PHYSICS IN CANADA
LA PHYSIQUE AU CANADA
Vol. 63 No. 2 (supplement)
May / June 2007
mai / juin 2007

2007 CAP CONGRESS
CONGRÈS DE L'ACP 2007

June 17-20 juin

University of Saskatchewan /
Université de la Saskatchewan

Saskatoon, Saskatchewan

Program / Programme

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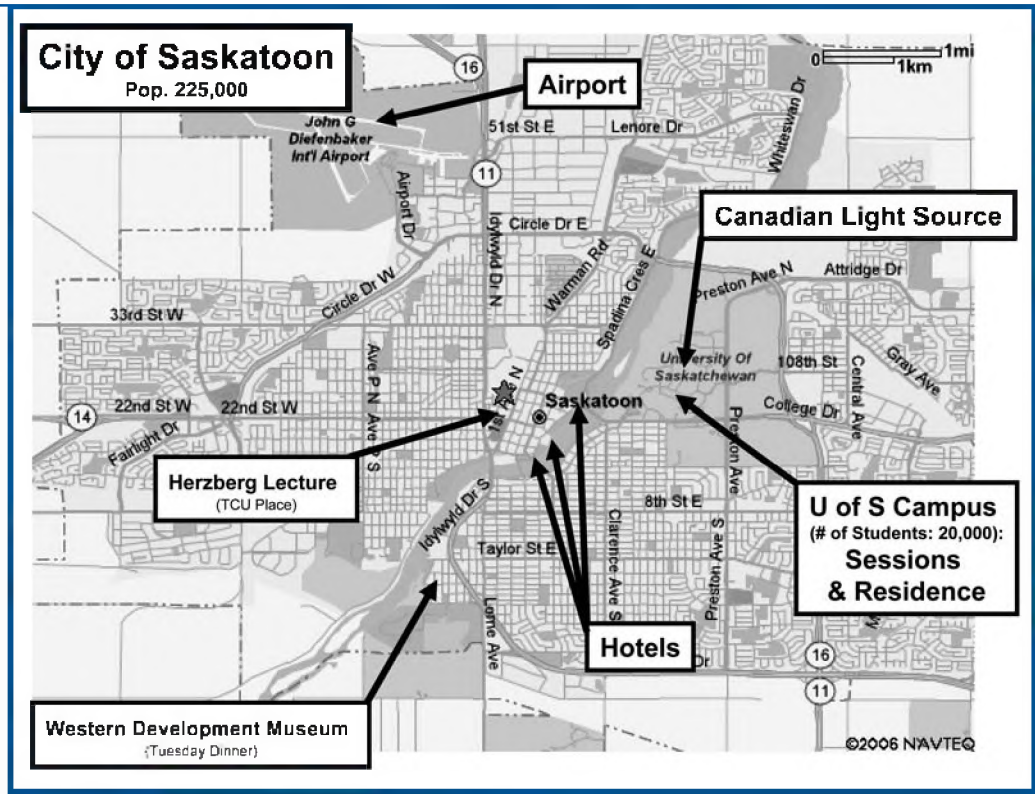
Travel Information / Comment se rendre à la conférence

The University of Saskatchewan is located approximately 20 minutes from Saskatoon's Diefenbaker Airport and ~25 minutes walking distance from East end of the University Bridge.

Taxi to the U of S from Diefenbaker Airport

Ask to be dropped off at the Physics Building at the end of Gymnasium Place (past the NRC Building).



Walking to (U of S) from the Hotels (West side of River)

Head East over the University Bridge towards the University. Stay left, on College Drive, once you cross the bridge. You will walk two very long blocks to Wiggins Avenue. Turn left on Wiggins and walk ~ 2 blocks to the 'y' in the road. Turn right to get to Place Riel (main campus centre) – it is approximately ½ block from the 'y' in the road. Enter Place Riel and head straight through to the other set of entrance doors. Walk out and you will be heading North between the Murray building and Marquis Hall. You will soon see The Bowl and signage to Geology on your right.

Bussing to (U of S) from the hotels (West side of the River)

Take busses that stop at Place Riel (which is most downtown busses). Enter Place Riel and head straight through to the other set of entrance doors. Walk out and you will be heading North between the Murray building and Marquis Hall. You will soon see The Bowl and signage to Geology on your right

Driving to Stadium Parkade (U of S) from Diefenbaker Airport

From the airport, you will be heading south on Airport Drive for ~7 blocks. Turn left on Circle Drive (you will now be heading East). Stay on Circle Drive for ~ 3 miles. After you cross the Circle Drive Bridge and you need to be in the right hand lane to turn right onto Preston Avenue (Campus Access) (you are now heading South). Turn right at the fourth set of lights (College Drive)(now heading West). Turn left at the first set of lights (Stadium Crescent). Once on Stadium Crescent, stay right and follow it around to the parkade. Walk over the pedway, past the Physical Activity Complex (The PAC)(heading NW), past the front of the Administration building and out into The Bowl (large green space). Keep heading NW and there will be signs directing you to the Geology Building (conference center).

L'Université de la Saskatchewan est située à environ 20 minutes de l'aéroport Diefenbaker de Saskatoon, et à 25 minutes de marche à partir du côté est du pont de l'Université.

Taxi vers l'Université à partir de l'aéroport Diefenbaker

Demandez qu'on vous laisse à l'édifice de physique au bout du Gymnasium Place (après l'édifice NRC).

Marche vers l'Université à partir des hôtels (côté ouest de la rivière)

Traversez le pont de l'Université vers l'est, vers le campus. Restez à gauche, sur College Drive, après avoir traversé le pont. Dépassez deux longs quadrilatères vers Wiggins Avenue. Tournez à gauche sur Wiggins et dépassez deux quadrilatères vers l'intersection en y. Tournez à droite pour vous rendre à la Place Riel (le centre du campus) – à environ ½ quadrilatère de l'intersection en y. Entrez dans la Place Riel et traversez-la jusqu'aux autres portes d'entrée. En sortant, vous vous dirigerez vers le nord entre l'édifice Murray et le Marquis Hall. Vous verrez alors le « Bowl » et les signaux vers l'édifice de géologie à votre droite.

Bus vers l'Université à partir des hôtels (côté ouest de la rivière)

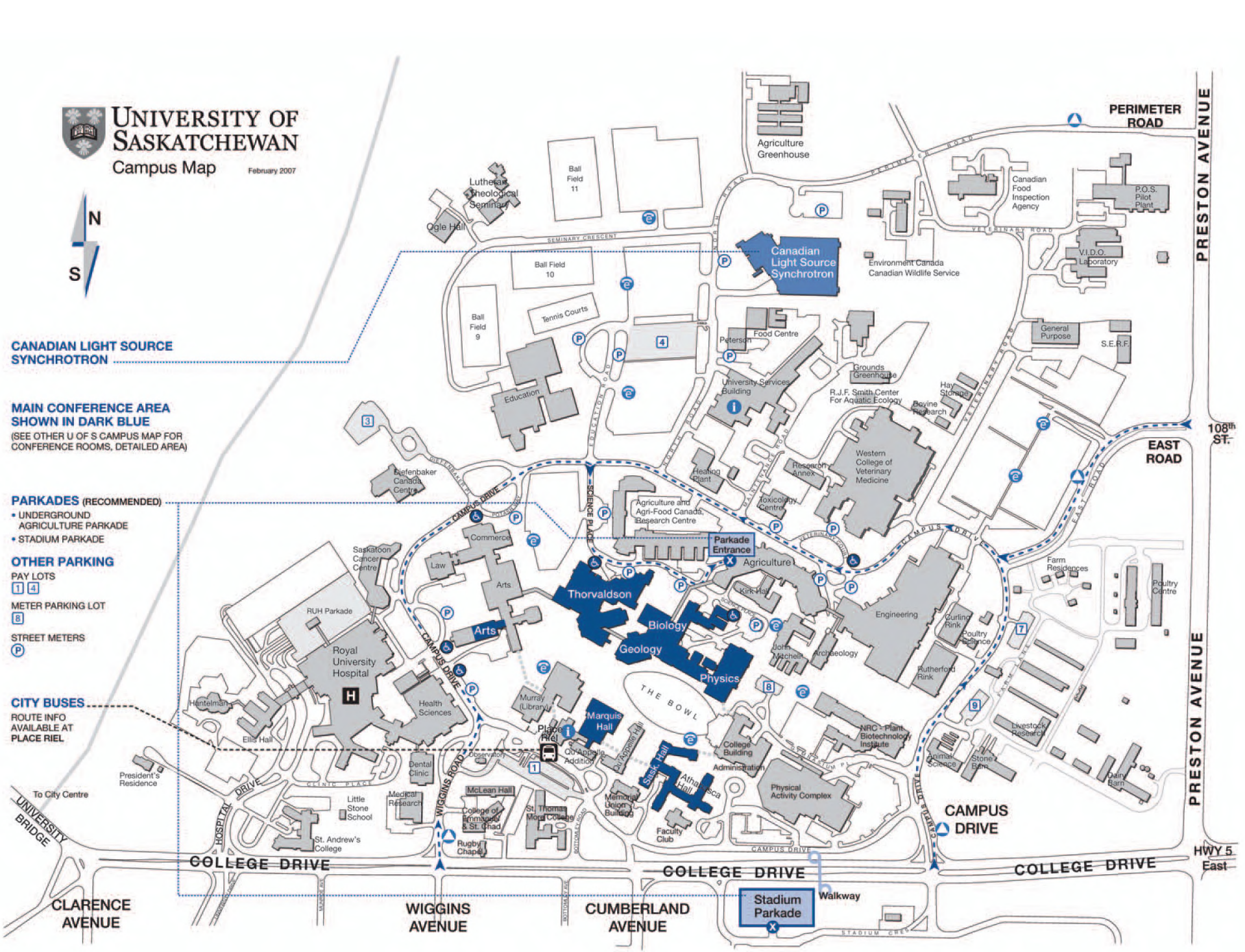
Prenez les bus qui arrêtent à la Place Riel (ce que font la plupart des bus du centre-ville). Entrez dans la Place Riel et traversez-la jusqu'aux autres portes d'entrée. En sortant, vous vous dirigerez vers le nord entre l'édifice Murray et le Marquis Hall. Vous verrez alors le « Bowl » et les signaux vers l'édifice de géologie à votre droite.

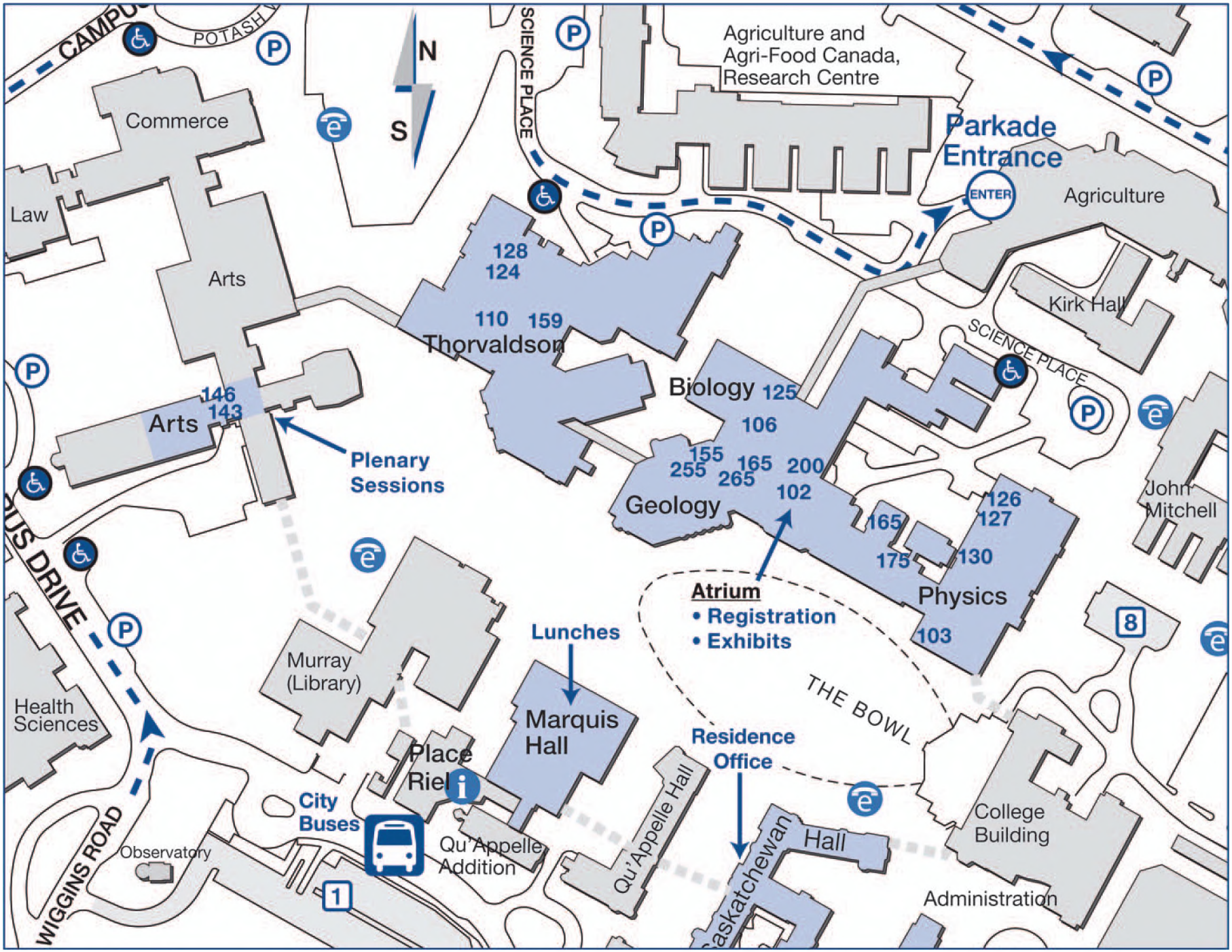
En voiture jusqu'au stationnement de l'Université, à partir de l'aéroport Diefenbaker

De l'aéroport, prenez Airport Drive en direction sud, pour environ 7 quadrilatères. Tournez à gauche sur Circle Drive (direction est). Roulez sur Circle Drive pour environ 3 miles. Traversez le pont de Circle Drive, restez dans l'allée de droite et tournez à droite sur Preston Avenue (Campus Access) (direction sud). Tournez à droite au quatrième feu (College Drive, direction ouest). Tournez à gauche au premier feu (Stadium Crescent). Sur Stadium Crescent, restez à droite et suivez la route jusqu'au stationnement. Traversez le passage pour piétons, dépassez le complexe d'activité physique (le PAC, direction nord-ouest), puis dépassez la façade de l'édifice d'administration jusque dans le « Bowl » (le grand espace vert). Continuez en direction nord-ouest et vous verrez des signaux vous dirigeant vers l'édifice de géologie (lieu de la conférence).

University of Saskatchewan
Campus Map

February 2007

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S
SCIENCE PLACE
Agriculture and
Agri-Food Canada,
Research Centre
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City
Buses
Qu'Appelle
Addition
Qu'Appelle Hall
Saskatchewan
Hall
College
Building
Administration
Observatory
WIGGINS ROAD
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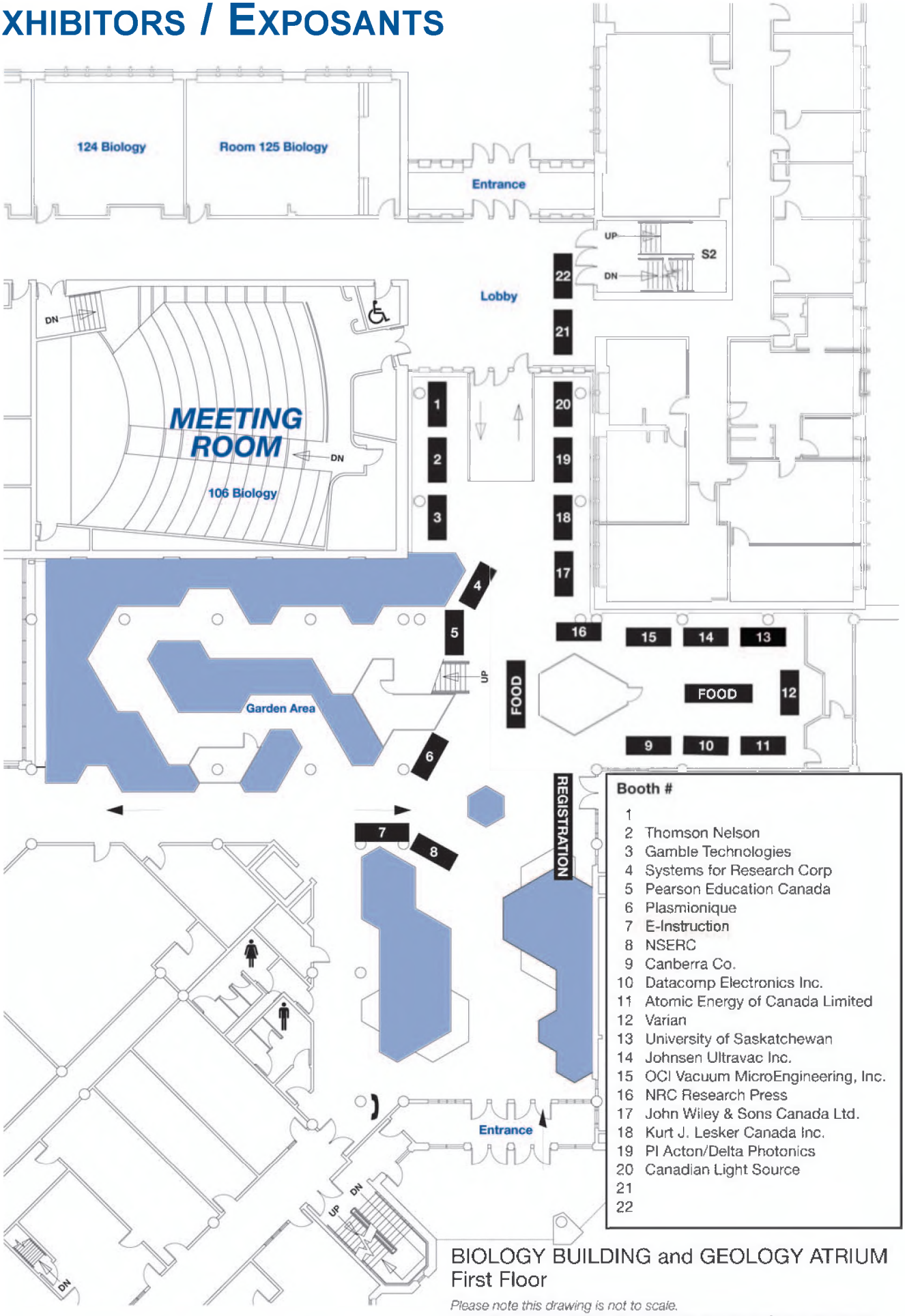
EXHIBITORS / EXPOSANTS



Booth #

1
2 Thomson Nelson
3 Gamble Technologies
4 Systems for Research Corp
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6 Plasmionique
7 E-Instruction
8 NSERC
9 Canberra Co.
10 Datacomp Electronics Inc.
11 Atomic Energy of Canada Limited
12 Varian
13 University of Saskatchewan
14 Johnsen Ultravac Inc.
15 OCI Vacuum MicroEngineering, Inc.
16 NRC Research Press
17 John Wiley & Sons Canada Ltd.
18 Kurt J. Lesker Canada Inc.
19 PI Acton/Delta Photonics
20 Canadian Light Source
21
22

BIOLOGY BUILDING and GEOLOGY ATRIUM
First Floor

Please note this drawing is not to scale.
Floor plan is subject to change in compliance with Fire Safety Regulations.

PHYSICS IN CANADA
LA PHYSIQUE AU CANADA

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MAI / JUIN 2007

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2007 CAP CONGRESS
CONGRÈS DE L'ACP 2007

Notice to Delegates

A copy of the printed Congress program will be provided to delegates at the Annual Congress at the University of Saskatchewan in Saskatoon, SK.

Avis aux délégués

Une copie du programme imprimé sera donnée aux délégués au Congrès, à l'Université de la Saskatchewan à Saskatoon, SK.

FRONT COVER / *COUVERTURE*

2007 CAP/CLS Congress poster designed by the Local Organizing Committee at the University of Saskatchewan.

Affiche du congrès 2007 de l'ACP/CCRS dessinée par le Comité d'organization local à l'Université de la Saskatchewan.

CANADIAN ASSOCIATION OF PHYSICISTS
ASSOCIATION CANADIENNE DES PHYSICIENS ET PHYSICIENNES

ANNUAL GENERAL MEETING
ASSEMBLÉE GÉNÉRALE ANNUELLE

DATE: Tuesday, June 19, 2007
Mardi, le 19 juin, 2007

TIME/HEURE: 17h00

PLACE: Room/Salle Arts 146, University of Saskatchewan, Saskatoon, SK

DRAFT AGENDA / ORDRE DU JOUR PROVISOIRE

1. Call to Order and Approval of the Agenda

2. Approval of the Minutes of the June 13, 2006 Annual General Meeting
   .1 Matters arising from the Minutes

3. Annual Report
   .1 Audited Financial Statements to December 31, 2006
   .2 Membership Report

4. Appointment of Auditors

5. Presidential Address summarizing year's activities

6. Report by the Chair of the 2007 Local Organizing Committee

7. Host Universities - Future Congresses

8. New Business
   .1 2008 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 2007 at SFU (Braden Brinkman, SFU)
   .6 CAM2007 at McGill University, Montreal (D. Beaton)
   .7 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 62nd CAP ANNUAL CONGRESS
62e CONGRÈS ANNUEL DE L'ACP

INFORMATION / PROGRAMME

(See page 14 for the Session Codes / Voir les indicatifs des sessions à la page 14)

2007 CAP CONGRESS / CONGRÈS DE L'ACP 2007

TECHNICAL PROGRAM COMMITTEE / COMITÉ DU PROGRAMME TECHNIQUE

Chair / Président	L. Marchildon	louis.marchildon@uqtr.ca
Atmospheric & Space Physics / physique atmosphérique et de l'espace	D. Degenstein	doug.degenstein@usask.ca
Atomic & Molecular Physics and Photon Interactions / physique atomique et moléculaire et d'interactions avec les photons	A.A. Madej	alan.madej@nrc.ca
Condensed Matter and Materials Physics / physique de la matière condensée et des matériaux	S. Idziak	idziak@uwaterloo.ca
History of Physics histoire de la physique	A. Griffin	griffin@physics.utoronto.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. Pejović -Milić	anamilic@ryerson.ca
Nuclear Physics / physique nucléaire	G. Huber	huberg@uregina.ca
Optics and Photonics / optique et photonique	P. Ashrit	ashritp@umoncton.ca
Particle Physics / physique des particules	A. Bellerive	alainb@physics.carleton.ca
Physics Education / enseignement de la physique	S.P. Goldman	goldman@ryerson.ca
Plasma Physics / physique des plasmas	T.W. Johnston	johnston@emt.inrs.ca
Surface Science / science des surfaces	K. Griffiths	griff@uwo.ca
Theoretical Physics / physique théorique	M. Paranjape	paranj@lps.umontreal.ca

LOCAL ORGANIZING COMMITTEE / COMITÉ ORGANISATEUR LOCAL

Chair / président		R. Pywell
Vice-Chair-Treasurer / *Vice-président et trésorier*		C. Xiao
Executive Assistant / *Secrétaire exécutif*		A. Manson
Assistant Treasurer / *Assistante trésorière*		M. Granrude
Posters, Exhibits, Sponsorships / *Affiches, exposants, commanditaires*		S. Koustov
Facilities / *Locaux*		Y. Pahatouroglou
Clerical Assistant / *Assistante*		D. Kowaliuk
Administrative Assistant / *Assistante administrative*		C. Jelinski
Canadian Light Source :	(Program organizer / *Responsable du programme*)	I. Pickering
Centre canadien de rayonnement synchrotron :	(Local organizers / *Organisateurs locaux*)	E. Hallin, L. Carter, J. Hamel

CAP OFFICE STAFF / PERSONNEL DE L'ACP

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

GENERAL INFORMATION / RENSEIGNEMENTS GÉNÉRAUX

2007 CAP Congress / Congrès de l'ACP 2007

University of Saskatchewan / Université de la Saskatchewan
116 Science Place
Saskatoon, SK S7N 5E2
Tel/tél. : (306) 966-6445; Fax/téléc. : (306) 966-6400
e-mail/courriel : cindy.jelinski@usask.ca; web : cap07.usask.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@physics.uottawa.ca web: http://www.cap.ca

REGISTRATION

From Sunday to Wednesday, the registration and information desk for the Congress will be located in the atrium of the Geology building and will be staffed according to the following schedule:

Sunday June 17th	10h00 - 14h00 (Geol. atrium)
Monday June 18th	07h30 - 14h15 (Geol. atrium)
Tuesday June 19th	07h30 - 14h15 (Geol. atrium)
Wednesday June 20th	07h30 - 11h00 (Geol. atrium)

NOTE: Registration will also be available at TCU Place immediately preceding the Herzberg Memorial Public Lecture on Sunday June 17th from 17h30 to 19h00.

PARKING

You are encouraged to walk from your hotel, ~ 20-25 minute walk from the Radisson and Bessborough (less time from the Parktown and on-campus residences).

Parking Lot	Location	Rate
Stadium Parking	College Drive & Stadium Crescent	$2/exit/day
Agriculture Parkade	Agriculture Building: South entrance via Science Place	$3/exit/day

E-MAIL ACCESS

Wireless is available in most areas of campus. For more information please check: www.usask.ca/its/services/networks/wireless/

Specific information on how to access the wireless service will be included in the registration packages as well as provided on line shortly before the conference.

EXHIBITORS

(see map on page iv for exhibitor list and layout)

SPONSORS

The Congress organizers thank each of the sponsors for their generous contributions. As of press time, these are:

Canadian Light Source
Natural Sciences and Engineering Research Council, Prairie Office

Canadian Institute for Photonics Innovation
University of Saskatchewan (President's Office, Conference Funds, and College of Arts & Science)
UMA
Saskatchewan Industry and Resources
Sasktel
Varian Inc.

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

A complete list of Exhibitors and Sponsors will be made available during the Congress.

INSCRIPTION

De dimanche à mercredi, l'inscription et le kiosque d'information pour le congrès seront situés dans l'atrium de l'édifice de géologie. Le personnel sera disponible aux heures suivantes :

Dimanche 17 juin	10h00 - 14h00 (atrium géol.)
Lundi 18 juin	07h30 - 14h15 (atrium géol.)
Mardi 19 juin	07h30 - 14h15 (atrium géol.)
Mercredi 20 juin	07h30 - 11h00 (atrium géol.)

NOTE: On pourra également s'inscrire à la Place TCU immédiatement avant la conférence commémorative Herzberg dimanche le 17 juin, de 17h30 à 19h00.

STATIONNEMENT

Nous vous encourageons à marcher de votre hôtel : ~ 20-25 minutes du Radisson et du Bessborough (un peu moins du Parktown et des résidences).

Aire de stationnement	Endroit	Taux
Stadium Parking	College Drive et Stadium Crescent	$2/sortie/jour
Agriculture Parkade	Édifice d'agriculture : entrée sud par Science Place	$3/sortie/jour

ACCÈS AU COURRIEL

L'accès à l'internet sans fil est disponible sur la plupart du campus. Pour plus d'information, veuillez consulter www.usask.ca/its/services/networks/wireless/.

Des renseignements spécifiques sur la façon d'accéder au service sans fil seront inclus dans la documentation remise sur place et disponibles en ligne peu avant le congrès.

EXPOSANTS

(Voir la carte à la page iv pour la liste des exposants et la disposition des kiosques)

COMMANDITAIRES

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

Centre canadien de rayonnement synchrotron
Conseil de recherches en sciences naturelles et en génie, bureau des prairies
Institut canadien pour les innovations en photonique
Université de la Saskatchewan (bureau du président, fonds de congrès, collège des arts et sciences)
UMA
Saskatchewan Industry and Resources
Sasktel
Varian Inc.

(Commanditaires des concours étudiants)
Plasmionique Inc.
Gamble Technologies
John Wiley & Sons Canada Ltd.
Pearson Education Canada

La liste complète des exposants et commanditaires sera disponible durant le congrès.

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*

2007 CAP CONGRESS

Welcome to Saskatoon and the University of Saskatchewan! The 62nd Annual Congress of the Canadian Association of Physicists is hosted by the Department of Physics and Engineering Physics and the Institute of Space and Atmospheric Studies (ISAS). The university is celebrating its 100th Anniversary and ISAS its 50th! The city celebrated its 100th Anniversary in 2006.

"Saskatoon" is derived from 'mis-sask-quah-toomina', the Cree Indian name for a local indigenous berry. The city is situated on the banks of the south Saskatchewan river which is crossed by seven bridges within the city limits. Saskatoon is Saskatchewan's largest city with a population of 210,000 and growing fast.

The University of Saskatchewan is the only university in Canada to house all five health science colleges and a major teaching hospital on the same campus. Some of the first experiments undertaken aboard the space shuttle were a result of research conducted here. Innovation Place, located on the university grounds, is one of the most successful university related research parks in North America.

Saskatchewan grows half of the entire quantity of Canada's major export crops: wheat, oats, barley, rye, flaxseed and canola. Mining is also an important part of the economy. The Saskatoon region is the world's largest exporter of uranium, and nearly two-thirds of the world's recoverable potash reserves are located here.

CONGRESS 2007 IN BRIEF

Sunday June 17th

- **Four joint CAP/CLS wokshops**
  Illuminating to New Depths: Our Understanding of Surface Phenomena
  Recent Advances in Condensed Matter Physics with Synchrotron Radiation
  Recent Progress in Studying Biomaterials with Synchrotron Radiation
  Industrial Applications of Synchrotron Radiation
- **Lunch with the Exhibitors in the Geology Atrium.**
- **Brockhouse Medal Talk** ("Photonic band gap materials: Semiconductors of light") by **Alongkarn Chutinan** of the University of Toronto (on behalf of Sajeev John)
- **3rd Annual CAP Congress Student Reception**
  16h30 -18h15 Students (graduate and undergraduate) are cordially invited to a reception in Marquis Hall (Exeter Room). Come meet and network with other students from all over Canada.
- **Public lecture:**
  The Herzberg Memorial Public Lecture will be given at TCU Place by **Nobel Laureate Carl Wieman** of the University of British Columbia, who will speak about "Science education in the 21st century: Using the tools of science to teach science". A reception for delegates and guests will follow.

Monday June 18th

- **Herzberg Medal Talk** ("Observations of the cosmic microwave background") by **C. Barth Netterfield** of the University of Toronto/CITA.
- **Plenary talk** ("Testing the limits of quantum mechanics: Motivation, state of play, prospects") by **Nobel Laureate Anthony Leggett** of the University of Illinois and the University of Waterloo.
- **All day HS Teachers' Workshop.** Professor Wieman will speak about his Nobel Prize winning discovery of Bose-Einstein condensation.
- **Medal of Achievement Talk** ("In the footsteps of Louis Néel: From micromagnetism to the Moon and Mars") by David J. Dunlop of the University of Toronto.
- **Teaching Medal Talk** ("Simplifying the complex with familiarity: An approach to effective physics education at all scale") by **Robert I. Thompson** of the University of Calgary.
- **Committee to Encourage Women in Physics:**
  The meeting will be held at 17:00. Men and women interested in women in physics issues are invited to participate.
- **Beer and Poster session:**
  The CAP07 beer and poster session (with a snack reception) will be held from 19h00 to 22h00 in the Geology Atrium (Atmospheric and Space Science poster session starts at 12h30). Posters should be set up between 12h00 Sunday and 08h00 Monday, and taken down before 17h00 Tuesday. Poster boards are 4' high by 8' wide. Finalists in the poster competition must be at their poster between 19h00 and 20h00 Monday.

Tuesday, June 19th

- **Plenary talk** ("The possibility of the emergence of elementary particle physics from quantum gravity") by **Lee Smolin** of the Perimeter Institute.
- **Two Science Policy Sessions on Establishing a successful public outreach program**, each preceded by a plenary talk:

CONGRÉS DE L'ACP 2007

Bienvenue à Saskatoon et à l'Université de la Saskatchewan! Le 62e congrès annuel de l'Association canadienne des physiciens et physiciennes est reçu par le département de physique et de génie physique et par l'Institut d'études spatiales et atmosphériques (ISAS). L'université célèbre cette année son 100e anniversaire et l'ISAS son 50e! La ville a célébré son 100e anniversaire en 2006.

