude of light backscattered by a traveling wave. To study the effects of light scattering, we apply both traveling wave and standing wave pulses at a variable time Δt before grating formation at $t = 2T$ and measure the grating contrast. In both cases, the contrast shows a periodic dependence on Δt that is consistent with theoretical predictions based on the Fourier transforms of the momentum distributions associated with the decohering pulses. We investigate the extent to which the periodic dependence in the contrast can be exploited for a precision measurement of the atomic recoil frequency. In the presence of CW standing wave light, the echo signal amplitude varies in a manner consistent with the scattering rate associated with a standing wave potential. We also present similar studies of decoherence due to collisions that suggest that the experiment is sensitive to diffractive collisions.

* This work is being supported by CFI, OIT, NSERC, OCE and York University

WE-P7-4 **15h00**

Comparative Dynamics of the liquid and dissolved gas during cavitation*, **Igor Mastikhin**, Benedict Newling, *University of New Brunswick* — A strong acoustic field in a liquid separates the liquid and dissolved gases by the formation of bubbles (cavitation). Information on the gas dynamics during cavitation is important in sonochemistry, hydraulic engineering and biomedical ultrasound. Commonly used optical and acoustical techniques are not suitable for direct measurements of how much of the dissolved gas participates in cavitation, how long the gas molecules stay inside the bubbles, or how gas dynamics depend on the number of nucleation sites. In this work, we attempted direct, spatially resolved measurement of liquid and gas dynamics in cavitating liquid. We employed Magnetic Resonance Imaging of both liquid and gas in acoustically (19.7kHz) cavitated, filtered and unfiltered water samples, with dissolved Freon-22 ($CHClF_2$). We found that the motions of dissolved gas and liquid can be strikingly different during acoustic cavitation and are strongly affected by filtration or previous cavitation of the solvent. The upper limit of the residence time for gas molecules inside cavitating bubbles, for filtered water, is on the order of 100, meaning that gas content within bubbles can be refreshed within two oscillation periods. Our observations are

strongly suggestive of motion in which each new position of a fully-expanded bubble involves a different collection of gas molecules than that of the previous cycle. Microbubbles remaining after cavitation events are remarkably stable, influencing cavitation dynamics significantly after 2 min delays but minimally after one hour delays between the events.

* This work is being supported by NSERC

WE-P7-5 15h15

Température Électronique Pour L'étude Du Fonctionnement Des Jonctions. **Mohamed Hedi Boukhatem** [1], El Tahchi Mario [2], Mialhe Pierre [3], [1] *Collège de l'Outaouais,* [2] Université Libanaise, Liban, [3] Université de Perpignan, France — Lorsque la température d'un matériau semiconducteur change, ses propriétés électroniques sont modifiées. Une des grandeurs physiques les plus importantes qui est à l'origine de ces modifications est la largeur de sa bande interdite puisqu'elle est dépendante de la température. Pour un état stationnaire, le gap E_g mesuré à basse température a une valeur supérieure à celle qui est mesurée à température ambiante. L'origine de ces variations avec la température a été d'abord reliée à la dilatation du réseau puis aux modes de vibration du réseau cristallin et aux interactions des porteurs avec le réseau. Ce travail propose une nouvelle formulation de l'étude de la description des fonctionnements des jonctions *n-p*. Il introduit la description statistique des populations de porteurs dans les niveaux d'énergie des semiconducteurs en faisant intervenir la température électronique T_e. Cette description a permis de décrire les caractéristiques courant-tension des jonctions et elle a conduit à une détermination de la température T_e des porteurs. Une expression analytique, reliant la température électronique à la température du réseau cristallin, a été introduite. Elle a été validée par l'expérimentation réalisée sur plusieurs semiconducteurs. La description des variations de l'énergie du gap avec la température est discutée. Les mesures du gap, à T=0 K, confirment la nécessité de travailler avec la température électronique et une relation linéaire entre E_g et T_e est obtenue.

1. S. M. Sze, *Physics of semiconductor Devices*, 2nd ed. New York, Wiley (1981).
2. Y. P. Varshni, *Physica* **34** (1967) 149.
3. J. L. Moll, *Physics of semiconductors,* USA, McGraw-Hill (1964).
4. M. H. Boukhatem, M. El Tahchi, G. W. El Haj Moussa, M. Ajaka, A. Khoury and P. Mialhe, *Microelectron. J.* **38**, 615 (2007).
5. M. El Tahchi, N. Toufik, F. Pelanchon, M. Ajaka, A. Khoury, and P. Mialhe, *J. Phys. D: Appl. Phys.* **35.** 478 (2002).
6. J. Bardeen and W. Shokley, *Phys. rev.* **80.** 72 (1950).
7. H. Y. Fan, *Phys. rev.* **78.** 808 (1950).
8. V. A. Johnson and H. Y. Fan, *Phys. rev.* **79.** 899 (1950).
9. R. Passler, *Phys. Stat. Sol. B.* **216.** 975 (1999).

WE-P7-6 15h30

Simulations of electrostatic systems at high temperatures*, **Hector Dominguez** , Edgar Nuñez, *Universidad Nacional Autonoma de Mexico, UNAM* — Molecular Dynamics simulations of electrically charged particles was studied to investigate the formation of aggregates in a very dilute system. Using a semi-hard-sphere (slightly variation of the restricted Primitive Model, RPM) model we studied the influence of two thermodynamic factors, density and temperature, in the formation of aggregates. For a given temperature, it was found a subinterval within the interval chosen in density (dilute region) where high aggregation is present for small changes in density at high (above critical) temperature. On the other hand, for a given density, the system behaves in an interesting way when the temperature changes in small intervals. The aggregation parameter fluctuates from high to low values as the temperature increased. These results suggest the presence of a possible phase at temperatures above the critical temperature of the RPM model.

* This work is being supported by CONACYT-Mexico and DGAPA-UNAM

WE-P7-7 15h45

Effects of extreme anisotropies in the t-J model*, **Kenneth Vos**, Chad Povey, Mark Tipper, *University of Lethbridge* — We have examined the effects of extreme anisotropies in the t-J model, with application to the low temperature tetragonal structural phase of the cuprates, using exact diagonalization on a twenty four-site cluster. For a selected set of parameters, that are representative for the hole doped cuprates, a stripe phase is found for isotropic parameters and the stripe is destroyed when the anisotropies are extreme enough, giving rise to a new phase. The phase transition produces a drastic change in the charge distribution and spin structure of the system. The computational infrastructure was provided by WESTGRID.

* This work is being supported by NSERC of Canada and the University of Lethbridge

16h00 Session Ends / *Fin de la session*

[WE-Exec] CAP Executive Meeting
(CAP / *ACP*) *Réunion de l'Exécutif de l'ACP*
WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
16h00 - 17h00

ROOM / SALLE POP 2165 (cap. 28) ***Chair: S.A. Page, University of Manitoba***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

17h00 Session Ends / *Fin de la session*

[WE-Counc] CAP Council Meeting (New and Old)
(CAP / *ACP*) *Réunion du conseil de l'ACP (nouveau et ancien)*
WEDNESDAY, JUNE 11
MERCREDI, 11 JUIN
17h00 - 19h00

ROOM / SALLE POP 1168 (cap. 150) ***Chair: S.A. Page, University of Manitoba***

Agenda circulated to participants separately / *Ordre du jour distribué aux participants séparément*

19h00 Session Ends / *Fin de la session*

2008 CONGRESS POSTER SESSION ABSTRACTS
RÉSUMÉS DE SESSION D'AFFICHES - CONGRÈS 2008

The poster session abstracts presented here will be on display in this order in the Main Hallway (2nd and 3rd floors) of the Pavillon Alexandre-Vachon, at 17h00 - 19h45 on Monday, June 9th. *Les résumés présentés en affiches publiés ci-après seront en montre de 17h00 à 19h45, le lundi, 9 juin dans le foyer principal (deuxième et troisième étages), Pavillon Alexandre-Vachon.*

[MO-POS] CEWIP / CEFEP — Monday / Lundi

MO-POS-1

Physique de femmes*, **Nadia Ghazzali**, *Universite Laval* — L'exposition Physique de femmes a été créée par la Mission pour la place des femmes au Centre national de la recherche scientifique (CNRS) à l'occasion de l'Année mondiale de la physique. Quinze portraits de scientifiques françaises œuvrant dans les domaines liés à la physique sont présentés afin de mettre en exergue leurs contributions à l'avancement des connaissances et la formation des jeunes. Par la suite, une adaptation québécoise, contenant sept profils de physiciennes québécoises, a été réalisée grâce à un partenariat entre le CNRS et le ministère de l'éducation, du loisir et du sport du Québec. Par leurs témoignages, ces femmes nous font découvrir différents aspects de la recherche en physique et tout un éventail de possibilités d'emploi. Elles nous font également découvrir plusieurs applications de la physique dans des domaines variés comme la santé et l'environnement qui sont susceptibles de servir la société. Ces vingt-deux femmes représentent des modèles de réussite et seront présentées sous forme de banières. Chacune d'entre elles dévoilera les raisons qui l'ont amené à choisir de faire des études en physique et donnera un bref aperçu de son parcours et de son milieu de travail actuel.

* This work is being supported by CNRS et MELS

[MO-POS] ATOMIC AND MOLECULAR PHYSICS AND PHOTON INTERACTIONS / PHYSIQUE ATOMIQUE ET MOLÉCULAIRE ET D'INTERACTIONS AVEC LES PHOTONS — Monday / Lundi

MO-POS-2 **(G*)**

A quantum tale of different, yet inseparable photons*, **Félix Bussières**, Joshua Slater, Yasaman Soudagar, Suzanne Lacroix, Nicolas Godbout, Wolfgang Tittel, Jeong Wan Jin, Terence Stuart, John Nguyen, *University of Calgary* — Quantum communication, the art of transferring quantum bits at a distance, requires reliable sources of entangled photons. We report on our efforts to create entangled photon pairs at widely separated wavelengths through three-wave mixing (parametric downconversion) in bulk PPLN crystals and four-wave mixing in microstructured fibre. As a benefit, we show how this approach also provided us with a high-quality source of single photon and we report on a fast and simple method we developed to characterize the desired suppression of multiphotons events.

* This work is being supported by NSERC, General Dynamics Canada, iCORE, AAET, CFI, NATEQ, AIF.

MO-POS-3

Atom Trapping Laboratory For Upper Level Undergraduates*, **C. Mok**, S. Winter, B. Barrett, V. Popovici, R. Berthiaume, M. Aggarwal, M.F Yachoua, A. Kumarakrishnan, *York University* — We have developed a comprehensive two-semester laboratory course dedicated to laser cooling and trapping of neutral atoms. The course is accessible to upper level undergraduate students in physics, applied physics, biophysics and engineering physics as well as incoming graduate students. In the first semester, students are introduced to eleven experiments dedicated to topics such as laser spectroscopy, laser frequency stabilization, optical detectors, electro-optic and acousto-optic devices, optical fibres, RF and digital electronics, vacuum systems, data acquisition and data analysis. In the second semester, students carry out atom trapping and preliminary investigations of the properties of laser-cooled atoms based on the expertise acquired in the first semester. We present an overview of experiments and give details related to the construction of home-built diode lasers and tapered amplifiers that can reduce the cost of course development.

We acknowledge the role of graduate teaching assistants M. Weel, S. Beattie, I. Chan, E. Rotberg and undergraduate students A. Vorozcovs, S. Chudasama, D. Gosset, and K. Sowka who developed different components of this course.

* The course was developed as a result of a gift from Optech Inc. and matching funds from the Faculty of Science.

MO-POS-4

An Automated System for Laser Frequency Stabilization Using Digital Feedback*, **Andrew Vorozcovs**, Vlad Popovici, A. Kumarakrishnan, *York University* — We have developed a compact, digitally controlled system to automatically stabilize the frequency of an external cavity diode laser to an atomic resonance. The key component of the system is a low-cost single-board computer with A/D and D/A capability that acts as a specialized lock-in amplifier. The system performs pattern matching between Doppler-free peaks obtained by scanning the laser frequency and reference peaks stored in the processor's memory. The incoming spectral signals are compared with the reference waveforms using a sliding correlation algorithm, which determines the control voltage required for adjusting the laser frequency to the desired lock point. The system has a scan amplitude of less than 1MHz when locked and it can re-lock for frequency drifts up to 10 GHz without human intervention. A useful option is that the scan control can be transferred from the laser to an acousto-optical device in a side arm if the scan range decreases below 100 MHz, so that the primary laser beam is not frequency modulated. The performance of the system is suitable for experiments in atom trapping that require long-term laser frequency stabilization.

* This work is being supported by CFI, OIT, NSERC, OCE and York University

MO-POS-5 **(G)**

Strong-field ionization of diatomic molecules with few-cycle laser pulses*, **Zi Jian Long**, *University of Waterloo* — We study the dynamics of strong field ionization of diatomic molecules by few-cycle laser pulses theoretically using the Strong Field Approximation (SFA). We focus on the high-laser-intensity low-frequency region where the compact analytical PPT-ADK formula, based on tunneling consideration, has been shown to be very useful in predicting atomic ionization rates. Our goal is to study the applicability of such tunneling formula for the molecular case. For an ultra short laser pulse, we consider the effects of the pulse envelope shape and carrier envelope phase on the ionization process. A comparison between results obtained from the analytical tunneling formula and numerical calculation of the SFA rates will be carried out. We will also study the interesting phenomenon of ionization enhancement at critical internuclear separations. Finally, we hope to modify the SFA so that the Coulomb effect is included.

* This work is being supported by NSERC

MO-POS-6

A Microwave 'Quantum' Power Standard, **A. Michaud**, D.C. Paulusse, C. Prévost, *National Research Council* — The performance of a new type of microwave power standard is presented. A laser cooled sample of rubidium is prepared in a standard magneto-optical trap, then dropped inside a RF rectangular transmission line. As the atoms exit on the bottom side of the waveguide, the internal states of the atoms are probed by a resonant laser beam. The amplitude of the RF field is kept constant and its frequency is resonant with the hyperfine transition. The very long interaction time and small velocity distribution allows a very precise measurement of the Rabi frequency for the interaction, and the incident power is determined from the dimensions of the waveguide and field distribution. Power levels measured with this instrument are compared with the ones from the common micro calorimeter.

MO-POS-7

Laser Spectroscopy of Small Lanthanide-containing Molecules: Recent Results*, **Damien Forthomme**, Colan Linton, Aaron Granger, Allan Adam, Dennis Tokaryk, *University of New Brunswick* — The investigation of the laser spectroscopy of small molecules containing lanthanide metals has been an ongoing project in our laboratory for many years. We report here some of our recent work which will include rotational analysis of some new transitions in several isotopologues of samarium monoxide (SmO). A search for transitions in samarium monosulphide (SmS) and other molecules has been conducted and the results of these experiments will be reported.

* This work is being supported by NSERC

MO-POS-8 **(G*)**

High Resolution Laser Spectroscopy of Transition Metal Monophosphides*, **Aaron Granger** [1], Allan Adam [1], Walter Balfour [2], Colan Linton [3], Dennis Tokaryk [3], Damien Forthomme [3], Michael Slaney [1], Laura Downie [1], [1] *University of New Brunswick, Dept. of Chemistry and Centre for Lasers, Atomic and Molecular Sciences*, [2] University of Victoria, [3] University of New Brunswick, Dept. of Physics and Centre for Lasers, Atomic, and Molecular Sciences — High resolution rotationally resolved spectra of selected transition metal monophosphides were obtained by laser induced fluorescence (LIF) spectroscopy in the visible region. These diatomic molecules were produced in a pulsed jet apparatus by laser ablation of an appropriate transition metal rod and subsequent reaction with PH_3 doped in helium carrier gas. The molecules were excited using both cw ring dye lasers and pulsed dye lasers. Ground state vibrational information was obtained by dispersed fluorescence experiments while upper state vibrational information was garnered from upper state vibrational progressions. The rotationally resolved spectra have allowed the electronic states to be characterized. Both excited and ground state molecular constants will be given for VP, IrP, CrP, and RhP and comparisons between the molecules will be made.

* This work is being supported by University of New Brunswick, NSERC

MO-POS-9

Dissociative Excitation of H_2S by Electron Impact*, **Stephen J. Brotton**, Wladek Kedzierski, J. William McConkey, *University of Windsor* — Vacuum ultraviolet emissions following electron-impact dissociative excitation of H_2S have been studied over the wavelength range of 90-170 nm for electron energies from threshold up to 300 eV. A crossed gas-electron beam system is used coupled to a Seya-Namioka, 0.5m monochromator with a CsI-coated channel electron multiplier as the detector. Calibrated spectral data are presented at specific electron energies. Absolute calibration of the dominant H, Lyman-α emission cross section is accomplished by comparison with the same emission obtained when using a H_2 target under identical excitation conditions. Excitation functions of all the major features will be presented with particular emphasis on the near threshold region.

* This work is being supported by NSERC

MO-POS-10 **(G*)**

Global fit analysis including hot band $\nu_9 + \nu_4 - \nu_4$ of disilane*, **Leila Borvayeh** [1], Nasser Moazzen- Ahmadi [1], V.-M. Horneman [2], [1] *University of Calgary*, [2] University of Oulu — The lowest frequency perpendicular fundamental band ν_9 of disilane occurs near 370 cm^{-1}.The first torsional hot band $\nu_9 + \nu_4 - \nu_4$ occurs in the same region; neither can be analyzed as an isolated band, since both are embedded in the torsional bath of the ground vibrational state. We have carried out a four-band analysis, which includes transitions from the far-infrared torsional bands, ν_4, $2\nu_4$-ν_4, $3\nu_4$-$2\nu_4$, two perturbation allowed rotational series from the overtone band $3\nu_4$ with transitions restricted to $-21 \leq k\Delta k \leq 21$ in the ν_9 fundamental band and $\nu_9 + \nu_4 - \nu_4$ band with transitions restricted to $-15 \leq k\Delta k \leq 15$. The main interest is in the hot band here reported for first time. An excellent fit to the included data was obtained. Two interactions are identified, a resonant Coriolis interaction between the ν_9 torsional stacks and that of the ground vibrational state (gs), a similar interaction between $\nu_9 + \nu_4 - \nu_4$ and that of the ground vibrational state (gs), and a Fermi interaction between the ν_3 fundamental and the gs. In this talk, I will present the results of the analysis and the effect of the two interactions on the fit.

* This work is being supported by University of Calgary & NSERC

MO-POS-11

Collisional effects on methane lineshapes in fundamental bands*, **Adriana Predoi-Cross** [1], Mary Ann H. Smith [2], D. Chris Benner [3], V. Malathy Devi [3], [1] *University of Lethbridge*, [2] NASA Langley Research Center, USA, [3] The College of William and Mary, Williamsburg, USA — Accurate values for line positions, absolute line intensities, self-broadened half width and self-induced pressure shift coefficients have been measured for allowed and forbidden transitions in the ν_2 and ν_4 bands of methane. Temperature dependences of half width and pressure shift coefficients were also determined for several transitions. The spectra used in this study were recorded at temperatures between 210 and 314 K at the Kitt Peak National Solar Observatory. Line mixing coefficients were determined for a number of A-, E-, and F-species transition pairs in several J manifolds of the P- and R-branches using the off-diagonal relaxation matrix element formalism. The measured half width and pressure-induced shift coefficients,

their temperature dependences and line mixing parameters are compared to results available in the literature to demonstrate the importance of considering line shape effects in the spectrum of methane for measurements in Earth's atmosphere using satellite remote sensing.

* This work is being supported by NSERC, NASA's AURA Validation and Outer Planets Research Programs

MO-POS-12

Temperature dependence of air-broadened half width and pressure shift coefficients in the 30012 → 00001 band of carbon dioxide*, **Adriana Predoi-Cross** [1], Robert McKellar [2], V. Malathy Devi [3], D. Chris Benner [3], Linda R. Brown [4], Chip Miller [4], Robert Toth [4], [1] University of Lethbridge, [2] Steacie Institute for Molecular Sciences, National Research Council of Canada, [3] The College of William and Mary, Williamsburg, USA, [4] Jet Propulsion Laboratory, California Institute of Technology, USA — For atmospheric applications, the temperature dependence of half width and shift coefficients is required on a line-by-line basis. In this study, transitions of carbon dioxide in the 30012 ← 00001 band broadened by air were recorded with two different Fourier Transform Spectrometers (a Bomem in Ottawa and the McMath-Pierce FTS in Arizona) using dilute mixtures at temperatures between 215 K and 296 K. These data were analyzed using a multispectrum fit technique applying a Speed Dependent Voigt line shape model with line mixing. The positions and intensities of the spectral lines were constrained to conform to the appropriate quantum mechanical relationships while retrieving the temperature dependences of air-induced pressure broadening and pressure shifts. Line mixing via the relaxation matrix has also been obtained. Results will be compared to values from other studies available in the literature.

* This work is being supported by NSERC, US National Aeronautics and Space Administration

MO-POS-13

Comparison of lineshape models on CO-Xe lines at 349 K*, **Adriana Predoi-Cross** [1], Francois Rohart [2], Daniel Hurtmans [3], [1] *University of Lethbridge*, [2] Universite de Lille, France, [3] Université Libre de Bruxelles, Brussels, Belgium — We present a lineshape analysis on the P(2) and P(7) transitions of CO broadened by Xe in the fundamental band. The spectra were recorded at 349 K using a difference frequency laser spectrometer. We obtained information on the influence of Dicke narrowing and line mixing effects . Several models for implementation of speed-dependent effects are discussed. We have tested the validity of calculating the narrowing parameters using the mass-diffusion or the optical diffusion constants and compared them with experimental narrowing parameters.

* This work is being supported by NSERC, CNRS

[MO-POS] ATMOSPHERIC AND SPACE PHYSICS / *PHYSIQUE DE L'ATMOSPHÈRE ET DE L'ESPACE* — Monday / *Lundi*

MO-POS-14 **(G*)**

Validation of Polar Sunrise 2008 Lidar Water Vapor Measurements from Eureka, Nunavut*, **Andrea Moss** [1], Robert Sica [1], Strawbridge Kevin [2], Walker Kaley [3], [1] *Department of Physics and Astronomy, University of Western Ontario*, [2] Science and Technology Branch, Environment Canada, Centre for Atmospheric Research Experiments, [3] Department of Physics, University of Toronto — Water vapor is an important part of the atmosphere due to its roles in the hydrological cycle and greenhouse heating. It is the largest contributor to the greenhouse effect and is responsible for about 60% of greenhouse heating (while carbon dioxide is responsible for only 26%). The stratospheric ozone lidar located at the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Nunavut is jointly operated by the Canadian Network for Detection of Atmospheric Change (CANDAC) and Environment Canada. It has recently been upgraded to measure water vapor in the troposphere and stratosphere. In concert with the ozone measurements the water vapor measurements will allow incidents of stratosphere-troposphere exchange to be measured, in addition to temperature and gravity wave parameters. This lidar uses a Lumonics Excimer 600 XeCl laser with a power of 40-50 W at 308 nm as its transmitter and a 1.0 m Newtonian telescope as a receiver. A new filter was installed on the receiver optics of the system last year with the high out-of-band blocking characteristics necessary for these measurements. Water vapor measurements are currently being taken and analyzed. The measurements will be validated through a comparison to water vapor data from regular radiosonde launches at Eureka, Nunavut as well as measurements from overpasses by the Arctic Chemistry Experiment (ACE) satellite during the Canadian Arctic ACE Validation Campaign in February and March 2008. Successful validation of the lidar measurements will allow scientific studies to begin with the coincident measurements from the suite of CANDAC instruments at PEARL.

* This work is being supported by National Sciences and Engineering Research Council of Canada, Canadian Network for the Detection of Atmospheric Change, Canadian Space Agency, Environment Canada

[MO-POS] CONDENSED MATTER AND MATERIALS PHYSICS / *PHYSIQUE DE LA MATIÈRE CONDENSÉE ET MATÉRIAUX* — Monday / *Lundi*

MO-POS-15 **(G*)**

Frequency-dependent viscoelasticity investigated by atomic force microscopy*, **Nan Yang**, John R. de Bruyn, Jeffrey L. Hutter, *University of Western Ontario* — We demonstrate a new technique for investigating the viscoelastic properties of soft materials using the atomic force microscope (AFM). A small oscillatory voltage (with RMS amplitude of ~ 0.1V) was added to the deflection signal of the AFM, causing a vertical sample motion. Monitoring the amplitude and phase of this response allows viscoelastic properties to be recorded during contact imaging. We tested this technique on poly(vinyl alcohol) (PVA) hydrogels and suspended PVA nanofibers. We found that the elastic modulus obtained from this technique matches that from traditional static methods. When the frequency increases, the mechanical moduli of both the PVA fibers (1–10 GPa) and the hydrogels (0.01–0.1 MPa) increase. For the PVA hydrogel, the storage modulus dominates the mechanical response at low frequency while the loss modulus dominates at high frequency.

* This work is being supported by NSERC

MO-POS-16

Monte Carlo Study of Maghemite Nanoparticles*, **Kenneth Adebayo**, Byron Southern, *University of Manitoba* — Monte Carlo methods are used to study the magnetic properties of γ-Fe_2O_3 nanoparticles. The properties of nanoparticles are strongly influenced by their finite size since the majority of the magnetic sites are found on the surface where the coordination number is reduced. The temperature dependence of the saturation magnetization, coercivity and exchange bias loop shift are calculated for various values of exchange coupling between the nanoparticle core and surface spins. The results are compared to recent measurements of the superparamagnetic properties of maghemite nanoparticle dispersions.

* This work is being supported by NSERC

MO-POS-17

Effect of substrate temperature on the optical and morphological properties of zirconium oxide deposited by DC reactive magnetron sputtering*, **Jean Desforges**, Tahar Ben-Messaoud, Martin Leblanc, Serge Gauvin, *Universite de Moncton* — Zirconium oxide (ZrO_2) has highly attractive optical properties such as low absorption of light, high refractive index, high transparency over a wide spectral range and high pulsed laser damage threshold. For this reason, ZrO_2 films are widely used in the optical and electronic industries. However, the properties of these films depend highly on the deposition method used as well as the deposition conditions (substrate nature and temperature, deposition rate and so on). In this work, we investigate the effect of substrate temperature on the optical and morphological properties of ZrO_2 thin films deposited by DC reactive magnetron sputtering. We show that, for this specific deposition method and for deposition on standard glass substrates, ZrO_2 thin films are best synthesized at 200K in order to meet optimum optical properties.

* This work is being supported by NSERC, FINB, FESR (UdM)

MO-POS-18 (G)

Computational Models of Complex Microstructures of Amphihilic Diblock Copolymers in Dilute Solution*, **Jesse Boer**, Apichart Linhananta, *Lakehead University* — The formation of micelles and vesicles in dilute solutions of amphihilic diblock copolymers are investigated by the real-space self-consistent field theory (SCFT) in two dimensions and by a Monte-Carlo lattice model in three dimensions. The real-space SCFT method produced rodlike and spherelike micelles and vesicles. It is found that the shapes of the microstructures are determined by the initial conditions in the SCFT algorithms, and that, in general, vesicles have lower free energy than micelles. In contrast, in the Monte Carlo simulation of the lattice model, it is found that as the volume fraction of copolymer increases, the microstructure go from spherelike micelles to rodlike micelles to vesicles and, at sufficiently high fraction, to the lamellar phase.

* This work is being supported by NSERC

MO-POS-19 (G)

Carbon nanostructures as catalyst support for PEM fuel cells: Porosity study. **Rosa Beig Agha**, Sadesh Kumar Natarajan, Jean Hamelin, *Université du Québec à Trois-Rivières* — We present a detailed procedure of carbon nanostructures synthesis to be used as catalyst support for polymer electrolyte membrane fuel cells (PEMFCs) [1,2]. The fabrication process is two-staged: first, ball milling of carbon graphite in the presence of hydrogen and transition metals (Fe, Co), followed by heating of the milled carbon initially in an argon atmosphere. The milling induces amorphous forms of carbon and metal, as well as C-H bonds. During the second stage, the production of methane by catalytic reaction of the bonded carbon and hydrogen is first observed, followed by the formation of metallic nanocrystals, and finally the formation of carbon structures on the metallic nanocrystals at a temperature of 700 °C. Subsequently, metals are nanoparticles are removed from the as-prepared sample. The effect of the carbon porosity (including micro and meso pores) is important in a PEMFC. They have to be optimize in order to maximize the power generated by the PEMFC. The size of the micro pores is important to prevent electrode flooding and the size of the meso pores is important for catalyst dispersion. The purpose of our research is to find what parameters affect the carbon pore volumes. Material characterization results obtained by XRD, SEM, TEM, TGA, AAS and liquid nitrogen adsorption isotherms are presented.

MO-POS-20

Molecular Beam Epitaxy Growth of GaAs1-xBix*, **X. Lu**, D. Beaton, M. Whitwick, T. Tiedje, *University of British Columbia* — Bismuth incorporation into GaAs to form the $GaAs_{1-x}Bi_x$ alloy produces a large reduction in the bandgap (7x greater than In, 4x greater than Sb) with a lattice strain that is only about 50% larger than the strain associated with indium. In addition, as the heaviest non-radioactive element, Bi has a large spin-orbit coupling which makes $GaAs_{1-x}Bi_x$ an interesting material for spintronic devices. Because of the strong tendency for Bi to surface segregate at high temperature, significant incorporation only occurs at low growth temperatures (~300 °C) and low As fluxes. The low growth temperature means that pseudomorphic layers can be obtained that are significantly thicker than predicted by equilibrium models for strain relaxation. Remarkably, for these anomalous growth conditions compared with usual GaAs growth, we find that the photoluminescence remains strong at least up to 5% Bi concentration. We report on the growth of $GaAs_{1-x}Bi_x$ epilayers by molecular beam epitaxy, with Bi concentrations as high as 10%. The Bi incorporation efficiency has been studied by high-resolution x-ray diffraction as a function of growth temperature (270-360 °C), growth rate (1-15 nm/min), and Bi and As fluxes. A key issue is the prevention of Bi droplet formation on the surface. A semi-empirical model for bismuth incorporation is proposed that describes the experimental observations.

* This work is being supported by NSERC and Zecotek Medical Systems

MO-POS-21 (G)

Ab Initio Studies of Silicon as a Negative Electrode Material for Lithium-Ion Batteries*, **Vincent Chevrier**, Josef Zwanziger, Jeff Dahn, *Dalhousie University* — Silicon has emerged as an excellent candidate as a negative electrode material for Li-ion batteries over the last several years. It offers excellent specific capacity, volumetric energy density, and safety compared to graphite, the common commercial negative electrode material. When Li is added to Si in an electrochemical cell at room temperature, the Si becomes amorphous *a*-Li_xSi and subsequently crystalline $Li_{15}Si_4$. When Li is removed from $Li_{15}Si_4$ the formed Li_xSi is amorphous again [1, 2]. However, if lithiation occurs in molten LiCl at 415 °C, the measured potential-composition profile displays plateaus at compositions matching each of the four binary phases of the Li-Si equilibrium phase diagram: $Li_{12}Si_7$, Li_7Si_3, $Li_{13}Si_4$, $Li_{22}Si_5$ [3]. Density functional theory (DFT) total energy calculations, using various pseudopotentials, were performed for each of the Li-Si equilibrium phases as well as for the $Li_{15}Si_4$ phase. The energies obtained from these calculations were then used to obtain a potential-composition curve for Li/Li_xSi cells. The calculated potential-composition curve correctly reproduces experimental results obtained at high temperature with an average absolute error of 16 mV. These calculations show that the DFT formalism accurately models the electrochemical properties of Li-Si alloys demonstrating its applicability for calculating the potential versus composition curve of Li/Li_xSi electrochemical cells at high temperature. Preliminary results of an incremental lithiation of Si cells at room temperature will also be presented. These yield insight into the structural changes occurring in Li_xSi during lithiation.

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* This work is being supported by NSERC and 3M

MO-POS-22

Pinning of Irradiation-induced Dislocations in Nanostructured Oxide Dispersed (Cr, Al) Ferritic Alloy Steels. **Satyen Baindur** — *Oxide dispersion strengthened steels* (ODSS), which contain dispersions of Y, Ti, Cr, and/or Al nanostructured particles within a ferritic matrix, have excited great interest recently in view of their exceptional high temperature irradiation creep resistance. These alloy steels have been experimentally studied in ambient conditions of high temperature, pressure and irradiating neutron flux. They are today viewed as promising candidates for *cladding materials (fuel sheaths)* under extreme conditions of high temperature and radiation dose, not only in Generation-IV fission reactors, but also future fast neutron spectrum reactors and fusion reactors. The nanostructured oxide particles within the microstructure of these steels are thought to contribute to (i) strong dislocation pinning, arising from lattice mismatches between the dispersed species and the matrix, leading to greater alloy strength (ii) lower rates of phase decomposition, leading to slower aging embrittlement and (iii) suppression of corrosion through preferential formation of homogeneous oxides of Al and Cr instead of Fe. Radiation damage being an inherently multiscale process, Multiscale Simulation Modeling (MSM) is intended to uncover the physical basis and predict the temperature and composition dependence of these phenomena. Some of the alloy materials, e.g. Cr and Al, have opposite effects on different desirable characteristics, so the interplay of species and composition with property correlations is particularly important to understand. Our effort ties together experimental data and known material property correlations with the simulation results both at a given length scale and between different scales. Preliminary simulation results will be presented.

MO-POS-23 (G*)

Colossal magnetoresistive manganite multilayers: for better or for worse*, **Jonathan Laverdière**, Serge Jandl, Patrick Fournier, Mangala P. Singh, Kim Truong, *Université de Sherbrooke* — $RE_{1-x}D_xMnO_3$ (RE = Rare Earths, D = Divalent) manganite compounds are well known for their colossal magnetoresistance (CMR) observed in a wide range of doping. The largest CMR is reported in antiferromagnetic insulators in which Mn^{3+} and Mn^{4+} order spatially at low temperature. In sufficiently high magnetic field, this charge order "melts" yielding a metallic state. Correspondingly, magnetoresistance ratio can then exceed 10^8 %, fairly out of range of any other materials. However, controlling the magnitude of the melting field (over 20T in single crystals) is still a major problem for applications. Generally, charge order appears when the material is dominated by electron-phonon coupling, via the so-called Jahn-Teller distortion. However, manganites become ferromagnetic and metallic if the double exchange prevails. Hence, we address the following question: which mechanism will be dominant at the interface between a charge ordered insulator and a ferromagnetic metallic manganite? Can we use proximity effect to control colossal magnetoresistance? Bilayer thin films of $Nd_{0.5}Ca_{0.5}MnO_3$ (charge ordered) and $Nd_{0.67}Sr_{0.33}MnO_3$ (ferromagnetic metallic) have been grown on $SrTiO_3$ substrate by pulsed laser ablation. In this communication, we present Raman scattering, electrical transport and magnetization measurements recorded on several samples with different thicknesses. Persistence of charge ordering in the vicinity of a ferromagnetic layer is observed and various scenarios are discussed.

* This work is being supported by NSERC, FQRNT, FCI, CIFAR

MO-POS-24 (G*)

Field-theoretical modeling of magnetic materials*, **Niloufar Faghihi** [1], Mikko Haataja [2], Ken Elder [3], Nikolas Provatas [4], Mikko Karttunen [1], [1] *University of Western Ontario*, [2] Princeton University, [3] Oakland University, Rochester (MI), [4] McMaster University — The so-called phase-field crystal (PFC) model has recently gained a lot of attention in materials modeling. One of its strengths is that it can model phenomena at atomic lengths, i.e., microscopic length scales, yet the integration of fast degrees of freedom yields diffusive time scales. Here, we present an extension of the PFC model to magnetic materials which can be used to fine-tune materials properties by application of external fields. Main Reference: K. R. Elder and M. Grant, *Modeling elastic and plastic deformations in nonequilibrium processing using phase field crystals*, Phys. Rev. E **70** 051605 (2004).