"Saskatoon" vient de 'mis-sask-quah-toomina', qui dans la langue des Cris désigne un petit fruit local. La ville est située sur les rives de la rivière Saskatchewan sud, que sept ponts traversent à l'intérieur de ses limites. Saskatoon est la plus grande ville de la Saskatchewan, avec une population de 210 000 qui s'accroît rapidement.

L'Université de la Saskatchewan est la seule université canadienne qui ait sur le même campus cinq collèges de sciences de la santé et un grand hôpital universitaire. Quelques-unes des premières expériences réalisées dans la navette spatiale sont le résultat de recherches menées ici. La Place de l'innovation, située sur le campus, est l'un des parcs de recherche para-universitaire qui ont le plus de succès en Amérique du Nord.

La Saskatchewan produit la moitié des principales récoltes d'exportation du Canada: blé, avoine, orge, seigle, graine de lin et canola. Les mines constituent également un secteur important de l'économie. La région de Saskatoon est le plus grand exportateur mondial d'uranium, et près des deux tiers des réserves mondiales de potasse utilisables se trouvent ici.

LE CONGRÈS DE 2007 EN BREF

Dimanche 17 juin

- **Quatre ateliers conjoints ACP/CCRS :**
  Scruter en profondeur: notre compréhension des phénomènes de surface
  Progrès récents en physique de la matière condensée avec rayonnement synchrotron
  Progrès récents dans l'étude des biomatériaux avec le rayonnement synchrotron
  Applications industrielles du rayonnement synchrotron
- **Dîner avec les exposants dans l'atrium de géologie.**
- **Conférence pour la médaille Brockhouse** ("Matériaux à bande interdite photonique: semi-conducteurs de lumière") par **Alongkarn Chutinan** de l'Université de Toronto (pour Sajeev John).
- **3e réception d'étudiants au congrès de l'ACP**
  16h30 à 18h15 Les étudiants de tous les cycles sont cordialement invités à une réception au Marquis Hall (salle Exeter). Venez fraterniser avec des confrères de partout au Canada.
- **Conférence publique :**
  La conférence commémorative Herzberg sera prononcée à la Place TCU par le **lauréat du prix Nobel Carl Wieman** de l'Université de la Colombie-Britannique, qui parlera de "L'éducation scientifique au XXIe siècle: utiliser la science pour l'enseigner". Une réception suivra pour les participants et les invités.

Lundi 18 juin

- **Conférence pour la médaille Herzberg** ("Observations du rayonnement cosmique micro-ondes") par **C. Barth Netterfield** de l'Université de Toronto.
- **Conférence plénière** ("Tester les limites de la mécanique quantique: motivation, état de la question, perspectives") par **le lauréat du prix Nobel Anthony Leggett**, de l'Université de l'Illinois et l'Université de Waterloo.
- **Atelier des enseignants de physique du secondaire.** Le professeur Wieman parlera du condensat de Bose-Einstein, la découverte qui lui a valu le prix Nobel.
- **Conférence pour la médaille pour contributions exceptionnelles à la physique** ("Sur les traces de Louis Néel: du micromagnétisme à la Lune et Mars") par **David J. Dunlop** de l'Université de Toronto.
- **Conférence pour la médaille d'enseignement** ("Simplifier le complexe par la familiarité: une approche de l'enseignement efficace de la physique à toute échelle") par **Robert I. Thompson** de l'Université de Calgary.
- **Comité pour encourager les femmes à la physique :**
  La réunion aura lieu à 17h00. Hommes et femmes intéressés aux questions des femmes en physique sont invités à participer.
- **Bière et session d'affiches :**
  La session d'affiches de 2007 de l'ACP avec bière et goûter aura lieu de 19h00 à 22h00 dans l'atrium de géologie (la session d'affiches de la physique atmosphérique et de l'espace débute à 12h30). On doit placer les affiches entre 12h00 dimanche et 8h00 lundi, et les enlever avant 17h00 mardi. Les panneaux font 4' de hauteur par 8' de largeur. Les finalistes du concours doivent être à leur affiche entre 19:00 et 20:00 lundi.

Mardi 19 juin

- **Conférence plénière** ("La possibilité que la physique des particules émerge de la gravité quantique") par **Lee Smolin** du Perimeter Institute
- **Deux sessions de politique scientifique sur L'établissement d'un programme pour rejoindre le public avec succès**, chacune précédée d'une conférence plénière:

"It was the best of times..." by **Jay Ingram** of Discovery Channel;
"Selling science to unwilling buyers" by **Lawrence Krauss** of Case Western Reserve University.

- **The CAP Annual General Meeting** will be held in Arts 146 from 17:00 to 18:15. Finalists of the student oral competition will be announced immediately before the AGM.
- **Banquet at Western Development Museum:**
  Cocktails will be served at 19:00 in the longest indoor museum street in North America. Dinner will follow, with medals awarded to recipients. Tickets are limited in number and should be booked early ($45 plus GST). Information about transportation will be available at the registration desk.

Wednesday, June 20th

- **Plenary talk** ("Dripping, jetting, drops and wetting: The magic of microfluidics") by **David A. Weitz** of Harvard University.
- **Plenary talk** ("The dark universe and microphysical cosmology") by **Jonathan Feng** of the University of California (Irvine).
- **Finals of the Student oral competition.**
- **Young/New Faculty Luncheon** at 12:00, followed by **NSERC workshop** (open to anyone interested) at 12:30.
- **CAP/CRM Prize Talk** ("Perturbation theory for many fermion systems") by **Joel Feldman** of the University of British Columbia.
- **Industrial and Applied Medal Talk** ("How advanced acoustic imaging will benefit modern industry") by **Roman Maev** of the University of Windsor.

ORAL PRESENTATION INSTRUCTIONS:

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

- Overhead projector
- Wired internet
- PC (Windows XP)
- LCD data projector
- VCR

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

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
- MS Office 2003 (with compatibility pkg. for 2007 Office system).

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

If you plan to use your PC or Mac for a presentation, make sure you contact the audio-visual 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 codex to run video clips, please contact the Division of Media and Technology at: dmtbooking.educ@usask.ca before your arrival on campus.

RECREATIONAL FACILITIES:

U of S Gym passes cost $8/day - they will be available for purchase from the Physical Activity Centre.

GENERAL INFORMATION ON SASKATOON AND THE UNIVERSITY OF SASKATCHEWAN:

More information than could be provided here is available on the Congress web site, cap07.usask.ca. You are encouraged to consult it for additional maps, detailed local information, recreational opportunities in the Saskatoon region, etc.

WEATHER:

Expect moderate to warm climate with average temperatures from 18°C - 25°C.

"C'était le bon temps..." par **Jay Ingram** de Discovery Channel
"Vendre la science à des acheteurs rébarbatifs" par **Lawrence Krauss** de l'Université Case Western Reserve.

- **L'assemblée générale annuelle de l'ACP** aura lieu dans la salle Arts 146 de 17h00 à 18h15. Les noms des finalistes du concours de présentations orales seront annoncés immédiatement avant l'assemblée.
- **Banquet au Western Development Museum :**
  L'apéritif sera offert à 19h00 sur la plus longue rue de musée intérieur en Amérique du Nord. Le banquet suivra, avec la remise des médailles aux récipiendaires. Le nombre de billets est limité, et ceux-ci devraient être réservés le plus tôt possible (45$ TPS en sus). L'information sur le transport sera disponible au kiosque d'inscription.

Mercredi 20 juin

- **Conférence plénière** ("Égoutture, jet, gouttes et mouillage: la magie de la microfluidité") par **David A. Weitz** de l'Université Harvard.
- **Conférence plénière** ("L'univers sombre et la cosmologie microphysique") par **Jonathan Feng** de l'Université de la Californie (Irvine).
- **La finale du concours de présentations orales d'étudiants.**
- **Dîner-rencontre des nouveaux professeurs** à 12h00, suivi de l'**atelier du CRSNG** à 12:30 (ouvert à tous les intéressés).
- **Conférence pour le prix ACP-CRM** ("Théorie des perturbations pour des systèmes de plusieurs fermions") par **Joel Feldman** de l'Université de la Colombie-Britannique.
- **Conférence pour la médaille industrielle et appliquée** ("Comment l'imagerie acoustique avancée va bénéficier à l'industrie moderne") par **Roman Maev** de l'Université de Windsor.

DIRECTIVES CONCERNANT LES EXPOSÉS

Matériel audio-visuel pour les exposés :
Toutes les salles de conférence sont dotées de :

- un projecteur à acétates
- l'internet avec fil
- un PC (Windows XP)
- un canon LCD
- un VCR

Les salles les plus grandes sont également pourvues de visualiseurs et de microphones. Des microphones peuvent être installés dans les salles de classe si on le demande 48 heures à l'avance.

On encourage tous les conférenciers à mettre leur présentation sur clé USB, CD ou DVD, dans un format compatible avec les versions récentes de :

- Acrobat Reader v.7
- MS Office 2003 (avec le paquet de compatibilité pour le système Office 2007)

Vous pouvez aussi apporter votre ordinateur portable. Si votre ordinateur est un Mac, veillez apporter votre adaptateur vidéo.

Si vous utilisez votre PC ou votre Mac pour votre présentation, contactez le technicien audio-visuel de votre salle 15 minutes avant le début de la session, pour connecter votre ordinateur au système multimédia et faire les tests appropriés. Étant donné que toutes les conférences doivent respecter l'horaire, le temps perdu à ajuster votre ordinateur réduira le temps de votre présentation.

Si vous avez besoin d'un codex pour la projection de clips, veuillez contacter la Division of Media and Technology à l'adresse dmtbooking.educ@usask.ca avant votre arrivée sur le campus.

INSTALLATIONS RÉCRÉATIVES :

Des tickets pour le gymnase sont disponibles au coût de 8$ par jour. On peut se les procurer du Physical Activity Centre.

RENSEIGNEMENTS GÉNÉRAUX SUR SASKATOON ET L'UNIVERSITÉ DE LA SASKATCHEWAN :

Plus d'information que ce qu'on peut fournir ici est disponible sur la page web du congrès, cap07.usask.ca. Vous pouvez la consulter pour des cartes additionnelles, 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 18°C à 25°C.

Canadian Assocation of Physicists
Association canadienne des physiciens et physiciennes

MEDALLISTS 2007 LAURÉATS

CAP Medal for Achievement in Physics
Médaille de l'ACP pour contributions exceptionnelles en physique

David Dunlop
University of Toronto

Herzberg Medal
Médaille Herzberg

Barth Netterfield
University of Toronto / CITA

CAP Medal for Excellence in Teaching Undergraduate Physics
Médaille de l'ACP pour l'excellence en enseignement de la physique au premier cycle

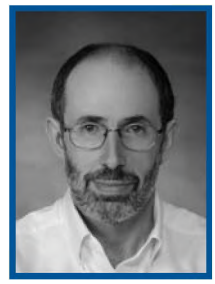
Robert I Thompson
University of Calgary

CAP-DCMMP Brockhouse Medal
Médaille Brockhouse de l'ACP-DPMCM

Sajeev John
University of Toronto

CAP-DIAP Medal for Outstanding Achievement in Industrial and Applied Physics / *Médaille de l'ACP-DPIA pour des réalisations exceptionnelles en physique industrielle et appliquée*

Roman Maev
University of Windsor



CAP/CRM Prize in Theoretical and Mathematical Physics
Prix ACP-CRM en physique théorique et mathématique

Joel Feldman
University of British Columbia

See https://www.cap.ca/awards/capmedals.html for more information about the 2007 medal winners, as well as information about our medals being awarded in 2008 (deadline for nominations is 2008 January 10).

Visitez https://www.cap.ca/awards/capmedals-f.html pour de plus amples renseignements concernant les lauréats de 2007, ainsi qu'une description des médailles qu'on décernera en 2008 (la date limite pour les nominations sera le 10 janvier 2008).

Come and visit the Art of Physics exhibition on display at the 2007 Congress. Entry forms for the 2007 competition will be available at the CAP Information Desk (deadine Dec. 31/07). Winning entries will be added to the travelling exhibition.

Venez visiter l'exposition l'<<Art de la Physique>> tenue lors du Congrès 2007. Les formulaires d'inscription pour le concours 2007 seront disponibles au bureau d'information (la date limite est le 31 décembre 2007). Les gagnants verront leurs œuvres ajoutées à l'exposition itinérante.

Canadian Assocation of Physicists
Association canadienne des physiciens et physiciennes

PRIZE WINNERS / GAGNANTS DES PRIX

University Prize Exam Results 2007
Résultats de l'examen du prix universitaire 2007

83 students from 23 post-secondary institutions competed this year. The exam was run by representatives from Memorial Univ. of Newfoundland and was held on February 6th, 2007. The examining committee members were: Iakov Afanassiev, Todd Andrews, Luc Beaulieu, Stephanie Curnoe, Entcho Demirov, Eric Meloche, Mike Morrow, Martin Plumer, Ivan Saika-Voivod, John Whitehead, and Anand Yethiraj and Len Zedel / 83 étudiants de 23 universités ont écrit l'examen cette année. *Le concours universitaire 2007 de l'ACP a eu lieu 6 février, 2007. Cet examen fut administré par l'Université Mémorial de Terre-Neuve. Les membres de comité étaient Iakov Afanassiev, Todd Andrews, Luc Beaulieu, Stephanie Curnoe, Entcho Demirov, Eric Meloche, Mike Morrow, Martin Plumer, Ivan Saika-Voivod, John Whitehead, Anand Yethiraj et Len Zedel*

Nan Yang	**First Prize / Premier Prix**	Univ. of Toronto / Univ. de Toronto
Brett Teeple	**Second Prize / Deuxième Prix**	Univ. of Calgary / Univ. de Calgary
Alexi Morin-Duchesne	**Third Prize / Troisième Prix**	Univ. of Montreal / Univ. de Montréal

4.	Alison Hill	Queen's U.	8.	Cedric Lin	UBC
5.	Stephen Inglis	UBC	9.	Will Guest	U.Manitoba
6.	Brian Shuve	U.Toronto	10.	Eric Zhu	U.Toronto
7.	Brent Pym	Queen's U.			

2007 University Prize Examination - Examen du prix universitaire 2007
(Highest scoring student from each participating University
L'étudiant supérieur à chaque université participante)

Dalhousie University / Université Dalhousie
- Tyler Burke

McGill University / Université McGill
- Sergei Dyda

McMaster University / Université McMaster
- Arthur Zhao

Mt. Allison University / Université Mt. Allison
- Robert Steele

Queen's University / Université Queen's
- Alison Hill

Royal Military College / Collège militaire royal
- Gabriel Massie

Simon Fraser University / Université Simon Fraser
- Braden Brinkman

St. Francis Xavier Univ. / Univ. St. Francis Xavier
- Patrick Shea

Trent University / Université Trent
- Julian Atfield

Univ. of British Columbia / Univ. de la Colombie-Brit.
- Stephen Inglis

University of Calgary / Université de Calgary
- Brett Teeple

University of Guelph / Université de Guelph
- Taylor Binnington

University of Manitoba / Université du Manitoba
- Will Guest

University of Montreal / Université de Montréal
- Alexi Morin-Duchesne

University of New Brunswick / Université du Nouveau-Brunswick
- Andrew King

University of Ottawa / Université d'Ottawa
- Stefan Guindon

University of P.E.I. / Université de l'I.P.E.
- Mostafa Fatehi

University of Toronto / Université de Toronto
- Nan Yang

University of Victoria / Université de Victoria
- Alistair Fraser

University of Waterloo / Université de Waterloo
- Paul McGrath

University of Windsor / Université de Windsor
- Matthew Williams

York University/ Université York
- Aaron Maxwell

The first prize winner receives an all-expense paid trip to the CAP Congress to receive his $600 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 de 600 $ au banquet.*

Seventh Annual Physics Teachers' Workshop

Monday, June 18th, 2007
University of Saskatchewan, Saskatoon
Room – Biol.106 (cap. 250)

08h15	Registration and light refreshment
09h00	**Testing the limits of quantum mechanics: motivation, state of play, prospects** - Anthony Leggett, Nobel Laureate, *University of Illinois at Urbana and University of Waterloo*
10h00	**Dark matter and dark energy** – Peter Watson, *Carleton University*
10h45	Coffee break
11h00	Meeting with department Chairs: **Skills that students need to be successful in college physics**
12h00	Luncheon
12h45	**Putting photons to work** – Robert Fedosejevs, *University of Alberta and CIPI*
13h30	**Simplifying the complex with familiarity: An approach to effective physics education at all scales** - Robert I. Thompson, *University of Calgary*, 2007 CAP Excellence in Undergraduate Teaching Medal Winner
14h30	**Bose-Einstein condensation: Quantum weirdness at the coldest temperature in the universe** – Carl Wieman, Nobel Laureate, *University of British Columbia*
15h15	Coffee break
15h30	**Science vs. pseudo-science and junk science** – Gary Slater, *University of Ottawa*
16h15	**The aurora borealis: what is it we know and don't know about it?** - Jean-Pierre St. Maurice, *University of Saskatchewan*
17h00	Wrap-up and invitation to poster session

HERZBERG MEMORIAL PUBLIC LECTURE
CONFÉRENCE PUBLIQUE COMMÉMORATIVE HERZBERG

TCU PLACE

Sunday, June 17, 2007 **19h00** **Dimanche, le 17 juin 2007**

Carl Wieman

DR. CARL WIEMAN, NOBEL LAUREATE
UNIVERSITY OF BRITISH COLUMBIA

"Science Education in the 21st Century: Using the Tools of Science to Teach Science"

Guided by experimental tests of theory and practice, science has advanced rapidly in the past 500 years. Guided primarily by tradition and dogma, science education meanwhile has remained largely medieval. Research on how people learn is now revealing how many teachers badly misinterpret what students are thinking and learning from traditional science classes and exams. However, research is also providing insights on how to do much better. The combination of this research with modern information technology is setting the stage for a new approach that can provide the relevant and effective science education for all students that is needed for the 21st century. I will discuss the failures of traditional educational practices, even as used by "very good" teachers, and the successes of some new practices and technology that characterize this more effective approach. Some applications to technical presentations will also be mentioned.

" L'éducation scientifique au XXIe siècle : utiliser la science pour l'enseigner"

Guidée par les tests expérimentaux de théories et par la pratique, la science a progressé rapidement depuis 500 ans. Guidée surtout par la tradition et les dogmes, l'éducation scientifique est demeurée pendant ce temps largement médiévale. La recherche sur la façon d'apprendre révèle comment de nombreux enseignants interprètent très mal ce que pensent les étudiants et ce qu'ils apprennent des cours et des examens de science traditionnels. Mais la recherche montre également comment faire beaucoup mieux. La combinaison de cette recherche et de la technologie informatique moderne prépare la voie à une nouvelle approche vers une éducation scientifique pertinente et efficace pour tous les étudiants, nécessaire au XXIe siècle. Je vais traiter de la faillite des pratiques traditionnelles, même lorsqu'elles sont utilisées par de « très bons » enseignants, et des succès de nouvelles pratiques et technologies caractérisant cette approche plus efficace. Je mentionnerai également quelques applications aux exposés techniques.

BIOGRAPHY / BIOGRAPHIE

Carl Wieman grew up in the forests of Oregon and was educated at MIT and Stanford. Dr. Wieman, a long-term Distinguished Professor of Physics at the University of Colorado, joined UBC in January 2007. He has carried out research in a variety of areas of atomic physics and laser spectroscopy, and was awarded the Nobel Prize in Physics in 2001 for the creation and study of Bose-Einstein condensation in a dilute vapor. His work on innovations in teaching physics to a broad range of students, on student beliefs about physics, and on problem-solving skills has been recognized by several prestigious awards.

Carl Wieman a grandi dans les forêts de l'Oregon et a étudié au MIT et à Stanford. Le Dr. Wieman est depuis longtemps distingué professeur de physique à l'Université du Colorado et il s'est joint à UBC en janvier 2007. Il a fait des recherches dans plusieurs domaines de la physique atomique et de la spectroscopie laser, et a reçu le prix Nobel de physique en 2001 pour la création et l'étude du condensat de Bose-Einstein dans une vapeur diluée. Ses travaux sur l'innovation dans l'enseignement de la physique à un large éventail d'étudiants, sur les croyances des étudiants à propos de la physique et sur les aptitudes à la solution de problèmes ont été reconnus par plusieurs prix prestigieux.

PLENARY SESSION - SESSION PLÉNIÈRE

09h00-09h45, MONDAY, JUNE 18, 2007 -- UNIVERSITY OF SASKATCHEWAN, ARTS 143/146

Anthony Leggett, Nobel Laureate

University of Illinois and University of Waterloo

"Testing the limits of quantum mechanics: motivation, state of play, prospects"

I present the motivation for experiments which attempt to generate, and verify the existence of, quantum superpositions of two or more states which are by some reasonable criterion "macroscopically" distinct, and show that various a priori objections to this program made in the literature are flawed. I review the extent to which such experiments currently exist in the areas of free-space molecular diffraction, magnetic biomolecules, quantum optics and Josephson devices, and sketch possible future lines of development of the program.

Anthony Leggett, Prix Nobel

Université de l'Illinois et Université de Waterloo

"Tester les limites de la mécanique quantique: motivation, état de la question, perspectives"

Je présente la motivation d'expériences qui tentent de produire des superpositions quantiques de deux états ou plus qui sont, selon des critères raisonnables, "macroscopiquement" distincts, et de vérifier leur existence. Je montre que différentes objections a priori faites à ce programme dans la littérature sont déficientes. J'examine à quel point de telles expériences existent présentement dans les domaines de la diffraction moléculaire libre dans l'espace, des biomolécules magnétiques, de l'optique quantique et des dispositifs de Josephson, et je trace les lignes de développement possibles du programme.

NEW FACULTY LUNCHEON / DÉJEUNER POUR LES NOUVEAUX PROFESSEUR(E)S

12h00, WEDNESDAY, JUNE 20, 2007 -- UNIVERSITY OF SASKATCHEWAN, LOCATION TBA

We extend a special invitation to new Faculty members to attend the CAP Congress, to be held at the University of Saskatchewan in Saskatoon, SK, from the 17th to the 20th of June 2007. The CAP Congress is a unique opportunity to meet and hear colleagues from universities across Canada, and to discover a part of our country. For new Faculty members who choose to attend the Congress, we have organized a special luncheon at 12h00 on Wednesday, June 20th. This luncheon will be hosted by NSERC and the CAP's Director of Academic Affairs. NSERC representatives will give a short presentation followed by a question period and a round table discussion of issues of interest to new professors.

If you would like to attend, please let us know by e-mail at cap@physics.uottawa.ca. We welcome any suggestions regarding information that you would like to obtain from NSERC, or topics that you would like to hear discussed at the round table.

We hope to see you in Saskatoon.

N.B. A new professor is any regular Faculty member who started after September 1, 2005.

Nous lançons une invitation spéciale aux nouveaux professeurs pour assister au Congrès de l'ACP à l'Université de la Saskatchewan, Saskatoon, SK du 17 au 20 juin. Le Congrès de l'ACP est une occasion unique de rencontrer et d'écouter vos collègues des autres universités canadiennes, en plus de découvrir un joli coin de notre pays. Pour les nouveaux professeurs, qui assisteront au Congrès, nous avons aussi organisé un déjeuner spécial à 12h00 le mercredi 20 juin. Le déjeuner sera animé par le CRSNG et le Directeur des affaires académiques de l'ACP. Des représentants du CRSNG vont faire une courte présentation sur les programmes disponibles aux professeurs de physique au Canada et resteront pour répondre à vos questions. La discussion sera suivie d'une table ronde sur les sujets d'intérêt des nouveaux professeurs.

Si vous souhaitez assister au déjeuner, veuillez nous le faire savoir en envoyant un courrier électronique à cap@physics.uottawa.ca. Toutes suggestions à propos des sujets que vous aimeriez entendre des représentants du CRSNG ou lors de la table ronde seront bienvenues.

Nous espérons vous voir à Saskatoon.

N.B. Un nouveau professeur est tout professeur régulier qui est entré en fonction après le 1er septembre 2005.

NSERC Workshop

Wednesday/Mercredi, June 20 juin

12h30 ; Biol. 106 (cap. 250)

News and Overview of the NSERC Grant Selection Process

Nouvelles et vue d'ensemble du processus de sélection des subventions du CRSNG

NSERC staff and Grant Selection Committee members will present an interactive overview of the peer review process, inform you of the latest changes at NSERC, give useful advice for the preparation of your next NSERC application and answer your questions on the functioning of grant selection committees. The workshop is open to all researchers. It will be particularly helpful to new faculty members and researchers likely to apply (or re-apply) in the fall.

Des employés du CRSNG et des membres des comités de sélection des subventions du CRSNG donneront une présentation en mode interactif sur le processus d'évaluation par les pairs, vous renseigneront sur les derniers changements opérés au CRSNG, vous donneront des conseils utiles pour l'élaboration de votre prochaine demande de subvention au CRSNG et répondront à vos questions sur le fonctionnement des comités de sélection des subventions. Tous les chercheurs peuvent participer à l'atelier, qui sera particulièrement utile aux professeurs et aux chercheurs récemment embauchés qui comptent soumettre une demande (ou une nouvelle demande) à l'automne.

SCIENCE POLICY SESSION SUR LA POLITIQUE SCIENTIFIQUE
2007 JUNE 19 JUIN -- ROOM-SALLE ARTS 143/146

COMMUNICATION AND OUTREACH WITH THE PUBLIC
LA COMMUNICATION AVEC LE PUBLIC

09h00 - Jay Ingram | 10h00 - Session I | 13h30 - Lawrence Krauss | 14h15 - Session II

Mr. Jay Ingram, Discovery Channel — Room-Salle Arts 143/146

It was the Best of Times ... / C'était le bon temps ...

We are living in a glass half-full / half-empty epoch. On one side there is a growing chorus of interest in science outreach, the stimulation of innovation and the establishment of a science culture. Governments and funding agencies are talking that talk. But who is walking the walk? In fact, does anybody know WHAT to do to achieve any of these goals? Are these goals even the right ones? Well Jay Ingram doesn't have the answers, but at least he's willing to ask the questions.

Nous vivons à une époque où le verre est à moitié plein et à moitié vide. Il y a d'un côté un intérêt croissant pour la communication scientifique, une stimulation de l'innovation et l'établissement d'une culture scientifique. Le gouvernement et les agences subventionnaires tiennent ce langage. Mais qui se met en marche ? Quelqu'un sait-il QUE faire pour parvenir à chacun de ces objectifs ? Et ces objectifs sont-ils vraiment les bons ? Jay Ingram n'a pas toutes les réponses, mais il est à tout le moins prêt à poser les questions.

Establishing a Successful Public Outreach Program I — Room-Salle Arts 143
Établir un programme pour rejoindre le public avec succès I — 10h00-12h30

10h00	Brian Alters, McGill University - Evolution & Intelligent Design Creationism: Big Failures of Science Outreach
10h30	Bill Peters, Canadian Association of Science Centers - The Joys and Challenges of Outreach
10h45	Normand Mousseau,, Université de Montréal - Science! on blogue. Commentaires sur 2 ans de blogue scientifique
11h00	Marge Bardeen, Fermilab - Education and Outreach at Femilab: Ideas from the Field
11h15	Emil Hallin, Canadian Light Source - Outreach at the Canadian Light Source
11h30	Discussion Break
12h30	Session Ends

Dr. Lawrence Krauss, Case Western Reserve University — Room-Salle Arts 143/146

Selling Science to Unwilling Buyers / Vendre la science à des acheteurs rébarbatifs

You meet someone at a party and they ask what you do. You tell them you are a physicist. Quickly they change the topic. On the other hand, ask them whether they are interested in black holes, warp drives, or time travel, and they are fascinated. Most people perceive that they have little interest in physics, and yet at the same they are remarkably interested in many of the things that physics deals with. I will discuss some fun ways to overcome the former and exploit the latter, as well as discuss some of the challenges and obstacles to overcoming scientific illiteracy that come from the media and the political arena.

Vous rencontrez quelqu'un à une soirée et il ou elle vous demande ce que vous faites. Vous répondez que vous êtes physicien. Très vite le sujet change. Mais demandez aux gens s'ils sont intéressés aux trous noirs, à la distorsion ou aux voyages dans le temps, et les voilà fascinés. La plupart des gens se reconnaissent peu d'intérêt pour la physique, et pourtant ils sont remarquablement intéressés par beaucoup de choses dont la physique s'occupe. Je vais parler de façons amusantes de modifier ces perceptions et d'exploiter l'intérêt, et traiter de quelques défis et d'obstacles au développement de la culture scientifique, liés aux médias et à la scène politique.

Establishing a Successful Public Outreach Program II — Room-Salle Arts 143
Établir un programme pour rejoindre le public avec succès II — 14h15-16h30

14h15	James Pinfold, University of Alberta - Forging a Cosmic Connection Between High Schools and Science
14h30	Marcello Pavan, TRIUMF - TRIUMF's experience with creating computer animation-intensive educational videos
14h45	Tracy Walker, Canadian Light Source - Educational Outreach Programs at the Canadian Light Source
15h00	Alan Nursall, Science North - Setting the stage for science: fun is learning
15h15	Damien Pope, Perimeter Institute - Educational Outreach at Perimeter Institute for Theoretical Physics
15h30	Discussion Break
16h30	Session Ends

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 instrumentation 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*

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
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 Graduate Student Paper Competition / Compétition 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*)

ALEKSEJEVS, Aleksandrs (DNP-DTP / DPN-DPT)
Saint Mary's University
Impact of Radiative Effects on Parity-Violating Electron-Nucleon Scattering

ALTERS, Brian (CAP / ACP)
McGill University
Evolution & Intelligent Design Creationism: Big Failures of Science Outreach

ANDO, Tsuneya (DCMMP / DPMCM)
Tokyo Institute of Technology
Quantum anomalies in graphene

APALKOV, Vadym (DCMMP / DPMCM)
Georgia State University
Dirac Electrons in Graphene : Magnetic Field and Artificial Atoms

APPADOO, Dominique (DAMPhi-DOP / DPAMip-DOP)
Canadian Light Source
Commissioning of the Far-Infrared Beamline at the Canadian Light Source Inc.

ATHERTON, John (DPE / DEP)
Eastern Commerce C.I.
Why bother teaching physics in high school at all?

BARBI, Mauricio (PPD-DTP / PPD-DPT)
University of Regina
Towards the International Linear Collider

BARDEEN, Marge (CAP / ACP)
Fermilab
Education and Outreach at Fermilab : Ideas from the Field

BARE, Simon (DIAP-CLS / DPIA-CCRS)
UOPLLC
The Impact of In Situ X-ray Absorption Spectroscopy on Catalysis Research at UOP

BECHHOEFER, John (DCMMP / DPMCM)
Simon Fraser University
How frog embryos replicate their DNA reliably

BERCIU, Mona Inesa (DCMMP-DTP / DPMCM-DPT)
University of British Columbia
Green's function of single Holstein polarons

BHARDWAJ, Ravi (DOP)
University of Ottawa
Femtosecond laser induced nanostructures inside glass: role of transient nanoplasmonics

BONEV, Stanimir (DCMMP / DPMCM)
Dalhousie University
Liquid-liquid transitions and exotic melting behavior in dense alkali metals

BOUCHARD, Vincent (DTP / DPT)
Perimeter Institute
Can string theory reproduce the Standard Model of particle physics?

BOULAY, Mark G. (PPD / PPD)
Queen's University
DEAP liquid argon dark matter particle search at SNOLAB

CAMPBELL, Melanie (CAP / ACP) **PLENARY**
University of Waterloo
CAP's Parnerships in the Promotion of Canadian Physics

CHANG, Gap Soo (DCMMP / DPMCM)
University of Saskatchewan
Ferromagnetism in Diluted Magnetic Semiconductors : Intrinsic or Extrinsic ?