* This work is being supported by NSERC

MO-POS-25

Pure and saturated red asymmetric microcavity Organic Light Emitting Diode doped with an osmium phosphorescent compound*, **Christophe Py** [1], Chien-Cheng Kuo [2], Daniel Poitras [1], Hiroshi Fukutani [1], Ye Tao [1], Yungliang Tung [3], Yun Chi [3], [1] *National Research Council of Canada*, [2] National Central University Taiwan, [3] National Tsing Hua UniversityTaiwan — Organic Light Emitting Diodes (OLED) displays have entered the commercial realm as credible competitors to Liquid Crystal Displays (LCDs) in the flat panel display market. A potentially lower cost fabrication process is attractive, but OLEDs also need better performance, such as a higher power efficiency and better optical properties, to surmount the enormous technological lead of LCDs. In particular, emission color can be readily tuned in OLEDs thanks to the great variety of materials properties offered by organic synthesis [1]. The use of phosphorescent dyes, which allows the harvesting of triplets excitons from luminescent hosts, can result in very high quantum efficiency OLEDs [2]. Osmium phosphorescent compounds have been shown to produce efficient red emission in OLEDs [3], one of which, referred to as Os2, has CIE (Commission Internationale de l'Eclairage) color coordinates very close to the NTSC (National Television Standard Committee) standard red. However, the emission spectrum of this compound is still too broad for a fully saturated red. We report here on the design and fabrication of a microcavity Os2-doped OLED with a substantially narrower emission spectrum. The microcavity is limited by the highly reflective metallic cathode of the OLED, and a distributed Bragg reflector coupled with a semi-transparent metal on the anode side.

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* This work is being supported by National Research Council of Canada

MO-POS-26

Depth Profiling of Polymer Films with GISAXS*, **Marsha Singh**, Michael Groves, *Queen's University* — Surfaces and interfaces play a significant role in determining the static and dynamic properties of copolymer materials. Much of the experimental work directed towards characterization of nanoscale self-assembly processes in bulk copolymers is based on small angle x-ray scattering (SAXS) methods. Grazing incidence small angle x-ray scattering (GISAXS), the surface-sensitive analogue of SAXS, is a rapidly maturing technique that has proven to be of great utility in the study of material surfaces at length scales ranging from about 1 to 100 nm. A recently proposed numerical inversion algorithm is shown to be capable of resolving depth-specific scattering information from GISAXS profiles, giving access to in-plane scattering data on nanometer length scales at varying depths below the sample surface. No a priori assumptions about the form of the depth-dependent scattering are necessary for the decomposition process. The proposed analysis technique is applied to simulated data on ideal multilayer systems and to GISAXS data from a spin-coated copolymer-copolymer blend where the individual copolymers exhibit macrophase separation in the bulk. The goal of this work is the development of a non-destructive, in-situ probe of the complicated phase diagrams exhibited by copolymer systems when the effects of surfaces and interfaces are incorporated.

* This work is being supported by NSERC

MO-POS-27 **(G*)**

Theoretical studies for optimization of Bio-mimetic polymer membranes and polymersomes*, **S.R.C. Murthy Ganti**, Russell B. Thompson, *University of Waterloo* — Polymersomes are self-assembled amphiphilic block copolymer vesicles in solvent, similar to lipid vesicles. Many of the properties of polymer vesicles are similar to lipid vesicles, but polymersomes often have higher thermal and mechanical stability. We are using block copolymer self-consistent field theory to investigate the structural stability of diblock copolymer bilayer membranes under different circumstances. Just as proteins can stabilize lipid bilayer membranes, we are interested in whether nano-particle inclusions in block copolymer membranes can stabilize the structures of polymersomes or add functionality to these vesicles.

* This work is being supported by NSERC,University of Waterloo

MO-POS-28

Fractal Hierarchy in Isotopic Positional Correlations. **Alexander Berezin**, *McMaster University* — From subatomic particles to superclusters of galaxies, nature has nested hierarchial fractal-like organization (R.L. Oldershaw). Earlier I discussed formation of isotopic superlattices due to self organizational dynamics among isotopes (A.A. Berezin, in Design and Nature II, WIT Press, UK, 2004). Informationally (in spirit of "Maxwell's demon" engine), formation of isotopic superlattices can be inferred from Maximum Entropy Principle (C.E. Shannon, E.T. Jaynes). In spite that effects of gravitation for isotopes (due to their nuclear mass difference) are very small, they can, nevertheless, manifest in such subtle effects as gravitationally-induced reduction (collapse) of wave functions (F. Karolyhazy, R. Penrose, A.A. Berezin). Since Planck mass (which is combination of h, G and c) is about 0.02 mg, size of desired isotopic fluctuation should be about 100 mkm (mesoscipic). Due to isotopic mass difference, distribution of isotopes at microscale (e.g., isotopic clusters) can affect dynamics of quantum gravitational collapse. Experimentally, isotopic correlations, micron and submillimeter isotopic fluctuations, isotopic clusters and isotopic fractal-type distribution can be probed by Rayleigh scattering (sampling at various wavelengths) and/or such high electric field effects as non-Ohmic hopping conductivity in which isotopic clusters act as trapping or scattering centers. Other aspects of purposeful isotopic structuring (isotopic engineering) include isotopic fiber optics when core and cladding has varied (step or gradual) isotopic content which causes total internal reflection and light confinement. Isotopically uniform clusters can lead to better entanglement and longer decoherency times (e.g., for localized phonon states) which may offer options for phonon-based quantum computing.

MO-POS-29 **(G*)**

Understanding the high pressure bonding properties of hydrogen*, **Isaac Tamblyn**, Stanimir Bonev, *Dalhousie University* — Although molecular hydrogen can be considered to be the simplest diatomic system, its behaviour at high pressure and temperature is not well understood. In particular, there has been considerable effort, both experimentally and theoretically, to describe the transition from a molecular to non-molecular fluid. Whether it is a first or second order phase transition is a fundamental question, the resolution of which is also expected to have significant implications in fields such as planetary science. We have preformed first-principles molecular dynamics simulations where we have artificially constrained the structure of liquid hydrogen in order to gain physical insight for the changes of the effective inter-atomic potentials with pressure and temperature. Additionally, we have preformed gas phase simulations that indicate a fundamental difference between molecular-molecular and molecular-atomic interactions. Finally, the structure of the compressed liquid is examined and related to the processes of molecular dissociation.

* This work is being supported by NSERC

MO-POS-30 **(G*)**

The ball-milling optimization of Mg_6Pd with iron to understand the activation phenomenon. **Julien Lang** [1], Jacques Huot [1], André Yonkeu [2], [1] *Institut de Recherche sur l'Hydrogène - Université du Québec a Trois-Rivières*, [2] Canadian Neutron Beam Center, Chalk River Laboratories — Metal hydrides usually need a certain activation time before any hydrogen absorption is possible. The activation phenomenon is presently not quite understood. To understand the activation mechanism, we selected Mg_6Pd alloy synthesized by mechanical alloying. The alloy was synthesized by ball-milling a stoichiometric mixture of magnesium and palladium. After 10 hours of milling, the intermetallic Mg_6Pd was formed. At 300°C and under 2000kPa of hydrogen this alloy takes more than 19 hours to fully absorb hydrogen. We found that when a certain amount of iron is added to the ball milled alloy and this mixture is further milled, the activation period is drastically reduced. As iron doesn't form alloys with magnesium the hydrogenation reactions do not suffer from this addition of iron in Mg_6Pd alloy. In this communication, we will report the optimum milling time and iron content for the shortest activation time. X-ray powder diffraction, thermodynamic analysis and electron microscopy were used to elucidate the role of iron in the activation process of Mg_6Pd.

MO-POS-98

Collapse of cavities in two-dimensional granular media*, Simon J. de Vet, **John R. de Bruyn**, University of Western Ontario — We experimentally study the collapse under gravity of a rectangular cavity in a two-dimensional granular bed. The cavity is viewed from the side with a high speed video camera. We digitally extract the profile of the free surface as a function of time, and use particle image velocimetry to determine the velocity field within the granular medium during the collapse process. For wide enough cavities, the two sides of the cavity collapse independently, and the process is the same as for two isolated steps (the granular dam-break problem). For narrower holes, however, the two granular flows from the two sides of the collapsing cavity collide and the dynamics changes significantly. When the flows meet, they rapidly lose kinetic energy and the evolution of the free surface slows. We model this system using the Saint Venant equations with basal friction and recover the key features observed experimentally.

* This work is being supported by NSERC

MO-POS-99

Manganites : matériaux exotiques destinés aux technologies du futur. Jonathan Vermette, Université de Sherbrooke — Cette présentation met en contexte les propriétés physiques exotiques de la grande famille des manganites qui est divisés en deux groupes. Le premier est bien connu pour sa perte de résistivité électrique lors de la transition de phase de l'état paramagnétique à ferromagnétique, ainsi que pour la possibilité de lui donner une magnétorésistance négative colossale. Le deuxième groupe possède la caractéristique d'être à la fois ferroélectrique et antiferromagnétique en dessous de la température de Néel, rendant ainsi possible le couplage entre l'ordre électrique et magnétique. La stoechiométrie de ces deux groupes de manganites est identique et le seul paramètre qui détermine la structure naturelle de ces cristaux est la taille des atomes de terre rare qui les composent. En fait, les terres rares de grand et petit rayons forment respectivement les manganites de structure orthorhombique et hexagonale. Ainsi, cette seule différence engendre deux cristaux totalement différents, aussi bien dans leur structure que dans leurs propriétés physiques.

[MO-POS] INDUSTRIAL AND APPLIED PHYSICS / PHYSIQUE INDUSTRIELLE ET APPLIQUÉE — Monday / Lundi

MO-POS-31

Study of Sn-Co-C Alloys as an Anode Material for Lithium-Ion Batteries Prepared by Mechanical Attriting. **Pierre Philippe Ferguson**, J.R. Dahn, *Dalhousie University* — Rechargeable lithium-ion batteries are used in almost all portable electronics. Since their introduction in 1991, graphite has been the negative electrode material of choice. Improvements over the years have been made to reach the theoretical specific capacity of graphite (372 mAh/g). However, a higher specific capacity is needed to create cells having higher energy density to ultimately power electric vehicles. Materials such as tin can alloy with lithium and have specific capacities as high as 993 mAh/g. However, this material has a poor discharge-charge cycle life due to the volume expansion that occurs upon alloying with lithium. Alloying tin with an inactive material can limit the overall volume expansion and improve cycle life. An industrially scaleable method to prepare nanostructured electrode materials is mechanical attrition. This method relies on collisions between media (usually steel balls) and powders of reactants to produce alloys. A vertical-axis attritor was used to prepare nanostructured Sn30Co30C40 electrode material. Nanostructured materials, which expand and contract uniformly when alloying with lithium, are known to obtain long cycle life. Materials prepared by this technique were characterized by X-ray diffraction (XRD), Mössbauer Effect spectroscopy and by electrochemical tests. Electrochemical testing of Sn30Co30C40 electrodes made from attrited materials showed stable charge-discharge capacity for more than 100 cycles. The attrited material attained a specific capacity near 470 mAh/g which is lower than the expected value of 701 mAh/g. The reasons for differences in attained specific capacity will be discussed.

MO-POS-32

Study of heat and mass transfer during the hydrogen loading/unloading of a metal hydride bed*. **Maha Bhouri**, Jacques Goyette, *Institut de recherche sur l'hydrogène* — Several research activities are focused on the development of proton exchange membrane fuel cell (PEMFC). In fact, due to their high power density and environmentally interesting proprieties, they are suitable for both mobile and portable applications. However, we are far from commercialisation breakthrough if we not find a practical and an efficient mean of storing hydrogen. Metal hydrides are a promising way of storing hydrogen. These compounds are formed through the reversible reactions of some pure metals or metallic alloys with hydrogen and can release or absorb hydrogen when necessary. The construction of efficient metal hydride hydrogen reservoirs will need a thorough understanding of the heat and mass transfer processes involved during the reversible reaction between hydrogen and a metal alloy forming hydride. We have therefore developed a phenomenological model of the absorption and desorption of hydrogen in a metal hydride reservoir. Both absorption and desorption can be described with a set of coupled partial differential equations. These equation sets were studied numerically with finite element software. The results of our simulations show that the behaviour of the temperature of the metal hydride bed and the rate of filling of a reservoir reproduces what is observed experimentally. This confirms both the general soundness of our model and the exactness of our computation.

* This work is being supported by NRCAN

MO-POS-33

Ultrasonic monitoring of cure process of the structural adhesives with matching filtration of the acoustic signals at gelation point of reaction. **Fedar Severin**, Ina Seviaryna, Elena Maeva, *University of Windsor* — Structural adhesives become more popular in automotive, aerospace and marine industries as a part of assembling process. The development of new bonding technologies shows necessity for effective non-destructive quality assessment of the joints. Conditions of the adhesive cure process play very important role in quality assessment of the adhesive joints. During cure, epoxy-based structural adhesive transforms from a liquid state into the highly cross-linked solid. It is known that cure degree of the adhesives correlates with adhesion strength, which is critical for structural adhesives. In this work, process of the adhesive hardening at different temperatures was characterized by pulse acoustic techniques. Evolution of the material's acoustic and elastic properties (attenuation, sound velocity, density, and elastic moduli) during cure reaction was monitored in relation to the substantial physical and chemical changes of the material. At the gelation point of the chemical reaction when polymer network is formed, acoustic attenuation highly increases. To improve system resolution, obtained data were digitally processed with using matching filtration technique. This significantly improves signal detection at highly adsorbing stages of cure process. It is demonstrated that cure degree obtained by acoustic method is in good correlation with adhesive strength determined by tensile test.

MO-POS-34 (G*)

Nondestructive Diagnostics of Paintings with Infrared Techniques. **Dmitry Gavrilov** [1], Elena Maeva [1], Oleg Grube [2], Clemente Ibarra-Castanedo [3], Xavier Maldague [3], Roman Gr. Maev [1], [1] University of Windsor, [2] Gallery Sixtyeight Auctions, Toronto, [3] Université Laval — Nowadays the problem of forgery in artwork becomes more and more acute with the raise of technologies and experience of paintings copiers. Art fraud reaches new levels and now even for an experienced expert it is sometimes not an easy problem to distinguish between genuine and faked paintings made of almost the same materials and sharing the same manner of drawing. Fighting art fraud is an important task – both from cultural and financial points of view. The second problem is the restoration of damaged and/or old paintings. Handling very old paintings requires an experience in restoration and a good knowledge about the region and origins of damage – such as delaminations, weakening of ground, cleavages, etc. It is evident that both the problems require a professional scientific examination to be performed. We face the necessity of developing of modern scientific procedures to successful and reliable detection of art fakery and collecting necessary information on damages on art pre-restoration process. Here we discuss three infrared-based methods for art inspection – near infrared reflectography, thermography and the method of pulsed phase thermography (PPT).Using several original paintings and simulated models we show these methods as reliable for both art inspection and restoration purposes. With the aid of these techniques it is possible to detect altered parts of paintings, previously restored areas, hidden underdrawings, the author's sketches on the ground layer as well as delaminations, areas of different paint thicknesses and other defects.

[MO-POS] INSTRUMENTATION AND MEASUREMENT PHYSICS / PHYSIQUE DES INSTRUMENTS ET MESURES — Monday / Lundi

MO-POS-35

Pushing the envelope: MRI of Materials with SPRITE*, **Igor Mastikhin**, Bryce MacMillan, Florin Marica, Ben Newling, Bruce Balcom, *University of New Brunswick* — Magnetic Resonance Imaging (MRI) is probably the most powerful and flexible diagnostic imaging technique available to clinical medicine. Its invention in the early 1970s has generated a multibillion dollar a year industry and permitted unparalleled and detailed diagnosis of a variety of human ailments. Nevertheless, traditional MRI as employed clinically, usually to visualize local water content, is unable to image relatively immobile ^{1}H containing tissues and structures *in vivo*. Immobile nuclei, with consequently short signal lifetimes, are the norm in most materials. The promise of MRI in material science – an ability to observe and quantify structure and dynamics evolv-

ing non-invasively as a function of treatment, processing, use or conditioning has been frustrated by the inability of traditional MRI techniques to observe the very short-lived magnetic resonance signals typically encountered. The UNB MRI Centre has invented a family of new MRI methods (which we generically term SPRITE[1]), which permit the ready visualization of mobile and immobile ^{1}H containing structures not only *in vivo*, but in a large range of materials including concrete, polymers, composites, gases, food materials as well as porous and microporous solids. In this poster we discuss the latest developments in SPRITE imaging, with applications to food science, advanced oil recovery, turbulent gas flow modeling, and portable MRI. These advances have opened entirely new vistas in material science research. The UNB MRI Centre is supported by an NSERC MRS award and is interested in making these techniques generally available to the Canadian research community.

1. B.J. Balcom, *et al.*, J. Mag. Res., A123, 131-134 (1996).

* This work is being supported by NSERC

MO-POS-36

Unilateral Nuclear Magnetic Resonance: design and applications*, **Igor Mastikhin**, Andrew Marble, Oleg Petrov, Bruce Colpitts, Bruce Balcom, *University of New Brunswick* — Nuclear magnetic resonance (NMR) is a powerful technique employed in scientific laboratories worldwide to non-invasively obtain information on the composition, structure, and mobility of a sample. Because of associated sample size constraints, and high hardware costs, NMR has traditionally been limited to laboratory research. Smaller, desktop permanent magnet-based systems exist, but are restricted to even smaller samples. A promising approach is single-sided or unilateral MR, for which there is no restriction on the sample size: a specially designed magnet array is applied to the sample so that the NMR signal is generated in the stray magnetic field outside of the magnet. The UNB MRI Centre has developed an approach that has allowed us to build a family of portable NMR devices with well-controlled magnetic field homogeneity and a large sensitive volume [1]. In one design, the sensitive volume size is maximized for rapid measurements of relaxation times [2]. In several others [3,4], a linear gradient allows 1D-profiling, velocity and diffusion measurements. In an exciting recent development, a unilateral magnet with magnetic field homogeneity on the scale of desktop NMR analyzers has been developed. Instead of looking for an application suitable for our unilateral instruments, we can build unilateral MRI instruments tailored to the demands of a particular project.