CHETTLE, David (DNP-DMBP / DPN-DPMB)
McMaster University
Nuclear and Atomic Physics Techniques for the Elemental Analysis of Living Human Subjects

CHUTINAN, Alongkarn (CAP-DCMMP / ACP-DPMCM) **PLENARY**
University of Toronto
Photonic Band Gap Materials : Semiconductors of Light

CLINE, Doug (DNP / DPN)
University of Rochester
Coulomb-excitation studies of radioactive ^{20,21}Na beams

CORRIVEAU, François (PPD)
McGill University
Electroweak Results from ZEUS

CUMMING, Andrew (DNP / DPN)
McGill University
Nuclear Physics in Type I X-ray Bursts and Superbursts

CZARNECKI, Andrzej (DNP / DPN)
University of Alberta
The Standard Model : A Critical Review

DASGUPTA, Keshav (DTP / DPT)
McGill University
Lumps in the throat

De JONG, Mark (DIMP / DPIM)
Canadian Light Source
Beam Position Measurements at CLS: Instrumentation and Application

DESROSIERS, Patrick (DTP / DPT)
Université Laval
Statistical properties of spectra and symmetric functions

DODGE, J. Steven (DCMMP / DPMCM)
Simon Fraser University
A view of metals through the terahertz window

DUNLOP, David J. (CAP / ACP) **PLENARY**
University of Toronto
In the Footsteps of Louis Néel : from Micromagnetism to the Moon and Mars

EDERY, Ariel (DTP / DPT)
Bishop's University
The Casimir piston in 3+1 dimensions

FARAONI, Valerio (DTP / DPT)
Bishop's University
f(R) Cosmology

FEDOSEJEVS, Robert (CAP / ACP)
University of Alberta
Putting Photons to Work

FELDMAN, Joel (DTP / DPT)
University of British Columbia
A Rigorous Variant of the Standard Many Boson Functional Integral

FELDMAN, Joel (CAP / ACP) **PLENARY**
University of British Columbia
Perturbation Theory for Many Fermion Systems

FENG, Jonathan (PPD-CAP / PPD-ACP) **PLENARY**
University of California, Irvine
The Dark Universe and Microphysical Cosmology

FORD, Nancy (DIMP / DPIM)
Ryerson University
Retrospectively gated imaging using a high-speed, flat-panel equipped cone beam micro-CT scanner

FORREST, Jamie (DCMMP / DPMCM)
University of Waterloo
Protein denaturing on nanospheres

FRISKEN, William Ross (DHP / DHP)
York University
The History of the Institute of Particle Physics : Linking Small Groups to do Big Physics

FROLOV, Andrei (DTP / DPT)
Simon Fraser University
To be announced / à venir

GADE, Alexandra (DNP / DPN)
Michigan State University
Nuclear Structure Studies with Fast Exotic Beams

GALINDO-URIBARRI, Alfredo (DNP / DPN)
Oak Ridge National Laboratory
Polarization Observables and Radioactive Ion Beams

GAULIN, Bruce (DCMMP / DPMCM)
McMaster University
Frustrated and Satisfied Ground States in Pyrochlore Magnets

GEORGE, Graham (DCMMP-DMBP-CLS / DPMCM-DPMB-CCRS)
University of Saskatchewan
Functionally Focused Biomaterials -- Metallo-Enzyme Active Sites

GERICKE, Michael (DNP / DPN)
University of Manitoba
Testing the Standard Model with Cold Neutrons: (The Nab Experiment)

GRAHAM, Kevin (PPD-CAP / PPD-ACP)
Carleton University
From Neutrinos to Dark Matter

HACHÉ, Alain (DOP-DAMPhi / DOP-DPAMip)
Universite de Moncton
Towards a New Type of Photonic Device

HALDOUPIS, Christos (DASP / DPAE)
University of Crete, Greece
An overview of mid-latitude sporadic E layers

HALJEN, Paul (DOP-DAMPhi / DOP-DPAMip)
Simon Fraser University
Simulating Quantum Magnets with Trapped Ions

HALLIN, Emil (CAP / ACP) and (DIMP-CLS / DPIM-CCRS)
University of Saskatchewan
Outreach at the Canadian Light Source, and The Research Toolkit at the Canadian Light Source

HAMZA, Abdelhaq M. (DASP / DPAE)
University of New Brunswick
Space Plasma Turbulence Revisited

HERBUT, Igor (DCMMP / DPMCM)
Simon Fraser University
Graphene : symmetries, interactions, Hall effect

HIROSE, Akira (DPP)
University of Saskatchewan
20 Years of STOM-M tokamak

INGRAM, Jay (CAP / ACP) **PLENARY**
Discovery Channel
It was the Best of Times ....

ISAKOV, Sergei (DCMMP-DTP / DPMCM-DPT)
University of Toronto
Fractionalized Mott insulating phases in hard-core boson models on the kagome and pyrochlore lattices

JACKSON, J. David (DHP / DHP)
University of California Berkeley
Phil Wallace and Theoretical Physics at McGill in the 1950s : a personal perspective

JENNINGS, Byron (DNP-DTP / DPN-DPT)
TRIUMF
The Nuclear Shell Model, the Renormalization Group, and the Projection Operator Formalism

JEON, Sangyong (DNP-DTP / DPN-DPT)
McGill University
Jet energy loss in hot Quark Gluon Plasma

JILLINGS, Chris (DNP / DPN)
SNOLAB
From Neutrino Oscillations to Nonproliferation: The amazing utility of proton inverse-beta decay

JONES, Dylan (DASP / DPAE)
University of Toronto
Space-based constraints on the global transport of pollution in the troposphere

JOOS, Béla (DHP / DPH)
University of Ottawa
Philip Wallace, Educator and Pioneer of the Canadian Theoretical Physics Community

KALMAN, Calvin (DPE / DEP)
Concordia University
Beyond Conceptual Change: Changing Students' Epistemologies

KANUNGO, Rituparna (DNP / DPN)
St. Mary's University
Lifetime of the 4.03 MeV State in ^{19}Ne and its Astrophysical Implications

KARTTUNEN, Mikko (DMBP / DPMB)
University of Western Ontario
Multiscale modeling of soft matter and biological systems

KATO, Issei (PPD / PPD)
TRIUMF
The T2K experiment: study of neutrino oscillations

KEDZIERSKI, Wladyslaw (DAMPhi / DPAMip)
University of Windsor
Studying Electron Collisions Using a Magneto-Optical Trap

KIEFFER, Jean-Claude (DAMPhi-DOP / DPAMip-DOP)
INRS-Energie, Materiaux et Telecommunications
Ultrafast Structural Imaging and High Field Science at the Advanced Laser Light Source (ALLS) Facility

KIRZ, Janos (DCMMP-DMBP-CLS / DPMCM-DPMB-CRRS)
Lawrence Berkeley National Laboratory
Diffraction Microscopy of Yeast

KONIK, Robert (DCMMP-DTP / DPMCM-DPT)
Brookhaven National Laboratory
To be announced / à venir

KRAUSS, Carsten (PPD)
Queen's University
News from the Final Phase of the Sudbury Neutrino Observatory

KRAUSS, Lawrence (CAP / ACP) **PLENARY**
CWRU
Selling Science to Unwilling Buyers

KUNSTATTER, Gabor (DTP / DPT)
University of Winnipeg
Can Holographic Arguments Yield the 5-D Choptuik Scaling Exponent from 4-D Yang-Mills Theory?

KURCHANINOV, Leonid (DNP-DMBP / DPN-DPMB)
TRIUMF
Liquid Xenon Detector for Medical Imaging

KURCHANINOV, Leonid (PPD)
TRIUMF
Development of instrumentation for particle physics in TRIUMF

KYCIA, Stefan (DCMMP / DPMCM)
University of Guelph
The Future Brockhouse X-Ray Diffraction and Scattering Sector for Materials Science at the Canadian Light Source

LEGARE, Francois (DIMP / DPIM)
INRS
Nonlinear Optical Microscopy for Biomedical Imaging

LEGGETT, Anthony (CAP / ACP) **PLENARY**
University of Waterloo / University of Illinois at Urbana-Champaign
Testing the limits of quantum mechanics: motivation, state of play, prospects

LILGE, Lothar (DMBP / DPMB)
University of Toronto / University Health Network
Can optical spectroscopy teach us something about tissue aging and preventive oncology?

LOGAN, Heather (PPD-DTP / PPD-DPT)
Carleton University
LHC Phenomenology

MACDONALD, Robert (PPD)
University of Alberta
Measurements of the Muon Decay Spectrum from TWIST

MAEV, Roman (CAP / ACP) **PLENARY**
University of Windsor
How Advanced Acoustic Imaging will Benefit Modern Industry

MANDELIS, Andreas (DIMP / DPIM)
University of Toronto
Dental Thermophotonics: Laser Photothermal Methods vs X-rays in the Race for Dental Caries Diagnostics in Clinical Denistry

MANN, Ian (DASP / DPAE)
University of Alberta
The Earth's magnetosphere as a plasmaphysical particle accelerator: The geophysical synchrotron?

MARANGONI, Alejandro (DCMMP / DPMCM)
University of Guelph
Exploiting small-molecule self-assembly properties to create edible supramolecular structures

MARZIALI, Andre (DIAP / DPIA)
University of British Columbia
Physics for CSI: Two dimensional non-linear electrophoresis for DNA extraction in forensics applications

McINTYRE, N. Stewart (DIAP-CLS / DPIA-CCRS)
Surface Science Western, University of Western Ontario
Mechanical Strain Measurements on a Microscopic Scale using Synchrotron Radiation : Applications to Nuclear Materials

MELCONIAN, Daniel G. (DNP / DPN)
University of Washington/CENPA
Nuclear beta decay and the CKM mass-mixing matrix

METZLER, Ralf (DMBP / DPMB)
University of Ottawa
Functional properties of DNA and its active role in DNA-protein interactions

MITARAI, Osamu (DPP)
Kyushu Tokai University
AC operation in the STOR-M tokamak

MOAZZEN-AHMADI, Nasser (DAMPhi / DPAMip)
University of Calgary
Toward an Accurate Database for the 12 Micron Band of Ethane

MORRIS, Stephen (DCMMP / DPMCM)
University of Toronto
Some new rope tricks

MOUSSEAU, Normand (CAP / ACP)
Université de Montréal
Science! on blogue. Commentaires sur 2 ans de blogue scientifique

NAGATA, M. (DPP)
Hyogo University, Hyogo, Japan
Compact Torus Injection Experiments on JFT-2M Tokamak

NETTERFIELD, C. Barth (CAP / ACP) **PLENARY**
University of Toronto / CITA
Observations of the Cosmic Microwave Background

NG, John (DNP / DPN)
TRIUMF
Operator Analysis of Physics Beyond the Standard Model and Low Energy Electroweak Measurements

NG, John (PPD)
TRIUMF
Radiative Neutrino Mass Generation as an Alternative to the Seesaw Mechanism

NILSSON, Anders (DCMMP-DMBP-CLS / DPMCM-DPMB-CCRS)
Stanford University
X-ray and electron spectroscopy investigations of water, in the liquid phase and on surfaces

NOBLE, Anthony (PPD)
Queen's University
The PICASSO Dark Matter Search Experiment

NURSALL, Alan (CAP / ACP)
Science North
Setting the stage for science : fun is learning

O'MEARA, Joanne (DPE / DEP)
University of Guelph
The CAP Physics 1st year curriculum – a first run

OSER, Scott (DNP / DPN)
University of British Columbia
Neutrino Interactions In, Around, and Beyond the Standard Model

PAGE, Shelley (DNP / DPN)
University of Manitoba
Testing the Standard Model via a new measurement of the electron's weak charge in parity-violating Möller scattering at 12 GeV

PAVAN, Marcello (CAP / ACP)
TRIUMF
TRIUMF's experience with creating computer animation-intensive educational videos

PETERS, Bill (CAP / ACP)
Canadian Association of Science Centers
The Joys and Challenges of Outreach

PIGNOLET, Alain (DIMP / DPIM)
INRS - Energie, Materiaux et Telecommunications
Voltage Modulated Piezoelectric Response Scanning Force Microscopy of Ferroic Oxide Films and Structures

PINFOLD, Jim (CAP / ACP)
University of Alberta
Forging a Cosmic Connection Between High Schools and Science

POGOSIAN, Levon (DTP / DPT)
Simon Fraser University
The Integrated Sachs-Wolfe effect as a probe of dark energy and modified gravity

POPE, Damien (CAP / ACP)
Perimeter Institute for Theoretical Physics
Educational Outreach at Perimeter Institute for Theoretical Physics

QIAN, Yong-Zhong (DNP / DPN)
University of Minnesota
Neutrinos and The Origin of the Elements

RAGAN, Ken (PPD / PPD)
McGill University
Status of and first results from the high energy gamma-ray experiment VERITAS

RANGACHARYRULU, Chary (DNP / DPN)
University of Saskatchewan
New Physics in the measurement of transverse muon polarization

RIGDEN, John (DHP / DHP)
American Physics Society
Physics History in Bronze

ROCCA, Jorge (DAMPhi-DOP / DPAMip-DOP)
Colorado State University
High brightness table-top soft x-ray lasers at high repetition rate

SAWATZKY, George (DCMMP-CLS / DPMCM-CCRS)
University of British Columbia
Resonant X-ray scattering: a new tool for structural studies of condensed matter systems

SÉNÉCHAL, David (DCMMP-DTP / DPMCM-DPT)
Université de Sherbrooke
Progress on strongly correlated electron systems with the variational cluster approximation

SHARAPOV, Sergei (DCMMP / DPMCM)
McMaster University
Dirac-like quasiparticles in Graphene

SHEN, Jun (DIMP / DPIM)
NRC Institute for Fuel Cell Innovation
Photothermal-deflection measurements of thermophysical and mass-diffusion properties of gases

SHEPHERD, Ted (DASP / DPAE)
University of Toronto
The role of the upper troposphere/lower stratosphere in the climate system

SLATER, Gary (CAP-DPE / DPE-CAP)
University of Ottawa
Science vs Pseudo-Science and Junk Science

SMOLIN, Lee (DTP-DHP-CAP / DPT-DHP-ACP) **PLENARY**
Perimeter Institute for Theoretical Physics
The possibility of the emergence of elementary particle physics from quantum gravity

SNIHUR, Robert (PPD)
McGill University
Latest Results from the CDF Collaboration

ST-MAURICE, Jean-Pierre (CAP-DPE / ACP-DEP)
University of Saskatchewan
The aurora borealis: what is it we know and don't know about it?

ST-MAURICE, Jean-Pierre (DASP / DPAE)
University of Saskatchewan
PolarDARM: A new window on magnetospheric processes at very high latitudes

SUTTON, Mark (DCMMP-CLS / DPMCM-CCRS)
McGill University
What's new in x-ray intensity fluctuation spectroscopy

SVENNE, Juris (DNP-DTP / DPN-DPT)
University of Manitoba
Coupled-channel study of scattering from and structure of nuclei on and off the line of stability

TAYLOR, Wendy (PPD / PPD)
York University
Recent results from the D0 Experiment

THOMPSON, Robert I. (CAP / ACP) **PLENARY**
University of Calgary
Simplifying the complex with familiarity : An approach to effective physics education at all scales

TORONOV, Vladislav (DMBP / DPMB)
Ryerson University
Combined Functional Near-Infrared and Magnetic Resonance Imaging of the Human Brain

TRIGGER, Isabel (PPD / PPD)
TRIUMF
ATLAS in Canada: International Solutions to Universal Questions

TSE, John (DCMMP-CLS / DPMCM-CCRS)
University of Saskatchewan
Electronic and Phonon Spectroscopy with Inelastic X-ray Scattering

VAN WAERBEKE, Ludovic (DTP / DPT)
University of British Columbia
Observational Cosmology in the 21st Century

VIAUD, Benoit (PPD / PPD)
Université de Montréal
Overall status and physics highlights of the BaBar Experiment

VILLENEUVE, David M. (DAMPhi / DPAMip)
National Research Council
Can We Image a Single Molecular Orbital Wave Function Using an Intense Femtosecond Laser?

VISWANATHAN, Kadayam S. (DTP / DPT)
Simon Fraser University
Understanding QCD via AdS/CFT correspondence

VOCKENHUBER, Christof (DNP / DPN)
TRIUMF
Ti-44 and Hf-182 – Two Nuclides in the World of Astrophysics

WALKER, Tracy (CAP / ACP)
Canadian Light Source
Educational Outreach Programs at the Canadian Light Source

WALTON, Mark (DTP / DPT)
University of New Brunswick
Phase-space quantum mechanics of a particle on the half-line

WARD, William (DASP / DPAE)
University of New Brunswick
Understanding the Role of the Middle Atmosphere : Canadian contributions

WATSON, Peter J.S. (DPE / DEP)
Carleton University
Dark Matter and Dark Energy

WEIHS, Gregor (DOP-DAMPhi / DOP-DPAMip)
University of Waterloo
Entangled Photon Pairs for Quantum Communication

WEITZ, David A. (DCMMP / DPMCM) **PLENARY**
Harvard University
Dripping Jetting, Drops and Wetting: the Magic of Microfluidics

WHITEHEAD, Lorne (DIAP / DPIA)
University of British Columbia
A cost-effective approach to core daylighting

WIEMAN, Carl (CAP-CLS / ACP-CCRS) **PLENARY**
University of British Columbia
Science Education in the 21st Century : Using the Tools of Science to Teach Science
PLUS 2 talks (DPE / DEP) -
Interactive simulations for teaching physics, a powerful (and dangerous) educational tool, AND Bose-Einstein condensation : quantum wierdness at the lowest temperature in the universe

WINICK, Herman (DIMP-CLS / DPIM-CCRS)
SLAC, Stanford University
From Roentgen to X-ray Free-electron Lasers : The Evolution of X-ray sources and science over 100 years

WYSOKINSKI, Tomasz W. (DMBP / DPMB)
Canadian Light Source Inc., University of Saskatchewan
Developing a World-Class Beamline for the Biomedical Imaging and Therapy Program -- Risks and Unknowns

ZHENG, Haishan (DIMP / DPIM)
BC Cancer Research Centre
Fast Raman Spectroscopy for Real-time in vivo Tissue Analysis for Early Cancer Detection

CAP Congress 2007
Listeners, Speakers, and Session Chairmen

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.

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 10 minutes for an invited paper.
- Answer questions and perhaps comments as completely and briefly as made necessary by the response of the audience.
- Obey your session chairman's instructions.
- Most important, practice giving your talk before the meeting. Remember, you are the ambassador of your department and institution, and you will be judged by your audience.

SESSION CHAIRS

- Get to the session room about half an hour before your session begins. Check that all needed projection and auxiliary equipment are present and operational. Check that your speakers are present.
- Introduce yourself to 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.
- If someone fails to appear to give a paper, then either close the session until the time of the next scheduled speaker or else use the time imaginatively, perhaps begin a discussion of earlier papers.
- Under no circumstances may the order of giving the papers differ from that given in the program, as all Congress participants rely on the timing indicated in the program to plan their participation/attendance at sessions or individual presentations.

LEGEND/*LÉGENDE*
Arts = Arts Building
Biol. =Biology Building
Geol. = Geology Building
Phys. = Physics Building
Thor. = Thorvaldson Building

CAP CONGRESS / CONGRÈS DE L'ACP

UNIVERSITY OF SASKATCHEWAN / UNIVERSITÉ DE LA SASKATCHEWAN
SASKATOON, SASKATCHEWAN
JUNE 17-20 JUIN 2007

Saturday / Samedi, June 16 juin

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

Sunday / Dimanche, June 17 juin

10h00 - 14h00	**Conference Registration and Information / *Inscription au Congrès et information***	Geol. (atrium)
08h15 - 11h00	Meeting of Heads/Chairs of Physics Depts / *ACP - Réunion des directeurs de départements de physique* (SU-Hd-Chr)	Marquis Hall (Selkirk Room)
08h30 - 12h00	Recent Advances in Condensed Matter Physics with Synchrotron Radiation / *Progrès récents en physique de la matière condensée avec rayonnement synchrotron* (SU-A1)	tba
08h30 - 12h30	Illuminating to New Depths: Our Understanding of Surface Phenomena I / *Scruter en profondeur : notre compréhension des phénomènes de surface I* (SU-A2)	tba
09h00 - 12h00	IPP Board of Trustees Meeting / *Réunion du conseil d'administration de l'IPP* (SU-IPP-Bd)	Phys. 127
12h00 - 13h15	Lunch with Exhibitors / *Dîner avec les exposants* (SU-EXHIBIT)	Geol. 102
12h15 - 13h15	Past Presidents' Luncheon / *Dîner des anciens présidents* (SU-Past-Pres)	tba
13h30 - 14h10	**CAP Brockhouse Medal Winner / *Récipiendaire de la médaille Brockhouse de l'ACP* - *Sajeev John,* *University of Toronto*** (SU-Plen1)	**Arts 143**
13h30 - 16h45	Illuminating to New Depths: Our Understanding of Surface Phenomena II / *Scruter en profondeur : notre compréhension des phénomènes de surface II* (SU-P4)	tba
14h00 - 17h00	SWARM / *SWARM* (SU-SWARM)	Geol. 155
14h15 - 17h30	Graphene / *Graphène* (SU-P1)	Biol. 106
14h15 - 17h15	Recent Progress in Studying Biomaterials with Synchrotron Radiation / *Progrès récents dans l'étude des biomatériaux avec le rayonnement synchrotron* (SU-P2)	tba
14h15 - 17h15	Industrial Applications of Synchrotron Radiation / *Applications industrielles du rayonnement synchrotron* (SU-P3)	tba
14h15 - 17h00	Curriculum / *Programmes* (SU-P5)	Phys. 130
14h30 - 18h00	IPP General Meeting / *Assemblée générale de l'IPP* (SU-IPP-Gen)	Thor. 159
15h30 - 16h45	Electromagnetic and Weak Probes / *Sondes électromagnétiques et faibles* (SU-P6)	Phys. 103
16h30 - 18h15	Student Reception at U of S / *Réception pour les étudiant(e)s* (SU-GRAD)	Marquis Hall (Exeter Room)
19h00 - 22h00	**CAP's Herzberg Memorial Public Lecture / *Conférence publique commémorative Herzberg de l'ACP* - Carl E. Wieman, Nobel Laureate (SU-KEY)**	**TCU Place**

Monday / Lundi, June 18 juin

07h30 - 14h15	**Conference Registration and Information / *Inscription au Congrès et information***	Geol. (atrium)
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)	Phys. 127
07h00 - 08h10	Friends of CAP Breakfast / *Déjeuner des "Ami(e)s de l'ACP"* (MO-Friends)	tba
08h15 - 09h00	Teachers' registration / *Inscription des enseignants* (MO-HS-REGN)	tba
08h15 - 09h00	**CAP Herzberg Medal winner - *Récipiendaire de la médaille Herzberg de l'ACP*** (MO-Plen1) BARTH NETTERFIELD	Arts 143
09h00 - 09h45	**Plenary Session / *Session plénière* - ANTHONY LEGGETT** (MO-Plen2)	Arts 143/146
10h00 - 12h00	High School Teachers' Workshop- am / *Atelier des enseignant(e)s de la physique - avant-midi* (MO-HS-1)	Biol. 106
10h00 - 12h00	Instrumentation at CLS (Invited) / *Instrumentation au CCRS (invités)* (MO-A1)	Geol. 155
10h00 - 12h30	Optics and Photonics: Advanced Materials / *Optique et photonique : matériaux avancés* (MO-A2)	Geol. 255
10h00 - 12h45	Medical Physics / *Physique médicale* (MO-A3)	Biol. 125
10h00 - 12h15	Relativity and Cosmology / *Relativité et cosmologie* (MO-A4)	Phys. 126
10h00 - 12h15	Nuclear Astrophysics / *Astrophysique nucléaire* (MO-A5)	Phys. 130
10h00 - 12h15	Atomic and Molecular Spectroscopy and Dynamics I / *Spectroscopie et dynamique des atomes et molécules I* (MO-A6)	Phys. 165
10h00 - 11h15	DCMMP Best Student Paper Competition / *Compétition pour les meilleures communications étudiantes DPMCM* (MO-A7)	Thor. 124
10h00 - 12h15	Atmospheric Processes of Climate Change I / *Processus atmosphériques et changements climatiques I* (MO-A8)	Thor. 159
10h00 - 12h30	Precision Frontier I / *Les limites de la précision I* (MO-A9)	Phys. 127
10h00 - 12h15	Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling I / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace I* (MO-A10)	Thor. 110
10h00 - 12h15	Physics Demonstrations and Student Engagement / *Démonstrations de physique et participation étudiante* (MO-A11)	Phys. 103
11h15 - 12h15	Thin Films / *Couches minces* (MO-A12)	Thor. 124

12h00 - 13h30	HS Workshop Luncheon / *Atelier des enseignant(e)s de la physique - dîner* (MO-HS-LUNCH)	tba
12h30 - 13h15	DAMPhi Business Meeting (with NSERC GSC-29 report at 13h10) / *Réunion d'affaires DPAMip (avec rapport du GSC-29 du CRSNG à 13h10)* (MO-DAMPhi)	Phys. 165
12h30 - 13h15	DCMMP Business Meeting (with NSERC GSC-28 report at 13h10) / *Réunion d'affaires DPMCM (avec rapport du GSC-28 du CRSNG à 13h10)* (MO-DCMMP)	Thor. 124
12h30 - 13h15	DHP Business Meeting / *Réunion d'affaires DHP* (MO-DHP)	Phys. 175
12h30 - 13h15	DIAP Business Meeting / *Réunion d'affaires DPIA* (MO-DIAP)	Geol. 265
12h30 - 13h15	DIMP Business Meeting / *Réunion d'affaires DPIM* (MO-DIMP)	Geol. 155
12h30 - 13h15	DNP Business Meeting / *Réunion d'affaires DPN* (MO-DNP)	Phys. 130
12h30 - 13h15	DPE Business Meeting / *Réunion d'affaires DEP* (MO-DPE)	Phys. 103
12h30 - 13h15	Poster Session - DASP (also from 19h00 to 22h00) / *Session d'affiches - DPAE (aussi de 19:00 à 22:00)* (MO-POS)	Geol.200(atrium)
13h30 - 14h10	**CAP Medal of Achievement winner - *Récipiendaire de la médaille ACP*** (MO-Plen3a) **DAVID DUNOP**	Arts 146
13h30 - 14h10	**Teaching Medal winner / *Récipiendaire de la médaille d'enseignement* (MO-Plen3b)** **- ROBERT I. THOMPSON**	Arts 143
14h30 - 17h00	High School Teachers' Workshop - pm / *Atelier des enseignant(e)s de la physique - après-midi* (MO-HS-2)	Biol. 106
14h15 - 16h45	Novel Light Sources and Their Application to Optics and Atomic and Molecular Physics Research / *Nouvelles sources de lumière et applications à la recherche en optique et en phys.atomique et moléc.* (MO-P1)	Phys. 165
14h15 - 16h30	DMBP Best Student Paper Competition / *Compétition pour les meilleures communications étudiantes DPMB* (MO-P2)	Geol. 155
14h15 - 17h00	Experimental Nuclear Structure Physics with Radioactive Beams / *Structure nucléaire expérimentale avec faisceaux radioactifs* (MO-P3)	Thor. 124
14h15 - 17h00	Condensed Matter Theory - contributed / *Théorie de la matière condensée - contribués* (MO-P4)	Geol. 265
14h15 - 16h30	Mathematical Physics / *Physique mathématique* (MO-P5)	Geol. 255
14h15 - 17h30	Precision Frontier II / *Les limites de la précision II* (MO-P6)	Thor. 110
14h15 - 17h00	Industrial and Applied Physics / *Physique industrielle et appliquée* (MO-P7)	Phys. 127
14h15 - 16h30	Atmospheric Processes of Climate Change II / *Processus atmosphériques et changements climatiques II* (MO-P8)	Phys. 126
14h15 - 17h00	History of Physics in Canada-invited / *Histoire de la physique au Canada-communications invitées* (MO-P9)	Thor. 159
14h15 - 17h00	Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling II / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace II* (MO-P10)	Phys. 103
14h15 - 15h30	Instrumentation at CLS (Contributed) / *Instrumentation au CCRS (contribués)* (MO-P11)	Phys. 130
14h15 - 16h45	Soft Matter I / *Matière molle I* (MO-P12)	Biol. 125
17h00 - 18h15	CEWIP Session (CEWIP) / *Session CEFEP (CEFEP)* (MO-CEWIP)	Geol. 155
17h00 - 18h00	Canadian Institute of Nuclear Physics (CINP) General Meeting / *Assemblée générale de l'Institut canadien de la physique nucléaire (ICPN)* (MO-CNIP-Gen)	Thor. 124
17h00 - 18h15	PiC Editorial Board Meeting / *Réunion du Comité de rédaction de La physique au Canada* (MO-PiC)	Phys. 175
18h30 - 21h00	CAP-NSERC Liaison Committee Meeting / *Réunion du comité de liaison ACP-CRSNG* (CAP-NSERC)	tba
18h30 - 21h00	CJP Editorial Board Meeting / *Réunion du conseil d'édition du journal canadien de la physique* (MO-CJP)	John's Saskatoon (restaurant)
19h00 - 22h00	**Poster Session, with Beer / *Session d'affiches, bière servie* (MO-POS)** **DASP/*DPAE* (); DAMPhi/*DPAMip* (); DIAP/*DPIA* (); DIMP/*DPIM* (); DCMMP/*DPMCM* (); DMBP/*DPMB* (); DOP (); DNP/*DPN* (); PPD (); DPP (); DSS (); DTP/*DPT* (); DPE/*DEP* (); DHP ()**	Geol.200 (atrium)

Tuesday / Mardi, June 19 juin

07h30 - 14h15	**Conference Registration and Information / *Inscription au Congrès et information***	Geol. (atrium)
07h00 - 08h05	CNILC Breakfast meeting / *Réunion du comité de liaison national canadien* (TU-CNILC)	tba
08h15 - 08h55	**Plenary - Lee Smolin / *Session plénière - Lee Smolin*** (TU-Plen1)	Arts 143
09h00 - 09h45	**Plenary - Jay Ingram - Science Policy (Communication and Outreach with the Public I) / *Plénière - Jay Ingram - la politique scientifique (La communication avec le public I)*** (TU-Plen2)	Arts 143/146
10h00 - 12h15	String Theory and Quantum Gravity / *Théorie des cordes et gravitation quantique* (TU-A1)	Phys. 127
10h00 - 12h30	Biophysics / *Biophysique* (TU-A2)	Thor. 159
10h00 - 12h30	Electroweak SM Tests I: Leptonic / *Tests électrofaibles du MS I : leptoniques* (TU-A3)	Thor. 110
10h00 - 12h15	Materials / *Matériaux* (TU-A4)	Arts 146
10h00 - 12h15	Young Investigators in Condensed Matter and Materials Physics (DCMMP) / *Jeunes chercheurs(ses) en matière condensée et matériaux (DPMCM)* (TU-A5)	Phys. 130
10h00 - 12h30	Energy Frontier and Phenomenology I / *Frontière énergétique et phénoménologie I* (TU-A6)	Thor. 124
10h00 - 12h45	Saskatchewan Plasma Physics and Tokamaks / *Physique des plasmas en Saskatchewan et tokamaks* (TU-A7)	Biol. 125
10h00 - 12h15	Atmospheric Processes of Climate Change III / *Processus atmosphériques et changements climatiques III* (TU-A8)	Geol. 155
10h00 - 12h30	Atomic and Molecular Spectroscopy and Dynamics II / *Spectroscopie et dynamique des atomes et molécules II* (TU-A9)	Biol. 106
10h00 - 12h15	Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling III / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace III* (TU-A10)	Phys. 165
10h00 - 12h30	Establishing a Successful Public Outreach Program I / *Établir un programme pour rejoindre le public avec succès I* (TU-A11)	Arts 143
10h00 - 12h15	Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling IV / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace IV* (TU-A12)	Phys. 103
12h30 - 13h15	DASP Business Meeting / *Réunion d'affaires DPAE* (TU-DASP)	Phys. 165
12h30 - 13h15	DMBP Business Meeting / *Réunion d'affaires DPMB* (TU-DMBP)	Thor. 159
12h30 - 13h15	DOP Business Meeting / *Réunion d'affaires DOP* (TU-DOP)	Geol. 255
12h30 - 13h15	DTP Business Meeting / *Réunion d'affaires DPT* (TU-DTP)	Phys. 127
12h30 - 13h15	PPD Business Meeting / *Réunion d'affaires PPD* (TU-PPD)	Thor. 124
12h45 - 13h15	DPP Business Meeting / *Réunion d'affaires DPP* (TU-DPP)	Biol. 125

13h30 - 14h10	**Plenary Session - Lawrence Krauss - Science Policy (Communication and Outreach with the Public II) / *Plénière - Lawrence Krauss - la politique scientifique (La communication avec le public II)*** (TU-Plen3)	Arts 143/146
14h15 - 16h30	Quantum Optics, Information and Computation I / *Optique, informatique et calcul quantiques I* (TU-P1)	Biol. 106
14h15 - 16h30	Electroweak SM Tests II: Semi-Leptonic / *Tests électrofaibles du MS II : semi-leptoniques* (TU-P2)	Biol. 125
14h15 - 16h30	Magnetic Systems / *Systèmes magnétiques* (TU-P3)	Geol. 155
14h15 - 16h15	General Plasma Physics / *Physique des plasmas* (TU-P4)	Geol. 255
14h15 - 15h45	Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling V / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace V* (TU-P5)	Thor. 159
14h15 - 16h30	Atmospheric Processes of Climate Change IV / *Processus atmosphériques et changements climatiques IV* (TU-P6)	Thor. 124
14h15 - 17h00	Energy Frontier and Phenomenology II / *Frontière énergétique et phénoménologie II* (TU-P7)	Phys. 165
14h15 - 16h30	Establishing a Successful Public Outreach Program II / *Établir un programme pour rejoindre le public avec succès II* (TU-P8)	Arts 143
14h15 - 17h00	Surface Science / *Science des surfaces* (TU-P9)	Phys. 127
14h15 - 16h30	Biomedical Instrumentation / *Instrumentation biomédicale* (TU-P10)	Phys. 103
14h15 - 16h30	Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling VI / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace VI* (TU-P11)	Thor. 110
16h45 - 18h00	**CAP Annual General Meeting / *Assemblée générale de l'ACP*** (TU-AGM)	Arts 146
19h00 - 22h30	**Reception/Banquet / *Réception et banquet* (CAP-Banq)**	Western Development Museum

Wednesday / Mercredi, June 20 juin

07h30 - 11h00	**Conference Registration and Information / *Inscription au Congrès et information***	Geol. (atrium)
08h15 - 09h00	**Plenary Session - Dave Weitz, Harvard University / *Session plénière - Dave Weitz, Université Harvard*** (WE-Plen1)	Arts 143
09h00 - 09h45	**Plenary - Jonathan Feng, University of California, Irvine / *Session plénière - Jonathan Feng, Université de la Californie à Irvine*** (WE-Plen2)	Arts 143
10h00 - 12h15	Atmospheric Processes of Climate Change (APOCC): Concept Working Groups I / *Processus atmosphériques et changements climatiques : groupes de travail sur le concept I* (WE-A1)	Thor. 159
10h00 - 12h15	e-POP Mission Meeting I / *Rencontre de la mission e-POP I* (WE-A2)	Arts 146
10h00 - 12h15	Instrumentation for Nuclear and Medical Physics / *Instrumentation pour la physique nucléaire et médicale (WE-A3)*	Biol. 106
10h00 - 12h15	*Soft Matter II / Matière molle II* (WE-A4)	Phys. 130
10h00 - 12h00	Instrumentation for Particle Physics / *Instrumentation en physique des particules* (WE-A5)	Geol. 155
10h00 - 12h15	Condensed Matter Theory - invited / *Théorie de la matière condensée - invités* (WE-A6)	Thor. 124
10h00 - 12h00	**CAP Best Student Presentations Final Competition / *Compétition finale de l'ACP pour les meilleures communications étudiantes*** (WE-A7)	Phys. 103
10h00 - 11h45	General Instrumentation / *Instrumentation générale* (WE-A8)	Phys. 127
10h00 - 12h15	Canadian Geospace Monitoring Mission Meeting / *Rencontre de la mission de surveillance géospatiale canadienne* (WE-A9)	Phys. 165
12h00 - 12h30	Young/New Faculty Luncheon with NSERC / *Dîner-rencontre des jeunes ou nouveaux professeurs avec le CRSNG* (WE-NSERC-Lunch)	Phys. 175
12h30 - 13h30	NSERC Workshop / *Atelier du CRSNG* (WE-Workshop)	Biol. 106
13h30 - 14h10	**CAP/CRM Medal winner - *Récipiendaire de la médaille ACP/CRM*** (WE-Plen3a) JOEL FELDMAN	Arts 143
13h30 - 14h10	**CAP/DIAP Medal winner -*Récipiendaire de la médaille industrielle et appliquée*** (WE-Plen3b) ROMAN MAEV	Arts 146
14h15 - 17h00	Atmospheric Processes of Climate Change (APOCC): Concept Working Groups II / *Processus atmosphériques et changements climatiques : groupes de travail sur le concept II* (WE-P1)	Thor. 159
14h15 - 16h45	e-POP Mission Meeting II / *Rencontre de la mission e-POP II* (WE-P2)	Arts 146
14h15 - 16h30	Advances in Nuclear Theory / *Progrès en théorie nucléaire* (WE-P3)	Phys. 130
14h15 - 17h00	Non-Accelerator Particle Physics / *Physique des particules sans accélérateur* (WE-P4)	Phys. 165
14h15 - 15h30	Quantum Optics, Information and Computation II / *Optique, informatique et calcul quantiques II* (WE-P5)	Phys. 103
14h15 - 17h00	Canadian Geospace Monitoring and e-POP Mission / *Surveillance géospatiale canadienne et mission e-POP* (WE-P6)	Arts 143
17h00 - 19h00	Council Meeting (Old and New) / *Réunion du conseil (nouveau et ancien)* (WE-Counc)	Phys. 175

DETAILED CONGRESS SUMMARY
PROGRAMME DÉTAILLÉ DU CONGRÈS

(SEE PG. 14 FOR DESCRIPTION OF CODES-ABBREVIATIONS / VOIR PG. 14 POUR UNE DESCRIPTION DES CODES-ABBRÉVIATIONS)
(ABSTRACTS START ON PAGE 40 / LES RÉSUMÉS COMMENCENT À LA PAGE 40)

Saturday, June 16, 2007 / *Samedi, le 16 juin*

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

Sunday, June 17, 2007 / *Dimanche, le 17 juin*

TIME HEURE	tba	tba	Arts 143 (cap. 350)	Other Rooms/Autres salles
	SU-A1 (DCMMP-CLS / *DPMCM -CCRS*) **RECENT ADVANCES IN CONDENSED MATTER PHYSICS WITH SYNCHROTRON RADIATION** / ***PROGRÈS RÉCENTS EN PHYSIQUE DE LA MATIÈRE CONDENSÉE AVEC RAYONNEMENT SYNCHROTRON*** Chair: S. Idziak, U.Waterloo	**SU-A2** (DSS-CLS / *DSS-CCRS*) **ILLUMINATING TO NEW DEPTHS: OUR UNDERSTANDING OF SURFACE PHENOMENA I** / ***SCRUTER EN PROFONDEUR : NOTRE COMPRÉHENSION DES PHÉNOMÈNES DE SURFACE I*** Chair: R. Sammynaiken, U.of S.		**08h15-11h00** **Marquis Hall (Selkirk Room)** Physics Department Heads/Chairs Meeting / *Réunion des directeurs de départements de physique* (SU-Hd-Chr)
08h30	**TSE, John** *Electronic and Phonon Spectroscopy with Inelastic X-ray Scattering* (SU-A1-1)	**HIMPSEL, Franz** *Attachment of Bio-Molecules to Surfaces, Characterized by NEXAFS* (SU-A2-1)		
09h00	↓	↓		**09h00-12h00** **Phys.127 (48)** IPP Board of Trustees Meeting *Réunion du conseil d'administration de l'IPP* (SU-IPP-Bd)
09h15	↓	**LIPKOWSKI, Jacek** *Field driven transitions in bilayers of phospholipids at electrode surfaces* (SU-A2-2)		
09h30	**SUTTON, Mark** McGill Univ. *What's new in x-ray intensity fluctuation spectroscopy* (SU-A1-2)	↓		
10h00	↓	**EVITTS, Richard** *Changes in the surface morphology of potash crystals after exposure to a wetting-drying cycle* (SU-A2-3)		
10h30	**Coffee Break / *Pause café***	**Coffee Break / *Pause café***		
11h00	**SAWATZKY, George** *Resonant X-ray scattering: a new tool for structural studies of condensed matter systems* (SU-A1-3)	**URQUHART, Stephen** *X-PEEM Microscopy for Surface Chemical Characterization* (SU-A2-4)		
11h45	↓	**MILLER, Tom** *To be announced / à venir* (SU-A2-5)		
12h00	**Morning Session ends / *Fin de la session du matin*** **Lunch / déjeuner**			**12h00-13h15** **Geol.102 (atrium)** Lunch with Exhibitors / *Dîner avec les exposants* (SU-Exhibit)
12h15				**12h15-13h15** **tba** Past Presidents' Lunch / *Dîner des anciens présidents* (SU-Past-Pres)
12h30		**Morning Session ends / *Fin de la session du matin*** **Lunch / déjeuner**		
13h30		**SU-P4** (DSS-CLS / *DSS-CCRS*) **ILLUMINATING TO NEW DEPTHS II** / ***SCRUTER EN PROFONDEUR II*** Chair: R. Sammynaiken, U.of S. **DAMASCELLI, Andrea** *Impurity-controlled valence, spin and orbital state in $Sr_3Ru_2O_7$* (SU-P4-1)	**SU-Plen1** Plenary Session plénière (CAP Brockhouse Medal winner - S.John / *Récipiendaire de la médaille Brockhouse de l'ACP - S.John*) Chair: S. Idziak, U. Waterloo **ALONGKARN CHUTINAN** U.of T *Photonic Band Gap Materials: Semiconductors of Light* (ends at 14h15)	

Sunday, June 17, 2007 / *Dimanche, le 17 juin* *(cont'd / suite)*

tba	tba	tba	Biol.106 (cap. 250)	Phys.130 (cap. 70)	Phys.103 (cap. 145)	Other locations autres endroits	TIME HEURE
SU-P4 (DSS-CLS / DSS-CCRS) ILLUMINATING (CONT'D) / *SCRUTER (CONT'D)* Chair: R. Sammynaiken, U.of S.	**SU-P2** (DCMMP-DMBP-CLS / DPMCM-DPMB-CCRS) RECENT PROGRESS IN STUDYING BIOMATERIALS... / *PROGRÈS RÉCENTS DANS L'ÉTUDE DES BIOMATÉRIAUX...* Chair: A. Moewes, U.of S.	**SU-P3** (DIAP-CLS / DPIA-CCRS) INDUSTRIAL APPLICATIONS OF SYNCHROTRON RADIATION / *APPLICATIONS INDUSTRIELLES DU RAYONNEMENT SYNCHROTRON* Chair: J. Cutler, CLS	**SU-P1** (DCMMP / DPMCM) GRAPHENE / *GRAPHENE* Chair: T. Chakraborty, U.Man.	**SU-P5** (DPE / DEP) CURRICULUM / *PROGRAMMES* Chair: S.P. Goldman, Ryerson U.		14h00-17h00 Geol.155 (70) SWARM (SU-SWARM)	14h00
MITCHELL, Katie *Small Biomolecules on Metal Surfaces: Probing Amino Acid/Surface Interactions with Scanning Tunneling Microscopy and Synchrotron spectroscopy* (SU-P4-2)	**KIRZ, Janos** *Diffraction Microscopy of Yeast* (SU-P2-1)	**McINTYRE, N.Stewart** *Mechanical Strain Measurements on a Microscopic Scale using Synchrotron Radiation: Applications to Nuclear Materials* (SU-P3-1)	**ANDO, Tsuneya** *Quantum anomalies in graphene* (SU-P1-1)	**KALMAN, Calvin** *Beyond Conceptual Change: Changing Students' Epistemologies* (SU-P5-1)			14h15
↓	↓	↓	↓	↓		14h30-18h00 Thor.159 (80) IPP General Meeting / Assemblée générale de l'IPP (SU-IPP-Gen)	14h30
↓	↓	↓	↓	**O'MEARA, Joanne** *The CAP Physics 1st year curriculum : a first run* (SU-P5-2)			14h45
Coffee Break / *pause café*	↓	**BARE, Simon** *The Impact of In Situ X-ray Absorption Spectroscopy on Catalysis Research at UOP* (SU-P3-2)	**SHARAPOV, Sergei** *Dirac-like quasiparticles in Graphene* (SU-P1-2)	↓	**SU-P6** (DNP / DPN) ELECTROMAGNETIC AND WEAK PROBES / *SONDES ÉLECTROMAGNÉTIQUES ET FAIBLES* Chair: G. Huber, U.Regina		15h00
↓	**NILSSON, Anders** *X-ray and electron spectroscopy investigations of water; in the liquid phase and on surfaces* (SU-P2-2)	↓	↓	**P. L. Walden (c)** *SSHRC and Intelligent Design, time for a change of the science education funding agency?* (SU-P5-3)			15h15
PARK, Changyong *In-Situ Observation of Mineral-Water Interfacial Processes with High-Resolution X-ray Reflectivity and Resonant Anomalous X-ray Reflectivity* (SU-P4-3)	↓	↓	↓	**Coffee Break / *pause café***	**A.J. Sarty (c)** *New polarization measurements in low-energy deuteron photodisintegration* (SU-P6-1)		15h30
↓	↓	**Coffee Break / *pause café***	**Coffee Break / *pause café***	↓	**J. Pan (c)** *Focal Plane Scanner for Q^{P}_{Weak} Experiment* (SU-P6-2)		15h45
↓	↓	**J. Cutler (c)** *Industrial and Environmental Studies at Canadian Light Source* (SU-P3-3)	**APALKOV, Vadym** *Dirac Electrons in Graphene: Magnetic Field and Artificial Atoms* (SU-P1-3)	**A. Predoi-Cross (c)** *Teaching Physics in an Interactive Classroom Setting* (SU-P5-4)	**W. Wurtz (c)** *Photodisintegration of lithium isotopes in the giant dipole resonance region using polarised gamma rays* (SU-P6-3)		16h00
Discussion	**GEORGE, Graham** *Functionally Focused Biomaterials — Metallo-Enzyme Active Sites* (SU-P2-3)	**L. Dallin (c)** *Canadian Light Source: Machine Update* (SU-P3-4)	↓	**S.B. Opps (c)** *A Yin Yang Approach to Teaching: High-tech, Low-tech* (SU-P5-5)	**O. Mavrichi (c)** *Design and Simulation Testing of a Photon Flux Monitor* (SU-P6-4)		16h15
↓	↓	**A. Sarkissian (c)** *Plasma-Assisted Cleaning of Sensitive Surfaces Contaminated by High Power Beam Interactions* (SU-P3-5)	↓	**M. Milner-Bolotin (c)** *Effect of Interactive Lecture Experiments on Student Academic Achievement and Attitudes Toward Science in Large Introductory Physics Courses* (SU-P5-6)	**D. Reitzner (c)** *Calibrating the SNO Neutral Current Detectors Using Time Series Analysis* (SU-P6-5)	16h30-18h00 Marquis Hall (Exeter Room) Student Reception / Réception pour les étudiant(e)s (SU-Grad)	16h30
Session ends / *Fin de la session*	↓	**J. Warner (c)** *Quality Assurance Strategies in Synchrotron XANES Commercial Measurements* (SU-P3-6)	**HERBUT, Igor** *Graphene: symmetries, interactions, Hall effect* (SU-P1-4)	**A. Robinson (c)** *Back to the envelope: using order of magnitude estimates to engage the student* (SU-P5-7)	**Session ends / *Fin de la session***		16h45
	↓	**Session ends / *Fin de la session***	↓	**Session ends / *Fin de la session***			17h00
	Session ends / *Fin de la session*		↓				17h15
			Session ends / *Fin de la session*				17h30

[SU-KEY] **CAP Herzberg Memorial Public Lecture / *Conférence publique commémorative Herzberg de l'ACP***
Carl Wieman, University of British Columbia - "*Science Education in the 21st Century: Using the Tools of Science to Teach Science*"
Followed by the Opening Reception / suivi par la réception d'accueil — TCU Place (see pg. 11 for details / voir pg. 11 pour les détails) — **19h00**

Monday, June 18

TIME HEURE	Arts 143 (cap. 350)	Arts 146 (cap. 154)	Biol.106 (cap. 250)	Biol.125 (cap. 70)	Geol.155 (cap. 70)	Geol.255 (cap. 48)	Phys.103 (cap. 145)
07h00	(MO-CINP-Bd) Canadian Institute of Nuclear Physics (CINP) Board of Trustees Meeting - 07h00-08h10 - Phys. 127						
07h00	(MO-Friends) Friends of CAP Breakfast - 07h00-08h10 - tba						
			MO-HS1 (CAP-DPE / ACP-DEP) HIGH SCHOOL TEACHERS' WORKSHOP / *ATELIER DES ENSEIGNANT(E)S DE LA PHYSIQUE* Chair: R. Pywell, U. of S.	**MO-A3** (DMBP / *DPMB*) MEDICAL PHYSICS / *PHYSIQUE MÉDICALE* Chair: V. Toronov, Ryerson U.	**MO-A1** (DIMP-CLS / *DPIM-CCRS*) INSTRUMENTATION AT CLS (INVITED) / *INSTRUMENTATION AU CCRS (INVITÉS)* Chair: K. Michaelian, NRCan	**MO-A2** (DOP-DCMMP / *DOP-DPMCM*) OPTICS AND PHOTONICS : ADVANCED MATERIALS / *OPTIQUE ET PHOTONIQUE : MATÉRIAUX AVANCÉS* Chair: P. Ashrit, U.Moncton	**MO-A11** (DPE / *DEP*) PHYSICS DEMONSTRATIONS AND STUDENT ENGAGEMENT / *DÉMONSTRATIONS DE PHYSIQUE ET PARTICIPATION ÉTUDIANTE* Chair: S.P. Goldman, Ryerson U.
08h15	**MO-Plen1** (CAP/*ACP*) (Herzberg Medal winner - Récipiendaire de la médaille Herzberg) Chair: M.Campbell, U.Waterloo **C. BARTH NETTERFIELD** *Observations of the Cosmic Microwave Background*		08h15-09h00 (MO-HS-Reg'n) Geol. atrium Teachers' registration / Inscription des enseignants				
09h00	**MO-Plen2** (09h00-09h45) (CAP Plenary Session - Session plénière de l'ACP) Chair: L. Marchildon, UQTR **ANTHONY LEGGETT** *Testing the limits of quantum mechanics : motivation, state of play, prospects*						
10h00			**WATSON, Peter** *Dark Matter and Dark Energy* (MO-HS1-1)	**WYSOKINSKI, Tomasz** *Developing a World-Class Beamline for the Biomedical Imaging and Therapy Program – Risks and Unknowns* (MO-A3-1)	**WINICK, Herman** *From Roentgen to X-ray Free-electron Lasers; The Evolution of X-ray sources and science over 100 years* (MO-A1-1)	**L. Levesque (c)** *Periodic relief gratings at fiber end faces* (MO-A2-1)	**WIEMAN, Carl** *Interactive simulations for teaching physics, a powerful (and dangerous) educational tool* (MO-A11-1)
10h15			↓	↓	↓	**B. Ramamoorthy (c)** *Investigations on the dry lithiated V2O5 thin films for electrochromic applications* (MO-A2-2)	↓
10h30			↓	**LILGE, Lothar** *Can optical spectoscopy teach us something about tissue aging and preventive oncology* (MO-A3-2)	↓	**X. Zhou (c)** *X-ray excited optical luminescence from some oxide nanostructures in time and energy domains: direct evidence for the origin of the luminescence and the role of surface states* (MO-A2-3)	**ATHERTON, John** *Why bother teaching physics in high school at all?* (MO-A11-2)
10h45			**Coffee Break / *pause café***	↓	**HALLIN, Emil** *The Research Toolkit at the Canadian Light Source* (MO-A1-2)	**S. Abdallah (c)** *Simulating light scattering from neuron cells over a broad wavelength range by use of pulsed Finite-Difference-Time-Domain (FDTD) method* (MO-A2-4)	↓
11h00			**Discussion**	**Coffee Break / *pause café***	↓	**G.Painchaud-April (c)** *Wave chaos in a new class of optical microcavity* (MO-A2-5)	**T. Antimirova (c)** *Role of Universities in K-12 Teachers' Preparation in the U.S.* (MO-A11-3)
11h15			↓	**TORONOV, Vladislav** *Combined Functional Near - Infrared and Magnetic Resonance Imaging of the Human Brain* (MO-A3-3)	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**S. Barkanova (c)** *Modern Physics and Community Outreach: Radon Detection in Nova Scotia* (MO-A11-4)
11h30			↓	↓	**DE JONG, Mark** *Beam Position Measurements at CLS: Instrumentation and Applications* (MO-A1-3)	**BHARDWAJ, Ravi** *Femtosecond laser induced nanostrcutures inside glass: role of transient nanoplasmonics* (MO-A2-6)	**M. Milner-Bolotin (c)** *Making your classes click: How to ask good clicker questions and get the most out of your teaching experience* (MO-A11-5)
11h45			↓	**B. Soroushian (c)** *A study on opto-mechanical properties of biomaterials and their effects on optoacoustic signals* (MO-A3-4)	↓	↓	**A.J. Sarty (c)** *Measuring the Effectiveness of "Clickers" in a Physics Lecture* (MO-A11-6)

Lundi, le 18 juin

Phys.126 (cap. 48)	Phys.127 (cap. 48)	Phys.130 (cap. 70)	Phys.165 (cap. 137)	Thor.110 (cap. 90)	Thor.124 (cap. 80)	Thor.159 (cap. 80)	TIME HEURE
(MO-CINP-Bd) Réunion-déjeuner du conseil d'administration de l'Institut canadien de physique nucléaire (ICPN) - 07h00-08h10 - Phys.127							07h00
(MO-Friends) Déjeuner des "Ami(e)s de l'ACP" - 07h00-08h10 - tba							07h15
MO-A4 (DTP / DPT) **RELATIVITY AND COSMOLOGY I** / *RELATIVITÉ ET COSMOLOGIE* Chair: M. Paranjape, U.Montreal	**MO-A9** (PPD / *PPD*) **PRECISION FRONTIER I** / *LES LIMITES DE LA PRÉCISION I* Chair: A. Bellerive, Carleton U.	**MO-A5** (DNP / *DPN*) **NUCLEAR ASTROPHYSICS** / *ASTROPHYSIQUE NUCLÉAIRE* Chair: B. Davids, TRIUMF	**MO-A6** (DAMPhi / *DPAMIp*) **ATOMIC AND MOLECULAR SPECTROSCOPY AND DYNAMICS I** / *SPECTROSCOPIE ET DYNAMIQUE DES ATOMES ET MOLÉCULES I* Chair: A. Madej, NRC	**MO-A10** (DASP / *DPAE*) **GEOSPACE PHYSICS ... I** / *PHYSIQUE GÉOSPATIALE ... I* Chair: K. McWilliams, U.of S.	**MO-A7** (DCMMP / *DPMCM*) **DCMMP BEST STUDENT PAPER COMPETITION** / *COMPÉTITION POUR LES MEILLEURS COMMUNICATIONS ÉTUDIANTES DPMCM* Chair: M. Sutton, McGill U.	**MO-A8** (DASP / *DPAE*) **ATMOSPHERIC PROCESSES OF CLIMATE CHANGE I** / *PROCESSUS ATMOSPHÉRIQUES ET CHANGEMENTS CLIMATIQUES I* Chair: D. Degenstein, U. of S.	
							08h15
							09h00
VAN WAERBEKE, Ludovic *Observational Cosmology in the 21st century* (MO-A4-1)	**VLAUD, Benoit** *Overall status and physics highlights of the BaBar experiment* (MO-A9-1)	**CUMMING, Andrew** *Nuclear Physics in Type I X-ray Bursts and Superbursts* (MO-A5-1)	**VILLENEUVE, David** *Can We Image a Single Molecular Orbital Wave Function Using an Intense Femtosecond Laser?* (MO-A6-1)	**MANN, Ian** *The Earth's magnetosphere as a plasmaphysical particle accelerator: The geophysical synchrotron?* (MO-A10-1)	**R. Flacau (c)** *Structural and Electron Density Changes in Dense $Ba8Si46$: Results from X-ray Diffraction Data as Analyzed by the Maximum Entropy Method* (MO-A7-1)	**SHEPHERD, Ted** *The role of the upper troposphere/lower stratosphere in the climate system* (MO-A8-1)	10h00
↓	↓	↓	↓	↓	**M. Zelli (c)** *Frustrated Heisenberg magnets: first or second order phase transition* (MO-A7-2)	↓	10h15
FROLOV, Andrei *to be announced / à venir* (MO-A4-2)	**R. Kowalewski (c)** *Is there NP in the UT* (MO-A9-2)	**KANUNGO, Rituparna** *Lifetime of the 4.03 MeV State in ^{19}Ne and its Astrophysical Implications* (MO-A5-2)	**M. Cummings (c)** *Ion Heating Models in Conventional and Rotating rf-Electric Quadrupole Traps* (MO-A6-2)	↓	**J.S. Smith (c)** *The high-pressure crystalline structure and lattice dynamics of the heavy alkali earth hydrides* (MO-A7-3)	↓	10h30
↓	**I. Nugent (c)** *Exclusive branching fraction measurements of semileptonic tau decays into three charged hadrons* (MO-A9-3)	↓	**R.M. Lees (c)** *A New VISTA on the Infrared Spectrum of Ammonia in the 1.5 mm Region: Assignment of Combination Bands of $^{14}NH_3$ and $^{15}NH_3$ by Isotopic Shift Labeling* (MO-A6-3)	**Z. Dent (c)** *Observations of Steep Plasmapause Density Gradients* (MO-A10-2)	**I. Tamblyn (c)** *Inside the Jovian atmosphere: Hydrogen and Helium at extreme conditions* (MO-A7-4)	**BOURQUI, Michel** *Extra-tropical stratosphere-troposphere exchange and dynamical structures at the tropopause* (MO-A8-2)	10h45
Coffee Break / *pause café*	**M. Roney (c)** *SuperB: New Physics Opportunities at a High Luminosity Flavour Factory* (MO-A9-4)	**QIAN, Yong-Zhong** *Neutrinos and The Origin of the Elements* (MO-A5-3)	**Coffee Break / *pause café***	**H. Turkakin (c)** *Mode trapping and tunnelling in the plasma sphere* (MO-A10-3)	**L. Ling (c)** *DFT Study of Band Structure of Polyacetylene and Fluorene-based Polymers* (MO-A7-5)	↓	11h00
POGOSIAN, Levon *The Integrated Sachs-Wolfe effect as a probe of dark energy and modified gravity* (MO-A4-3)	**Coffee Break / *pause café***	↓	**MOAZZEN-AHMADI, Nasser** *Toward an Accurate Database for the 12 Micron Band of Ethane* (MO-A6-4)	**F. Fenrich (c)** *Investigation of Magnetospheric Field Line Resonances and Solar Wind Discrete Continuous Oscillations via Cross-Phase Techniques* (MO-A10-4)	**Session ends / *Fin de la session*** **MO-A12** (DCMMP / *DPMCM*) **THIN FILMS** / *COUCHES MINCES* Chair: K. Kavanagh, SFU **S. Penson (c)** *Structural Analysis of Y2O3 Films Grown by Molecular Beam Epitaxy* (MO-A12-1)	**EVANS, W.F.J.** *Investigations of Relative Humidity in the UTLS with the ACE satellite* (MO-A8-3)	11h15
↓	**KATO, Issei** *The T2K experiment : study of neutrino oscillations* (MO-A9-5)	**VOCKENHUBER, Christof** *Ti-44 and Hf-182 - Two Nuclides in the World of Astrophysics* (MO-A5-4)	↓	**G. Sofko (c)** *Inner Magnetosphere Effects of Suprathermal Auroral Post-Secondary Ions* (MO-A10-5)	**O. Gautreau (c)** *Comparison of BFO and BLT epitaxial thin film heterostructures and their possible applications* (MO-A12-2)	↓	11h30
FARAONI, Valerio *f(R) Cosmology* (MO-A4-4)	↓	↓	**A. Predoi-Cross (c)** *Collisional-Broadened and Dicke-Narrowed Lineshapes of Oxygen* (MO-A6-5)	**L. Ozeke (c)** *How radiation belt electrons may be energised by ring current ions, via a particle-wave-particle interaction mechanism* (MO-A10-6)	**M. Fleischauer (c)** *Nanostructured organic thin films* (MO-A12-3)	**HEGGLIN, Michaela** *Validation of Chemistry Climate Models in the UTLS using ACE satellite data* (MO-A8-4)	11h45

TIME HEURE	Arts 143 (cap. 350)	Arts 146 (cap. 154)	Biol.106 (cap. 250)	Biol.125 (cap. 70)	Geol.155 (cap. 48)	Geol.255 (cap. 48)	Phys.103 (cap. 145)
12h00			**Session ends / *Fin de la session***	**E Galiano-Riveros (c)** *On the physical, spectral, and dosimetric characteristics of a new ^{125}I brachytherapy source* (MO-A3-5)	**Session ends / *Fin de la session***	**P. Varma (c)** *Study of Vanadium Oxide thin films prepared with Laser Assisted Molecular Beam Deposition* (MO-A2-7)	**G. Williams (c)** *Training science graduate students how to teach* (MO-A11-7)
12h15			**MO-HS1** (Location: tba) HIGH SCHOOL TEACHERS' LUNCHEON / *ATELIER DES ENSEIGNANT(E)S DE LA PHYSIQUE - DÎNER* Chair: L. Marchildon, UQTR	**M. Martin (c)** *In Vivo Magnetic Resonance Imaging of Quail Embryo Brain* (MO-A3-6)		**T. Galstian (c)** *Electrically controllable light scattering in dispersions of particles in liquid crystals* (MO-A2-8)	**Session ends / *Fin de la session***
12h30	ROOM/SALLE Geol.265 DIAP Business Meeting / *Réunion d'affaires DPIA* (lunches provided/*repas fournis*)	Geol. atrium DASP Poster Session / *Session d'affiches - DPAE* - Ends / fin 13h15	12H45 AFTER LUNCH SPEAKER / *APRÈS-DÎNER CONFÉRENCIER À 12H45*	**E Galiano-Riveros (c)** *Modeling of an Iterated Birth/Death Markov Process for Optimization of Radiotherapy Treatment Planning* (MO-A3-7)	DIMP Business Meeting / *Réunion d'affaires DPIM* (lunches provided/*repas fournis*)	**Session ends / *Fin de la session***	DPE Business Meeting / *Réunion d'affaires DEP* (lunches provided/*repas fournis*)
12h45			**FEDOSEJEVS, Robert** *Putting Photons to Work* (MO-HS-LUNCH) - Ends / *Fin* 13h30	**Session ends / *Fin de la session***			
13h30	**MO-Plen3b** (CAP/*ACP*) (Teaching Medal winner - Récipiendaire de la médaille d'enseignement) Chair: B. Sanders, U.Calgary **ROBERT THOMPSON** *Simplifying the complex with familiarity: An approach to effective physics education at all scales* **(ends at 14h15)**	**MO-Plen3a** (CAP/*ACP*) (Medal of Achievement winner - Récipiendaire de la médaille pour contributions exceptionnelles) Chair: M.Campbell, U.Waterloo **DAVID DUNLOP** *In the Footsteps of Louis Néel: From Micromagnetism to the Moon and Mars* **(ends at 14h15)**					