1. A.E. Marble, I.V. Mastikhin, B.G. Colpitts, and B.J. Balcom, JMR, 174 (2005) 78-87.
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* This work is being supported by NSERC

[MO-POS] MEDICAL AND BIOLOGICAL PHYSICS / *PHYSIQUE MÉDICALE ET BIOLOGIQUE* — Monday / *Lundi*

MO-POS-37 **(G*)**

Taking Control of the Bacterial Flagellar Motor of Escherichia coli*, **Mathieu Gauthier**, Dany Truchon, Simon Rainville, *Université Laval* — Motility is critical for most living cells. The bacterium *Escherichia coli* (*E. coli*), like many other bacteria, swims in its aqueous environment using long helical filaments driven at their base by a rotary motor called the bacterial flagellar motor. With a diameter of 45 nm, this system is a nanotechnological marvel that is remarkably sophisticated but of manageable complexity. Much is known about the flagellar motor, but many questions remain open and the study of this system is a very active and exciting area of current research. Because it is imbedded in the multiple layers of the bacterial membrane, it has not been studied in vitro like many other linear biological motors. Our goal is therefore to develop an in vitro system that will provide the essential control over experimental parameters to achieve the precise study of the flagellar motor's physical and chemical characteristics. Our system consists of a filamentous *E. coli* bacterium partly introduced inside a glass micropipette. Femtosecond laser pulses (60 fs and ~ 15 nJ/pulse) are then tightly-focused on the part of the bacterium that is located inside the micropipette using a 1.3 NA microscope objective. This vaporizes a submicrometer-sized hole in the wall of the bacterium. We have demonstrated that this grants us access to the inside of the cell and the control over the proton-motive force which powers the motor. Finally, we are also developing novel approaches to precisely monitor the rotation speed of a working flagellar motor outside the micropipette using nanoparticles.

* This work is being supported by CRNSG, FQRNT, COPL, Université Laval

MO-POS-38 **(G*)**

Tomographie par cohérence optique dans le domaine spatial*, **Luc Langevin** [1], David Gay [2], Michel Piché [1], [1] *Centre d'Optique Photonique et Laser*, [2] Institut National d'Optique — La tomographie par cohérence optique (OCT) est une technique d'imagerie non invasive apparût en 1991 et permettant l'observation de tissus biologiques à des profondeurs de l'ordre du millimètre avec des résolutions de l'ordre de quelques micromètres. Dans le montage standard d'OCT dans le domaine temporel, une source lumineuse à large bande spectrale est utilisée avec un interféromètre de Michelson ou l'un des miroirs est remplacé par l'échantillon étudié (qui est transversalement déplacé de façon mécanique durant la prise de données) et l'autre vibre axialement. En analysant le signal temporel à la sortie, une coupe tomographique à haute résolution de l'échantillon peut être obtenue. Beaucoup de nouveaux montages d'OCT ont été proposés depuis 1991 afin d'améliorer la vitesse d'acquisition des données. L'invention des montages dans le domaine de Fourier a notamment permis d'éliminer la nécessité de déplacer un miroir mécaniquement pour obtenir l'information axial de l'échantillon. Ici nous proposons deux nouveaux montages ayant cette même capacité en plus de ne nécessiter aucun traitement numérique du signal. Comme ces deux montages sont tels que l'information sur la structure axiale de l'échantillon se retrouve linéairement distribuée en différent point de l'espace sur une figure d'interférence, nous leur avons donné le nom de montage d'OCT dans le domaine spatial (SD-OCT). Les montages de SD-OCT utilisent un miroir incliné dans un interféromètre de Michelson pour produire une figure d'interférence qui est imagée sur une caméra CCD. La figure contient toute l'information sur l'échantillon et est obtenue sans mouvement mécanique ou traitement numérique du signal. Afin de démontrer le bon fonctionnement et les performances de ces nouveaux montages, deux prototypes ont été construit dans les laboratoires du COPL à l'Université Laval et des échantillons biologiques tels que pelure d'oignon, phloème d'arbre et œil de bœuf y ont été placé afin d'en faire l'imagerie tomographiques. La comparaison de certains résultats obtenus avec ceux fournit par un montage commercial utilisé avec le même échantillon a notamment confirmé la capacité de nos prototypes à imager correctement un échantillon biologique.

* This work is being supported by CRSNG

MO-POS-39 **(G*)**

Spatially Resolved Oxygen Sensing Based On Frequency Domain Phosphorescence Lifetime Detection. **Benjamin Lai**, Lothar Lilge, *Department of Medical Biophysics, University of Toronto, Toronto* — A Fiber-optic oxygen sensing system, based on triplet oxygen ($^3O_2$) mediated phosphorescence lifetime (ô) quenching, is being developed. The system contains of a fiber-optic probe with different phosphorescent sensors embedded along its length. Sensors are made of phosphorescent metalloporphyrin compounds emitting phosphorescence at different wavelengths, thus permitting spatially resolved detection of ($^3O_2$) via a single optical fiber. Four candidate sensors have been

identified all with strong absorption near 405nm and phosphorescence emission maxima at 667nm, 680nm, 698nm and 700nm, respectively. The dependence of τ on $^3O_2$ concentration is described by the Stern-Volmer relationship as being inverse linear proportional. Determination of τ, hence $^3O_2$concentration, is accomplished in the frequency domain by using an amplitude modulated excitation source to induce phosphorescence from the probe's sensors. The detected emission signal is equal to the sum of each individual sensor emission. A grating is used to spatially separate the emission spectrum before it is detected by a 32-channel Photomultiplier Tube (PMT) array. The τ's of each sensor are recovered by performing global non-linear least squares fit [1] on each of the 32 PMT signals by looking at the measured phase and modulation index over a range of modulation frequencies. With the τ of each sensor known, the oxygen concentration at the sensor's location can be determined by the Stern-Volmer relationship.

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MO-POS-40 (U*)

Low-Frequency Diffuse Reflectance for Medical Diagnostics. **Johannes Schleusener**, William Lo, Kevin Parry, Lothar Lilge, *Division of Biophysics and Bioimaging, Ontario Cancer Institute* — It is known, that various components of the human tissue absorb light of discrete wavelengths to a varying amounts, Standard continuous wave reflectance spectroscopy applied on the skin is used to detect the different dominant chromophores within human tissue such as haemoglobins, water and lipids. However, detection of minor amounts of other chromophores is not possible. By using low frequency modulated light, we propose to extract additional information about other chromophores through the exploitations of known temporal biorhythmic processes within the tissue, such as the conversion from NAD to NADH. This project focuses on the use of modulated light of 7 wavelengths in the red and infrared spectrum (635nm, 685nm, 780nm, 808nm, 850nm, 904nm and 980nm). The modulation is provided by an FPGA board, under control of a Graphical User Interface. A laser driver controller board was designed to provide each of the 7 laser drivers with the appropriate current between the lasing threshold and a maximum limit. The output of all laser diodes is coupled into a single 1mm fibre, leading to the tissue surface. Detector fibres, located in two concentric circles around the light source fibre direct the diffuse reflected light to photodiodes equipped with bandpass filters selecting only one laser wavelength. Each wavelength will be detected at two distances from the source. The current from the photodiodes is inverted to a voltage and provided to a D/A converter and fed into a FPGA board. A FFT algorithm is applied to eliminate noise and the demodulation of each wavelength determined and converted into an attenuation. Initial in vivo measurements are currently initiated.

MO-POS-41 (U*)

Decoupling Absorption and Scattering Information in Transillumination Spectroscopy. **Bastian Braeuer**, Mark L. Gurari, Maxim V. Lostchenov, *Division of Biophysics and Bioimaging, Ontario Cancer Institute* — Transillumination Breast Spectroscopy is an alternative method to X-ray mammography tissue density for Cancer Risk determination. The correlation is purely heuristic and further understanding of the information content embedded in the transillumination spectra requires decoupling of the absorption and Scattering information contained therein. To achieve decoupling we propose using the Kramers-Kronig (K-K) relation for separating the imaginary and real parts of the dielectric permeability constant of tissue for further analysis in the diffusion theory model. To establish a relationship between the tissue's scattering and absorption coefficients and the averaged dielectric permeability characteristics, an energy density equation is derived. For verification of the derived diffusion model for the determination of the effective attenuation coefficients (μ_{eff}) experiments were executed in identical phantom pairs with different thicknesses. The phantoms are based on Intralipid 1.25% v/v used as light scatterers and absorbers. Optodes, acting as source and detector were submerged into the centre of the phantom pointing towards one another, with interoptode distances varied from 1, 2, 3 and 4 cm. On the basis of the derived relationship the scattering and absorption coefficients of the phantoms were calculation and compared to the known true values at 633nm. The uncertainty of the derived μ_{eff} using our diffusion model was below 1%. The K-K application converged for a K-K integral of approximately nm. Decoupling of the scattering and absorption coefficients is possible with almost negligible loss in spectral bandwidth. Decoupling of scattering and absorption coefficients provide the first step in identifying particular chromophores which contributed to the risk assessment information.

MO-POS-42 (U*)

Influence of branching points on forward and backward action potential propagation in thalamocortical neuron*, **Reza Zomorrodi Moghaddam**, Helmut Kroger, Igor Timofeev, *Laval University* — Modeling studies have indicated that the geometry of the dendritic tree plays a key role in controlling the extent of the action potential backpropagation (AP-BP). Recent electrophysiological data distinguish attenuation in proximal from distal dendrites in thalamocortical (TC) neurons. The multi-branched structure of thalamocortical (TC) neuron dendrites allows direct investigation of the role of dendritic branch points in the control of AP-BP. The failure of action potential invasion into parts of a multi-branched dendritic tree may have important functional consequence. For example, AP-BP may invade some areas of the dendritic tree resetting synaptic integration but fail to influence activity in other dendrites. We investigated dendritic structure of seven TC cells from adult cat in VPL nucleus and performed modeling experiments. To determine how this specific behavior at bifurcation points in TC neuron influence forward and back propagations, we developed a multi compartment model for an artificial cell with 22 bifurcation points obeying Rall's power law with different exponents numbers; n=1.2, 1.5, 2. The model of the TC neuron contained fast Na^+/K^+ currents inserted in the soma, T-current and h-current distributed in the dendrites with higher density in proximal dendrites. Since, the input resistance of the cell was decreasing with increase in Rall's power from 1.2 to 2, we changed the leak conductance to obtain the same input resistance for adequate comparison of results. Simulation results on the artificial cell show the following behavior: attenuation of AP-BP and somatic response to a distal synaptic input has inverse and direct relation to the exponential number in the Rall's law, respectively. These results suggest that independent of channel type and density, different attenuation of AP-BP is related to the Rall's law at bifurcation points. Our simulation for a reconstructed TC neuron shows: (a) There are different attenuation factors for proximal and distal dendrites in agreement with experimental data. (b) According to a bigger value of the exponent number in Rall's law in distal dendrites than in proximal ones, a generated postsynaptic potential at distal dendrite can reach the soma with little attenuation in amplitude. We conclude that inputs arriving at distal dendrites of TC cell would have stronger influence than it was previously thought.

* This work is being supported by NSERC

MO-POS-43 (U*)

Determination of radiation dose by electron paramagnetic resonance (EPR) for various natural and man-made materials. **Ibrahim Abu Atiya**, Jeroen Thompson, Douglas Boreham, *McMaster University* — Response by public agencies to radiological incidents–such as potential terrorist attacks or radiation accidents–requires knowledge of the radiation dose. In any given radiological incident, it is unlikely that a dosimeter will be available to individuals at risk. It is necessary therefore to develop protocols for the measurement of radiation dose in common natural and man-made materials. These so-called fortuitous dosimeters may be useful in targeting the response of public agencies and in screening populations for treatment requirements (i.e., triage). Electron paramagnetic resonance (EPR) is used to identify radiation-induced paramagnetic defects in several common natural and man-made materials. The radiation-sensitive signals are presented, and the process by which the signals are characterized is discussed. Potential applications include forensic and retrospective dosimetry. Finally, we discuss the possibility of screening individuals for treatment following a radiological incident.

MO-POS-44 (G*)

Anthropomorphic Brain phantom for Ultrasound Thermal Heating*, **Jose Martinez**, Boguslaw Jarosz, *Carleton University* — Several technologies that use ultrasound for heating the brain have emerged in the last decade. Replicas or thermal brain phantoms are crucial in order to find the clinical protocols for the technology. Such phantoms not only need to have the acoustic and thermal properties that match the brain but also must include major brain arteries. In this work an anthropomorphic brain phantom

made of a gel (11% of bovine gelatin powder by mass of ethylene glycol) is presented. The gel has both acoustic and thermal properties comparable to the brain. The amplitude attenuation coefficient at 1MHz, 1.6 MHz and 2.5 MHz were (62 ± 1) dB/m, (115 ± 4) dB/m and (175 ± 9) dB/m, respectively. The mass density and the acoustic speed of that sample gave at room temperature (~24 °C) (1038 ± 11) kg/m^3 and (1540 ± 18) m/s, respectively. The thermal conductivity was determined to be (0.544 + 0.072) W/m/K. These results compared favourably with the literature and they fall within the values recommended for tissue mimicking material of a thermal phantom. Typically stereolithography (SAL) technique is used to reproduce in great details 3D anatomic models. In this work is also presented an inexpensive methodology for casting 3D brain models and inclusion of major brain arteries that can be reproduced by any research lab. The three dimensional reconstruction of the MRI scan gathered from the anthropomorphic brain phantom showed high spatial resolution suitable for building brain thermal models or for quality insurance of the MRA.

* This work is being supported by NSERC

MO-POS-45 (G*)

Analytical Model of the Transient Bioheat Transfer Equation for Cylindrical or Tubular Heating Devices. **Jose Martinez**, Boguslaw Jarosz, *Carleton University* — A major problem in thermal therapy research is to determine the optimal heating techniques for specific types of treatment. The assessment of the existing heating technologies relies on the prediction of both spatial and temporal distribution of temperature rise *in vivo* tissue or in adequate tissue mimicking materials (TMM). The spatial distribution of the temperature rise has been studied extensively by number of authors, however only few studies address the temporal dependence. The boundary value problem of the Bioheat Transfer Equation (BHTE) for cylindrical or tubular heating device is solved. A close expression for the temperature elevation dependent on both the average volumetric specific absorption rate (SAR^v) and the thermal diffusivity of the TMM is obtained. This analytical solution was experimentally corroborated and allowed to make an indirect estimation of the thermal diffusivity of the TMM as well to predict the SAR^v deposited by a single Interstitial Ultrasound Waveguide Applicator (IUWA). The model could become an invaluable assessment tool for the quality assurance of the Interstitial Ultrasound Waveguide Applicator.

MO-POS-46 (G)

Influence of mechanosensitive channels on the mechanical properties of native E. coli and artificial membranes. **Elvis Pandzic**, Maria Kilfoil, Paul Wiseman, *McGill University* — In order to sense and respond to external mechanical stimuli, cells have evolved to incorporate mechanosensors within their plasma membranes. Many organisms share similar mechanisms of transduction of mechanical signals to electrical ones in physiological processes, such as touch and pain sensation, hearing, and blood pressure control. Mechanosensitive channels of large conductance (MscL) in E. coli cell membranes appear to confer ability to rapidly equilibrate unbalanced osmotic pressure across a membrane by inducing non-selective conduction of osmolytes. We study MscL in its native membrane environment of the bacterial cell, and in an artificial bilayer (GUV), in tandem. For the native environment, we use E. coli cells producing MscL labeled with the green fluorescent protein (GFP), and transform them into giant spheroplasts, enabling direct visualization by microscopy. For the model membrane environment, we insert purified channels into GUV membranes, where we can control the lipid composition. For both systems, we apply the micropipette aspiration technique to measure mechanical properties in the presence and absence of the MscL channel.

MO-POS-47 (G*)

Cell-Penetrating Peptides*, **Mohsen Pourmousa** [1], Michael Patra [2], Mikko Karttunen [1], [1] *Dept. of Applied Mathematics, University of Western Ontario*, [2] Dept. of Physical Chemistry, University of Lund, Sweden — Translocation of peptides through cellular membranes is a fundamental problem in drug delivery and in developing antimicrobial peptides. It is known from experiments that there are a number of very different classes of peptides that are able to penetrate membranes. It is not known, what are the physical mechanisms that facilitate the translocation. Here, we use large-scale Molecular Dynamics simulations to study the penetration of Penetratin (charged) and Transportan (uncharged) across lipid bilayers consisting of POPC and POPC/sphingosine. Our objective is to find the controlling mechanisms though a detailed analysis of different peptide-membrane interactions and free energy analysis.

* This work is being supported by University of Western Ontario

MO-POS-48 (G)

The role of the molecular environment on DNA damage induced by low energy electrons: The Effect of salt concentration*, **Ariane Dumont**, Yi Zheng, Pierre Cloutier, Darel Hunting, Léon Sanche, *Université de Sherbrooke* — When ionizing radiation (i.e., primary high-energy particles or other fast charged particles generated by the primaries) propagates through a biological medium, a large number of ions, free radicals and secondary electrons are produced with kinetic energies distributed mostly from 0 to about 100 eV. These low-energy electrons (LEEs) carry most of the energy from the primaries and deposit their kinetic energy within short ranges in the biological medium by producing electronic excitations, ionizations, and temporary anions, before being thermalized or solvated. To improve radiotherapy, it is necessary to understand how these LEEs interact with the major cellular target (i.e., DNA). Many studies have already described different processes by which LEEs induce DNA damage. However, the effect of salt on the reaction of LEE with DNA and its components was not constant throughout these experiments. Thus, it is important to determine the effect of salts on the formation of LEE-induced DNA damage. To answer this question, 5-monolayer films of plasmid DNA with varying amounts of Tris-EDTA between 0 and 256 molecules/ nucleotide, were deposited on clean tantalum substrates and exposed to LEEs between 1 and 100eV. The degradation products were then analyze by gel electrophoresis, which separates the plasmid DNA into its different forms, and allows one to quantify the yield of different strand breaks as a function of the LEE exposure. From the percentage of single and double strand breaks induced by LEEs, we report that salt protects DNA from the effects of LEE-induced damage.