TIME HEURE	Other Locations Autres endroits	Geol.265 (cap. 40)	Biol.106 (cap. 250)	Biol.125 (cap. 70)	Geol.155 (cap. 48)	Geol.255 (cap. 48)	Phys.103 (cap. 145)
		MO-P4 (DCMMP / *DPMCM*) CONDENSED MATTER THEORY - CONTRIBUTED / *THÉORIE DE LA MATIÈRE CONDENSÉE - CONTRIBUÉ* Chair: S. Idziak, U.Waterloo	**MO-HS2** (CAP-DPE / *ACP-DEP*) HIGH SCHOOL TEACHERS' WORKSHOP / *ATELIER DES ENSEIGNANT(E)S DE LA PHYSIQUE* Chair: L. Marchildon, UQTR	**MO-P12** (DCMMP / *DPMCM*) SOFT MATTER I / *MATIÈRE MOLLE I* Chair: J. Forrest, U.Waterloo	**MO-P2** (DMBP / *DPMB*) DMBP BEST STUDENT PAPER COMPETITION / *COMPÉTITION POUR LES MEILLEURES COMMUNICATIONS ÉTUDIANTES DPMB* Chair: A. Pejović-Milić, Ryerson	**MO-P5** (DTP / *DPT*) MATHEMATICAL PHYSICS / *PHYSICS MATHÉMATIQUE* Chair: D. Brydges, UBC	**MO-P10** (DASP / *DPAE*) GEOSPACE PHYSICS ... II / *PHYSIQUE GÉOSPATIALE... II* Chair: J-P St-Maurice, U. of S.
14h15		**D. Plouffe (c)** *Lanczos methods at finite temperature for the Hubbard Model and cluster quantum approaches* (MO-P4-1)		**MORRIS, Stephen** *Some new rope tricks* (MO-P12-1)	**A. El Kaffas (c)** *Particle Tracking Microrheology for the extraction of mechanical properties of water, glycerol and f-actin* (MO-P2-1)	**WALTON, Mark** *Phase-space quantum mechanics of a particle on the half-line* (MO-P5-1)	**HALDOUPIS, Christos** *An overview of mid-latitude sporadic E layers* (MO-P10-1)
14h30		**M. Azzouz (c)** *Quantum and classical critical phenomena in the frustrated Heisenberg two-leg ladder* (MO-P4-2)	**WIEMAN, Carl** *Bose-Einstein condensation: quantum weirdness at the lowest temperature in the universe* (MO-HS2-1)	↓	**D. Banks (c)** *Application of Sample Volume Controlled-Fluorescence Correlation Spectroscopy to the Study of Anomalous Diffusion* (MO-P2-2)	↓	↓
14h45		**K. Tanaka (c)** *Effects of hybridization of diffusive and ballistic bands on vortex structure in a multi-band superconductor* (MO-P4-3)	↓	**A. Yethiraj (c)** *Putting a spin on colloids: dynamic self-assembly of magnetic patterns* (MO-P12-2)	**V. Vivcharuk (c)** *The Calculation of the Potential of Mean Force between Lactoferricin B and Model Membranes from Molecular Dynamics Simulations* (MO-P2-3)	**DESROSIERS, Patrick** *Statistical properties of spectra and symmetric functions* (MO-P5-2)	**B. Shizgal (c)** *Suprathermal Particle Distributions in Space Physics; Kappa Distributions and Nonextensive Entropy* (MO-P10-2)
15h00		**F. Marsiglio (c)** *Electron-Phonon coupling in Spin Hall Effect systems* (MO-P4-4)	↓	**K. Hildebrand (c)** *Phase statistics and correlations of multiply scattered ultrasonic waves in dynamic mesoscopic systems* (MO-P12-3)	**F. Torres (c)** *Diffusion in a Network of Square Cavities: Exact Numerical Results* (MO-P2-4)	↓	**A. Parent (c)** *Characterizing the Imprint of the Ionospheric Alfvén Resonator on Ground Magnetometer Data* (MO-P10-3)
15h15		**H-Y. Chen (c)** *Tunable Ground-State Degeneracies in Double Quantum Dots* (MO-P4-5)	**Coffee Break / *pause café***	**J. Page (c)** *Localization of sound in a disordered three-dimensional system* (MO-P12-4)	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**HAMZA, Abdelhaq** *Space Plasma Turbulence: Revisited* (MO-P10-4)
15h30		**P. Hawrylak (c)** *Topological Hunds rules and the electronic properties of a triple lateral quantum dot molecule in a magnetic field* (MO-P4-6)	**SLATER, Gary** *Science vs. Pseudo-Science and Junk Science* (MO-HS2-2)	**Coffee Break / *pause café***	**R.Khatchadourian (c)** *Nanoparticles and modified fluorescent proteins for imaging of transmembrane potential* (MO-P2-5)	**EDERY, Ariel** *The Casimir piston in 3+1 dimensions* (MO-P5-3)	↓

Phys.126 (cap. 48)	Phys.127 (cap. 48)	Phys.130 (cap. 70)	Phys.165 (cap. 137)	Thor.110 (cap. 90)	Thor.124 (cap. 80)	Thor.159 (cap. 80)	TIME HEURE
↓	**K. Fransham** (c) *Time Projection Chambers in the ND280m detector of the T2K neutrino oscillation experiment* (MO-A9-6)	**J. Fallis** (c) *Mass Measurements of Proton Rich Isotopes in the Vicinity of ^{92}Pd Using the Canadian Penning Trap Mass Spectrometer* (MO-A5-5)	**M. Afshari** (c) *Infrared Spectroscopy of OCS clusters* (MO-A6-6)	**K. Murphy** (c) *The generation of Pi2 pulsations, by magnetotail flow enhancements or characteristic eigenfrequencies of the night-side field topology* (MO-A10-7)	**K. Kavanagh** (c) *Reproducible Schottky Contacts by Electrodeposition* (MO-A12-4)	↓	12h00
Session ends / *Fin de la session*	**J. Ives** (c) *Background Estimates Using a Blind Analysis for the Rare Decay K+ to pi+, nu, nubar from E949* (MO-A9-7)	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	12h15
	Session ends / *Fin de la session*	DNP Business Meeting / *Réunion d'affaires DPN* (lunches provided/*repas fournis*)	DAMPhi Business Meeting - with NSERC GSC-29 Report at 13h10 *Réunion d'affaires DPAM - avec rapport du GSC-29 du CRSNG à 13h10* (lunches provided/*repas fournis*)		DCMMP Business Meeting - with NSERC GSC-28 Report at 13h10 *Réunion d'affaires DPM CM - avec rapport du GSC-28 du CRSNG à 13h10* (lunches provided/*repas fournis*)	ROOM/SALLE Phys.175 DHP Business Meeting / *Réunion d'affaires DHP* (lunches provided/*repas fournis*)	12h30
							12h45
							13h30

Phys.126 (cap. 48)	Phys.127 (cap. 48)	Phys.130 (cap. 70)	Phys.165 (cap. 137)	Thor.110 (cap. 90)	Thor.124 (cap. 80)	Thor.159 (cap. 80)	TIME HEURE
MO-P8 (DASP / *DPAE*) ATMOSPHERIC PROCESSES OF CLIMATE CHANGE II / *PROCESSUS ATMOSPHÉRIQUES ET CHANGEMENTS CLIMATIQUES II* Chair: E. Llewellyn, U. of S.	**MO-P7** (DIAP / *DPIA*) INDUSTRIAL AND APPLIED PHYSICS / *PHYSIQUE INDUSTRIELLE ET APPLIQUÉE* Chair: G. Beer, U.Victoria	**MO-P11** (DIMP / *DPIM*) INSTRUMENTATION AT CLS (CONTRIBUTED) / *INSTRUMENTATION AU CCRS (CONTRIBUÉS)* Chair: K. Michaelian, NRCan	**MO-P1** (DAMPhi-DOP / *DPAMip-DOP*) NOVEL LIGHT SOURCES ... / *NOUVELLES SOURCES DE LUMIÈRE ...* Chair: W.K. Liu, U.Waterloo	**MO-P6** (PPD / *PPD*) PRECISION FRONTIER II / *LES LIMITES DE LA PRÉCISION II* Chair: R. Kowalewski, U.Victoria	**MO-P3** (DN P / *DPN*) EXPERIMENTAL NUCLEAR STRUCTURE PHYSICS ... / *STRUCTURE NUCLÉAIRE EXPÉRIMENTALE AV EC FAISCEAUX RADIOACTIFS* Chair: R. Austin, St. Mary's U.	**MO-P9** (DHP / *DPH*) HISTORY OF PHYSICS IN CANADA - INVITED / *HISTOIRE DE LA PHYSIQUE AU CANADA - COMMUNICATIONS INVITÉES* Chair: A. Griffin, U.Toronto	
WARD, William *Understanding the Role of the Middle Atmosphere: Canadian Contributions* (MO-P8-1)	**WHITEHEAD, Lorne** *A Cost-Effective Approach to Core Daylighting* (MO-P7-1)	**J. Asai** (c) *Radiation shielding considrations against gas bremsstarhlung for a photon shutter and collimator unit of the VESPERS beamline at the CLS* (MO-P11-1)	**ROCCA, Jorge** *High brightness table-top soft x-ray lasers at high repetition rate* (MO-P1-1)	**CORRIVEAU, F.** *Electroweak Results from ZEUS* (MO-P6-1)	**GALINDO-URIBARRI, Alfredo** *Polarization Observables and Radioactive Ion Beams* (MO-P3-1)	**JACKSON, J. David** *Phil Wallace and theoretical physics at McGill in the 1950s: a personal perspective* (MO-P9-1)	14h15
↓	↓	**D. Muir** (c) *Design of a Soft X-Ray Emission Spectrometer for the REIXS Beamline at the CLS* (MO-P11-2)	↓	↓	↓	↓	14h30
↓	**MARZIALI, Andre** *Physics for CSI: Two dimensional non-linear electrophoresis for DNA extraction in forensics applications* (MO-P7-2)	**Coffee Break / *pause café***	**APPADOO, Dominique** *Commissioning of the Far-Infrared Beamline at the Canadian Light Source Inc.* (MO-P1-2)	**KRAUSS, Carsten** *News From The Final Phase Of The Sudbury Neutrino Observatory* (MO-P6-2)	**CLINE, Doug** *Coulomb excitation studies of radioactive ^{20,21}Na beams* (MO-P3-2)	**JOOS, Béla** *Philip Wallace, Educator and Pioneer of the Canadian Theoretical Physics Community* (MO-P9-2)	14h45
J. Du (c) *Semidiurnal tides from the Extended Canadian Middle Atmosphere Model (CMAM) and comparisons with TIMED Doppler Interferometer (TIDI) and meteor radar observations* (MO-P8-2)	↓	**T. May** (c) *Mid Infrared Spectromicroscopy Beamline at the Canadian Light Source* (MO-P11-3)	↓	↓	↓	↓	15h00
D.Y. Wang (c) *Diurnal Variations of the MLT Horizontal Winds Observed by WINDII/UARS and Simulated by CMAM* (MO-P8-3)	↓	**K. Michaelian** (c) *Commissioning experiments in photoacoustic infrared spectroscopy at the Canadian Light Source* (MO-P11-4)	**D. Tokaryk** (c) *High resolution rovibrational spectra of five-membered rings with heteroatoms: New results from the far-infrared beamline of the Canadian Light Source* (MO-P1-3)	**M. Auger** (c) *Neutron calibration of the PICASSO detector for the search of dark matter* (MO-P6-3)	**J. Wong** (c) *Design Study of DESCANT - DEuterated SCintillator Array for Neutron Tagging* (MO-P3-3)	**Coffee Break / *pause café***	15h15
CHSHYOLKOVA, Tatyana *Polar Vortex Evolution during Northern Hemispheric Winter 2004/05* (MO-P8-4)	**Coffee Break / *pause café***	**Session ends / *Fin de la session***	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**P.L. Walden** (c) *TACTIC, an annular ionization chamber for the tracking and identification of charged particles from nuclear reactions pertinent to nuclear astrophysics* (MO-P3-4)	**RIGDEN, John** *Physics History in Bronze* (MO-P9-3)	15h30

TIME HEURE	Other Locations Autres endroits	Geol.265 (cap. 40)	Biol.106 (cap. 250)	Biol.125 (cap. 70)	Geol.155 (cap. 48)	Geol.255 (cap. 48)	Phys.103 (cap. 145)
15h45		**H-Y. Chen** (c) *The Fock-Darwin States of Dirac Electrons in Graphene-based Artificial Atoms* (MO-P4-7)	↓	**MARANGONI, Alejandro** *Exploiting small-molecule self-assembly properties to create edible supramolecular structures* (MO-P12-5)	**J.D. Thiessen** (c) *Magnetic Resonance Imaging and Behavioural Test Comparisons in a Mouse Model of Alzheimer's Disease* (MO-P2-6)	↓	**L. Kagan** (c) *Excitation mechanism of extraordinary bright E-region radiowave-induced airglow observed above HAARP at 557.7 nm on 10 March 2004* (MO-P10-5)
16h00		**D. Sprung** (c) *Band splitting and transparent states in biperiodic superlattices (SL)* (MO-P4-8)	↓	↓	**C. Bicamumpaka** (c) *Distinct Oncocytic Renal Cell Carcinoma with Immunohistochemical Properties of Renal Oncocytoma* (MO-P2-7)	**FELDMAN, Joel** *A Rigorous Variant of the Standard: Many Boson Functional Integral* (MO-P5-4)	**G. James** (c) *Electron cyclotron waves observed on a sounding rocket* (MO-P10-6)
16h15		**P. Abumov** (c) *Interminiband carrier dynamics in presence of dissipation in biased superlattices* (MO-P4-9)	**ST-MAURICE, Jean-Pierre** *The aurora borealis: what is it we know and don't know about it?* (MO-HS2-3)	**I. L'Heureux** (c) *Elimination of the Intermediate Colloidal Product in Models of Periodic Precipitation Pattern* (MO-P12-6)	**Discussion**	↓	**L. Sangalli** (c) *Ion Flow Measurements from the JOULE and JOULE II Sounding Rocket Missions* (MO-P10-7)
16h30		**A. Plyukhin** (c) *Stochastic dynamics with nonlinear dissipation* (MO-P4-10)	↓	**J. Harden** (c) *Microscopic dynamics of recovery in sheared glassy depletion gels* (MO-P12-7)	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**J-M. Noel** (c) *How Ionospheric Electrodynamics Affect Low-Earth-Orbiting Satellites (LEOS)* (MO-P10-8)
16h45		**A.S. Sampangiraj** (c) *An Argument on the Existence of Sub-Exponential Enumeration of Inin Hard Potential Systems* (MO-P4-11)	↓	**Session ends / *Fin de la session***			**J.Z. Guo Ma** (c) *Auroral ion velocity distributions in inhomogeneous cylindrical electric field geometries* (MO-P10-9)
17h00	17h00-18h15 **Phys. 175** PiC Editorial Board Meeting / Réunion du Comité de rédaction de la PaC. (MO-PiC)	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***		**MO-CEWIP** 17h00-18h15 CEWIP SESSION / *SESSION CEFEP* Chair: J. McKenna, UBC		**Session ends / *Fin de la session***
17h15							
17h30							
18h30	18h30-21h00 **tba** CAP-NSERC Liaison Committee Meeting / Réunion du Comité de liaison ACP-CRSNG (MO-Liaison)	18h30-21h00 **John's Saskatoon** CJP Editorial Board Meeting / Réunion du conseil d'édition du journal canadien de la physique (MO-CJP)					

19h00 Poster Session, with Beer — Geology Building atrium

Atmospheric and Space Physics / *Physique atmosphérique et de l'espace* (12)	Atomic and Molecular Physics and Photon Interactions / *Physique atomique et moléculaire et d'interactions avec les photons* (17)	Condensed Matter and Materials Physics / *Physique de la matière condensée et matériaux* (19)	Instrumentation and Measurement Physics / *Physique des instruments et des mesures* (0)	Industrial and Applied Physics / *Physique industrielle et appliquée* (2)	Medical and Biological Physics / *Physique médicale et biologique* (2)	Nuclear Physics / *Physique nucléaire* (6)
MO-POS-1-12	MO-POS-13-29	MO-POS-30-49		MO-POS-50-51	MO-POS-52-53	MO-POS-54-59

Phys.126 (cap. 48)	Phys.127 (cap. 48)	Phys.130 (cap. 70)	Phys.165 (cap. 137)	Thor.110 (cap. 90)	Thor.124 (cap. 80)	Thor.159 (cap. 80)	TIME HEURE
↓	**A. Faust** (c) *Development of Neutron-based Explosives Detection Technologies* (MO-P7-3)		**KIEFFER, Jean-Claude** *Ultrafast Structural Imaging and High Field Science at the Advanced Laser Light Source (ALLS) Facility* (MO-P1-4)	**W. Trischuk** (c) *CDF's Measurement of the W Boson Mass* (MO-P6-4)	**M. Brodeur** (c) *Mass Measurement of Neutron Rich Isotopes at the TITAN Experiment* (MO-P3-5)	↓	15h45
MANSON, Alan *Solar Tides at Arctic Polar Latitudes; PEARL, Eureka and Svalbard* (MO-P8-5)	↓		↓	**BARBI, Mauricio** *Towards the International Linear Collider* (MO-P6-5)	**K. Leach** (c) *The search for a non-superallowed branch in the beta decay of ^{38}mK* (MO-P3-6)	**FRISKEN, William** *The History of the Institute of Particle Physics: Linking Small Groups to do Big Physics* (MO-P9-4)	16h00
↓	**M. Reza Shadnam** (c) *Governmental Catalysis for Industry-Academia Collaboration in Canada* (MO-P7-4)		**Y. Godwal** (c) *Laser Induced Breakdown Spectroscopy for Detection of Elemental Contaminants in Water* (MO-P1-5)	↓	**P. Finlay** (c) *High-Precision Branching Ratio Measurement for the Superallowed Beta+ Emitter ^{62}Ga* (MO-P3-7)	↓	16h15
Session ends / *Fin de la session*	↓		**A. Madej** (c) *Optical Frequency Comb Measurements of Rb Reference lines in the Violet Region of the Spectrum* (MO-P1-6)	**B. Jasper** (c) *Search for Dark Matter in the stau-neutralino Coannihilation Region at 800 GeV ILC* (MO-P6-6)	**GADE, Alexandro** *Nuclear Structure Studies with Fast Exotic Beams* (MO-P3-8)	↓	16h30
	G. Drysdale (c) *Predicted Noise Reduction from Asphalt Rubber Concrete in Urban Streets Using a Diffusion Theory Model* (MO-P7-5)		**Session ends / *Fin de la session***	**MacDONALD, Robert** *Measurements of the Muon Decay Spectrum from TWIST* (MO-P6-7)	↓	↓	16h45
	Session ends / *Fin de la session*			↓	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	17h00
				B. Leverington (c) *Results of the GlueX BCal Hall-B(JLab) beam test* (MO-P6-8)	**MO-CINP-Gen** **17h00-18h00** CANADIAN INSTITUTE OF NUCLEAR PHYSICS GENERAL MEETING / *ASSEMBLÉE GÉNÉRALE DE L'INSTITUT CANADIEN DE LA PHYSIQUE NUCLÉAIRE* Chair: G. Huber, U.Regina		17h15
				Session ends / *Fin de la session*			17h30
							18h30

Geology Building atrium — **Session d'affiches, bière servie** — 19h00

Optics and Photonics / *Optique et photonique* (5)	Physics Education / *L'enseignement de la physique* (5)	Plasma Physics / *Physique des plasmas* (7)	Surface science / *Sciences des surfaces* (1)	Theoretical Physics / *Physique théorique* (22)	Particle Physics / *Physique des particules* (0)	History of Physics / *L'histoire de la physique* (0)
MO-POS-60-64	MO-POS-65-69	MO-POS-70-76	MO-POS-77	MO-POS-78-100		

Tuesday, June 19

TIME HEURE	Other locations autres endroits	Arts 143 (cap. 350)	Arts 146 (cap. 154)	Biol.106 (cap. 250)	Biol.125 (cap. 70)	Geol.155 (cap. 70)
07h00	(TU-CNILC) CNILC Breakfast meeting - 07h00-08h10 - tba					
08h15		**TU-Plen1** (DTP-DHP) (Plenary session / *Session plénière*) Chair: M. Paranjpae, U.Montréal **LEE SMOLIN** *The possibility of the emergence of elementary particle physics from quantum gravity* (ends at 09h00)				
09h00		**TU-Plen2** (09h00-09h45) (CAP Plenary Session - Session plénière de l'ACP) Chair: W. Davidson, NRC **JAY INGRAM** *It was the Best of Times ....* (ends at 09h45)				
		TU-A11 (CAP / *ACP*) ESTABLISHING A SUCCESSFUL PUBLIC OUTREACH PROGRAM I / *ÉTABLIR UN PROGRAMME POUR REJOINDRE LE PUBLIC AVEC SUCCÈS I* Chair: W. Davidson, NRC	**TU-A4** (DCMMP / *DPMCM*) MATERIALS / *MATÉRIAUX* Chair: J. Tse, U. of S.	**TU-A9** (DAMPhi / *DPAMp*) ATOMIC AND MOLECULAR SPECTROSCOPY AND DYNAMICS II / *SPECTROSCOPIE ET DYNAMIQUE DES ATOMES ET MOLÉCULES II* Chair: R.I. Thompson, U.Calgary	**TU-A7** (DPP / *DPP*) SASKATCHEWAN PLASMA PHYSICS AND TOKAMAKS / *PHYSIQUE DES PLASMAS EN SASKATCHEWAN ET TOKAMAKS* Chair: J. Morelli, Queen's U.	**TU-A8** (DASP / *DPAE*) ATMOSPHERIC PROCESSES OF CLIMATE CHANGE III / *PROCESSUS ATMOSPHÉRIQUES ET CHANGEMENTS CLIMATIQUES III* Chair: A. Manson, U. of S.
10h00		**ALTERS, Brian** *Evolution & Intelligent Design Creationism: Big Failures of Science Outreach* (TU-A11-1)	**H. Myers** (c) *Influence of Na2Se in melt-grown monocrystalline CuInSe2* (TU-A4-1)	**KEDZIERSKI, Wladyslaw** *Studying Electron Collisions Using a Magneto-Optical Trap* (TU-A9-1)	**HIROSE, Akira** *20 Years of STOR-M tokamak* (TU-A7-1)	**JONES, Dylan** *Space-based constraints on the global transport of pollution in the troposphere* (TU-A8-1)
10h15		↓	**D. Crandles** (c) *Optical Properties of Dilute Magnetic Semiconductors Sb1.97V0.03Te3 and Sb1.94Cr0.06Te3* (TU-A4-2)	↓	↓	↓
10h30		**PETERS, Bill** *The Joys and Challenges of Outreach* (TU-A11-2)	**J. Yang** (c) *Structural and Electronic Properties of Pristine and Ba-doped Clathrate-like Carbon Fullerenes* (TU-A4-3)	**L. LeBlanc** (c) *Exploring quantum statistics with ultracold neutral atoms* (TU-A9-2)	**MITARAI, Osamu** *AC operation in the STOR-M tokamak* (TU-A7-2)	↓
10h45		**MOUSSEAU, Normand** *Science! on blogue. Commentaires sur 2 ans de blogue scientifique* (TU-A11-3)	**S. Raymond** (c) *Progress on InAs/InP Quantum Dot Lasers emitting at 1.55 microns* (TU-A4-4)	**K-P. Marzlin** (c) *Slow photons as charged quasi-particles, and photonic Aharonov-Bohm effect* (TU-A9-3)	↓	**D. Degenstein** (c) *Stratospheric Sulphate Aerosols as Measured by OSIRIS on Odin* (TU-A8-2)
11h00		**BARDEEN, Marge** *Education and Outreach at Fermilab: Ideas from the Field* (TU-A11-4)	Coffee Break / *pause café*	Coffee Break / *pause café*	**NAGATA, Masayoshi** *Compact Torus Injection Experiments on JFT-2M Tokamak* (TU-A7-3)	**C.Z. Roth** (c) *The OSIRIS Ozone Database Created with the SASKMART Processing Code* (TU-A8-3)
11h15		**HALLIN, Emil** *Outreach at the Canadian Light Source* (TU-A11-5)	**L. Livadaru** (c) *Designing Electron Beams for In-Line Holography of Nanostructures* (TU-A4-5)	**R. Roy** (c) *Lanthanide fluorescence induced by radioluminescence* (TU-A9-4)	↓	**N.D. Lloyd** (c) *A case study of a tropopause folding event observed by OSIRIS* (TU-A8-4)
11h30		Discussion	**M. Yablonskikh** (c) *Resonant X-ray Emission Spectroscopy of transition metals in metallic alloys and compounds as an element-selective probe of spin character of d electrons* (TU-A4-6)	**A. Predoi-Cross** (c) *High Accuracy Near-Infrared Spectroscopy of Carbon Dioxide for Atmospheric Applications* (TU-A9-5)	Coffee Break / *pause café*	**D. Mak** (c) *New Method for Sulfate $d^{17}O$ Measurements* (TU-A8-5)
11h45		↓	**E. Dufresne** (c) *Progress towards a picosecond long x-ray source at the Advanced Photon Source* (TU-A4-7)	**L-H. Xu** (c) *New Terahertz Database of Astrophysical Interest: Methanol (CH_3OH & $CH_3{}^{18}OH$)* (TU-A9-6)	**C. Xiao** (c) *The role of the plasma current direction in plasma toroidal flows in the STOR-M tokamak* (TU-A7-4)	Session ends / *Fin de la session*
12h00		↓	Session ends / *Fin de la session*	**M. Dehghani** (c) *Infrared diode laser spectroscopy of N_2O clusters* (TU-A9-7)	**G. Olynyk** (c) *Design and evaluation of a repetitive-fire compact toroid fuelling system for ITER* (TU-A7-5)	
12h15		↓		**L. Borvayeh** (c) *The lowest frequency vibrational fundamental of disilane: A three-band analysis* (TU-A9-8)	**A. Smolyakov** (c) *Generation of large scale structures in magnetized plasmas and geostrophic fluids* (TU-A7-6)	

Mardi, le 19 juin

Phys.103 (cap. 145)	Phys.127 (cap. 48)	Phys.130 (cap. 70)	Phys.165 (cap. 137)	Thor.110 (cap. 90)	Thor.124 (cap. 80)	Thor.159 (cap. 80)	TIME HEURE
(TU-CNILC) Réunion du comité de liaison national canadien - 07h00-08h10 - tba							07h00
							08h15
							09h00
TU-A12 (DASP / *DPAE*) GEOSPACE PHYSICS ... IV / *PHYSIQUE GÉOSPATIALE ... IV* Chair: G. Hussey, U. of S.	**TU-A1** (DTP / *DPT*) STRING THEORY AND QUANTUM GRAVITY / *THÉORIE DES CORDES ET GRAVITATION QUANTIQUE* Chair: L. Smolin, Perimeter Inst.	**TU-A5** (DCMMP / *DPMCM*) YOUNG INVESTIGATORS / *JEUNES CHERCHEURS(SES)* Chair: S. Desgreniers, U.Ottawa	**TU-A10** (DASP / *DPAE*) GEOSPACE PHYSICS ... III / *PHYSIQUE GÉOSPATIALE ... III* Chair: R. Chouchary, U. of S.	**TU-A3** (DNP / *DPN*) ELECTROWEAK SM TESTS I : LEPTONIC / *TESTS ÉLECTROFAIBLES DU MS I : LEPTONIQUES* Chair: W. van Oers, U.Manitoba	**TU-A6** (PPD / PPD) ENERGY FRONTIER AND PHENOMENOLOGY I / *FRONTIÈRE ÉNERGÉTIQUE ET PHÉNOMÉNOLOGIE I* Chair: W. Trischuk, U. Toronto	**TU-A2** (DMBP / *DPMB*) BIOPHYSICS / *BIOPHYSIQUE* Chair: A. Linhananta, Lakehead U	
ST-MAURICE, Jean-Pierre *PolarDARN: a new window on magnetospheric processes at very high latitudes* (TU-A12-1)	**DASGUPTA, Keshav** *Lumps in the throat* (TU-A1-1)	**KYCIA, Stefan** *The Future Brockhouse X-Ray Diffraction and Scattering Sector for Materials Science at the Canadian Light Source* (TU-A5-1)	**D. Sydorenko (c)** *Simulation of electron acceleration and wave propagation in the low-altitude magnetosphere* (TU-A10-1)	**CZARNECKI, Andrzej** *The Standard Model: A Critical Review* (TU-A3-1)	**TAYLOR, Wendy** *Recent Results from the D0 Experiment* (TU-A6-1)	**METZLER, Ralf** *Functional properties of DNA and its active role in DNA-protein interactions* (TU-A2-1)	10h00
↓	↓	↓	**J. Rae (c)** *Open-Closed Separatrix Determination using Global Magnetospheric Simulation and Observational Data* (TU-A10-2)	↓	↓	↓	10h15
NEWITT, Larry *Space Weather - the Dark Side of Faraday's Law* (TU-A12-2)	**VISWANATHAN, Kadayam** *Understanding QCD via AdS/CFT correspondence* (TU-A1-2)	**CHANG, Gap Soo** *Ferromagnetism in Diluted Magnetic Semiconductors: Intrinsic or Extrinsic?* (TU-A5-2)	**R. Marchand (c)** *Test kinetic calculations as a tool for assessing model self-consistency* (TU-A10-3)	**NG, John** *Operator Analysis of Physics Beyond the Standard Model and Low Energy Electroweak Measurements* (TU-A3-2)	**S. Beale (c)** *Bs Mixing at D0 with decays* (TU-A6-2)	**KARTTUNEN, Mikko** *Multiscale modeling of soft matter and biological systems* (TU-A2-2)	10h30
↓	↓	↓	**M. Connors (c)** *Automated Forward Modelling and its Results for Substorms and Sawtooth Events* (TU-A10-4)	↓	**G. Williams (c)** *Measurement of the di-b-jet cross section at CDF run-II* (TU-A6-3)	↓	10h45
J.B. Pfeifer (c) *Implications of Global SuperDARN Convection Measurements for the Selection Criteria of Steady Magnetospheric Convection Intervals* (TU-A12-3)	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**PAGE, Shelley** *Testing the Standard Model via a new measurement of the electron's weak charge in parity-violating Möller scattering at 12 GeV* (TU-A3-3)	**Z. Liu (c)** *Tau identification and tau energy correction at D0* (TU-A6-4)	**J. Katsaras (c)** *Neutron Diffraction Study of Pseudomonas aeruginosa Lipopolysaccharide Bilayers* (TU-A2-3)	11h00
A. Koustov (c) *PCN magnetic index and its relevance to convection studies in the polar cap* (TU-A12-4)	**BOUCHARD, Vincent** *Can string theory reproduce the Standard Model of particle physics?* (TU-A1-3)	**BONEV, Stanimir** *Liquid-liquid transitions and exotic melting behavior in dense alkali metals* (TU-A5-3)	**A. Yau (c)** *Non-Classical Features of the Polar Wind* (TU-A10-5)	↓	**SNIHUR, Robert** *Latest Results from the CDF Collaboration* (TU-A6-5)	**N. Kucerka (c)** *Influence of Cholesterol on the Bilayer Properties of Monounsaturated Phosphatidylcholine Unilamellar Vesicles* (TU-A2-4)	11h15
R. Fiori (c) *Introduction of an analysis tool for observations of the Near-Earth space* (TU-A12-5)	↓	↓	**R. Gillies (c)** *SuperDARN radio wave power distribution characteristics in the ionosphere from an ePOP perspective* (TU-A10-6)	**OSER, Scott** *Neutrino Interactions In, Around, and Beyond the Standard Model* (TU-A3-4)	↓	**J. Berashevich (c)** *Polaron tunneling in the DNA molecule* (TU-A2-5)	11h30
D. Danskin (c) *Using Riometers to investigate space weather* (TU-A12-6)	**KUNSTATTER, Gabor** *Can Holographic Arguments Yield the 5-D Choptuik Scaling Exponent From 4-D Yang-Mills Theory?* (TU-A1-4)	**DODGE, J. Steven** *A view of metals through the terahertz window* (TU-A5-4)	**J. McMahon (c)** *The Threshold-Temperature effect in spacecraft charging and the sheath structure around the e-POP satellite in low-polar-orbit conditions* (TU-A10-7)	↓	**S. Carron (c)** *Top Quark Mass Measurement in Combined Lepton+Jets and Dilepton Decay Channels Using a Mass Template Method from pp Collisions at 1.96 TeV* (TU-A6-6)	**M-P. Nieh (c)** *Controlled-Release And Controlled-Size Spontaneous Unilamellar Vesicles with Low Polydispersities* (TU-A2-6)	11h45
D. Megan Gillies (c) *Rapid Auroral Flow Intensifications in response to sudden increase in magnetic activity* (TU-A12-7)	↓	↓	**G. Hussey (c)** *Proposed satellite radar instrument for top-side observations of the terrestrial ionosphere* (TU-A10-8)	**RANGACHARYULU, C.** *New Physics in the measurement of transverse muon polarization* (TU-A3-5)	**S. Pashapour (c)** *First Measurement of sigma(gg->ttbar)/sigma(ppbar->ttbar)* (TU-A6-7)	**A. Linhananta (c)** *Field Theoretic Computer Simulations of Two-Component Lipid Systems* (TU-A2-7)	12h00
Session ends / *Fin de la session*	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	↓	**D. Gillberg (c)** *Evidence for single top quark production at D0* (TU-A6-8)	**F. Mansour (c)** *Hydrophobic Wetting: Low field NMR study of the hydrophobic effect for water confined in pores of carbon nanohorns* (TU-A2-8)	12h15