* This work is being supported by IRSC et Université de Sherbrooke

MO-POS-49 (G)

Effects of Terminal Phosphate on LEE Induced DNA Damage*, **Zejun Li**, Yi Zheng, Pierre Cloutier, J. Richard Wagner, Léon Sanche — The biological effects of ionizing radiation may be attributed to the reaction of water radiolysis products (hydroxyl radicals, solvated electrons, H-atoms), the reaction of radical ions resulting from the direct ionization of macromolecules, and the reaction of secondary low-energy electrons (LEE; < 30 eV). Previously, we demonstrated that the bombardment of DNA with electrons of 5-20 eV induced the formation of single and double-strand breaks in supercoiled plasmid DNA [1]. Recent research on the interaction of LEE with oligonucleotide tetramers (e.g., GCAT) indicated that LEE efficiently induces *N*-glycosidic bond cleavage (base release) and phosphodiester C–O bond cleavage (strand breaks) via a resonance process known as dissociative electron attachment (DEA) [2]. The phosphate group may play an important role in LEE-induced damage in view of the very high cross-section (10^{-15} cm^2) for the reaction of LEE (7 to 12 eV) with NaH_2PO_4 leading to fragmentation of the phosphate group [3]. For this reason, we investigated the effect of terminal phosphate groups on LEE-induced *N*-glycosidic and phosphodiester bond cleavage for a series of small DNA segments containing thymine (dThd, pT, Tp, pTp, TpT, pTpT, TpTp, pTpTp). The samples were irradiated by electrons with energies ranging from 3 to 15 eV. The mixture of radiation products was subsequently analyzed by HPLC/UV. In comparison with nonirradiated samples, HPLC analysis revealed the formation of several products including thymine and fragments containing a terminal phosphate resulting from C–O bond cleavage of the phosphoester bond. The formation of products as a function of electron energy showed a broad resonance centered near 9-11 eV for all of the above target molecules, which is consistent with the formation of "core-excited" transient anions located near this energy. The addition of a phosphate to the terminal positions of monomers and dimers resulted in a considerable increase (about 2-fold) in the amount of total damage. Any increase in damage due only to the addition of a phosphate group must therefore arise from the direct attachment of electrons to the phosphate group. Thus, the results show that the terminal phosphate group directly and efficiently captures electrons and that these events lead to considerable chemical modifications. In sharp contrast, the addition of terminal phosphate(s) to monomers and dimers resulted in a marked decrease in base release, and to a lesser extent, in phosphodiester C–O bond cleavage. For example, the addition of one phos-

phate group lowered base release by 2~3-fold, whereas the second phosphate group lowered it by another 4~5 fold. These results suggest that the direct capture of LEE by phosphate groups does not contribute to base release and phosphodiester cleavage; in other words, the resulting transient anions of phosphate do not undergo electron transfer to either the base or sugar moiety in such a way as to induce C–O bond cleavage. In support of previous work, and theoretical studies, the electron appears to first attach to the base and then it either breaks the *N*-glycosidic bond or transfers to the P=O pi* orbital of the phosphate group, which leads to scission of the sugar-phosphate C–O bond [4,5].

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MO-POS-50

A Physical Mechanism for the Combined Action of Chemotherapeutic Agents and Radiation in Cancer Therapy*, **Zejun Li**, Yi Zheng, Darel Hunting, Patrick Ayotte, Leon Sanche, *University of Sherbrooke* — Among the different strategies to improve the treatment of cancer, combining chemotherapeutic drugs with radiation has met with considerable success [1,2]. In many clinical trials, it has been shown that the concomitant administration of both modalities increases the survival rate of cancer patients over those who received randomized treatments. In the case of the chemotherapeutic agent cisplatin, it has been proposed that the immediate species created by the radiation in cells cause additional damage when cisplatin is covalently bonded to DNA [3]. In order to investigate the details of this super additive phenomenon, solid films of plasmid DNA with and without cisplatin bonded to guanine were bombarded with electrons of 1, 10, 100 and 60,000 eV. The electron-induced damage was analysed by electrophoresis. The results showed that the presence of cisplatin increased single and double strand breaks by factors varying from 1.3 to 4.4. Analysis of the data obtained at all energies, leads to the conclusion that when a cisplatin-DNA complex is irradiated by high energy particles, capture of secondary low energy electrons (LEE) at the site of cisplatin, followed by rupture of the backbone, is increased by orders of magnitude. The increase in ionization cross section due to the presence of Pt atoms probably also contributes to this huge increase in local damage, mostly by increasing the quantity of LEE near cisplatin. This mechanism of increase in DNA bond dissociation triggered by the formation of transient anions may lie at the basis of the efficiency of concomitant cisplatin-radiation therapy.

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MO-POS-51

Local viscoelasticity of the surfaces of individual Gram-negative bacterial cells measured using atomic force microscopy*, **John Dutcher**, Virginia Vadillo-Rodriguez, Terry Beveridge, *University of Guelph* — The cell wall of Gram-negative bacteria performs many important biological functions: it plays a structural role, it allows the selective movement of molecules across itself, and it allows for growth and division. These functions not only suggest that the cell wall is dynamic, but that its mechanical properties are very important. We have used a novel, AFM-based approach to probe the mechanical properties of single bacterial cells by applying a constant compressive force to the cell under physiological conditions while measuring the time-dependent displacement (creep) of the AFM tip due to the viscoelastic properties of the cell. For these experiments, we chose a representative Gram-negative bacterium, *P. aeruginosa* PAO1, and we used AFM tips of different size and geometry. We find that the cell response is well described by a three element mechanical model with an effective cell spring constant k and an effective time constant t for the creep motion. Adding glutaraldehyde, which increases the covalent bonding of the cell surface, produced a significant increase in k and a significant decrease in t.

* This work is being supported by AFMnet, NSERC, CRC

MO-POS-52

Système du Québécium. Pourquoi avons-nous 56 phalanges et 4 membres? Regard d'un physicien platonicien sur l'évolution biologique*, **Pierre Demers**, *Québécium* — Je cherche une réponse dans un parallèle entre le squelette humain et le tableau du québécium appliqué aux 120 éléments chimiques. Ce tableau est une grille de 120 cases organisées en 4 strates inégales. Il convient à la classification des atomes pour des raisons quantiques et géométriques. Il définit les nombres magiques 4, 20, 56, 64 et 120. Or le squelette des membres renferme : 4 membres, 20 doigts et orteils, 56 phalanges et 120 os au total. La coïncidence serait-elle purement fortuite? Ou serait-elle la conséquence d'une loi de la nature que le système du québécium exprime? Cette dernière hypothèse viendrait à l'appui de Owen 1849 et de son platonicisme, de Denton 2002 avec ses reploiements des protéines, de Staune 2007 qui s'oppose au Darwinisme. Travaux financés par Entreprise Pierre Demers Voyez http://www.er.uqam.ca/nobel/c3410/QbPlaEvoAtoXI2007bis.htm

* This work is being supported by Enteprise Pierre Demers

[MO-POS] NUCLEAR PHYSICS / PHYSIQUE NUCLÉAIRE — Monday / Lundi

MO-POS-53 (G*)

Study of Astrophysically Important Resonant States in ^{30}S by the ^{32}S(p,t) Reaction*, **Kiana Setoodehnia** [1], Alan A. Chen [1], Jason Clark [2], Catherine Deibel [2], Peter Parker [2], Christopher Wrede [2], [1] *McMaster University*, [2] Wright Nuclear Structure Laboratory, Yale University — The nova nucleosynthetic paths can be inferred by better understanding the details of nova explosions. The Si isotopic ratios in presolar grains of nova origins provide us with information about the nature of the underlying white dwarf and the peak temperatures achieved during the outburst. In order to measure the Si isotopic abundances in presolar grains, it is crucial to know the rates of the thermonuclear reactions which affect the Si production and destruction in novae. One such reaction is the ^{29}P(p,γ)^{30}S, whose rate is still quite uncertain, and depends significantly on the level structure of the compound nucleus, i.e. ^{30}S. ^{30}S is located in the beginning of the rp-process reaction path, and its level structure is yet not well understood. It is known that at nova temperatures, the ^{29}P(p,γ)^{30}S reaction rate is dominated by low-energy 3^+ and 2^+ resonances above the proton threshold in ^{30}S. These two states have only been observed recently in experiments which were separately carried out by Bardayan *et al.* at the ORNL Holifield Radioactive Ion Beam Facility and by Galaviz *et al.* at NSCL in 2007. In November 2007, we have carried out an experiment at Yale university to study the ^{30}S structure via the ^{32}S(p,t)^{30}S reaction using a high resolution measurement. In this work we provide a description of the experimental setup for the latter experiment. Our analysis indicates that we have observed these two new states. We will present our results and compare them with the results of those other groups.

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MO-POS-54

Étude des signaux de transition de phase dans les noyaux*, **René Roy**, Francis Gagnon-Moisan, Marie-France Rivet, Bernard Borderie, John Fankland, Josiane Moisan, *Université Laval* — L'étude des réactions d'ions lourds est un domaine en pleine effervescence. Depuis plusieurs années, la recherche d'une preuve expérimentale d'une transition de phase dans les noyaux est l'un des principaux objectifs de ce domaine. Afin d'y parvenir, le mutlidétecteur d'INDRA est utilisé par la collaboration internationale du même nom, depuis plusieurs années. Les expériences menées avec cet ensemble composé de chambres à ionisation, détecteurs silicium et scintillateurs CsI(Tl), au GANIL, à Caen (France) ont prouvé la fiabilité d'INDRA dans l'étude des collisions d'ions lourds. Lors des réactions centrales, il y aura composition d'une source unique formée du projectile et de la cible. Un des modes de désexcitation possible pour un système (avec une énergie d'excitation $e^* > 3$ A.MeV) est la multifragmentation. Ce processus s'apparente à une transition de phase. Différentes signatures expérimentales (thermodynamiques et dynamiques) doivent exister si le système subit une telle transition. La décomposition spinodale, signature dynamique, implique que le système sera divisé en fragments possédant une charge similaire. Il s'agit de la signature de transition de phase recherchée dans les analyses effectuées sur la 5ième campagne d'INDRA à l'IPN d'Orsay (France), dans le cadre d'une cotutelle de thèse entre l'Université Laval et l'Université Paris-Sud XI. L'étude spécifique des corrélations en charge dans les réactions $^{136}Xe+^{124}Sn$ et $^{124}Xe+^{112}Sn$ à 32 et 45 A.MeV devrait permettre de conclure définitivement sur la présence d'une décomposition spinodale, signe d'une transition de phase dans les noyaux. Les derniers résultats et analyses sont présentés.

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MO-POS-55

The phase transition from the low-lying hadronic mass spectrum gas to the Hagedorn gas and to the deconfined quark-gluon plasma*, **Ismail Zakout**, *Bethlehem University* — The thermodynamical partition function for a gas of color-singlet quark and gluon bags in $SU(N_c)$ representation is reviewed. The gas of bags is probed to study the phase transition for the nuclear matter in the extreme conditions. It is found that the hadronic density of states has the Gross-Witten critical point and exhibits a third order phase transition from a hadronic phase dominated by the discrete low-lying hadronic mass spectrum particles to another hadronic phase dominated by the Hagedorn states. The gas of low-lying hadronic mass spectrum particles undergoes a third order phase transition to a hadronic matter dominated by the Hagedorn states and then the subsequent Hagedorn phase undergoes a first order phase transition to an explosive quark-gluon plasma. The results for the quark and gluon polarizations with internal color structures are presented.

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[MO-POS] OPTICS AND PHOTONICS PHYSICS / *OPTIQUE ET PHOTONIQUE* — Monday / *Lundi*

MO-POS-56

Highly Directional Emission from Inhomogeneous Dielectric Microcavities*, **Guillaume Painchaud-April** [1], Julien Poirier [1], Samir Saïdi [2], Yves-Alain Peter [2], Etienne Brasselet [3], Louis J. Dubé [1,4], [1] *Université Laval*, [2] Ecole Polytechnique, [3] Université de Bordeaux I, [4]Université Pierre et Marie Curie, Paris — We propose a novel method of extracting light beams from 2D microcavities. The concept is based on *inhomogeneous dielectric cavities* (IDC) where the inhomogeneities arise from a space-dependent refractive index whose variations may be continuous (e.g. a localized induced gaussian profile of the index) or discontinuous (e.g. holes or refractive steps in the cavity material). Instead of the so-called asymmetric resonant cavities (ARC), which are smooth deformations of a circular cavity and produce directional output while sacrificing the quality factor Q, we intend to operate with an integrable geometry (a disk) and induce directionality through the (possibly reconfigurable) medium while preserving a high Q. The systems are interesting on two counts. Firstly, as classical objects, the IDC are equivalent to dielectric billiards (i.e. photonic escape is possible) where the broken symmetry of the material can induce a transition from regular to chaotic dynamics: chaos in an integrable billiard geometry, an almost unique combination. Secondly, guided by the classical phase space information, the wave dynamics can be "engineered" to produce highly directional emission with tailored optical properties, the grail of microcavity research. We have studied a number of configurations and will present results on their respective performances.

* This work is being supported by NSERC (Canada) and FQRNT-Equipe (Québec)

MO-POS-57

Transport Mechanisms in Dielectric Optical Microcavities*, **Guillaume Painchaud-April** [1], Julien Poirier [1], Louis J. Dubé [1,2], [1] *Université Laval*, [2] University Pierre et Marie Curie, Paris — Optical 2D microcavities have become a source of promising new technologies over the last decades. Applications ranging from high accuracy spectrometry to laser design will benefit from the development of such devices. The versatility of the concept resides in the ray-wave correspondence [1,2]: the short wavelength limit of the system exhibits properties of well-known billiard systems, which may include Hamiltonian chaos. Therefore, since the wave behaviour of an optical microcavity is influenced by the underlying phase-space structure, a study and characterization of this structure becomes important to predict where the electromagnetic energy will flow out of the cavity. Whereas the correspondence works reasonably well for regular (classically integrable) and completely chaotic systems, partially chaotic systems of mixed phase space show transport properties largely influenced by tunnelling and localization effects with the consequence that the correspondence is all but lost. We will present the results of our investigations, in the ray and wave dynamics, in order to shed some light on the collaborating influence of the different transport mechanisms.

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* This work is being supported by NSERC (Canada) and FQRNT-Equipe (Québec)

MO-POS-58 (G*)

Cavité laser étendue syntonisée de façon continue par la translation d'un réseau à période spatiale variable*, **Gilles Fortin**, Nathalie McCarthy, *COPL, Département de physique, Université Laval* — Les cavités laser étendues, comportant un laser à semi-conducteurs, une lentille et un coupleur externe, sont des sources couramment utilisées dans les télécommunications, la spectroscopie et la caractérisation de lasers et d'amplificateurs optiques. Elles sont habituellement accordées au moyen d'un réseau à période spatiale constante agissant comme coupleur externe dans la configuration de Littrow ou de Littman–Metcalf [1]. Afin d'éviter les discontinuités lors de la syntonisation sur une grande étendue de longueurs d'onde, ce réseau doit à la fois être tourné et translaté [2]. Nous présentons ici une technique d'accord continu originale, soit la simple translation d'un réseau de diffraction à période spatiale variable dans la configuration de Littrow. Cette technique nécessite la production d'un réseau particulier. L'espacement variable entre ses différentes lignes permet à la fois de changer la longueur d'onde sélectionnée et de garder constant le déphasage induit par un cycle de propagation dans la cavité lors de la translation. Avec un tel réseau, produit dans nos laboratoires, la plage expérimentale d'accord continu atteint actuellement 12 nm

autour de la longueur d'onde de 1550 nm, avec une puissance de sortie relativement constante. Cette étendue représente celle de 35 modes longitudinaux du laser à semi-conducteurs. Elle peut encore être améliorée, la configuration testée étant légèrement différente de celle pour laquelle le réseau a été produit.

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* This work is being supported by Travaux financés par le CRSNG, l'ICIP et le FQRNT

MO-POS-59 **(G*)**

Matrices ABCD d'un réseau de diffraction à lignes courbes et à période spatiale variable*, **Gilles Fortin**, Alexandre April, Nathalie McCarthy, *COPL, Département de physique, Université Laval* — Les matrices *ABCD*, ou matrices optiques, sont utiles pour décrire les propriétés paraxiales des systèmes optiques. Les premières matrices *ABCD* développées pour un réseau de diffraction à période spatiale variable (RPSV) étaient restreintes à un réseau à lignes droites [1]. Nous présentons maintenant les matrices *ABCD* tangentielle et sagittale pour un RPSV dont les lignes sont courbes. Elles sont obtenues par la comparaison du trajet optique tronqué au deuxième ordre et de la fonction iconale (la phase apparaissant dans le noyau de l'intégrale de diffraction de Fresnel–Kirchhoff) [2]. Les paramètres présents dans ces matrices sont l'ordre de diffraction, la longueur d'onde, les angles d'incidence et de diffraction, les indices de réfraction des milieux d'entrée et de sortie, les rayons de courbure tangentiel et sagittal de la surface du réseau et enfin les dérivées secondes tangentielle et sagittale de la distribution des lignes du réseau. Grâce à ces matrices, l'analyse des propriétés de focalisation des systèmes optiques comportant un RPSV à lignes courbes est systématisée. Les matrices tangentielle et sagittale comportent 2×2 éléments et sont valides lors d'une propagation orthogonale des rayons, ce qui requiert une symétrie des lignes du réseau par rapport au plan tangentiel. Lorsque cette symétrie est absente, l'analyse devient non orthogonale et le formalisme plus général des matrices comportant 4×4 éléments est requis.

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* This work is being supported by Travaux financés par le CRSNG, l'ICIP et le FQRNT.

MO-POS-60

Long-range nanograting formation inside silica glass by 1 kHz femtosecond laser and its availing to microchannel fabrication*, **Quan Sun**, Feng Liang, Réal Vallée, See Leang Chin, *Laval University* — By scanning the focus of 1 kHz femtosecond laser pulses inside silica glass, we can get long-range nanogratings. It is believed to be the first observation of femtoseond induced nanogratings inside silica glass with 1 kHz laser repetition. Although the observed nanograting here is not as regular as those observed at higher laser repetition. The formation of nanogratings is still demonstrated to be responsible for the polarization dependent microchannel fabrication by 1 kHz femtosecond with help of chemical etching. The evolution of the microchannel cross during the etching process is also discussed and a self-circle effect is observed.

* This work is being supported by NSERC, FQRNT, CFI, and CIPI

MO-POS-61 **(G*)**

Progress toward a Silicon Laser using Plasma Ion Implantation*, **Phillip Desautels**, Michael Bradley, James Mantyka, J.T. Steenkamp, *University of Saskatchewan* — There is strong interest in the fabrication of electrically pumped, silicon-compatible lasers for use in high-speed computing and telecommunications. Plasma Ion Implantation (PII) is a means to modify the surface and sub-surface properties of silicon in order to produce the luminescent medium that such a device would require. Silicon treated with PII is immersed in weak plasma and biased to a high, negative voltage; this accelerates ions into the sample and implants them beneath its surface. We applied electric current to samples treated with PII and observed visible light emission in the optical range. This poster will present a quantitative analysis of the emission spectra we obtained and comment on the feasibility of PII for producing a practical silicon laser.

* This work is being supported by NSERC, CFI

MO-POS-62

Electrochromic study and fabrication of photonic crystals to basis of WO_3, **Kamel Bouhara**, *Universite de Moncton* — Photonic band gap crystals have been an active research area since the initial predictions of Yablonovitch and John, and experiments of Yablonovitch and Gmitter. Photonic band-gap crystals are synthetic materials in which electromagnetic waves within a certain frequency range are not allowed to propagate. They have been studied because this property, known as the photonic band gap, can provide a means to control optical signals. However, to obtain a photonic band gap for optical frequencies, one must fabricate structures that are three-dimensionally periodic on an optical length scale and composed of a solid with a high refractive index. Recently, considerable efforts have been made to fabricate photonic crystals by colloidal crystal templating. The basic idea is to use a colloidal crystal as a template, infiltrate the interstitial spaces between the polystyrene spheres of the template with another material in our case is the WO_3, and then selectively remove the spheres by calcination. The WO_3 matrix was obtained through a dip-infiltrating sol-gel process. The reflection spectra show two pronounced Bragg diffraction peaks. By inserting lithium into the crystals, the first reflection peak shifts gradually toward shorter wavelength, while the second reflection peak shifts toward longer wavelength. This should be of great interest for photonic device applications.

MO-POS-63 **(G*)**

Faisceaux optiques TM et TE fortement focalisés*, **Alexandre April**, Michel Piché, COPL — Des expressions analytiques pour les composantes du champ électromagnétique de faisceaux transverses magnétiques (TM) et transverses électriques (TE) fortement focalisés, solutions exactes des équations de Maxwell, sont utiles dans plusieurs applications, notamment en microscopie de haute résolution et pour l'accélération d'électrons par des impulsions laser. Les faisceaux TM non paraxiaux peuvent être obtenus à partir d'un vecteur potentiel magnétique A (défini tel que son rotationnel vaut la densité de flux magnétique **B**) orienté le long de l'axe de propagation. Avec la condition de Lorenz, le vecteur **A** doit être proportionnel à une fonction qui est une solution exacte à l'équation d'Helmholtz. Avec les équations de Maxwell et les relations constitutives, les expressions des champs électromagnétiques peuvent être calculées analytiquement. Plus précisément, si le vecteur **A** est proportionnel à un mode de Laguerre–Gauss élégant non paraxial [1], alors les champs électromagnétiques sont ceux d'un faisceau TM, dont les composantes non nulles s'expriment comme une combinaison linéaire simple de fonctions qui font intervenir des fonctions de Bessel sphériques et des fonctions associées de Legendre d'arguments complexes. On trouve ainsi que les profils d'intensité théoriques du faisceau TM01 sont en accord avec des résultats expérimentaux [2]. Les expressions des champs électromagnétiques d'un faisceau TE peuvent être aisément déduites à partir de celles d'un faisceau TM, en exploitant le principe de dualité des champs électromagnétiques.

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* This work is being supported by CRSNG, ICIP, FQRNT

MO-POS-64 **(G*)**

Focalisation de faisceaux gaussiens sans lentille*, **Gabrielle Thériault**, Réal Tremblay, Nathalie McCarthy, *COPL, Université Laval* — La focalisation par diffraction apporte une gamme d'applications potentielles allant de la focalisation de rayons X aux effets de diffraction dans les nanostructures. Nous présentons ici les résultats de la diffraction en champ proche d'un faisceau gaussien monochromatique, avec une petite taille à l'étranglement, par une séquence d'ouvertures circulaires coaxiales et paral-

lèles. Une méthode pour concevoir des systèmes focalisants spécifiques à la longueur d'onde avec de telles séquences d'ouvertures a été développée en se basant sur les ellipsoïdes de Fresnel. Dans les recherches précédemment effectuées sur la focalisation par des ouvertures [1,2], les résultats étaient théoriques mais approximatifs ou purement expérimentaux. Les solutions numériques que nous obtenons en utilisant la transformée de Hankel quasi-discrète s'accordent remarquablement avec les résultats expérimentaux. Par exemple, pour un faisceau gaussien, on obtient que l'intensité maximale au point focal est multipliée par un facteur 12. Ces résultats corroborent à la fois la simulation numérique et l'utilisation des ellipsoïdes de Fresnel dans la conception de géométries focalisantes. Dans un avenir proche, étendre cette recherche aux faisceaux polychromatiques pourrait mener à une meilleure compréhension de l'effet des nanostructures sur les faisceaux laser cohérents, ainsi que du modelage d'impulsions par la diffraction.

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* This work is being supported by CRSNG

MO-POS-65 **(G*)**

Imagerie de haute résolution avec des faisceaux TM01. **Harold Dehez** [1], Michel Piché [1], Yves De Koninck [1,2], [1] *Université Laval, Centre d'Optique Photonique et Laser*, [2] Université Laval Robert Giffard — Nous présentons deux composants optiques transformant un faisceau gaussien en un faisceau transversal magnétique de plus petit ordre (faisceau laser TM_{01}). Si un tel faisceau est focalisé avec un objectif d'ouverture numérique supérieure à 0.9, la théorie prévoit l'apparition d'un spot focal parfaitement circulaire, de taille inférieure à celle du spot que l'on aurait obtenu avec un faisceau gaussien. On s'attend donc en intégrant ce faisceau dans un microscope de haute résolution (à deux photons, par exemple), à augmenter les performances de ce dernier. Les deux systèmes sont construits sur la base de quatre lames demi-onde placées dans une mosaïque, suivies d'une lame introduisant un déphasage de π. Le premier convertisseur de mode est un modulateur à cristaux liquides, adaptable à toute longueur d'onde. Le second est un assemblage de quatre lames demi-onde, réalisées en quartz cristallin; il est statique, mais très simple d'alignement. Ces deux systèmes ont été testés avec des lasers continus à 633 nm et 800 nm et un laser femtoseconde (150 fs) à 800 nm. À ce stade de nos expériences, nous avons intégré le convertisseur de mode dans un microscope avec excitation de fluorescence à deux photons, et nous caractérisons la résolution obtenue avec un faisceau laser TM_{01} focalisé par un objectif d'ouverture numérique 1.4 à immersion dans l'huile.

MO-POS-66 **(G*)**

Écriture de structures photoniques à l'aide de faisceaux Bessel. **Véronique Zambon**, Nathalie McCarthy, Michel Piché, *Université Laval* — Au cours de la dernière décennie, l'inscription directe de modifications d'indice dans des matériaux à l'aide de lasers femtoseconde a permis la fabrication d'une panoplie de composants photoniques tels que des guides d'onde ou des coupleurs. Ces expériences ont été réalisées en focalisant des faisceaux gaussiens à l'aide de lentilles. Les faisceaux Bessel, obtenus par la focalisation avec un axicon, constituent une alternative intéressante pour la microfabrication. Un axicon est une lentille de forme conique qui permet d'obtenir un faisceau optique dont le profil transversal du champ électrique est décrit par une fonction de Bessel d'ordre 0. Les axicons produisent des faisceaux Bessel avec une grande profondeur de champ et un lobe central étroit qui est entouré par des anneaux concentriques de moindre intensité. Nous présentons comment le lobe central étroit de faisceaux Bessel ultrarapides a été utilisé pour inscrire différents types de guides d'onde dans du verre de silice. Par la focalisation, à l'aide d'un axicon, d'impulsions femtoseconde dans du verre de silice, un changement positif d'indice de réfraction est induit le long de la ligne focale de l'axicon; cette ligne focale correspond à la distance sur laquelle le profil du faisceau Bessel est invariant (> 1 cm). Par cette technique, nous avons obtenu des guides d'onde cylindriques d'excellente qualité qui ne présentent aucune biréfringence, conséquence de la symétrie circulaire parfaite du faisceau Bessel. De plus, nous avons pu induire un changement d'indice de réfraction le long d'un mince plan en translatant l'échantillon de verre durant l'inscription.

MO-POS-67 **(G*)**

Formation de faisceaux laser avec un moment angulaire. **Bruno Roy**, Michel Piché, *COPL, Université Laval* — La lame de phase en spirale ou à vortex est un élément optique dont l'épaisseur varie linéairement selon la position azimutale. Cet élément permet d'introduire une variation de phase selon exp(-imö), où m est un entier et ö est la position azimutale. Cet élément permet de convertir un faisceau gaussien en un faisceau avec un moment angulaire. Un tel faisceau, lorsque m est non nul, possède un vortex (tourbillon) au centre. Puisque son intensité est nulle au centre, ce faisceau sert, entre autres, à manipuler des microparticules et à améliorer le contraste de microscopes. Plusieurs méthodes furent utilisées pour former un tel élément. Certains ont déposé un monomère dans un moule qui fut gravé à l'aide d'une pointe de diamant. D'autre firent plusieurs dépôts d'épaisseurs différentes pour former un escalier. La microlithographie a aussi été utilisée. Nous avons mis au point une nouvelle méthode où on effectue un dépôt d'or dans une cloche à vide en utilisant un masque en rotation. Contrairement aux autres lames qui fonctionnent par transmission, notre procédé opère en réflexion. On a aussi analysé la forme du dépôt à l'aide d'un interféromètre Zygo. Finalement, on a testé les lames de phase en spirale avec un laser visible. On a observé la conversion d'un faisceau gaussien en un faisceau avec moment angulaire, donc avec un zéro au centre. On vise utiliser ces faisceaux pour l'incription de guides d'ondes dans des verres.

MO-POS-68 **(G*)**

Dielectric-mediated field enhancement in a periodic array of gold nanoparticles*. **Seyed Mohammad Hashemi Rafsanjani**, Chitra Rangan, *University of Windsor* — We calculate the white light extinction spectrum associated with localized surface plasmon oscillations in gold nanoparticles immobilized on a surface, when coated with an organic layer. This spectrum is characterized for sensing of biomolecules. Specifically, we compute the electric field between hemispherical nanoparticles in a linear array, both without and with the organic coating. We find that the electric field between particles is enhanced when we add the coating on the particles provided the light polarization is along the inter particles axis. This dielectric-mediated field enhancement produces a distinct additional peak in the optical plasmon spectrum when one adds the coating on the particles. The results provide the potential for a new biosensing mechanism based on a periodic array of nanoparticles.

* This work is being supported by Sharcnet

MO-POS-69 **(G)**

Impulsions femtoseconde de haute puissance à 1550 nm générées par un oscillateur laser tout fibre. **Sébastien Ellyson** [1], Vincent Roy [2], Nathalie McCarthy [1], Michel Piché [1], [1] *Université Laval*, [2] Institut Nationale d'Optique — Les sources laser à synchronisation modale passive, opérées en régime d'impulsions étirées, ont largement été étudiées afin de réaliser des sources femtoseconde tout fibre. Le principe de cette méthode consiste à fusionner différents segments de fibre optique possédant un coefficient de dispersion chromatique de signe opposé. Un arrangement minutieux de ces segments de fibre procure à la cavité laser un coefficient de dispersion total légèrement positif. Ceci permet d'éviter la formation d'impulsions solitoniques dans la cavité. Ces sources sont généralement formées d'une cavité en anneau, munies d'un isolateur optique polarisé, placé entre deux contrôleurs de polarisation. La synchronisation modale est effectuée par la rotation non-linéaire de la polarisation, résultant de l'automodulation de phase et de la modulation de phase croisée. La fibre de sortie est utilisée comme compresseur des impulsions quittant la cavité. Généralement, ce type de laser produit des impulsions ayant une énergie inférieure à 1 nJ pour une cadence de 30MHz et plus. L'objectif premier de nos travaux était d'augmenter l'énergie par impulsion tout en diminuant la cadence des impulsions émises, afin de faciliter l'utilisation d'une source tout fibre lors d'applications à haute puissance. Nous avons conçu une source laser tout fibre à 1550 nm avec une cavité en anneau longue de 20 m, produisant des impulsions de 2 nJ à une cadence de 10 MHz. Nous avons observé une durée d'impulsion qui descendait jusqu'à 81 fs. Ces résultats représentent une nette amélioration par rapport aux valeurs typiques rapportées pour les oscillateurs laser fibrés dopés à l'erbium.

MO-POS-70 **(G*)**

Génération d'effets non linéaires dans une fibre optique à l'aide d'impulsions femtosecondes produites par un laser à fibre dopée à l'erbium*, **Karl-Alexandre Jahjah** [1], Louis Desbiens [2], Michel Piché [2], [1] *Université Laval*, [2] Centre d'optique photonique et laser — Les fibres optiques sont un milieu de choix pour l'étude de toutes sortes de phénomènes non linéaires car leurs propriétés de guidage permettent aisément de maintenir des intensités lumineuses importantes sur des distances qui peuvent atteindre plusieurs mètres. Cet article présente les résultats obtenus en propageant des impulsions femtosecondes puissantes à 1,55 μm dans différents types et différentes longueurs de fibres ce qui a donné lieu a plusieurs phénomènes non linéaires intéressants. Notre groupe a mis au point un puissant système laser femtoseconde constitué d'une source laser à fibre dopée à l'erbium et de deux amplificateurs de puissance disposés selon une configuration « amplification par dérive de fréquences ». Cette source nous permet de générer des impulsions d'une durée de 400 fs avec une énergie dépassant 0,4 μJ et un taux de répétition de 2,4 Mhz. Avec ce laser et une simple fibre SMF-28, on peut facilement créer un supercontinuum très large s'étendant du visible à l'infrarouge moyen ($\lambda > 2\mu m$). Nous avons étudié la dépendance spectrale du supercontinuum envers la puissance injectée et la longueur de la fibre, Nous avons également identifié des phénomènes résonnants dans la partie visible du spectre qui peuvent être liés à une génération de troisième harmonique. Nous comparerons les résultats obtenus dans différents types de fibres (SMF-28, fibres dopées, fibre à dispersion modifiée, fibres de chalcogénure, etc.). Finalement, nous présentons des résultats qui indiquent possiblement de l'absorption multiphotonique dans une fibre dopée à l'ytterbium.

* This work is being supported by Centre d'optique photonique et laser, CRSNG

MO-POS-71 **(G)**

Génération de seconde harmonique dans des milieux anisotropes par la composante longitudinale de faisceaux laser vectoriels*, **Pierre-Yves Fortin**, Michel Piché, *Centre d'optique, photonique et laser (COPL)* — On considère la propagation de faisceaux laser vectoriels fortement focalisés dans certaines directions privilégiées à l'intérieur de cristaux anisotropes et non-linéaires appropriés. Ceci permet de mettre à profit le champ électrique longitudinal de faisceaux du type transverse magnétique pour exciter des composantes du tenseur non-linéaire qui, autrement, auraient un effet négligeable avec un faisceau paraxial. On caractérise le rendement de conversion en seconde harmonique et la qualité optique du faisceau obtenu pour quelques cristaux en fonction de la focalisation du faisceau de pompage. Même si la condition d'accord de phase n'est pas pleinement satisfaite pour la propagation selon ces directions privilégiées, on montre dans quelle mesure ces propriétés sont maintenues pour un volume d'interaction non-linéaire restreint.

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MO-POS-72

Improving composite polymer films for photovoltaic applications*, Yanfei Ding, **Qiying Chen**, *Memorial University of Newfoundland* — Polymer photovoltaic materials have received considerable attention in recent years for their applications in solar cells as a new technology for sustainable energy. However, further research is needed to increase the efficiency of polymer photovoltaic devices in which the selection of suitable photovoltaic materials and the optimization of the material properties are the most important tasks. In this talk, we investigate bulk-heterojunction photovoltaic devices consisting of (poly[2-methoxy,5-(2-ethylhexoxy)-1,4-phenylene vinylene]) (MEHPPV) as a donor and [6,6]-phenyl-C61-butyric acid methyl ester (PCBM) as an acceptor. In order to achieve an efficient photo-induced charge transfer, we will discuss the following aspects: (1) Selection of suitable solvent to obtain good morphology of the films and optimal absorption spectrum; (2) Determination of the donor/acceptor composition ratio that yields good film interface and high photon absorption; (3) Thermal annealing process to enhance the photon absorption, improve the short circuit current and the filling factor, and therefore the efficiency of the devices. It has been found that the absorbance of the film increases gradually with thermal annealing up to a temperature of 150°C. The morphologies of the films before and after thermal annealing at different temperatures have been observed by atomic force microscopy (AFM), which indicates that the largest roughness occurs at 150°C for 30 minutes. The corresponding optical constants (refractive index and extinction coefficient) of the MEHPPV/PCBM films have been revealed by ellipsometry. The current-voltage characteristics of the MEHPPV/PCBM photovoltaic cells will also be discussed.

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MO-POS-73 **(G*)**

Strain and temperature discrimination using a high-birefringence fiber loop mirror and a fiber Bragg grating*, **Da-Peng Zhou**, Li Wei, Wing-Ki Liu, John W.Y. Lit, *University of Waterloo* — There has been considerable interest in developing methods which enable optical fibers to measure strain and temperature simultaneously. These fiber-optic sensors are usually made by detecting two physical parameters which have different sensitivities to temperature and strain. Considerable efforts have been made on strain and temperature discrimination with fiber Bragg gratings, such as using two superimposed fiber Bragg gratings, the combination of a fiber Bragg grating with a section of multi-mode fiber, and so on. On the other hand, high-birefringence fiber loop mirror is also a very attractive device for use in optical sensing to measure strain and temperature. In this work, we present a new all-fiber sensor capable of simultaneous measurement of temperature and strain, based on a fiber Bragg grating combined with a high-birefringence fiber loop mirror that acts as a Mach-Zehnder interferometer for temperature and strain discrimination. Because fiber Bragg grating and high-birefringence fiber loop mirror have different sensitivities to temperature and strain, we can achieve the temperature and strain discrimination. The sensing resolution of ±1 °C in temperature and ±21 με in strain can be achieved. Our configuration has the advantages of simple structure, low cost, high resolution, and it is easy to fabricate.