TIME HEURE	Other locations autres endroits	Arts 143 (cap. 350)	Arts 146 (cap. 154)	Biol.106 (cap. 250)	Biol.125 (cap. 70)	Geol.155 (cap. 70)
12h30		**Session ends / *Fin de la session***		**Session ends / *Fin de la session***	**I. Khalzov (c)** *Magnetorotational instability in rotating conducting fluid* (TU-A7-7)	
12h45					**Session ends / *Fin de la session*** **DPP Business Meeting / *Réunion d'affaires DPP*** (lunches provided/*repas fournis*)	
13h30		**TU-Plen3** (13h30-14h10) (CAP Plenary Session - Session plénière de l'ACP) Chair: W. Davidson, NRC **LAWRENCE KRAUSS** *Selling Science to Unwilling Buyers*				
		TU-P8 (CAP / *ACP*) ESTABLISHING A SUCCESS-FUL PUBLIC OUTREACH PROGRAM II / *ÉTABLIR UN PROGRAMME POUR REJOINDRE LE PUBLIC AVEC SUCCÈS II* Chair: W. Davidson, NRC		**TU-P1** (DCP-DAMPhi / DOP-*DPAMip*) QUANTUM OPTICS, INFORMATION AND COMPUTATION I / *OPTIQUE, INFORMATIQUE ET CALCCUL QUANTIQUES I* Chair: P. Ashrit, U.Moncton	**TU-P2** (DNP / *DPN*) ELECTROWEAK SM TESTS II : SEMI-LEPTONIC / *TESTS ÉLECTROFAIBLES DU MS II : SEMI-LEPTONIQUES* Chair: J. Martin, U.Winnipeg	**TU-P3** (DCMMP / *DPMCM*) MAGNETIC SYSTEMS / *SYSTÈMES MAGNÉTIQUES* Chair: B. Gaulin, McMaster U.
14h15		**PINFOLD, James** *Forging a Cosmic Connection Between High-Schools and Science* (TU-P8-1)		**HALJAN, Paul** *Simulating Quantum Magnets with Trapped Ions* (TU-P1-1)	**CIRIGLIANO, Vincenzo** *Low Energy Tests of the Standard Model* (TU-P2-1)	**GAULIN, Bruce** *Frustrated and Satisfied Ground States in Pyrochlore Magnets* (TU-P3-1)
14h30		**PAVAN, Marcello** *TRIUMF's experience with creating computer animation-intensive educational videos* (TU-P8-2)		↓	↓	↓
14h45		**WALKER, Tracy** *Educational Outreach Programs at the Canadian Light Source* (TU-P8-3)		**G. Howard (c)** *Real Source Quantum Key Distribution Relays* (TU-P1-2)	**GERICKE, Michael** *Testing the Standard Model with Cold Neutrons: (The Nab Experiment)* (TU-P2-2)	**J. van Lierop (c)** *The effect of significant surface spin disorder on the magnetism of gamma-Fe_2O_3 nanoparticles* (TU-P3-2)
15h00		**NURSALL, Alan** *Setting the stage for science: fun is learning* (TU-P8-4)		**S. Simmons (c)** *Experimental Demonstration of Magic State Purification* (TU-P1-3)	↓	**Coffee Break / *pause café***
15h15		**POPE, Damien** *Educational Outreach at Perimeter Institute for Theoretical Physics* (TU-P8-5)		**C. Meunier (c)** *Quantum Dynamics of an Atom trapped in a Lattice* (TU-P1-4)	**MELCONIAN, Dan** *Nuclear beta decay and the CKM mass-mixing matrix* (TU-P2-3)	**P. Russo (c)** *Muon Spin Rotation/Relaxation Study of Ba_2CoO_4* (TU-P3-3)
15h30		**Discussion**		**Z. Shaterzadeh Yazdi (c)** *A New Approach to Mutlipartite Squeezed States* (TU-P1-5)	↓	**G. Williams (c)** *The Magnetic and Transport Properties of Single Crystal Manganites - Appearance of a Griffiths Phase* (TU-P3-4)
15h45		↓		**R. Cabrera (c)** *Overcoming the su(2^n) sufficient condition for the coherent control of n-qubit systems* (TU-P1-6)	**JILLINGS, Chris** *From Neutrino Oscillations to Nonproliferation: the amazing utility of proton inverse-beta decay* (TU-P2-4)	**M. Saoudi (c)** *Polarized neutron reflectometry study on thin AuFe spin glass films* (TU-P3-5)
16h00		↓		**A. Haché (c)** *Towards a new type of photonic device* (TU-P1-7)	↓	**H. Fritzsche (c)** *Out-of-plane magnetization reversal in an (110)-oriented epitaxial ($ErFe_2$ / $DyFe_2$) Laves-phase superlattice* (TU-P3-6)
16h15		↓		↓	**R. Hydomako (c)** *First results with the ALPHA antihydrogen apparatus* (TU-P2-5)	**Session ends / *Fin de la session***
16h30		**Session ends / *Fin de la session***		**Session ends / *Fin de la session***	**Session ends / *Fin de la session***	

Phys.103 (cap. 145)	Phys.127 (cap. 48)	Geol.255 (cap. 48)	Phys.165 (cap. 137)	Thor.110 (cap. 90)	Thor.124 (cap. 80)	Thor.159 (cap. 80)	TIME HEURE
	DTP Business Meeting / *Réunion d'affaires DPT* (lunches provided/*repas fournis*)	DOP Business Meeting / *Réunion d'affaires DOP* (lunches provided/*repas fournis*)	DASP Business Meeting / *Réunion d'affaires DPAE* (lunches provided/*repas fournis*)	**Session ends / *Fin de la session***	**Session ends / *Fin de la session*** PPD Business Meeting / *Réunion d'affaires PPD* (lunches provided/*repas fournis*)	**Session ends / *Fin de la session*** DMBP Business Meeting / *Réunion d'affaires DPMB* (lunches provided/*repas fournis*)	12h30
							12h45
							13h30
TU-P10 (DIMP-DMBP / *DPIM-DPMB*) BIOMEDICAL INSTRUMENTATION / *INSTRUMENTATION BIOMÉDICALE* Chair: K. Michaelian, NRCan	**TU-P9** (DSS / *DSS*) SURFACE SCIENCE / *SCIENCE DES SURFACES* Chair:L. Wilson, U of S.	**TU-P4** (DPP / *DPP*) GENERAL PLASMA PHYSICS / *PHYSIQUE DES PLASMAS* Chair: T. Johnston, INRS	**TU-P7** (PPD-DTP / *PPD-DPT*) ENERGY FRONTIER AND PHENOMENOLOGY II / *FRONTIÈRE ÉNERGÉTIQUE ET PHÉNOMÉNOLOGIE II* Chair: W. Taylor, York U.	**TU-P11** (DASP / *DPAE*) GEOSPACE PHYSICS ... VI / *PHYSIQUE GÉOSPATIALE ... VI* Chair: R. Gillies	**TU-P6** (DASP / DPAE) ATMOSPHERIC PROCESSES OF CLIMATE CHANGE IV / *PROCESSUS ATMOSPHÉRIQUES ET CHANGEMENTS CLIMATIQUES IV* Chair: N. Lloyd, U of S.	**TU-P5** (DASP / *DPAE*) GEOSPACE PHYSICS ... V / *PHYSIQUE GÉOSPATIALE ... V* Chair: D.M. Gillies	
MANDELIS, Andreas *Dental Thermophotonics : Laser Photothermal Methods vs. X-rays in the Race for Dental Caries Diagnostics in Clinical Dentistry* (TU-P10-1)	**L. Livadraru (c)** *Holographic Imaging of Nanostructures and Interfaces with Low Energy Electrons* (TU-P9-1)	**M. Bradley (c)** *Advances in Plasma Processing for Photonic Applications* (TU-P4-1)	**P-H. Beauchemin (c)** *Search for Large Extra Dimension with the CDF detector at the Tevatron* (TU-P7-1)	**R.K. Choudhary (c)** *PolarDARN observations of sunward convection under strong interplanetary magnetic field B_y conditions* (TU-P11-1)	**WARD, William** *An Overview of the CAWSES Global Observing Campaign on Tides* (TU-P6-1)	**D. Knudsen (c)** *The Swarm Canadian Electric Field Instruments* (TU-P5-1)	14h15
↓	↓	**M. Risch (c)** *Plasma ion implantation for band gap engineering of dilute $GaAs_{1-x}N_x$ alloys* (TU-P4-2)	**G. Kertzscher (c)** *Search for Charged Higgs Boson Using the DZero Experiment* (TU-P7-2)	**M. Watanabe (c)** *The origin of the interhemispheric potential mismatch of merging cells for IMF BY-dominated periods* (TU-P11-2)	↓	**J.K. Burchill (c)** *Prospective Swarm CEFI studies of high-latitude auroral electrodynamics* (TU-P5-2)	14h30
LEGARE, Francois *Nonlinear Optical Microscopy for Biomedical Imaging* (TU-P10-2)	**W. Wu (c)** *Au-induced faceting a vicinal Si(111) surface* (TU-P9-2)	**D. Hunter (c)** *Plasma Ion Engine Development for Spaceflight Applications* (TU-P4-3)	**K. Moats (c)** *Longitudinal WZ scattering at the LHC in the Littlest Higgs Model* (TU-P7-3)	**T. Jayachandran (c)** *Observations of Dipolarization at Geo-Synchronous Orbits and its Response in the Polar Cap Convection* (TU-P11-3)	**BATHGATE, A.** *The Measurement of Mesospheric Water Vapour, Ozone and Temperature with OSIRIS* (TU-P6-2)	**D.J. McEwen (c)** *New Auroral Studies from the South Pole* (TU-P5-3)	14h45
↓	**Y. Li (c)** *Direct growth of adherent diamond films on steel* (TU-P9-3)	**W. Chen (c)** *Synthesis of nanocrystalline diamond thin films at high gas flow rate in a microwave plasma reactor* (TU-P4-4)	**D. Fortin (c)** *News from the CMS Experiment and Results from the 2006 Cosmic Challenge* (TU-P7-4)	**E. Donovan (c)** *A New Era of Ground-Based Auroral Remote Sensing* (TU-P11-4)	↓	**L. Cogger (c)** *The Fast Auroral Imager Experiment on the Canadian ePOP Satellite* (TU-P5-4)	15h00
Coffee Break / *pause café*	**S. Urquhart (c)** *Canadian Photoelectron emission Research Spectromicroscope (CaPeRS) for materials characterization* (TU-P9-4)	**A. Smolyakov (c)** *Resonant transparency of opaque materials* (TU-P4-5)	**N. Kolev (c)** *Detection of SUSY signals in the stau-neutralino coannihilation region at the LHC* (TU-P7-5)	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**J. Beaudette (c)** *CIMON - The Royal Military College of Canada's proposed nanosatellite mission for the purpose of space based magnetometry* (TU-P5-5)	15h15
ZENG, Haishan *Fast Raman Spectroscopy for Real-time in vivo Tissue Analysis for Early Cancer Detection* (TU-P10-3)	**Coffee Break / *pause café***	**Coffee Break / *pause café***	**LOGAN, Heather** *LHC Phenomenology* (TU-P7-6)	**K. McWilliams (c)** *The Study of Solar Wind-Magnetosphere-Ionosphere Coupling Using Multiple Instruments* (TU-P11-5)		**G. Hussey (c)** *A Frequency Modulated Continuous Wave (FMCW) VHF radar for E-region plasma irregularity studies* (TU-P5-6)	15h30
↓	**S. Yang (c)** *Nucleation, growth and properties of diamond films on Ti_2SiC_2 by chemical vapor deposition* (TU-P9-5)	**R. Fedosejevs (c)** *Wakefield Acceleration of Quasi-Monoenergetic 20 MeV to 200 MeV Electrons in Nitrogen and Helium Gas Targets* (TU-P4-6)	↓	**D. Milling (c)** *Substorm timing and location using the combined CARISMA and THEMIS GMAG magnetometers* (TU-P11-6)	**S. Petelina (c)** *Interannual and interhemispheric variability in properties of Polar Mesospheric Clouds detected by Odin/OSIRIS* (TU-P6-3)	**Session ends / *Fin de la session***	15h45
FORD, Nancy *Retrospectively gated imaging using a high-speed, flat-panel equipped cone beam micro-CT scanner* (TU-P10-4)	**J. Shi (c)** *Nucleation and post growth relaxation of tetracene thin films on silicon oxide* (TU-P9-6)	**P-E. Masson-Laborde (c)** *Kinetic modeling of the stimulated Raman scattering* (TU-P4-7)	**TRIGGER, Isabel** *ATLAS in Canada: International Solutions to Universal Questions* (TU-P7-7)	**J. Rae (c)** *Global ULF Wave Energy Transport in the Magnetosphere* (TU-P11-7)	**R. Querel (c)** *Calibration of a 20µm Water Vapour Monitor (IRMA) for TMT site testing operations* (TU-P6-4)		16h00
↓	**A. Tersigni (c)** *Structure of tetracene films on hydrogen-passivated Si(001) studied via STM, AFM and NEXAFS* (TU-P9-7)	**Session ends / *Fin de la session***	↓	**J. MacDougall (c)** *Gravity waves near the polar cap boundary* (TU-P11-8)	**W. Ward (c)** *The Waves AND Coupling Theme of the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Canada* (TU-P6-5)		16h15
Session ends / *Fin de la session*	**P. Westreich (c)** *Surface science in a jar: Preferential adsorption and exclusion of salts impregnated into activated carbon* (TU-P9-8)		**NG, John** *Radiative Neutrino Mass Generation as an Alternative to the Seesaw Mechanism* (TU-P7-8)	**Session ends / *Fin de la session***	**Session ends / *Fin de la session***		16h30

TIME HEURE	Other locations autres endroits	Arts 143 (cap. 350)	Arts 146 (cap. 154)	Biol.106 (cap. 250)	Biol.125 (cap. 70)	Geol.155 (cap. 70)
16h45		**CAP Annual General Meeting / *Assemblée générale de l'ACP***				
17h00						
19h00	**Banquet Reception**					Western Development Museum
19h30	**Banquet**					

Wednesday, June 20

TIME HEURE	Arts 143 (cap. 350)	Arts 146 (cap. 154)	Biol.106 (cap. 250)	Geol.155 (cap. 70)	Phys.165 (cap. 137)
08h15	**WE-Plen1** (08h15-09h00) (CAP Plenary Session - Session plénière de l'ACP) Chair: B. Gaulin, McMaster U. **DAVID A. WEITZ** *Dripping, Jetting, Drops and Wetting: the Magic of Microfluidics*				
09h00	**WE-Plen2** (09h00-09h45) (CAP Plenary Session - Session plénière de l'ACP) Chair: A. Bellerive, Carleton U. **JONATHAN FENG** *The Dark Universe and Microphysical Cosmology*				
		WE-A2 (DASP / *DPAE*) (10h00 - 12h15) **E-POP MISSION MEETING I / *RENCONRE DE LA MISION E-POP I***	**WE-A3** (DNP / *DPN*) **INSTRUMENTATION FOR NUCLEAR AND MEDICAL PHYSICS / *INSTRUMENTATION POUR LA PHYSIQUE NUCLÉAIRE ET MÉDICALE*** Chair: G. Hackman, TRIUMF	**WE-A5** (PPD / *PPD*) **INSTRUMENTATION FOR PARTICLE PHYSICS / *INSTRUMENTATION EN PHYSIQUE DES PARTICULES*** Chair: K. Ragan, McGill U.	**WE-A9** (DASP / *DPAE*) (10h00 - 12h15) **CANADIAN GEOSPACE MONITORING MISSION MEETING / *RENCONTRE DE LA MISSION DE SURVEILLANCE GÉOSPATIALE CANADIENNE***
10h00		↓	**CHETTLE, David** *Nuclear & Atomic Physics Techniques for the Elemental Analysis of Living Human Subjects* **(WE-A3-1)**	**KURCHANINOV, Leonid** *Development of instrumentation for particle physics in TRIUMF* **(WE-A5-1)**	↓
10h15		↓	↓	↓	↓
10h30		↓	**K. Davis (c)** *Bone Aluminum Measurement with Accelerator-based In Vivo Neutron Activation Analysis* **(WE-A3-2)**	**T. Lindner (c)** *Construction of the Fine Grained Detector for the T2K long baseline neutrino oscillation experiment* **(WE-A5-2)**	↓
10h45		↓	**Aslam (c)** *In Vivo Assessment of Mg Status in Human Body using Accelerator-based Neutron Activation Measurement of hands: A feasibility study* **(WE-A3-3)**	**A. Marino (c)** *An Optical Transition Radiation Beam Monitor for the T2K Beamline* **(WE-A5-3)**	↓
11h00		↓	**KURCHANINOV, Leonid** *Liquid Xenon Detector for Medical Imaging* **(WE-A3-4)**	**Z. Papandreou (c)** *Large-Area Silicon Photo Multipliers for the GlueX Project* **(WE-A5-4)**	↓
11h15		↓	↓	**Coffee Break / *pause café***	↓
11h30		↓	**W.E. Kieser (c)** *Development of a System for Bio-medical Carbon-14 Analysis by Accelerator Mass Spectrometry* **(WE-A3-5)**	**BOULAY, Mark** *DEAP liquid argon dark matter particle search at SNOLAB* **(WE-A5-5)**	↓

Phys.103 (cap. 145)	Phys.127 (cap. 48)	Geol.255 (cap. 48)	Phys.165 (cap. 137)	Thor.110 (cap. 90)	Thor.124 (cap. 80)	Thor.159 (cap. 80)	TIME HEURE
	A. Sallabi (c) *A Monte Carlo simulation study of CO on KCl (001)* (TU-P9-9)		↓				16h45
	Session ends / *Fin de la session*		**Session ends / *Fin de la session***				17h00

19h00 — **Réception du banquet** — Western Development Museum

19h30 — **Banquet**

Mercredi, le 20 juin

Phys.127 (cap. 48)	Phys.130 (cap. 70)	Phys.103 (cap. 145)	Thor.124 (cap. 80)	Thor.159 (cap. 80)	TIME HEURE
					08h15
					09h00
WE-A8 (DIMP / *DPIM*) GENERAL INSTRUMENTATION / *INSTRUMENTATION GÉNÉRALE* Chair: K. Michaelian, NRCan	**WE-A4** (DCMMP / *DPMCM*) SOFT MATTER II / *MATIÈRE MOLLE II* Chair: J. Katsaras, NRC	**WE-A7** (CAP/ACP) (10h00 - 12h00) CAP BEST STUDENT PRESENTATION - FINAL COMPETITION / *COMPÉTITION FINALE DE L'ACP POU LES MEILLEURES COMMUNICATIONS ÉTUDIANTS* Chair: W. Davidson, NRC	**WE-A6** (DCMMP-DTP / *DPMCM-DPT*) CONDENSED MATTER THEORY - INVITED / *THÉORIE DE LA MATIÈRE CONDENSÉE INVITÉS* Chair: D. Sprung, McMaster U.	**WE-A1** (DASP / *DPAE*) (10h00 - 12h15) ATMOSPHERIC PROCESSES OF CLIMATE CHANGE (APOCC): CONCEPT WORKING I / *PROCESSUS ATMOSPHÉRIQUES ET CHANGEMENTS CLIMATIQUE : GROUPES DE TRAVAIL I*	
SHEN, Jun *Photothermal-deflection measurements of thermophysical and mass-diffusion properties of gases* (WE-A8-1)	**BECHHOEFER, John** *How frog embryos replicate their DNA reliably* (WE-A4-1)	**Competitor #1** tba	**KONIK, Robert** *A Numerical Renormalization Group for Continuum One Dimensional Systems* (WE-A6-1)	↓	10h00
↓	↓	**Competitor #2** tba	↓	↓	10h15
PIGNOLET, Alain *Voltage Modulated Piezoelectric Response Scanning Force Microscopy of Ferroic Oxide Films and Structures* (WE-A8-2)	**M-P. Nieh** (c) *Characterization of biocompatible polymer thin films, grafted poly-(methacrylate) with oligo(ethylene glycol) and phosphorylcholine side chains, by neutron reflectometry* (WE-A4-2)	**Competitor #3** tba	**ISAKOV, Sergei** *Fractionalized Mott insulating phases in hard-core boson models on the kagome and pyrochlore lattices* (WE-A6-2)	↓	10h30
↓	**J. Harden** (c) *Self-assembling, bioactive protein hydrogels via engineered coiled-coil aggregation* (WE-A4-3)	**Competitor #4** tba	↓	↓	10h45
Coffee Break / *pause café*	**FORREST, James** *Protein denaturing on nanospheres* (WE-A4-4)	**Competitor #5** tba	**Coffee Break / *pause café***	↓	11h00
B. Kirby (c) *Fine Grained Detector Electronics for the T2K Experiment* (WE-A8-3)	↓	**Competitor #6** tba	**SÉNÉCHAL, David** *Progress on strongly correlated electron systems with the variational cluster approximation* (WE-A6-3)	↓	11h15
A. Litherland (c) *A low energy isobar separator for Accelerator Mass Spectrometry (AMS)* (WE-A8-4)	**N. Kucerka** (c) *Curvature Effect on the Structure of Phospholipid Bilayers* (WE-A4-5)	**Competitor #7** tba	↓	↓	11h30

TIME HEURE	Phys. 175 (cap. 48)	Arts 146 (cap. 154)	Biol.106 (cap. 250)	Geol.155 (cap. 70)	Phys.165 (cap. 137)
11h45		↓	**R. LeClair** (c) *Measurement of total linear attenuation coeffecients of tissues using energy dispersive transmission measurements with a CdTe detector* **(WE-A3-6)**	**J. Lidgard** (c) *Recent developments and status of the DEAP liquid argon WIMP detector* **(WE-A5-6)**	↓
12h00	**WE-NSERC** Young New Faculty Luncheon with NSERC / *Dîner-rencontre des jeunes ou nouveaux professeurs avec le CRSNG*	↓	**R. Roy** (c) *Conception d'un système de pulsation lumineuse comme point de référence interne pour le multidétecteur HÉRACLES* **(WE-A3-7)**	**Session Ends / *Fin de la session***	↓
12h15	↓	**Meeting Ends / *Fin de la réunion***	**Session Ends / *Fin de la session***		**Meeting Ends / *Fin de la réunion***
12h30	**Session Ends / *Fin de la session***		**WE-Workshop** NSERC Workshop / *Atelier du CRSNG* **(ends at 13h30)**		

TIME HEURE	Arts 143 (cap. 350)	Arts 146 (cap. 154)	Phys.165 (cap. 137)
13h30	**WE-Plen3a** (13h30-14h10) (CAP-CRM Medal Winner / Récipiendaire de la médaille ACP-CRM) Chair: M. Paranjape, U.Montréal **JOEL FELDMAN** *Perturbation Theory for Many Fermion Systems*	**WE-Plen3b** (13h30-14h10) (CAP Industrial Medal Winner / Récipiendaire de la médaille industrielle de l'ACP) Chair: M. Steinitz, St. F-X **ROMAN MAEV** *How Advanced Acoustic Imaging will Benefit Modern Industry*	
	WE-P6 (DASP / *DPAE*) (14h15 - 17h00) **CANADIAN GEOSPACE MONITORING AND E-POP MISSION / *SURVEILLANCE GÉOSPATIALE CANADIENNE ET MISSION E-POP***	**WE-P2** (DASP / *DPAE*) (14h15 - 16h45) **E-POP MISSION MEETING II / *RENCONRE DE LA MIIS-SION E-POP II***	**WE-P4** (PPD / PPD) **NON-ACCELERATOR PARTICLE PHYSICS / *PHYSIQUE DES PARTICULES SANS ACCÉLÉRATEUR*** Chair: Z. Papandreou, U.Regina
14h15	↓	↓	**NOBLE, Anthony** *The PICASSO Dark Matter Search Experiment* **(WE-P4-1)**
14h45	↓	↓	**G. Giroux** (c) *Fabrication and characterisation of PICASSO detectors* **(WE-P4-2)**
15h00	↓	↓	**P. Nadeau** (c) *A Method for the Determination of the Droplet Distribution of the PICASSO Detectors* **(WE-P4-3)**
15h15	↓	↓	**Coffee Break / *pause café***
15h30	↓	↓	**RAGAN, Kenneth** *Status of and first results from the high energy gamma-ray experiment VERITAS* **(WE-P4-4)**
15h45	↓	↓	↓
16h00	↓	↓	**GRAHAM, Kevin** *From Neutrinos to Dark Matter* **(WE-P4-5)**
16h15	↓	↓	↓
16h30	↓	↓	**W. Rau** (c) *Search for Dark Matter with CDMS and SuperCDMS* **(WE-P4-6)**
16h45	↓	**Meeting Ends / *Fin de la réunion***	**D. Singh** (c) *Can Gravity Distinguish Between Dirac and Majorana Neutrinos?* **(WE-P4-7)**
17h00	**Meeting Ends / *Fin de la réunion***		**Session Ends / *Fin de la session***

Room Phys. 175 -- CAP Council (New and Old) Meeting (17h00 - 19h00)

Phys.127 (cap. 48)	Phys.130 (cap. 70)	Phys.103 (cap. 145)	Thor.124 (cap. 80)	Thor.159 (cap. 80)	TIME HEURE
Session Ends / *Fin de la session*	**S.B. Opps** (c) *Discontinuous molecular dynamics for fluids composed of rigid molecules* (WE-A4-6)	**Competitor #8** **tba**	**BERCIU, Mona** *Green's function of single Holstein polarons* (WE-A6-4)	↓	11h45
	N. Mousseau (c) *Self-organized criticality of elastic networks* (WE-A4-7)	Session Ends / *Fin de la session*	↓	↓	12h00
	Session Ends / *Fin de la session*		Session Ends / *Fin de la session*	Meeting Ends / *Fin de la réunion*	12h15
					12h30

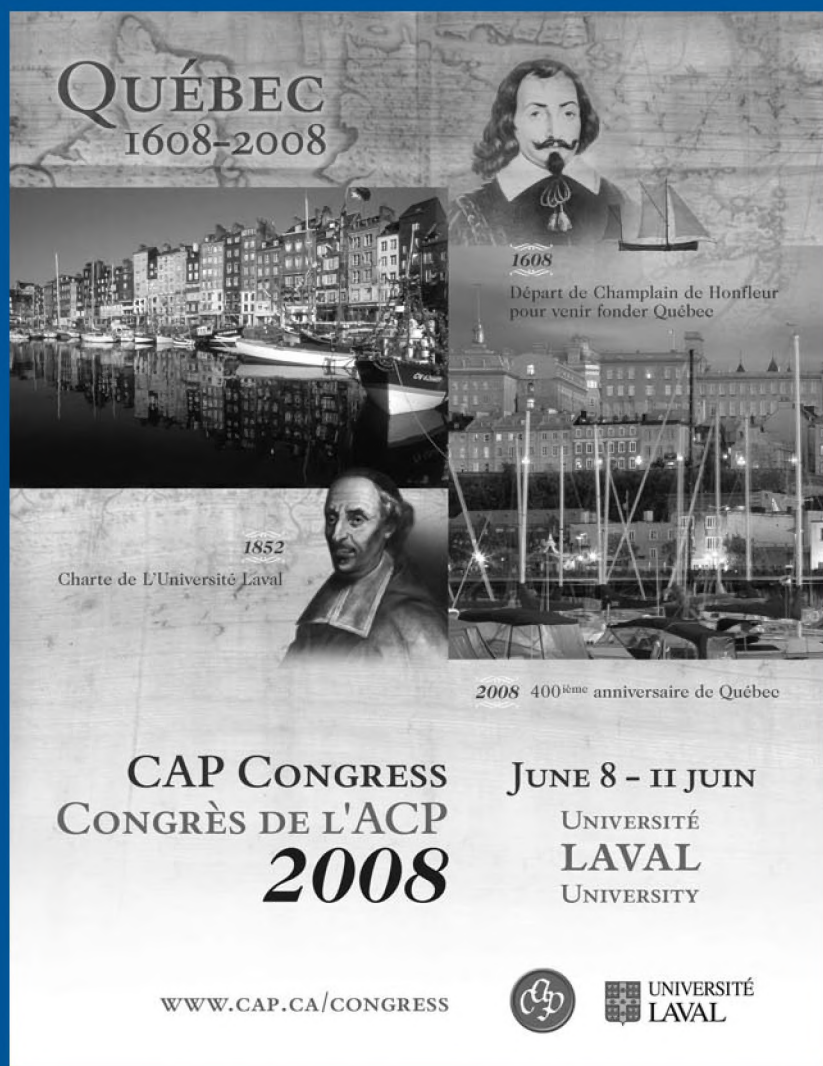
Phys.130 (cap. 70)	Phys.103 (cap. 145)	Thor.159 (cap. 80)	TIME HEURE
			13h30
WE-P3 (DNP-DTP / *DPN-DPT*) ADVANCES IN NUCLEAR THEORY / *PROGRÈS EN THÉORIE NUCLÉAIRE* Chair: R. Mackenzie, U. Montréal	**WE-P5** (DAMPhi-DOP/ *DPAMip-DOP*) QUANTUM OPTICS, INFORMATION AND COMPUTATION II / *OPTIQUE, INFORMATIQUE ET CALCUL QUANTIQUES II* Chair: P. Haljan, SFU	**WE-P1** (DASP / *DPAE*) (14h15 - 17h00) ATMOSPHERIC PROCESSES OF CLIMATE CHANGE (APOCC): CONCEPT WORKING II / *PROCESSUS ATMOSPHÉRIQUES ET CHANGEMENTS CLIMATIQUE : GROUPES DE TRAVAIL II*	
JENNINGS, Byron *The Nuclear Shell Model, the Renormalization Group, and the Projection Operator Formalism* (WE-P3-1)	**WEIHS, Gregor** *Entangled Photon Pairs for Quantum Communication* (WE-P5-1)	↓	14h15
SVENNE, Juris *Coupled-channel study of scattering from and structure of nuclei on and off the line of stability* (WE-P3-2)	**J. Slater** (c) *Towards the Production of Entangled Photon Pairs in Optical Fiber via Four-Wave Mixing* (WE-P5-2)	↓	14h45
↓	**F. Bussières** (c) *Hybrid Photonic Entanglement Using a PPLN Crystal* (WE-P5-3)	↓	15h00
ALEKSEJEVS, Aleksandrs *Impact of Radiative Effects on Parity-Violating Electron-Nucleon Scattering* (WE-P3-3)	**I. Lucio Martinez** (c) *Towards Fast Quantum Key Distribution* (WE-P5-4)	↓	15h15
↓	Session Ends / *Fin de la session*	↓	15h30
JEON, Sangyong *Jet energy loss in hot Quark Gluon Plasma* (WE-P3-4)		↓	15h45
↓		↓	16h00
R. Haq (c) *Power Spectrum Analysis of the Average-Fluctuation Separation in Interacting Particle Systems* (WE-P3-5)		↓	16h15
Session Ends / *Fin de la session*		↓	16h30
		↓	16h45
		Meeting Ends / *Fin de la réunion*	17h00

Salle Phys. 175 -- Réunion du conseil (nouveau et ancien) (17h00 - 19h00)

Next CAP Annual Congress

2008 June 8-11

at Laval University, Ste-Foy, Québec



Prochain Congrès annuel de l'ACP

8-11 juin 2008

à l'Université Laval, Ste-Foy, Québec

Come and visit the Art of Physics exhibition on display at the 2007 Congress. Entry forms for the 2007 competition will be available at the CAP Information Desk (deadine Dec. 31/07). Winning entries will be added to the travelling exhibition.

Venez visiter l'exposition l'<<Art de la Physique>> tenue lors du Congrès 2007. Les formulaires d'inscription pour le concours 2007 seront disponibles au bureau d'information (la date limite est le 31 décembre 2007). Les gagnants verront leurs œuvres ajoutées à l'exposition itinérante.

2007 CONGRESS ORAL SESSION ABSTRACTS
RÉSUMÉS DES SESSIONS ORALES - CONGRÈS 2007

The oral session abstracts presented here are organized by session codes (SU-A1 to WE-P6). Each presentation is cross-referenced in the Author Index (pg. 145). *Les résumés des sessions orales ci-après sont par code (SU-A1 à WE-P6). L'index des auteurs (pg. 145) 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 2007 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 2007.*

SATURDAY, JUNE 16 - SAMEDI, 16 JUIN

[SA-Exec] Meeting of CAP Executive / *Réunion de l'exécutif de l'ACP*

(CAP-Exec / Exec-ACP)

SATURDAY, JUNE 16
SAMEDI, 16 JUIN
09h30 - 13h30

ROOM / SALLE Parktown Hotel

Chair: M. Campbell, University of Waterloo

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

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

[SA-Council] Meeting of CAP Council (Old and New) / *Réunion du conseil (ancien et nouveau) de l'ACP*

(CAP-Council / *Conseil-ACP*)

SATURDAY, JUNE 16
SAMEDI, 16 JUIN
14h00 - 17h30

ROOM / SALLE Parktown Hotel

Chair: M. Campbell, University of Waterloo

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

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

SUNDAY, JUNE 17 - DIMANCHE, 17 JUIN

[SU-Hd-Chr] Meeting of Heads/Chairs of Physics Departments / *Réunion des directeurs de départements de physique*

(Heads / *Directeurs*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
08h15 - 11h00

ROOM / SALLE Marquis Hall (Selkirk Room)

Chair: R. Pywell, University of Saskatchewan

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

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

[SU-A1] Recent Advances in Condensed Matter Physics with Synchrotron Radiation / *Progrès récents en physique de la matière condensée avec rayonnement synchrotron*

(DCMMP-CLS / *DPMCM-CCRS*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
08h30 - 12h00

ROOM / SALLE tba

Chair: S. Idziak, University of Waterloo

SU-A1-1 **08h30**

JOHN TSE, University of Saskatchewan

Electronic and Phonon Spectroscopy with Inelastic X-ray Scattering

Owing to advances in the production of high intensity, coherence and highly monochromatized synchrotron radiation in recent decade, X-rays scattering has become a high-

ly desirable technique for the investigation of the electronic and dynamical properties of condensed matter. Through explicit examples, application of non-resonant and resonant inelastic scattering using synchrotron radiation on the determination of the vibrational and electronic structure of materials particularly under high pressure condition will be illustrated. It is shown that phonon dispersion and site specific vibrations information can be obtained. By changing the momentum transfer in an inelastic scattering experiment, information on excited conduction bands with different symmetries can be determined.

SU-A1-2 **09h30**

MARK SUTTON, McGill University

What's new in x-ray intensity fluctuation spectroscopy *

X-ray intensity fluctuation spectroscopy or x-ray photon correlation spectroscopy allows one to directly measure the structural fluctuations in condensed matter. Since the microstructure of most materials evolve in time by the equilibration of such fluctuations, this gives a unique probe into the dynamics of materials both in and out of equilibrium. This talk will summarize such results from the dynamics of first order phase transitions in binary alloys, fluctuations in colloids and polymer mixtures and the study of capillary fluctuations in polymer thin films. Most recently, it has been demonstrated that by coherently mixing the scattering from a reference signal, a heterodyne version of the technique can be performed giving direct access to the relative phase of the scattering. The talk will conclude with an example of this heterodyne technique studying the visco-elastic properties of rubber.

* This work is being supported by NSERC, FQRNT

10h30 **Coffee Break / *Pause café***

SU-A1-3 **11h00**

GEORGE SAWATZKY, University of British Columbia

Resonant X-ray scattering: a new tool for structural studies of condensed matter systems

Recent advances in synchrotron radiation facilities and in the theoretical understanding of x ray spectroscopy of atoms, molecules and solids has opened the door to combining x ray spectroscopy with x ray scattering to obtain a detailed picture of the charge, spin and orbital, spatial distribution with extreme sensitivity. I will introduce the basic ideas involved in this new resonant x ray scattering technique and then show some examples of recent work on superconducting, and novel magnetic systems. The new beamline being constructed at the Canadian light source will include full polarization control opening up new areas of research including coherent scattering on biological systems.

12h00 **Session Ends / *Fin de la session***

[SU-A2] Illuminating to New Depths: Our Understanding of Surface Phenomena I / *Scruter en profondeur: notre compréhension des phénomènes de surface I*

(DSS-CLS / DSS-CCRS)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
08h30 - 12h30

ROOM / SALLE T.B.A.

Chair: R. Sammynaiken, University of Saskatchewan

SU-A2-1 **08h30**

FRANZ HIMPSEL, University of Wisconsin

Attachment of Bio-Molecules to Surfaces, Characterized by NEXAFS

SU-A2-2 **09h15**

JACEK LIPKOWSKI, University of Guelph

Field driven transitions in bilayers of phospholipids at electrode surfaces

SU-A2-3 **10h00**

RICHARD EVITTS, University of Saskatchewan

Changes in the surface morphology of potash crystals after exposure to a wetting-drying cycle

10h30 **Coffee Break / *Pause café***

SU-A2-4 **11h00**

STEPHEN URQUHART, University of Saskatchewan

X-PEEM Microscopy for Surface Chemical Characterization

SU-A2-5 **11h45**

TOM MILLER, University of Illinois

To be announced / à venir

12h30 **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 17
DIMANCHE, 17 JUIN
09h00 - 12h00

ROOM / SALLE Phys. 127 (48)

Chair: W. Trischuk, University of Toronto

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

12h00 **Session Ends** / ***Fin de la session***

[SU-Exhibit] Lunch with the Exhibitors / Dîner avec les exposants

(CAP-CLS / *ACP-CCRS*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
12h00 - 13h15

ROOM / SALLE Geol. 102 (atrium)

Lunch for all delegates will be available in the exhibit area / Le dîner pour tous les délégués sera disponible à la salle des exposants.

13h15 **Session Ends** / ***Fin de la session***

[SU-Past-Pres] CAP Past President's Luncheon / Dîner des anciens présidents *de l'ACP*

(CAP / *ACP*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
12h15 - 13h15

ROOM / SALLE T.B.A.

Chair: W. Davidson, National Research Council Canada

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

13h15 **Session Ends** / ***Fin de la session***

[SU-Plen1] Brockhouse Medal Winner / *Médaille Brockhouse de l'ACP* (Dr. Sajeev John, University of Toronto)

(CAP-DCMMP / *ACP-DPMCM*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
13h30 - 14h10

ROOM / SALLE Arts 143 (350)

Chair: S. Idziak, University of Waterloo

SU-Plen1-1 **13h30**

ALONGKARN CHUTINAN, University of Toronto

Photonic Band Gap Materials: Semiconductors of Light †

The 20th century has been the Age of Artificial Materials, due in large part to the role of condensed matter physics. One material that stands out in this regard is the semiconductor of electricity. The electronics revolution of the 20th century was made possible by the ability of semiconductors to microscopically mould the flow of electrons. Analogies between electrons and photons have made possible a new class of artificial materials that can microscopically mould the flow of laser light in ways more remarkable than their electronic counterparts. Photonic Band Gap (PBG) materials are periodic dielectrics that enable engineering of the most fundamental properties of electromagnetic waves. These properties include the laws of refraction, diffraction, and emission of light from atoms. This opens a new frontier in integrated optics as well as the basic science of radiation-matter interactions. Unlike electronic semiconductors, PBG materials execute their novel functions through selective trapping or "localization of light" using engineered defects within the dielectric lattice. This is of direct practical importance for all-optical communications and information processing. Unlike electronic micro-circuitry, optical wave-guides in a PBG micro-chip can simultaneously conduct hundreds of wavelength channels of information in a three-dimensional circuit path. We review the history of the field of PBG materials and recent approaches to micro-fabrication of these crystals. We discuss how the unusual properties of PBG materials provide a foundation for practical applications in information technology, energy conversion, and medicine.

† In collaboration with Sajeev John, University of Toronto

14h10 **Session Ends** / ***Fin de la session***

[SU-SWARM] SWARM / *SWARM*

(DASP / *DPAE*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
14h00 - 17h00

ROOM / SALLE Geol. 155 (70)

Chair: D.J. Knudsen, University of Alberta

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

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

[SU-P1] Graphene / *Graphène*

(DCMMP / *DPMCM*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
14h15 - 17h30

ROOM / SALLE Biol. 106 (250)

Chair: T. Chakraborty, University of Manitoba

SU-P1-1 **14h15**

TSUNEYA ANDO, Tokyo Institute of Technology

Quantum anomalies in graphene

In graphene, electronic states are described by Weyl's equation for a massless neutrino [1]. The system has a topological singularity at the origin of the wave vector (**k**=0), giving rise to nontrivial Berry's phase when **k** is rotated around the origin. The singularity causes various zero-mode anomalies such as discrete jumps in the diagonal, off-diagonal Hall, and dynamical conductivity at the Fermi energy corresponding to (**k**=0). In the presence of a magnetic field, a Landau level with zero energy exists independent of the strength of the field, giving rise to a singular diamagnetism of graphene and the large magnetic anisotropy of the carbon nanotube used extensively for the observation of the Aharonov-Bohm effect. The phonon spectrum can be modified directly by the change in the electron or hole concentration by a gate voltage through electron-phonon interaction as observed in recent experiments. In a magnetic field the interaction leads to a magnetic oscillation of frequency and broadening. Reference: [1] T. Ando, *J. Phys. Soc. Jpn.* **74**, 777 (2005) and references cited therein.

SU-P1-2 **15h00**

SERGEI SHARAPOV, McMaster University

Dirac-like quasiparticles in Graphene †*

Graphene, a new material made of the graphite films with a thickness down to a single atomic layer, is a condensed matter realization of the Dirac equation since the electronic dispersion close to the Brillouin zone edges is conical with a Fermi-Dirac velocity of order of one hundredth of the velocity of light. Landau level quantization reflects the Dirac nature of the quasiparticles and graphene has been found to exhibit an unusual integer quantum Hall effect. In particular, the lowest Landau level can be thought as shared equally by electrons and holes and this leads to characteristic behavior of the magneto-optical conductivity as a function of frequency of the photon. We show that the evolution of the pattern of absorption lines as the carrier density is varied encodes the information about the presence of the anomalous lowest Landau level. References: V.P. Gusynin, S.G. Sharapov, *Phys. Rev. B* **71** (2005) 125124; *Phys. Rev. Lett.* **95** (2005) 146801, *Phys. Rev. B* **73** (2006) 245411; V.P. Gusynin, S.G. Sharapov, J.P. Carbotte, *Phys. Rev. Lett.* **96** (2006) 256802; *J. Phys.: Condens. Matter* **19** (2007) 026222.

† In collaboration with Valery Gusynin[1] , Jules Carbotte [2] , [1] Bogolyubov Institute for Theoretical Physics, Kiev, Ukraine, [2] McMaster University
* This work is being supported by NSERC and CIAR

15h45 **Coffee Break / *Pause café***

SU-P1-3 **16h00**

VADYM APALKOV, Georgia State University

Dirac Electrons in Graphene: Magnetic Field and Artificial Atoms †

Two-dimensional electrons in graphene are known to behave as massless fermions with Dirac-Weyl type linear dispersion near the Dirac crossing points. The relativistic nature of electrons in graphene results in specific features of the electron behavior in magnetic field and in confinement potential. We will discuss the properties of the electrons in graphene both in strong magnetic field, where the electron confinement within graphene plane is provided by magnetic field, and in the parabolic external confinement potential, *i.e.* in quantum dots. In a strong magnetic field the inter-electron interaction becomes crucial and the system shows the fractional quantum Hall effect. The relativistic nature of the energy dispersion relation of the electrons in the graphene significantly modifies the inter-electron interactions. This results in a specific dependence of the ground state energy and the energy gaps for relativistic electrons on the Landau level index. In the light of the Klein tunneling, in the parabolic confinement potential we discuss the possibility of trapping of electrons by external potential and discuss the effects of magnetic field on the properties of Dirac electrons in quantum dots, *i.e* Fock-Darwin states of the massless fermions. We also provide the evaluation of the dipole-allowed transitions between the energy levels of the dots.

† In collaboration with Hong-Yi Chen, Tapash Chakraborty, University of Manitoba

SU-P1-4 **16h45**

IGOR HERBUT, Simon Fraser University

Graphene: symmetries, interactions, Hall effect *

I will discuss the emergent low-energy symmetry of the electronic spectrum of two-dimensional graphite, also known as graphene, and the pattern of its eventual breakdown at strong Coulomb repulsion. Although the electron interaction is probably not strong enough to turn the usual semi-metallic state of graphene into an insulator, it will be argued that even an infinitesimal interaction will immediately do so in an external magnetic field. Recent Hall effect measurements at fields up to 45 Tesla will be interpreted as a manifestation of this magnetically induced transition, and a global phase diagram of graphene will be introduced.

* This work is being supported by NSERC

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

[SU-P2] Recent Progress in Studying Biomaterials with Synchrotron Radiation / *Progrès récents dans l'étude des biomatériaux avec le rayonnement synchrotron*

(DCMMP-DMBP-CLS / *DPMCM-DPMB-CCRS*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
14h15 - 17h15

ROOM / SALLE T.B.A.

Chair: A. Moewes, University of Saskatchewan

SU-P2-1 **14h15**

JANOS KIRZ, Lawrence Berkeley National Laboratory

Diffraction Microscopy of Yeast

A coherently illuminated isolated specimen creates a speckle pattern in the far field. If the intensity of this diffraction pattern is recorded with sufficient detail, the image of the specimen can be reconstructed using an iterative algorithm. I will outline the principles of this "lensless" imaging technique, along with a description of the instrumentation used, and the technical challenges involved. The ultimate limiting factor in resolution is radiation damage to the specimen. While this technique is now being used by several groups, I will emphasize the work done by the Stony Brook/Cornell/LBNL group working at the Advanced Light Source. The goal of our project is to create a high resolution 3D image of a frozen hydrated yeast cell.

SU-P2-2 **15h15**

ANDERS NILSSON, Stanford University

X-ray and electron spectroscopy investigations of water; in the liquid phase and on surfaces

Water and its ability to form Hydrogen bonding (H-bonding) is the basis for all life on the planet earth. Nearly all biological macromolecules such as proteins and DNA are physiological inactive without the presence of water. In many enzymatic processes, electron and proton transfers involves H-bonding and water plays a key role. If we want to understand the influence of water on biological processes we need to first address the nature of water in the bulk liquid itself and in various aqueous solutions. There are recent experiments that have raised the question whether we really understand the nature of H-bonding and the structure of liquid water. We have recently devoted a major effort to the development of x-ray spectroscopy measurements of water in the different aggregation forms and adsorbed on surfaces. Using x-ray absorption spectroscopy (XAS), x-ray Raman scattering (XRS) and x-ray emission spectroscopy (XES) together with density functional theory (DFT) calculations we have demonstrated the appearance of specific spectral features that can be related to two different types of water species in the liquid, tetrahedral water similar to ice and asymmetric H-bond configurations. The latter species dominates the liquid. The understanding of water adsorption, wetting and reactions at solid surfaces is of importance for many different areas of science such as biomaterials, catalysis, electrochemistry, corrosion, environmental science and technologies related to hydrogen as a future energy carrier. I will address fundamental questions regarding geometric structure, electronic structure, nature of surface chemical and hydrogen bonding and reactivity of water on surfaces. The connection between studies performed at both UHV and ambient conditions will be emphasized. Several examples of different water adsorption system will be illustrated such as Pt(111), Ru(001), Cu(110), Cu(111), TiO2, Fe2O3 and MgO.

SU-P2-3 **16h15**

GRAHAM GEORGE, University of Saskatchewan

Functionally Focused Biomaterials — Metallo-Enzyme Active Sites

Abstract not available at time of publication / *Résumé non disponible à l'heure de la publication*

17h15 **Session Ends / *Fin de la session***

[SU-P3] Industrial Applications of Synchrotron Radiation / *Application industrilles du rayonnement synchrotron*

(DIAP-CLS / *DPIA-CCRS*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
14h15 - 17h00

ROOM / SALLE T.B.A.

Chair: J. Cutler, Canadian Light Source Inc.

SU-P3-1 **14h15**

N. STEWART MCINTYRE, Surface Science Western, University of Western Ontario

Mechanical Strain Measurements on a Microscopic Scale using Synchrotron Radiation: Applications to Nuclear Materials †

Mapping of elastic and plastic strains in metals is now possible using an intense micro-focused X-ray beam and high speed detection hardware/software for Laue diffraction. Such capabilities have been used to measure some strains imposed on Alloy 600- a nickel-based alloy used worldwide in nuclear steam generator tubing. This material can undergo stress corrosion cracking and the microscopic origins of this degradation process are of interest. Grain texture and deformation tensors have been mapped for polycrystalline Alloy 600 that had been deformed by a 1% uniaxial stress. The elastic tensors show small tensile and compressive strains that are somewhat dependant on grain orientation. The effects of surface scratches on local strain distributions in the material have been studied. Heavy plastic deformation was observed up to distances of 20 microns from the scratches. Further away from the scratches, misoriented dislocation cell structures are observed.

† In collaboration with M. Fuller [1], S.Ramamurthy [1], E. Lehockey [2], P. King [3], W. Liu [4], [1] Surface Science Western, University of Western Ontario, [2] Ontario Power Generation, [3] Babcock and Wilcox Canada, [4] Advanced Photon Source, Argonne National Laboratory

SU-P3-2 **15h00**

SIMON BARE, UOP LLC

The Impact of In Situ X-ray Absorption Spectroscopy on Catalysis Research at UOP

In the last 10 years there have been an average of 330 papers published per year that mention "XAFS and Catalysis", with approximately 20% of these conducted under *in situ* conditions. So, what has all this research provided to the field of catalysis? What have we learned? In this talk I will present my personal (industrial) view of the impact that this body of work has had on our understanding of heterogeneous catalysis, with particular emphasis that the spectroscopy has had on UOP's research. The overall goal of this work is to identify the precise atomic level detail of the catalytically active site, under operating conditions, and understand how the specific details of the catalyst preparation and catalyst activation affect the site, and moreover, how different operating conditions affect the site. The assumption is that if we can identify this site, and understand the factors that affect it, then we can design from the ground up a better catalyst with improved performance. This is the so-called "structure-reactivity" relationship. These ideas will be explored using examples from UOP's research over the years.

15h45 **Coffee Break / *Pause café***

SU-P3-3 **16h00**

Industrial and Environmental Studies at Canadian Light Source. **Jeffrey Cutler**, Tom Kotzer, Jeff Warner, Thava Pushparajah, *Canadian Light Source Inc.* — As applied research moves into the 21st century, industry is discovering that traditional analytical techniques are not answering all of their questions. For example, new materials are being developed daily that may have significantly different properties but are chemically indistinguishable using current analysis techniques. It is important for industry to understand these differences and be able to go back to the lab and impart those unique properties to a new product. Therefore, today, industry is turning to new tools to shed light on old and new questions. In a similar manner, environmental waste management is motivating many proactive industries to move toward new technologies that will provide answers to environmental questions yet to be asked. Within the mining sector, the ability to understand and predict the long-term stability and future bioavailability of heavy metals (e.g. arsenic) in mine waste is critical for operation and absolutely essential to their capacity to decommission that site in the future. Currently, the environmental impact of tailings is monitored and stability is predicted by combining thermodynamic models with powder x-ray diffraction data to determine material composition and with assorted wet chemistry techniques to determine total species concentrations. Although these techniques have supplied a significant amount of important ecological information, increasing pressure from environmental groups demands more detailed information beyond the range of these procedures. Synchrotron light-based spectroscopy techniques are now being looked at as that enabling technology that will help answer many of these difficult questions. This talk will present an overview and various examples from the industrial and environmental programs currently on-going at the Canadian Light Source.

SU-P3-4 **16h15**

Canadian Light Source: Machine Update. **Les Dallin**, *Canadian Light Source* — The Canadian Light Source (CLS) is a third generation synchrotron radiation source presently supplying photons from far IR to hard x-rays to seven experimental beamlines. The source is a 2.9 GeV electron storage ring consisting of 12 cells containing bending and focusing elements. Light from the bend magnets in the storage ring is used to produce the IR radiation. Ten of twelve long drift regions separating the 12 cells can be used to house one or two insertion devices (IDs (wigglers and undulators)) used to produce the higher energy radiation. At present five IDs are in operation. The electron beam has a horizontal emittance of 18 nm-rad. The vertical emittance, adjusted by coupling control, is 0.1% of this value. Using a single 2.4 MV superconducting RF cavity up to 300 mA of current can be stored. The magnetic lattice, RF system, orbit control, coupling control and other aspects of the storage operations will be described.

SU-P3-5 **16h30**

Plasma-Assisted Cleaning of Sensitive Surfaces Contaminated by High Power Beam Interactions*. **Andranik Sarkissian** [1], Claude Côté [1], Sylvain Fourmaux [2], François Martin [2], Royston Paynter [2], [1] *Plasmionique Inc*, [2] INRS-EMT — Prolonged exposure of surfaces to high intensity beams (laser, x-ray, synchrotron, electron or particle beams) in a vacuum environment tends to contaminate the surfaces with a deposited thin film. This contamination alters the surface properties of the components, with detrimental effects. This contamination is believed to stems from the decomposition of hydrocarbons by the high intensity beam. The source of hydrocarbons in the vacuum is either priori surface contamination and/or out-gassing from the vacuum chamber walls. For instances were it is not feasible to replace these components or clean them using conventional techniques, plasma-assisted in-situ or ex-situ decontamination of the surfaces becomes an attractive option. Typically, a source of reactive atomic oxygen produced by plasma is used to remove hydrocarbon deposits from surfaces, by conversion of bound hydrocarbons to volatile molecules (CO_2, CO, H_2O) with low vapor pressure, which are subsequently pumped away. In this presentation we report the results of experiments for surface decontamination of diffraction gratings used in the compressor of high intensity / high repetition rate lasers. The increased absorption of the laser beam by the contaminated surface, if not corrected, will eventually cause permanent damage to the surface of the compressor. We have used gold mirrors to simulate the grating. The contamination was produced under real operating conditions, by repetitive high power fs-laser pulses. Quantitative analysis of the gold mirror surfaces, before and after plasma-cleaning, using X-ray photoelectron spectroscopy, laser scattering and absorption measurements has been used to evaluate the efficacy of the cleaning process.

* This work is being supported by NSERC, PLASMIONIQUE Inc

SU-P3-6 **16h45**

Quality Assurance Strategies in Synchrotron XANES Commercial Measurements. **Jeff Warner**, Jeff Cutler, *Canadian Light Source* — Synchrotron-based X-ray Absorption Near-Edge Structure (XANES) spectroscopy is increasingly being used to analyze and quantify chemical species and relative amounts of elemental oxidation states in natural environments and complex industrial process streams. The characteristics of XANES that make it a popular method of quantitative analysis are the minimal sample preparation required and its element selectivity and sensitivity to changes in oxidation states. However, many aspects of its quantification capabilities and limitations have not been fully explored. We examine a series of mixtures of nickel and arsenic to determine the effect of (i) the number of components, (ii) edge energy, (iii) component percent, (iv) nearest neighbours, and (v) aspects of the sample data processing, on the accuracy and reproducibility of XANES quantification. We further explore the reliability and potential for errors in fitting species lacking distinctive spectral features.

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

[SU-P4] Illuminating to New Depths: Our Understanding of Surface Phenomena II / *Scruter en profondeur: notre compréhension des phénomènes de surface II*

(DSS-CLS / *DSS-CCRS*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
13h30 - 16h45

ROOM / SALLE T.B.A.

Chair: R. Sammynaiken, University of Saskatchewan

SU-P4-1 **13h30**

ANDREA DAMASCELLI, University of British Columbia

Impurity-controlled valence, spin and orbital state in $Sr_3Ru_2O_7$

SU-P4-2 **14h15**

KATIE MITCHELL, University of Saskatchewan

Small Biomolecules on Metal Surfaces: Probing Amino Acid/Surface Interactions with Scanning Tunneling Microscopy and Synchrotron spectroscopy

15h00 **Coffee Break / *Pause café***

SU-P4-3 **15h30**

CHANGYONG PARK, Argonne National Laboratory

In-Situ Observation of Mineral-Water Interfacial Processes with High-Resolution X-ray Reflectivity and Resonant Anomalous X-ray Reflectivity

16h15 **Discussion / *Discussion***

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

[SU-P5] Curriculum / *Programmes*

(DPE / *DEP*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
14h15 - 17h00

ROOM / SALLE Phys. 130 (70)

Chair: S.P. Goldman, Ryerson U.

SU-P5-1 **14h15**

CALVIN KALMAN, Concordia University

Beyond Conceptual Change: Changing Students' Epistemologies *

It is the goal of any introductory Physics course to help students to develop a Physics mindset. Such a mindset includes a critical understanding of the basic principles of the subject and as such requires higher orders of thinking (critical thinking). It is well known that Physics students hold views different from or alternative to those that they will be taught in their courses. Developing a Scientific mindset may not simply be a conceptual change from such personal scientific concepts to scientifically accepted concepts. It may also be a change in attitude from a view that study in science is a matter of solving problems using an independent set of tools, classified according to problem type, to a view that a science subject consists of a web of interconnected concepts. There is no quick fix to achieve this goal. For most students, such change can only accomplished by means of a variety of interventions over the entire course

* This work is being supported by SSHRC

SU-P5-2 **14h45**

JOANNE O'MEARA, University of Guelph

The CAP Physics 1st year curriculum : a first run

There is a need for continuing revitalization of undergraduate physics education in order to track the changes in the world in which university students find themselves. Frequently too little connection is made between undergraduate physics programs and the latest developments in the field, and students often lack an appreciation for the connections between physics and societal needs, societal impact, and daily life. Furthermore, the job market emphasizes the need for a broader training in science and mathematics, expects versatility, and requires enhanced communication and teamwork skills. In response to these concerns, a committee was established by the Canadian Association of Physicists (CAP) with the task of developing a recommended undergraduate physics curriculum for Canadian universities, one which works toward the nation-wide goal of increasing enrollment in undergraduate physics programs. In addition, this recommended curriculum may assist the CAP in assessing undergraduate degrees of applicants to the professional certification program for the *P.Phys.* designation. The model proposed in our first report to the physics community will be reviewed, which focuses on the core curricular material recommended for an honours major in physics. In addition, feedback gathered from undergraduate students both in physics and other science majors will be presented to highlight the importance of many seemingly peripheral elements to the success of revitalizing undergraduate physics education. The presentation will also highlight our experiences at the University of Guelph in offering a revised 1st year curriculum in the academic year 2006/2007 based on the CAP recommendations.

SU-P5-3 **15h15**

SSHRC and Intelligent Design, time for a change of the science education funding agency?. **Patrick Lorne Walden** [1], Brian Alters [2], [1] *TRIUMF*, [2] McGill University — In 2006 Brian Alters of McGill, holder of the Tomlinson Chair in Science Education and director of the Evolution Education Research Centre, was turned down by SSHRC for

a research grant to survey Canadians as to the inroads the popularization of Intelligent Design had made on the students, teachers, and decision-makers in Canadian education. The statement turning the proposal down questioned his assumption that Evolution and not Intelligent Design was the correct theory. This touched off an international scandal. However SSHRC has not backed away from its committee's statement regarding Evolution and Intelligent Design and its official position is that its mandate does not allow it to participate in the debate between the two theories. It is time to question SSHRC as the granting agency for the science education research portfolio in light of this incident. From the SSHRC committee's statement to Alters and in comments to the press it appears that the committee members did regard Intelligent Design as a legitimate scientific theory and that stripped of any religious connotations, committee members regarded Intelligent Design was an honestly debated issue among scientists. Given that the committee was a random selection from SSHRC's pool of qualified members, it is quite probable that future proposals concerning Evolution and Intelligent Design would meet a similar fate. There is no indication that SSHRC is taking any corrective measures. It seems apparent that the science education community would be better served by having the portfolio transferred from SSHRC to NSERC.

15h30 **Coffee Break** / ***Pause café***

SU-P5-4 **16h00**

Teaching Physics in an Interactive Classroom Setting*. **Adriana Predoi-Cross**, Ken Vos, Saurya Das, *Physics Department, University of Lethbridge, Lethbridge, AB, Canada* — We will discuss different teaching methods focused on enhancing student learning and effective teaching. We are actively trying to develop classroom activities that develop a group learning environment that encourages discussion and reasoning about the physics. We will discuss the role of 'hard' demonstrations, student participation, and their importance in teaching the physics concepts. The type of demonstration chosen is important and will depend not only on the concept being taught but also on its ability to engage students. Another tool for Physics education is computer simulations, such as physlets ("**Physi**cs app**lets**"). Physlets are used in introductory courses to probe the conceptual understanding of our students. Students respond to what they experience hands-on and don't rely as much on memorization. In a number of courses, we also engage students by making them give presentations on topics related to the course. This motivates the student to work independently on preparing a coherent presentation. The presentations themselves are lively and interactive. We intend to increase the effectiveness of our teaching by developing curriculum activities that couple classroom demonstrations, computer-based activities and student presentations.

* This work is being supported by NSERC,University of Lethbridge

SU-P5-5 **16h15**

A Yin Yang Approach to Teaching: High-tech. Low-tech. **Sheldon B. Opps**, *University of Prince Edward Island* — In this talk, I will elaborate on teaching strategies that aim to balance both traditional low tech approaches and modern high tech methods. Although my teaching style initially gravitated towards a computer-based delivery of lectures and demonstrations, I have found that the old-fashioned "chalk and talk" can be equally stimulating and pedagogically effective. I argue that a more harmonized approach to engaging students involves a healthy mixture of both "chalk and talk", as well as computer-based or high-tech methods. Along the theme of balance, I have adopted what I term "Lectorials" as a combination of lecture and tutorial formats into one format. Hence, instead of 3 hours of lectures and 3 hours of tutorials per week, students participate in 6 hours of "Lectorials" per week. Another teaching tool that I have developed and implemented is a "Road Map", which is a technique that links the various topics of a course into an interwoven network forming a "conceptual continuity". The method helps students obtain a better overall picture of the course and a sense of vision. Students are required to independently, and creatively, develop a Road Map which is submitted for grading at the end of the semester.

SU-P5-6 **16h30**

Effect of Interactive Lecture Experiments on Student Academic Achievement and Attitudes Toward Science in Large Introductory Physics Courses*. **Marina Milner-Bolotin**, Andrzej Kotlicki, Georg Rieger, Rachel Moll, Fran Bates, *University of British Columbia* — Interactive Lecture Experiments (ILE) have been used in the introductory physics course at the University of British Columbia for two years. A systematic study was conducted using the Colorado Learning Attitudes about Science Survey (CLASS), Force Concept Inventory (FCI), physics open-ended exam problems and focus group interviews to determine the impact of ILE on student academic achievement, motivation and attitudes towards physics. Three sections of Physics 100 students (750 students) experienced four ILE experiments on some of the topics in the course. FCI and CLASS were administered twice and academic results for students who experienced the ILE for a particular topic were compared to students, from a different section, who did not complete the ILE for that topic. Qualitative data on students' attitudes was also collected using open ended survey questions and interviews. Preliminary results will be presented with conclusions about the impact of using ILE as an effective pedagogy in large introductory physics courses.

* This work is being supported by TLEF UBC

SU-P5-7 **16h45**

Back to the envelope: using order of magnitude estimates to engage the student. **Andrew Robinson**, *University of Saskatchewan* — The "back of envelope" calculation, synthesizing a simple physical model and calculating an answer to the nearest order of magnitude without electronic aids, is a traditional skill in physics. Since the widespread introduction of electronic calculators, this skill has been in decline, and today's students often think in terms of an "exact" solution for every problem. Moreover, first year students often prefer the "hunt for an equation with the right variables" problem solving methodology, rather than devising a model based on the physical situation. The back of envelope calculation stresses the model rather than the answer and naturally introduces the model based problem solving technique. By introducing the student to the art of the order of magnitude estimate as a classroom exercise, it is possible to teach the students this skill, and simultaneously use the exercise as a method of active teaching, engaging the students in a much closer manner than is possible in a traditional lecture format. By allowing students to work together, it is also possible to introduce an element of peer instruction. I will give examples of this technique applied to a first year physics class and show results indicating that solving these problems is a skill which that needs to be taught and nurtured through practice.