* This work is being supported by NSERC

MO-POS-74 **(U)**

Quasi-phase matching in AlGaAs waveguides*, **Rolf Horn**, Om Patange, Gregor Weihs, *Institute for Quantum Computing* — We present an analysis of periodically bent, AlGaAs ridge waveguides that are capable of supporting optical parametric down conversion / second harmonic generation. Quasi-phase matching is achieved using the changing angle between the linearly polarized pump EM field and the crystallographic axes as the pump field propagates along the guide. The physical parameters of the waveguide are chosen such that degenerate down conversion occurs within the telecommunications c-band. The results of this analysis are compared to the well characterized case where periodically-poled Lithium Niobate is used as the optical medium. The feasibility of the bent waveguide solution is analyzed with consideration given to the benefits that AlGaAs offers owing to it's relatively high non-linear co-efficient and ease of integration.

* This work is being supported by NSERC, CFI, CRC, CIFAR, Quantum Works, ORI

MO-POS-97

Introduction to the Far-Infrared Beamline at the Canadian Light Source. A.W.R. McKellar 1, Tim May 2, dominique Appadoo 3, and Brant E. Billinghurst [2], [1]*Steacie Institute for Molecular Sciences*, National Research Council of Canada, [2]Canadian Light Source, and [3]Australian Synchrotron Company — This poster summarizes some of the capabilities of the far-infrared (Far-IR) beamline at the Canadian Light Source (CLS). The Far-IR beamline at the CLS is a state of the art facility, which offers significantly more Far-IR brightness than conventional globar sources. While there is the potential to direct this advantage to any number of research areas, to date most of the effort has been directed toward high-resolution gas phase studies. The infrared radiation is collected from a bending magnet through a 55 X 37 $mrad^2$ port to a Bruker IFS 125 HR spectrometer, which is equipped with a 9 compartment scanning arm, allowing it to achieve spectral resolution down to 0.001 cm^{-1}. The beamline is equipped with

two multi-pass optical cells, a 0.3 m ambient temperature cell and a 2 m variable temperature cell, which can attai pathlengths of up to 12 and 100 meters respectively. Currently the beamline has been commissioned in the 120-800 cm^{-1} region, where the S/N ratio achieved using the synchrotron light is significantly better than is possible with a traditional globar source. Proposals for research pertaining to this spectral range are currently being accepted. Work continues to increase the commissioned range of the beamline, with the ultimate goal of having the full synchrotron advantage available between 10 and 1000 cm^{-1}. Furthermore, the experiments into the generation and use of Coherent THz synchrotron radiation, offering intensities up to 1000 times that of non-coherent synchrotron radiation have shown great promise.

[MO-POS] PHYSICS EDUCATION / *ENSEIGNEMENT DE LA PHYSIQUE* — Monday / *Lundi*

MO-POS-75 **(G)**

Measuring the Impact of Teaching Physics in a Real-World Context on Student Beliefs and Problem-Solving Skills*, **Mathew Martinuk**, *University of British Columbia* — A major goal of introductory physics education is to improve the students' scientific literacy. This implies that students will learn to recognize where scientific thinking is relevant in real-world issues, and ideally to apply their scientific knowledge to situations they encounter in their academic career or outside life. However, prior research has shown a significant decline in students' belief in the real-world relevance of physics after taking an introductory physics course, a shift in beliefs which may prevent them from even attempting to utilize their scientific knowledge in any context outside the classroom. To address this disconnect between classroom physics and real-world issues UBC's Physics 100 course (introductory physics for students that haven't taken Grade 12 Physics) was completely revamped for the fall term in 2007. The course curriculum was reworked to present the traditional introductory physics topics in a real-world context and to add discussion of our most important scientific issues: energy production & consumption and climate change. This presentation focuses on the ongoing research to measure the impact of these major changes to Physics 100. Shifts in student attitudes are measured using the Colorado Learning Attitudes about Science Survey (CLASS) and individual interviews. In addition, a new survey instrument is being developed to measure students' component problem solving skills, with an eye towards developing a reliable measure of their ability to apply physics knowledge outside the classroom. Results from these measurements will be presented, along with initial interpretations and suggestions for further improvements to the course.

* This work is being supported by the Carl Wieman Science Education Initiative

[MO-POS] Plasma PHYSICS / *PHYSIQUE DES PLASMAS* — Monday / *Lundi*

MO-POS-76

HIBP diagnostics for the STOR-M tokamak: numerical optimization and design features*, **Mykola Dreval**, Chijin Xiao, Dallas Trembach, Akira Hirose, *University of Saskatchewan* — Heavy Ion Beam Probe (HIBP) diagnostics proposed for the STOR-M tokamak are presented. The design geometry has been optimized by use of numerical simulations. The decay of the toroidal magnetic field during plasma discharges presents a significant challenge in implanting HIBP diagnostics on STOR-M. A novel energy sweeping technique is proposed to compensate for this magnetic field drooping. Adjustments to HIBP accelerator and energy analyzer are considered. The required minimum set of HIBP hardware for STOR-M is discussed.

* This work is being supported by Canada Research Chair Program and Natural Sciences and Engineering Research Council of Canada

MO-POS-77

Influence of Various Types of Low Pressure Magnetron Discharges on Thin Film Deposition Conditions, **Andranik Sarkissian**, Pawel Jedrzejowski, Sergiy Navala, Claude Cote, *Plasmionique Inc.* — Plasma parameters in the near substrate region are of a particular interest, since they determine mechanisms of thin film growth. In this work we study thin film growth conditions in plasma discharges created in various types of magnetic field configurations, namely: balanced and unbalanced in RF and DC discharges. Magnetron sputtering of thin films is a versatile technique for different film - substrate combinations since it allows for decoupling various plasma parameters. It gives a high degree of control over the ion and neutral atom fluxes which is an important factor in thin film synthesis. We control the energetics of substrate surface reactions by modifications of magnetic field distribution in the discharge zone. For a DC discharge of 200 W in 9 mTorr of Ar we obtain a variation in ion current density from 4.9×10^{-2} mA/cm^2 to 1.8×10^{-1} mA/cm^2 measured at the distance of 100 mm from the target. Plasma density and plasma potential distribution are related to the ratio of ion to atom fluxes for different locations on a substrate holder.

MO-POS-78 **(G*)**

Fluence Prediction for Plasma Ion Implantation*, **Marcel Risch**, Michael Bradley, *University of Saskatchewan* — Plasma Ion Implantation (PII) is a method to modify the surface and subsurface properties of materials; the ions surrounding the target are forced into all plasma exposed surfaces simultaneously by virtue of high-voltage pulses. For the synthesis of new materials by PII, it is essential to know the total number of ions impinging on the surface area of the target. In-situ monitoring is difficult due to the immersion in plasma. However, a simple model exists for the plasma current which yields the fluence upon integration if the ion density and the plasma temperature are known. We obtained the latter two variables from Langmuir probe measurements. Our implementation of the model includes previously reported extensions for multiple ion species and plasma density enhancement due to secondary electrons. For the first time, the errors of the measured inputs are utilized to add error boundaries to the predictions. Firstly, it was proven that the predicted and measured plasma ion currents agree within error boundaries. Secondly, the scaling of the fluence was investigated for three widely used voltage pulse shapes and various densities of a nitrogen plasma. The dependence of the fluence on the plasma density in our study is weaker than expected from the solutions for an ideal rectangular voltage pulse. The discussed method of a numerical fluence prediction is reliable and quick and therefore a valuable tool for materials engineering.

* This work is being supported by NSERC

MO-POS-79

Étude des mécanismes de la stérilisation de spores bactériennes par l'ozone*, **Ahlem Mahfoudh**, Yassine Kabouzi, Danielle Keroack, Jacynthe Séguin, Michel Moisan, Jean Barbeau, *Université de Montréal* — La possibilité d'inactiver des microorganismes vivants à l'ozone est connue depuis fort longtemps. Cet agent oxydant est utilisé depuis la fin du 19ième siècle dans la désinfection des eaux usées à l'échelle mondiale. Au niveau industriel, l'ozone est utilisé en papeterie pour le blanchiment de papiers mais aussi dans la désinfection des fruits, légumes et viandes… L'application de l'ozone comme agent stérilisant dans le milieu hospitalier n'a toutefois été envisagé que très récemment. Cependant, bien que les propriétés physico-chimiques de l'ozone (fort pouvoir d'oxydation) soient reconnues comme permettant une action stérilisante efficace dans le cas de plusieurs micro-organismes, peu d'études traitent des mécanismes de l'inactivation par l'ozone. En particulier les espèces responsables de cette inactiva-

tion par l'ozone et leurs mécanismes d'action n'ont pas encore été clairement identifiés. Dans ce travail, nous présenterons des résultats préliminaires sur les mécanismes d'inactivation de spores bactériennes, micro-organismes de référence tels : *B. atrophaeus*, *Geobacillus stearothermophilus* et *pumilus* par l'ozone en milieu sec puis en milieu humide (humidité contrôlée). Pour mettre en évidence les mécanismes impliqués dans l'inactivation de ces micro-organismes, nous avons, d'une part, déterminé la cinétique d'inactivation par des courbes de survie (taux de mortalité des spores en fonction du temps d'exposition à l'ozone) et, d'autre part, examiné par spectroscopie électronique à balayage les dommages induits sur le manteau des spores. Concernant le cas sec, nous étudierons l'effet de la nature du substrat sur lequel sont déposés les spores sur l'efficacité d'inactivation

* This work is being supported by FQRNT

[MO-POS] SURFACE SCIENCE / *SCIENCE DES SURFACES* — Monday / *Lundi*

MO-POS-80 (G*)

C-alkylation reactions (Benzene alkylation with benzyl alcohol or benzyl chloride)catalyzed by silica-supported Preyssler Heteropolyacids(as surface and Hetergeneous)*, Ali Gharib [1], **Manochehr Jahangir** [2], [1] *Islamic Azad University,Mashhad/Iran&Agricultural Researches Center,Mashhad/Iran*, [2] Islamic Azad University,Mashhad/Iran — The use of catalytic processes with Keggin-type heteropolycompounds has been widely studied in recent decades. Due to their strong Brønsted acidity, Keggin heteropolyacids (HPA) can be used instead of conventional acid catalysts, such as sulfuric acid [1].Other advantages comprise the environmental benefit of decreasing the amount of acid effluents that the conventional technologies produce and the easy recovery and reuse of the catalysts. Electrophilic aromatic substitution and in particular Friedel–Crafts reactions are among the prevailing reactions in organic and industrial chemistry, and they are also reactions that require catalysis [2]. Aromatic alkylation reactions were studied using molybdophosphoric and tungstophosphoric acids supported on silica as catalysts. Benzene and toluene alkylation was carried out with benzyl chloride or benzyl alcohol. Also, cyclohexene and cyclohexanol were used as alkylating agents of toluene. Aromatic alkylation reactions to explore the catalytic activity of preyssler $H_{14}NaP_5W_{30}O_{110}$ and its mixed addenda $H_{14}NaP_5W_{29}MoO_{110}$ catalysts in aromatic alkylation reactions, benzene benzylation to obtain diphenylmethane (1) was firstly chosen as a test reaction, using benzyl alcohol or benzyl chloride as alkylating agents(Scheme).

1. I. Kozhevnikov, Chem. Rev. 90 (1998) 171.
2. G.A. Olah, D. Meidar, 3rd ed., Friedel–Crafts Chemistry Kirk– Othmer Encycl. Chem. Technol., 11, Wiley, New York, 1980, p. 269.

* This work is being supported by Islamic Azad University,Mashhad/Iran

MO-POS-81 (G*)

Adsorption of Hydrogen on Nanoporous Materials: Modelling and Thermodynamics*, **Marc-André Richard**, Richard Chahine, Pierre Bénard, *Université du Québec à Trois-Rivières* — The adsorption of hydrogen on nanoporous materials (activated carbon or MOFs) at cryogenic temperatures is a potential alternative for hydrogen storage. An adsorption model and the simulation of the thermal phenomenon associated with adsorption are necessary for the design of adsorption-based gas storage systems. The adsorption model should fit hydrogen adsorption data over the 60 to 300 K temperature range and pressures up to 35 MPa with only one set of parameters. We developed a semi-empirical Dubinin-Astakhov type model that fit adsorption data over the desired range with parameters that can be determined from only two isotherms (for example: 77K and 300K). The thermodynamic properties of the adsorbed phase are derived from this model. Finally, the mass and energy conservation equations for an adsorption system are presented.

* This work is being supported by Natural Resources Canada, National Sciences and Engineering Research Concil of Canada, Bourse Fonds québécois de la recherche sur la nature et les technologies

MO-POS-82

Morphological and magnetic properties of cobalt nanoclusters electrodeposited from two different sulphate solutions*, **Margarita Rivera** [1], Clara H. Rios-Reyes [2], Luis H. Mendoza-Huizar [3], [1] *Instituto de Fisica UNAM*, [2] UNAM - UAM-Azcapotzalco, [3] CIQ - UAEH — In this work, cobalt nanoclusters were produced by using electrodeposition techniques onto highly oriented pyrolitic graphite electrodes. In this study, two different electrochemical baths were employed. In one case, the electrolyte solution contained a Na^+ cation while the other, contained a NH_4^+ cation in solution. The morphological and magnetic characterization of these clusters was performed by SEM, AFM and MFM techniques. From these results, it was observed that cobalt nanoclusters from the sodium bath exhibited larger diameters but smaller aspect ratios (hight/diameter) for the mono to multimagnetic domain transition in comparison with clusters obtained from the ammonium bath. By using a theoretical single domain ferromagnetic model on the experimental data, it was obtained that the exchange constant value was very similar to the bulk cobalt value for both cases; although, a small difference was obtained in the ammonium case, which can be attributed to a different grain structure in the formation process.

* This work is being supported by UNAM PAPIIT-IN-112106 and CONACYT-42842-F.

MO-POS-83

Mass spectrometry investigation of the degradation of polyethylene terephtalate induced by low-energy (≤ 100 eV) electrons*, **Sylvain Massey** [1], Pierre Cloutier [2], Léon Sanche [2], Denis Roy [1], [1] *Université Laval*, [2] Université de Sherbrooke — Polyethylene terepthalate (PET) thin films were damaged by low-energy (0-100 eV) electron irradiation to simulate the degradation of this polymer in electronic devices. The products formed were analyzed by positive and negative ion mode mass spectrometry. The anionic emission of hydrogen from the polymer surface is associated with dissociative electron attachment (DEA) with the observation of a resonant structure in the emission yield at 8.5 ± 0.4 eV, and with dipolar dissociation (DD) at higher energies. The emission of O^- showed only a monotonic rise as a function of incident electron energy and is associated with DD. This anion is produced by mid-chain C–O–C cleavage, leading to chain scission. The signal of the several positive mass fragments showed only a monotonic increase with electron energy, which is associated with DD and dissociative ionization. In this case, the analysis of mass fragments suggests chemical recombination with dissociated hydrogen atoms from the polymer surface. Analysis of the products leads to the conclusion of degradation of the polymer by chain scission caused by the low-energy electron interactions.

* This work is being supported by CRSNG/NSERC

MO-POS-84

TOF Mass Spectrometry of the low energy electron stimulated desorption of anions from thin films of CF_2Cl_2*, **Andrew Bass** [1], Christopher Arumainayagam [2], Léon Sanche [1], [1] *Université de Sherbrooke*, [2] Wellesley College — A recently constructed time-of-flight (ToF) mass spectrometer has been used to measure the electron stimulated desorption of anions from thin films of vapor-deposited CF_2Cl_2 in the 0–20 eV incident electron energy (E_i) range. The enhanced sensitivity of the ToF mass spectrometer reveals the ESD of anions to be even richer than previously reported; in addition to signals of F^- and Cl^-, the desorption of anions F_2^-, CF_2^-, ClF_2, Cl_2^- have been observed for the first time and to proceed via dissociative electron attachment (DEA) through previously unidentified Transient Negative Ion (TNI) states of the molecule. The desorption yields produced by DEA and by Dipolar Dissociation (DD) are strongly modulated by proximity to the supporting metal surface, particularly so in the

case of F^- and Cl^- desorption signals at $E_i > 10$ eV attributable to DD. As previously reported, prolonged bombardment of the CF_2Cl_2 film leads to the production of Cl_2 molecules as evidenced by an enhanced desorption signal of Cl^0 at incident electron energies near 5 eV. We have used this effect to measure the relative cross section for production of Cl_2 as a function of energy and observe a threshold energy for this process of 7 eV.

* This work is being supported by Canadian Institutes of Health Research

MO-POS-85 **(G)**

Désorption des anions des couches minces de méthanol par l'attachement dissociatif d'électrons et la dispersion réactive d'ions*, **Marc Bazin** [1], Sylwia Ptasiska [2], Andrew Bass [1], Léon Sanche [1], [1] *Université de Sherbrooke*, [2] The Open University — Le rayonnement de haute énergie dépose son énergie dans la matière condensée selon une succession d'événements multiples d'ionisation qui produisent ions et électrons secondaires [1]. Par conséquent, la chimie induite par radiation, même longtemps après l'irradiation, dépend des interactions de ces espèces secondaires avec leur environnement moléculaire. Pour identifier les interactions des électrons secondaires dans la matière condensée, une approche est de bombarder des films minces avec des faisceaux d'électrons de faible énergie (0 à 20 eV), puis de mesurer les rendements des espèces désorbés en utilisant des techniques de spectrométrie de masse[2]. Ici nous étudions la dissociation induite dans le méthanol par impact d'électrons en observant la désorption des anions. Avec un spectromètre de masse très sensible et des échantillons marqués par des isotopes, nous observons la désorption des ions O^-, CH_2^-, CH_3^- et CH_3O^- en plus du signal H^- précédemment observé [3]. Les mesures en fonction de l'énergie incidente des électrons montrent une forte modulation de tous les rendements ioniques en-dessous de 10 eV et indiquent que le mécanisme responsable de la désorption est le processus d'attachement dissociatif (AD) [4]. En phase gazeuse, les anions H^-, O^- et CH_3O^- ont déjà été observés comme produits de l'AD dans le méthanol mais pas CH_3^- et CH_2^-[5]. En suivant la désorption en fonction de la quantité de méthanol déposée sur un film de Xe, nous prouvons que les ions CH_3^-, CH_2^- et CH_3O^- sont issus de la dispersion réactive des ions [6] H^- par les molécules du méthanol.

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3. L. Parenteau, J.-P. Jay-Gerin, L. Sanche J. Phys. Chem. **98**, 10277 (1994).
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5. A. Kuhn, H.P. Fenzlaff, E. Illenberger, J. Chem. Phys. 88, 7453 (1988).
6. R.L. Champion and L.D. Doverspike, in *Electron-Molecule Interactions and Their Applications*, Vol. 1, edited by L. G. Christophorou; Academic Press: Orlando, FL. USA, 1984; Chpt. 7, and references cited therein.

* This work is being supported by IRSC et FCI

[MO-POS] Theoretical PHYSICS / PHYSIQUE THÉORIQUE — Monday / Lundi

MO-POS-86 **(U*)**

Searching for Isospectral Quantum Graphs*, **Gilad Ben-Shach** [1], Ram Band [2], Uzy Smilansky [2], [1] *McGill University*, [2] Weizmann Institute of Science — A drum, to physicists, is a solid, planar frame, to which an elastic membrane is attached. In 1966, Marc Kac asked "Can one hear the shape of a drum?" In other words, is every spectrum of frequencies associated with a unique shape of a drum? This question was answered in 1992, when a pair of drums with different shapes, but the same spectrum was discovered. Since then, the question has been extended to other physical objects, including quantum graphs. A graph is a collection of vertices, connected by bonds. By defining a Laplacian with boundary conditions on these graphs, we obtain quantum graphs. The solutions can represent the motion of quantum particles along the graph. Only discrete frequencies of standing waves will match the boundary conditions. The set of frequencies of these waves is called the spectrum. We searched for a pair of isospectral quantum graphs – two graphs with different shapes, but the same spectrum. A pair was constructed recently by Band and Smilansky, using representation theory arguments applied on the dihedral group D_4 – the group of symmetries of the square. We tried similar techniques on the group O_h of symmetries of the cube. We found that this method failed for the cube. We have also developed a theorem, based on induced representations of groups, outlining a new method for the construction of isospectral graphs. This method has enabled us to expand the D_4 pair into a triple of isospectral graphs, and has produced three isospectral graphs from O_h.

* This work is being supported by Weizmann Institute of Science KKISS Scholarship

MO-POS-87

Schrodinger Cats and It from Bit. **Alexander Berezin**, *McMaster University* — Popular interpretations and illustrations of QM observer effect (Schrodinger Cats, Wigner friend), such as (A) MWIQM (Everett), and (B) gravitationally induced psi-reduction (Karolyhazy, Penrose) may turn out to be complimentary rather than contradictory to each other. We suggest existence of phase diagram separating areas of predominantly A or B where transitions between A and B, like melting lines on traditional material phase diagrams, indicate exponential enhancement of zero-point fluctuations near critical line at which density of states experiences singularity. Since at this point the effective masses of quasi particles composing system change sign (similar to electron hole transition in condensed matter), de-Broglie wavelength diverges. This indicates on-set of strong overall quantum nonlocality. Thus, coherency in system becomes frozen and may lead to non-exponential decay of many-body excitations. Strong coherency and nonlocality translates into enhancement of spontaneous pattern formation, informational connectivity akin to holographic memory effect (Berezin, in Ultra High Dilution, Kluwer, 1994) and what J.A. Wheeler calls It from Bit paradigm. Critical aspect of latter may be individualization of elementary excitations (akin to labelability of elementary particles in Bohm theories of hidden variables) which can have implications to fundamental ascending processes including bioevolution and human creativity, origins of which may lie at Planck scale. Extension of MWIQM paradigm to higher Alephs (uncountable number of branching sub Universes) lifts Planck scale as ultimate limit and implies indefinite scale fractalization in both micro and macro directions, as was anticipated already by Anaxagoras (quite in Berezin and Nakhmanson, Physics Essays, 1990).

MO-POS-88 **(G*)**

On the momentum space basis and its use as a tool for solving the Schrödinger equation*, **Ryan Arseneault**, Normand Beaudoin, *Université de Moncton* — In quantum theory, Schrödinger's equation is usually solved in the coordinate basis $\boldsymbol{r}$, mainly because the potential energy operator V is usually given in this basis. However, it would also be possible to solve it in another basis, i.e. the momentum base $\boldsymbol{p}$.[1][2][3] A possible advantage is the fact that it would give another image when solving Schrödinger's equation. Essentially, we are exploring the possibility of using the $\boldsymbol{p}$ space formalism for solving potential forms that already have solutions in $\boldsymbol{r}$ space. Using a general basis transformation procedure from $\boldsymbol{r}$ to $\boldsymbol{p}$ (and vice-versa) for operators and eigenvectors, we will solve the Schrödinger equation for several forms of potential energy in both the $\boldsymbol{r}$ and $\boldsymbol{p}$ bases. We will then compare the two methods and conclude on the $\boldsymbol{p}$ basis' viability as an alternate solution method for determining eigenstate values and eigenvectors.

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2. L. Marchildon, *Mécanique quantique*, DeBoeck Université, 2000
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* This work is being supported by NSERC, FESR (Faculté des Études Supérieures et de la Recherche) and Université de Moncton

MO-POS-89 **(G*)**

Numerical simulations of the decoherence of a single qubit in an environment of N qubits*, **Olivier Landon-Cardinal**, *Université de Montréal* — Decoherence provides a framework explaining why an open quantum system coupled to its environment will exhibit a set of preferred states, usually ruling out a coherent superposition of arbitrary states. In most systems, the density matrix representing the state of the system will be quasi-diagonal in the preferred basis, giving rise to a mixture of quasi-classical states. We will study an explicit toy model [1] for the decoherence of a system of one qubit (or any two-state quantum system) in an environment of N qubits. Although the total system {qubit + environment} exhibits unitary dynamics, evolution of the qubit density matrix is non-unitary when tracing over the environment. In the simplest version, the total Hamiltonian only contains a tensor product of operators and is diagonal in the computational basis. Analytical formulas are derived for the eigenvalues. Numerical results show that the off-diagonal terms of the density matrix become quickly negligible. Their time-averaged amplitudes decrease to a value exponentially small with the size N of the environment. This simple model nevertheless exhibits a superselection rule easily pictured on the Bloch sphere. Extensions to Hamiltonians with non-zero self-evolution operators are also discussed.

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MO-POS-90

Infrared Spectral Density of Hydrogen Bonds Within the Strong Anharmonic Coupling Theory: Evolution of the Infrared Absorption Spectra From Weak to Strong H-bonds*, **Najeh Rekik** [1,*], Brahim Ouji [1], Marek J. Wójcik [2], [1] *Laboratoire de Physique Quantique, Faculté des Sciences de Monastir, Tunisia.*, [2] Laboratory of Molecular Spectroscopy, Faculty of Chemistry, Jagiellonian University, Poland — Theoretical IR spectral density of the high frequency stretching mode of Hydrogen bonds is reported using a two-dimensional model. The approach involving both the intrinsic anharmonicity of the fast mode and the H-bond bridge, together with direct and indirect relaxations is studied within the linear response theory. The fast mode is described by an asymmetric double well potential whereas the anharmonicity of the H-bond bridge is described by a "Morse" curve. In addition, the repulsive potential intervening in the asymmetric double well potential is chosen in Gaussian form. The anharmonic coupling between the high frequency and the low frequency modes is treated inside the strong anharmonic coupling theory. The relaxation of the fast mode (direct damping) and of the H-bond bridge (indirect damping) is incorporated by aid of our previous results [1]. The IR SD is obtained by Fourier transform of the autocorrelation function of the dipole moment operator of the fast mode. The evolution of the infrared absorption spectra from weak to strong H-bonds is demonstrated.

1. Rekik *et al.*, J. Mol. Struct. 687 (2004) 125]

* In collaboration with Rekik Najeh

MO-POS-91

Holonomy decomposability in general relativity*, **Johan Brannlund**, Alan Coley, Sigbjorn Hervik, *Dalhousie University* — The holonomy decomposition theorem for Riemannian manifolds was first proven by de Rham. Roughly speaking, this theorem says that if the holonomy group of a manifold is a product, then the manifold itself is also a product. Wu extended this to Lorentzian manifolds, but left open a physically interesting case. We will discuss applications of some recent mathematical results to general relativity and in particular cover this loophole.

* This work is being supported by NSERC, The Blanceflor Foundation

MO-POS-92 **(G)**

On the tidal heating of a stellar-mass black hole, **Simon Comeau**, Eric Poisson, *University of Guelph* — We study a feature in the gravitational interaction between 2 black holes which is the general relativistic analogue of tidal heating. When worked on by tidal forces, a black hole acquires an increase in its surface area which by the first law of black hole thermodynamics implies a change in its mass and spin. We focus our study on an extreme mass ratio system consisting of two spinning black holes in the idealized configuration where the small black hole travels on circular geodesics of the background geometry fixed by the larger supermasive black hole. The rates of change in the mass and spin of the orbiting black hole are calculated analytically to leading order in the mass ratio. We then investigate whether this effect could have any impact on the detectability of some types of gravitational wave signals observable by LISA.

MO-POS-93

New symmetry for diachronic observers*, **Michel A. Duguay**, *Universite Laval* — In the diachronic representation of space-time [1] a first central observer, now here, assigns the time of his wristwatch to distant events observed on his light cone by means of electromagnetic waves and immediately recorded. A second diachronic observer moving at a uniform speed relative to the first will find, as she passes by the first, that her history of observed and recorded events, up-dated now here, is structurally the same as the history of the first observer up-dated now here. In the diachronic perspective history up-dated now here is therefore Lorentz invariant. This is not the case for conventional observers in Einstein's synchronic representation of space time because the conventional ''now out there'' moves up and down the time axis according to the moving observer's speed, thereby making the collection of past historical events speed-dependent. This new symmetry for diachronic observers will be discussed in the context of the path integral formulation of quantum mechanics.

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* This work is being supported by NSERC

MO-POS-94 **(G)**

U(1) Lattice Gauge Theory Beyond Ground States*, **Ahmad Hosseinizadeh**, *Laval University* — We suggest a new Monte Carlo method to find excited-state energies and wave functions for the U(1) lattice gauge theory in (2+1)-dimension. We construct a finite set of physical states via the Euclidean path integral Monte Carlo method and using the pure gauge section of the Wilson action. We calculate transition amplitudes between each pair of those states under Euclidean time evolution of the Kogut-Susskind Hamiltonian. From the matrix of transition amplitudes, we extract energy spectrum and wave functions. Using energy spectrum, we also compute a number of physical observables for the lattice, such as thermodynamical functions.

* This work is being supported by NSERC

MO-POS-95

Time Evolution of Epidemic Dynamics on Finite and Infinite Networks*, **Pierre-André Noël**, Bahman Davoudi [2], Robert C. Brunham [2], Louis J. Dubé [3], Babak Pourbohloul [4], [1] *UBC Centre for Disease Control and Université Laval*, [2] UBC Centre for Disease Control, [3] Université Laval and Université Pierre et Marie Curie, France, [4] University of British Columbia and UBC Centre for Disease Control — In the last decade, many real-world systems have been shown to display complex network structures [1,2,3]. The dynamics on such networks has attracted considerable attention: for instance, the propagation in human populations of infectious diseases or of rumours indicates how crucial a good dynamical understanding is. While numerical simulations offer great generality, they are generally difficult to interpret and one often

relies on analytical approaches to provide the necessary insights. Existing formalisms [4,5,6,7] partly include the full complexity of the systems at hand: structure of the networks (realistic, finite-size), time evolution and characterization of outcomes (*e.g.* outbreak vs epidemics) to name a few. We have developed an analytical framework that improves over previous works in two complementary directions*: i. finite-size effects* have been identified and taken into account for discrete dynamics; and *ii. continuous time evolution* has been formulated for infinite networks. These are the first steps towards a formalism unifying continuous dynamics and finite-size networks. We will discuss the quantitative and qualitative differences with earlier studies and point out directions for further improvements.

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* This work is being supported by CIHR, Michael Smith Foundation for Health Research, BC Ministry of Health (PAN, BD, BP) and NSERC (LJD).

MO-POS-96

Heterogeneous Bond Percolation on Complex Networks: Application to Epidemiology*, **Antoine Allard** [1], Pierre-André Noël [1], Louis J. Dubé [2], Babak Pourbohloul [3], [1] *Université Laval and UBC CDC (Vancouver)*, [2] Université Laval (Québec) and Université Pierre et Marie Curie (Paris), [3] University of British Columbia and UBC CDC (Vancouver) — In the past decade, considerable attention has been paid by the physics community to complex networks. Empirical studies on real-world networks (proteins, food chain, social networks, WWW, Internet, etc.) highlighted many important topological properties [1,2] that allowed scientists to build always more complex mathematical models. For instance, physicists have successfully used the bond percolation of such networks to model the propagation of infectious diseases in populations. This in turn can help public health officials to make critical decisions during crisis [3] or to elaborate efficient intervention/prevention plans before any epidemics have even started [4]. Despite these successes, actual models [5] are still based on simplifying assumptions which restrict the categories of diseases that can be accurately described. Efforts have therefore been undertaken to remove some of the limitations to make the approach more realistic. We present a new model of bond percolation of complex networks with an arbitrary degree distribution. Our mathematical formalism adds a structural improvement allowing different types of nodes in the networks and therefore admitting an heterogeneous probability of occupation of edges. This will permit the simulation of propagation of diseases with an heterogeneous transmissibility and will hopefully lead to more precise intervention/prevention scenarios.

1. M.E.J. Newman, SIAM Review 45, 167 (2003)
2. A.-L. Barabási *et al.*, Science 286, 509 (1999)
3. L.A. Meyers *et al.*, J. Theor. Biol. 232, 71 (2005)
4. B. Pourbohloul *et al.*, Emerg. Infect. Dis., 11, 1249 (2005)
5. M.E.J. Newman, Phys. Rev. E 66, 016128 (2002)

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Author index / Index des auteurs

- C -

- D -

- I -

- J -

- K -

- L -

- M -

- S -

- T -

- V -

- W -

- X -

- Y -

- Z -

NOTES ** NOTES **

Exhibitors
Exposants

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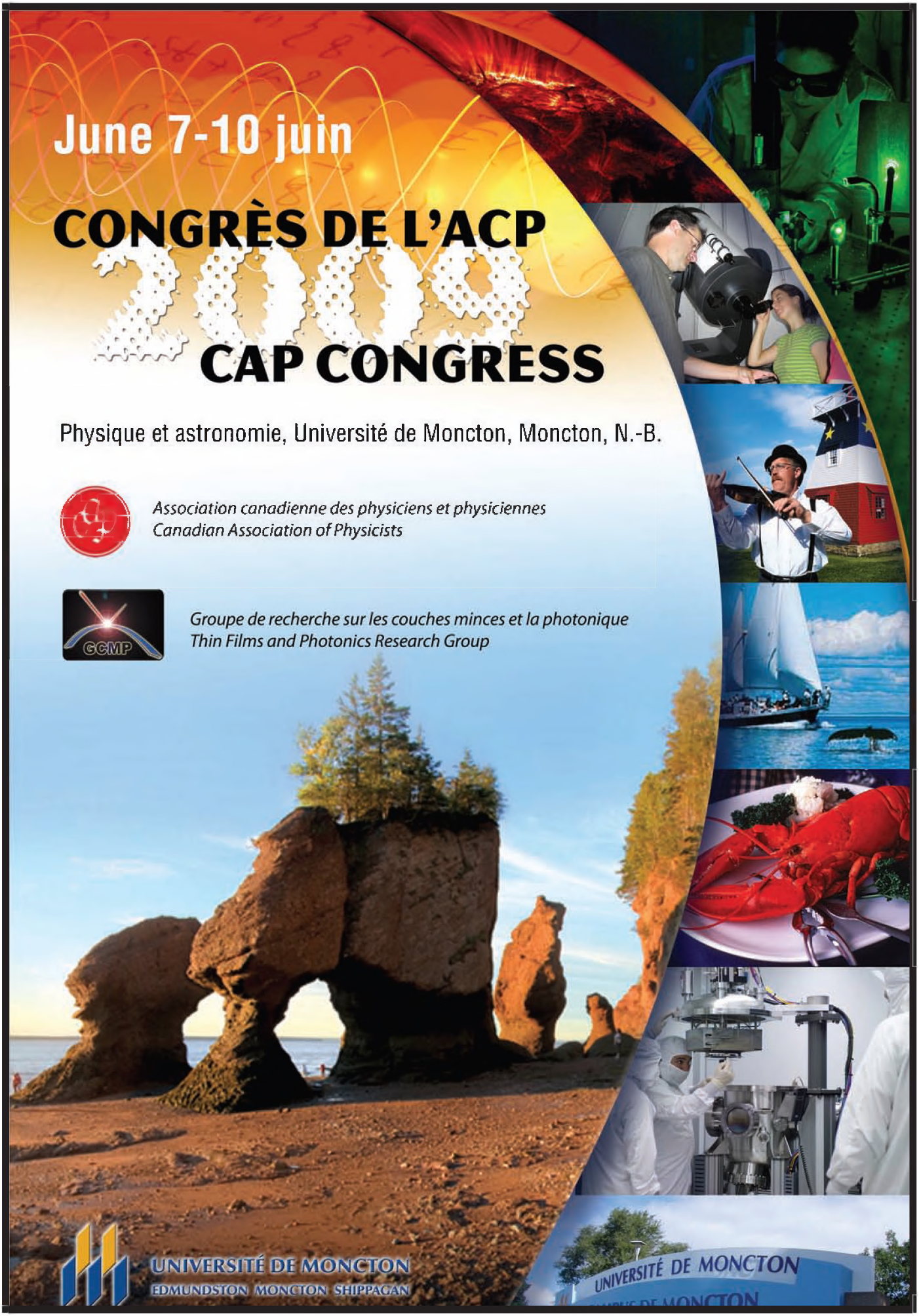

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