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

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

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
14h30 - 18h00

ROOM / SALLE Thor. 159 (80) ***Chair: W. Trischuk, University of Toronto***

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

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

[SU-P6] Electromagnetic and Weak Probes / *Sondes électromagnétiques et faibles*

(DNP / *DPN*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
15h30 - 16h45

ROOM / SALLE Phys. 103 (145)

Chair: G.M. Huber, University of Regina

SU-P6-1 **15h30**

New polarization measurements in low-energy deuteron photodisintegration*. **Adam James Sarty** [1], Jackie Glister [2], Guy Ron [3], Ron Gilman [4], Steffen Strauch [5], Doug Higinbotham [6], L. Byungwuek [7], [1] *Saint Mary's University*, [2] Saint Mary's University and Dalhousie University, [3] Tel Aviv University, [4] Rutgers University, [5] University of South Carolina, [6] Jefferson Lab, [7] Seoul National University — Electromagnetic probes of light nuclear systems – the deuteron, in particular – provide useful testing grounds for examining details of the nucleon-nucleon interaction. At high energies, this N-N interaction may be described by perturbative QCD, where the degrees of freedom are current quarks exchanging gluons. At lower energies, where QCD becomes non-pertubative (and non-soluable), hadronic theories are relied upon, where the degrees of freedom are hadrons (nucleons) exchanging mesons. In order to understand where/how the transition from such hadronic degrees of freedom to quark/gluon degrees of freedom occurs, searches are often undertaken to find N-N observables that show deviation from the best "standard" hadronic models. However, before any such observed deviations from these hadronic models are attributed to the onset of quark/gluon degrees of freedom, the hadronic models must be clearly tested and calibrated in regions where they are generally expected to be within their limits of validity. In deuteron photodisintegration below a few hundred MeV of excitation energy, the measured cross sections and polarization observables are all well described by hadronic theories. However, above roughly 300 MeV there is a clear discrepancy for the so-called induced proton polarization in this reaction which remains 30 years after first being observed. During the summer of 2006, recoil-polarization measurements were made of deuteron photodisintegration in the range of 270-370 MeV in Hall A of the Thomas Jefferson National Accelerator Facility (Jefferson Lab). The high-precision polarization observables measured in this experiment will help focus in on whether this discrepancy with hadronic models is real, and (if so) whether it can be rectified within the standard hadron framework or not. An overview of this experiment will be given, and preliminary results will be shown.

* This work is being supported by NSERC

SU-P6-2 **15h45**

Focal Plane Scanner for Q^p_{Weak} Experiment. **Jie Pan** [1], Jeff Martin [2], [1] *University of Manitoba*, [2] University of Winnipeg — The Q^p_{Weak} experiment at Jefferson Laboratory will extract the proton's weak charge Q^p_W by measuring the parity violating asymmetry in elastic electron-proton scattering. The precise measurement of Q^p_W in this experiment will play a significant role in testing the Standard Model prediction for the running of $\sin^2\theta_W$ from the Z-pole to low energy. A deviation from the prediction could signify "new physics". In this experiment, the elastically scattered electrons will be focused by a magnetic spectrometer onto fused silica Čerenkov bars located in the focal plane. In order to map the light distribution in the focal plane, a scanning detector with a small active area mounted on a linear motion assembly will scan over the fiducial area of the main detector. The primary purpose of scanner is to allow extrapolation from low beam current, where a tracking system is used, to high current, where the parity-violation measurement is conducted. The basic principle and design of the focal plane scanner will be presented along with simulations and prototyping tests.

SU-P6-3 **16h00**

Photodisintegration of lithium isotopes in the giant dipole resonance region using polarised gamma rays*. **Ward Wurtz**, Rob Pywell, *University of Saskatchewan* — New computational techniques, such as the Lorentz Integral Transform, have allowed for improved theoretical calculations of the photodisintegration cross section. Predictions have been made for isotopes as large as ^{7}Li. However, the experimental data for these cross sections is often old and with very large error bars. New experimental data is needed to compare with these predictions. We propose to study the photoneutron cross section of ^{6}Li and ^{7}Li in the giant dipole resonance region. For this measurement we will use the Blowfish neutron detector array, which consists of 88 organic scintillator neutron detectors arranged spherically. These detectors cover about ¼ of 4π steradians. This experiment will take place at the High Intensity Gamma Source located at Duke University in Durham, N.C., U.S.A. which is capable of producing linearly polarised photons. Using the spherical nature of Blowfish and the linearly polarised photons, we will be able to perform a novel study of the angular distribution of the emitted photoneutrons. This talk will describe the preparations for, and the expected physics addressed by, these experiments.

* This work is being supported by NSERC

SU-P6-4 **16h15**

Design and Simulation Testing of a Photon Flux Monitor*. **Octavian Mavrichi**, Rob Pywell, Ward Wurtz, *University of Saskatchewan* — The University of Saskatchewan's Subatomic Physics group is involved with photodisintegration experiments at the High Intensity Gamma Source (HIGS) facility at the Duke Free Electron Laser Laboratory (DFELL), Duke University. An upgrade to the facility that is under construction will be capable of delivering both linearly and circularly polarized gamma rays, with polarizations of ~100% in either cases. The presentation will outline our work toward designing a photon flux monitor for the HIGS. The simulation results from GEANT4 used with our computing facilities at the UofS and comparative high-statistics results obtained through the WestGrid advanced performance computing infrastructure will be presented. The testing and tuning of the design parameters using a GEANT4 simulation to meet the specifications necessary for an absolute flux monitor will be also discussed. The presentation will also report on the progress we have made toward building the photon flux monitor.

* This work is being supported by NSERC

SU-P6-5 **16h30**

Calibrating the SNO Neutral Current Detectors Using Time Series Analysis*. **Diane Reitzner**, Jimmy Law, on behalf of the SNO Collaboration, *University of Guelph* — The Sudbury Neutrino Observatory (SNO) was built to measure solar neutrinos. It was setup to run in three phases. Phase I ran with the acrylic vessel filled with pure D_2O. Phase II included about 2000 kg of NaCl to enhance the Neutral Current signal. In the current Phase III the dissolved NaCl in the D_2O has been removed and an array of Neutral Current Detectors (NCDs), which are ^{3}He proportional counters, inserted. This will allow for an independent determination of the Neutral Current signal. Calibration of the NCDs which detect the neutrons from the Neutral Current signal is done using various radioactive sources such as ^{252}Cf, ^{24}Na and AmBe. The Time Series analysis (TSA) has been developed as an independent and complementary means for determining various experimental parameters relevant to the calibration of the NCDs using the ^{252}Cf source. A model based on an analytical formula describing the waiting time distribution between detected events for a model ^{252}Cf source in SNO is the basis of TSA. This model has as input the relevant parameters; such as neutron detection efficiency, lifetime and source strength; needed to calibrate the NCDs. The results for the experimental parameters are found by determining which combination of input parameters will produce the best fit of the model to the data. Presented are the TSA results for the fit to the ^{252}Cf data.

* This work is being supported by NSERC

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

[SU-GRAD] Student Reception / *Réception pour les étudiants*

(CAP / *ACP*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
16h30 - 18h15

ROOM / SALLE Marquis Hall (Exeter Room)

Chair: S. Page, University of Manitoba

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

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

[SU-KEY] Herzberg Memorial Lecture / *Conférence publique commémorative Herzberg* (Carl Wieman, University of British Columbia)

(CAP-CLS / *ACP-CCRS*)

SUNDAY, JUNE 17
DIMANCHE, 17 JUIN
19h00 - 22h00

ROOM / SALLE TCU Place

Chair: M.C.W. Campbell, University of Waterloo

SU-KEY-1 **19h00**

CARL WIEMAN, University of British Columbia

Science Education in the 21st Century: Using the Tools of Science to Teach Science

Guided by experimental tests of theory and practice, science has advanced rapidly in the past 500 years. Guided primarily by tradition and dogma, science education meanwhile has remained largely medieval. Research on how people learn is now revealing how many teachers badly misinterpret what students are thinking and learning from traditional science classes and exams. However, research is also providing insights on how to do much better. The combination of this research with modern information technology is setting the stage for a new approach that can provide the relevant and effective science education for all students that is needed for the 21st century. I will discuss the failures of traditional educational practices, even as used by "very good" teachers, and the successes of some new practices and technology that characterize this more effective approach. Some applications to technical presentations will also be mentioned.

22h00 **Session Ends** / ***Fin de la session***

MONDAY, JUNE 18 - LUNDI, 18 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 18
LUNDI, 18 JUIN
07h00 - 08h10

ROOM / SALLE Phys. 127 (48)

Chair: G.M. Huber, University of Regina

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

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

[MO-Friends] *Friends of CAP Breakfast / Déjeuner des "Ami(e)s de l'ACP"*

(CAP / *ACP*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
07h00 - 08h10

ROOM / SALLE T.B.A.

Chair: S.A. Page, University of Manitoba

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

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

[MO-HS-REGN] *Teachers' Registration / Inscription des enseignant(e)s*

(CAP / *ACP*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
08h15 - 09h00

ROOM / SALLE Geol. atrium

See page 10 for details about workshop / Voir page 10 pour les détails de l'atelier.

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

[MO-Plen1] *Herzberg Medal Winner / La médaille Herzberg*

(CAP / *ACP*)

(Barth Netterfield, CITA/U.Toronto)

MONDAY, JUNE 18
LUNDI, 18 JUIN
08h15 - 09h00

ROOM / SALLE Arts 143 (350)

Chair: M.C.W. Campbell, University of Waterloo

MO-Plen1-1 **08h15**

C. BARTH NETTERFIELD, University of Toronto / CITA

Observations of the Cosmic Microwave Background

The past decade has seen a revolution in cosmology, with the determination of the age, geometry, and content of the Universe, and the discovery of a significant 'dark energy' contribution. Observations of the Cosmic Microwave Background have been central to this revolution. While ultimate sensitivity and all sky coverage require satellite observations such as WMAP and the upcoming Planck Explorer, many of the basic results were previously determined by the balloon borne BOOMERANG experiment. The Spider balloon borne polarimeter promises to provide a critical compliment to Planck in the exploration of the epoch of Inflation in the early Universe. Balloon borne astronomy can benefit other wavelengths as well. The successful flight of the BLAST sub-mm telescope in December of 2006 promises to bring significant advances in several areas of sub-mm astronomy in preparation for the upcoming launch of the Herschel satellite.

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

[MO-Plen2] *Plenary / Plénière*

(CAP / *ACP*)

(Anthony Leggett, University of Waterloo / University of Illinois at Urbana-Champaign)

MONDAY, JUNE 18
LUNDI, 18 JUIN
09h00 - 09h45

ROOM / SALLE Arts 143/146 (504)

Chair: L. Marchildon, Université du Québec à Trois-Rivières

MO-Plen2-1 **09h00**

ANTHONY LEGGETT, University of Waterloo / University of Illinois at Urbana-Champaign

Testing the limits of quantum mechanics: motivation, state of play, prospects

I present the motivation for experiments which attempt to generate, and verify the existence of, quantum superpositions of two or more states which are by some reasonable criterion "macroscopically" distinct, and show that various a priori objections to this program made in the literature are flawed. I review the extent to which such experiments currently exist in the areas of free-space molecular diffraction, magnetic biomolecules, quantum optics and Josephson devices, and sketch possible future lines of development of the program.

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

[MO-HS-1] High School Teachers' Workshop - a.m. / *Atelier des enseignant(e)s de la physique - avant-midi*

(DPE / *DEP*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
10h00 - 12h00

ROOM / SALLE Biol. 106 (250)

Chair: R.E. Pywell, University of Saskatchewan

MO-HS-1-1 **10h00**

PETER J.S. WATSON, Carleton University

Dark Matter and Dark Energy

Dark Matter and Dark Energy: Over the last ten years, it has become clear that "ordinary" matter makes up perhaps 4% of the energy in the universe, dark matter another 25% and the remainder seems to be in the form of the so-called "dark energy". I will discuss how we got here, and how the experiments, many with a significant Canadian involvement, will guide us in the future.

10h45 **Coffee Break** / ***Pause café***

11h00 **Meeting with department Chairs: Skills that students need to be successful in college physics** / ***Rencontre avec les directeurs de départements : « Compétences nécessaires pour réussir en physique au premier cycle »***

12h00 **Lunch** / ***Dîner***

[MO-A1] Instrumentation at CLS (Invited) / *Instrumentation au CCRS (invités)*

(DIMP-CLS / *DPIM-CCRS*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

10h00 - 12h00

ROOM / SALLE Geol. 155 (70)

Chair: K.H. Michaelian, CANMET, Natural Resources Canada

MO-A1-1 **10h00**

HERMAN WINICK, SLAC, Stanford University

From Roentgen to X-ray Free-electron Lasers; The Evolution of X-ray sources and science over 100 years

For about six decades after the serendipitous discovery of X-rays by Wilhelm Röntgen the performance of X-ray sources advanced very little. The advent of synchrotron radiation from high energy (several hundred MeV to several GeV) electron accelerators built for high energy physics research in the 1960's and 70's provided a sudden increase in X-ray source brightness of about 5 orders of magnitude. Initially synchrotron radiation programs ran parasitically during the high energy physics operation of these cyclic electron synchrotrons and electron-positron colliding-beam storage rings. The impact that these secondary programs on these "First Generation Sources" had on many areas of science that use X-rays led to the design and construction in the 1980's of the first round of dedicated synchrotron radiation sources; storage rings designed from the start as radiation sources; the so-called "Second Generation Sources". Starting in the late 1970's, wiggler and undulator magnets were developed and installed in colliding beam storage rings as more powerful synchrotron radiation sources at Stanford and Novosibirsk. This led to the development of "Third Generation Sources"; storage rings optimized for these insertion devices, rather than primarily utilizing the ring bending magnets as sources. There are now more than 50 storage rings in operation around the world as fully dedicated synchrotron radiation sources, including 12 Third Generation Sources, plus additional facilities in construction or in advanced stages of design (see www.lightsources.org). Also in construction are the linac-based Fourth Generation Sources X-ray sources; energy recovery linacs (ERLs) and X-ray free-electron lasers (FELs). The FELs will offer X-rays with an instantaneous brightness that exceeds third generation storage rings by about 10 orders of magnitude, as well as offering full transverse coherence and sub-picosecond pulses. The first of these, the Linac Coherent Light Source (LCLS) at the Stanford Linear Accelerator Center (SLAC) is scheduled to begin operation in 2009. This talk will trace these developments, the science that has been made available by synchrotron radiation sources to date, and the new science that will become available as new sources are developed.

MO-A1-2 **10h45**

EMIL HALLIN, University of Saskatchewan

The Research Toolkit at the Canadian Light Source

The Canadian Light Source is a 2.9 GeV synchrotron designed to be a bright source of synchrotron radiation. This radiation is allowed to escape from the synchrotron tunnel into a number of beamlines, which deliver these photons to a series of experimental endstations in which they are (or will be) used to visualize structures from the atomic length scale all the way up to the internal organs of large animals. Experimental facilities at the CLS are being built in three phases. The first set of seven is currently functioning. The next seven are in construction, and five more have just been partially funded. This report describes the status of these facilities and highlights some of their visualization capabilities.

11h15 **Coffee Break** / ***Pause café***

MO-A1-3 **11h30**

MARK DE JONG, Canadian Light Source

Beam Position Measurements at CLS: Instrumentation and Applications †

Accurate measurement of the position of the electron beam in the storage ring at the Canadian Light Source is essential to the successful operation of the facility. This talk will review the instrumentation used to measure the transverse beam position with micron resolution, and the longitudinal beam phase with picosecond resolution. Several examples will be given of how these measurements are then used to determine many of the major accelerator operating characteristics that affect the performance as a synchrotron light source.

† In collaboration with J.M. Vogt, J. Bergstrom, Canadian Light Source

12h00 **Session Ends** / ***Fin de la session***

[MO-A2] Optics and Photonics: Advanced Materials / *Optique et photonique: matériaux avancés*

(DOP-DCMMP / *DOP-DPMCM*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

10h00 - 12h30

ROOM / SALLE Geol. 255 (48)

Chair: P. Ashrit, Université de Moncton

MO-A2-1 **10h00**

WITHDRAWN

Periodic relief gratings at fiber end faces*. **Luc Levesque,** Paul Rochon, *Royal Military College of Canada*: Azopolymer polymer gratings have been used to produce 1D photonic band gaps, optical notch filters and in waveguide coupling structures for biosensors. In this paper we discuss methods to create abrupt changes in reflectivity using periodic corrugated surfaces of azopolymer films. The advantages and flexibility of producing these periodic gratings on a polished end face on an optical fiber will also be presented. Some azopolymer gratings produced on large diameter core fibers will be shown along with potential applications involving laser micromachining.

* This work is being supported by DND

MO-A2-2 10h15

Investigations on the dry lithiated V2O5 thin films for electrochromic applications*. **Balu Ramamoorthy**, Pandurang Ashrit, *Université de Moncton* — Vanadium pentoxide thin films exhibit both anodic and cathodic electrochromic nature in different wavelength ranges. V_2O_5 is known to intercalate large amounts of lithium which makes it an attractive candidate for the fabrication of electrochromic devices. Lithium ion intercalation in these systems are normally carried out using polymer electrolytes and other electrochemical techniques. But in the construction of electrochromic devices, a complete solid state device fabrication route is always preferred. Hence, an attempt has been made in this work to investigate the effect of dry lithiation on the structural and optical nature of the V_2O_5 thin films. V_2O_5 films were deposited by reactive RF sputtering and were dry lithiated by controlled evaporation of $LiNbO_3$. The structural studies by Raman Spectroscopy reveal a difference in structural nature with substrate temperatures. The lithiated films show an increased mixed phase formation (V^{4+} and V^{5+}) and alteration of the layered structure leading to the structural disorder. This variation is also reflected in the AFM studies in which an uniform increase in grain size followed by grain coalescence is observed. This variation is seen as a color shift from 470 to 350 nm in the optical transmission measurements. A change in transmission intensity is also observed in the near IR region. However, films deposited with 1:10 ratio of O_2:Ar mixture show a minimal intensity variation in the near IR region and good color shift in the visible region. These observations do not reveal any color shift saturation corresponding to the structural disorder observed at higher lithium concentrations. This indicates the higher possible intercalation efficiencies and show dry lithiation as a suitable technique for the fabrication of solid state electrochromic devices.

* This work is being supported by NSERC

MO-A2-3 10h30

X-ray excited optical luminescence from some oxide nanostructures in time and energy domains: direct evidence for the origin of the luminescence and the role of surface states*. **Xingtai Zhou** [1], F. Hetgl [1], M.W. Murphy [1], J.Y.P. Ko [1], J.G. Zhou [1], T.K. Sham [1], T. Regier [2], I. Coulthard [2], R.I.R. Blyth [2], [1] *The University of Western Ontario*, [2] Canadian Light Source/University of Saskatchewan — X-ray excited optical luminescence (XEOL) in time and energy domains and X-ray absorption near-edge structure have been employed to study the origin of the luminescence from SnO_2 and Ga_2O_3 nanostructures and the role of surface states on the luminescence. We find that an intrinsic band in the band gap is involved in the process responsible for the luminescence. The luminescence with shorter lifetime is attributed to the radiative transition of an electron from the bottom of conduction band to the intrinsic band in the band gap or from the intrinsic band to the top of valence band, while the luminescence with longer lifetime is related to the defects in the nanostructures. We show that luminescence from SnO_2 nanoribbons is dominated by energy transfer from the excitation of the whole SnO_2 lattice to the surfaced states and discuss the energy transfer and site specificity of the XEOL or the lack of the site specificity from a single-phase sample. This observation shows that XEOL is a powerful tool to study the origin of luminescence from nanoscale semiconductors.

* This work is being supported by NSERC and CRC

MO-A2-4 10h45

Simulating light scattering from neuron cells over a broad wavelength range by use of pulsed Finite-Difference-Time-Domain (FDTD) method*. **Samer Abdallah**, Omar Ramahi, Kostadinka Bizheva, *University of Waterloo* — A pulsed-response, finite-difference time-domain (FDTD) method was developed for simulating light scattering from biological cells over a broad range of wavelengths in static and dynamic conditions. With regard to spatial geometry, the pulsed FDTD method has advantages over Mie calculations, since it can be used to compute the static scattering patterns of cells containing a number of spherically- or non-spherically shaped organelles. In addition, our method can be used to simulate changes in the light scattering pattern associated with cell dynamics. Simulations were performed using a modified version of MEEP, a freely available 3D FDTD code with subpixel smoothing for increased accuracy. The code was modified to include support for plane wave and Gaussian beam sources. On a 2.13GHz Intel Duo Core system running Linux, a typical simulation of 10μm x 5μm x 5μm computational domain at wavelength λ=1μm and with a resolution of 0.04μm consumes about 2.5 GB of memory and about 18 hours to simulate a time stepping equivalent to 25 wave periods. Using simulations results, we calculate the scattering patterns for common homogeneous models of biological cells and for specialized neuronal cells. The outcome of this research project will have a significant impact on the development of better spectroscopic and optical imaging techniques designed for medical diagnostics.

* This work is being supported by NSERC

MO-A2-5 11h00

Wave chaos in a new class of optical microcavity*. **Guillaume Painchaud-April** [1], Julien Poirier [1], Pierre-Yves St-Louis [1], Josette Lépine [1], Samir Saïdi [2], Louis J. Dubé [3], [1] *Université Laval*, [2] Université Pierre et Marie Curie, [3] Université Laval et Université Pierre et Marie Curie — We introduce a new class of open optical microcavity whose confinement and directional emission properties can be engineered through modification of a space-dependent refractive index. Numerical results are provided for a microdisc with Gaussian deformation of the refractive index. This leads to a new way of breaking integrability and inducing chaos in the classically equivalent system (*photonic billiard*) and to the potential fabrication of reconfigurable microlasers.

* This work is being supported by NSERC

11:15 Coffee Break / *Pause café*

MO-A2-6 11h30

RAVI BHARDWAJ, University of Ottawa

Femtosecond laser induced nanostrcutures inside glass: role of transient nanoplasmonics †

Any laser induced material modification is always limited in size by the diffraction limited focal volume. However, I will show that material modification can be localized to sub-wavelength dimensions due to interaction of light with nanoplasmas produced by nonlinear ionization of the material. Multiphoton ionization inside glass by intense femtosecond light pulses induces permanent changes in the index of refraction locally. This has significant technological potential in photonics as it enables 3D optical wiring and patterning. However, under certain conditions, we demonstrate that the localized uniform *laser-modified region evolves into self-organized periodic modified regions with sub-diffraction limit dimensions.* The nanoplanes are < 10 nm thick, stacked perpendicular to the laser polarization and are spaced at half the wavelength of light in the medium. I will discuss physical mechanisms involved in the formation of such periodic nanostructures in terms of (a) influence of solid densities on light propagation (b) inhomogeneous ionization, (c) shot-to-shot memory in nonlinear ionization that leads to formation of transient nanoplasmas, and (d) Interaction of light at transient plasma- dielectric interface that leads to local field enhancements contributing to the growth of nanoplasmas and their ordering. We propose that such a spatial control in glass along with temporal control that can be achieved with femtosecond light pulses will open the door for future attosecond studies in dense media.

† In collaboration with Paramel Rajeev, Marina Gertsvolf, Eli Simova, Cyril Hnatovsky, Rod Taylor, Paul Corkum, David Rayner, NRC

MO-A2-7 **12h00**

Study of Vanadium Oxide thin films prepared with Laser Assisted Molecular Beam Deposition*. **Pravin Varma** [1], Balu Ramamoorthy [2], Pandurang Ashrit [2], [1] *Mount Allison University*, [2] Université de Moncton — Vanadium Oxide thin films were prepared with Laser Assisted Molecular Beam Deposition (LAMBD), a relatively recent entrant into the field of the various thin films deposition methods currently available. The LAMBD method, which is based on the high temperature molecular level reaction between the gas and the metal that occurs in the presence of the blue plasma, is expected to give high quality stoichiometric films. This method is a unique combination of pulsed laser deposition, molecular beam epitaxy and chemical vapour deposition methods. In this process reactive gas O_2 is pulsed into a small reactive chamber at ~3 bar. Pulses from an excimer KrF laser of wavelength 248 nm are focused on to a very small area of a rotating cylindrical Vanadium target causing some target material to ablate and create a plume of a high temperature. The high temperature metal in the plume reacts with the gas to form stoichiometric oxide molecules. The oxide molecules are expanded through a nozzle into a vacuum chamber at ~10^{-3} mbar and deposited on a glass substrate mounted in front of the nozzle. Pulsed energies of 150 mJ to 250 mJ were used for relatively fast deposition rates. Initial film characterization, done with Spectrophotometer, AFM, X-Ray diffraction and Ellipsometry will be reported.

* This work is being supported by AIF

MO-A2-8 **12h15**

Electrically controllable light scattering in dispersions of particles in liquid crystals. **Tigran Galstian**, Nathalie Bosc, *Université Laval* — Traditional display applications of liquid crystals require polarizers to achieve light's intensity modulation via electro-optic polarization modulation. Polymer dispersed liquid crystal (PDLC) droplets were developed to control light intensity by means of its scattering without using polarizers. The process of liquid crystal droplet formation in those materials being relatively complex (for example, via photopolymerization induced phase separation), we have developed an alternative material system, a dispersion of particles in the liquid crystal (DPLC) matrix allowing a controllable light scattering. The principle of operation is based on the electric field induced reorientation of liquid crystal molecules which are in the space between polymer particles. The refractive index of polymer particles n_p and extra ordinary n_e and ordinary n_o refractive indexes of the liquid crystal are chosen in a way to be able to optically "hide" the polymer particles by an appropriate orientation of liquid crystal molecules. That is achieved when the effective refractive index n_{eff} of the liquid crystal is equal to n_p. We have characterized the controllable scattering of light by such a DPLC for different wavelengths (blue, green, red) and two perpendicular linear polarizations of light. The performance of the material is promising but still requires further optimization to obtain better modulation contrast. The material system developed may be useful not only for polarizer-less displays, but also for other applications such as controllable random lasing, tissue scattering modeling, etc.

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

[MO-A3] Medical Physics / *Physique médicale*

(DMBP / *DPMB*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
10h00 - 12h45

ROOM / SALLE Biol. 125 (70) ***Chair: V. Toronov, Ryerson University***

MO-A3-1 **10h00**

TOMASZ W. WYSOKINSKI, Canadian Light Source Inc., University of Saskatchewan

Developing a World-Class Beamline for the Biomedical Imaging and Therapy Program – Risks and Unknowns *

The Biomedical Imaging and Therapy Facility (BMIT) at the Canadian Light Source (CLSI) includes next generation beamlines dedicated specifically to biomedical research. The goal is to develop technology using those beamlines that can be transferred readily to hospital radiology departments. This paper presents the general design of the facility including details of the two light-sources: bend magnet and superconducting insertion device, unique positioning stages, detectors and shielding. Synchrotron beamlines are designed to provide better image quality with higher spatial resolution all with a lower absorbed dose. Using monochromatic light allows for direct quantification of contrast elements within organs. BMIT beamlines provide wide horizontal beam (up to 290 mm wide) that will be used to image animals ranging from insects to horses with a spatial resolution of up to a few i m. The insertion device beamline will also be used for novel cancer therapy tests. The optics allow either monochromatic or filtered (20-100 keV) white beam to be used in the experimental hutches. Important factors that define the design limits are discussed including major risk items and implementations. A brief overview of novel synchrotron-based imaging and therapeutic approaches follows including a quick summary of a pilot experiments conducted by members of our research team and an outline of research plans for BMIT. Successful development of novel therapy and imaging methods will require advances in X-ray optics as well as micron level dosimetry and detectors, new imaging methods and unique animal positioning and restraint systems.

* This work is being supported by Canada Foundation for Innovation Infrastructure Grant, Province of Saskatchewan, and other granting agencies

MO-A3-2 **10h30**

LOTHAR LILGE, University of Toronto/ University Health Network

Can optical spectoscopy teach us something about tissue aging and preventive oncology †,*

Aging in general is a fact for all biological systems based on eukaryotes. The rate of aging depends widely on the species and within a given species is determined by various genetic and environmental factors. As tissue is aging its ability to auto regulate its biochemical integrity is changing, often limiting the complete biological differentiation of cells which leads to metabolic and structural changes in the tissue which among other endpoints can also lead to cancer. These metabolic and structural changes will in turn also affect the optical properties, such as the spectral absorption and scattering cross sections. Hence, this research group is evaluating the ability of optical spectroscopy to monitor changes in the biological tissues, here the female breast, resulting in aging and the development of cancer. We have demonstrated, that optical transillumination spectroscopy (TiBS) has high sensitivity and selectivity in identifying women with elevated risk to develop breast cancer in the future when compared to other physical risk assessment techniques. We also demonstrated that in a cohort of 150 women aged 25-45 significant changes in tissue spectroscopy are observable over only a 2 year time span. Current ongoing studies aim at developing mathematical models correlating TiBS with the incidence of breast cancer. The concept of using optical transillumination spectroscopy can be extended also to other body locations and indications, such as the development of neurodegenerative diseases such as Alzheimer's disease or Multiple Sclerosis.

† In collaboration with Kristina Blackmore [1], Samantha Dick [2], Gina Lockwood [2], Sally Hanna [2], Julia Knight [1], Robert Weersink [2], Brian Wilson [3], [1] Mount Sinai Hospital, [2] University Health Network, [3] University of Toronto/ University Health Network

* This work is being supported by DoD/Susan Komen /CBCRA/NIH

11h00 Coffee Break / *Pause café*

MO-A3-3 11h15

VLADISLAV TORONOV, Ryerson University

Combined Functional Near - Infrared and Magnetic Resonance Imaging of the Human Brain *

Due to its non-invasiveness, limitless penetration, and high spatial resolution, functional MRI is the main method used in functional brain imaging today. However, as a quantitative metabolic measurement tool fMRI is much less efficient than it is for the spatial mapping of brain activity. Therefore, in recent years different combinations of fMRI with other, metabolically more specific methods were proposed. Among those approaches, the combination with the near-infrared spectro-imaging (NIRSI) is one of the most versatile and promising ones. NIRSI uses optical radiation in the waveband approximately from 700 to 900 nm, because at these wavelengths light exhibits deepest penetration into the biological tissues. However, the trade off for the high biochemical specificity of NIRSI is the problem of the high light scattering in the tissue, which requires significant research effort to improve the spatial resolution of the technique. I will discuss the basics of fMRI and NIRSI, their advantages and limitations, and the benefits of their combined use in studies of functional activity in the human brain.

* This work is being supported by National Institutes of Health

MO-A3-4 11h45

A study on opto-mechanical properties of biomaterials and their effects on optoacoustic signals*. **Behrouz Soroushian**, William Whelan, Michael Kolios, *Ryerson University* — As a non-invasive method for medical diagnostics, *Opto-Acoustic imaging* is a potentially powerful tool which elicits interest among researchers in the field of biomedical physics. It is based on time-resolved detection of laser induced transient acoustic waves in biological tissues. The greatest advantage in this imaging modality is that it can offer the imaging contrast based on optical properties and the imaging resolution of ultrasonic techniques. However, the images are largely dependent on the optical and mechanical properties of the target. Therefore, the understanding of how such properties affect the performance of optoacoustic imaging is of a great importance to the development of this imaging modality. In this work, we investigate the influence of opto-mechanical properties of different samples on the optoacoustic images. For determining the optical properties of samples a double-integrating-sphere (DIS) is used. This system allows us to measure the reflectance and transmittance of 1 mm thick samples over a range of wavelengths between 650 and 950 nm. A Monte-Carlo model is used to determine the intrinsic optical properties of samples such as the scattering coefficient, the absorption coefficient, and the anisotropy factor from these results. The surface movement of tissue immediately after the irradiation with a short laser pulse is intimately related to the distribution of absorbed energy, the instantaneous pressure generated by this energy, and the mechanical properties of the tissue. We have developed an interferometry system based on Michelson method for monitoring such movements with a temporal resolution of less than 10 ns and spatial resolution of < 10 nm. This system will help us to determine the Grüneisen coefficient, an important thermo-mechanical property of the samples that describes their behavior after receiving the energy from laser pulse. In this presentation the principles of both systems will be discussed and preliminary validation results for tissue phantoms will be presented.

* This work is being supported by NSERC & CIHR, Canada Research Chairs Program & the Canada Foundation for Innovation & Ryerson University.

MO-A3-5 12h00

On the physical, spectral, and dosimetric characteristics of a new 125I brachytherapy source*. **Eduardo Galiano-Riveros** [1], Rosana Pirchio [2], [1] *Laurentian University*, [2] Argentine Atomic Energy Agency — A new ^{125}I source under the name Braquibac^{TM} has been developed in Argentina for applications for interstitial brachytherapy. The aim of this work is to study the new seed design and to calculate its dosimetric parameters. Radiographic and destructive sectional studies were carried out on inactive seeds to determine the physical characteristics of the source. Values of $g(r)$, Λ, $F(r, \theta)$, and $\varphi_{an}(r)$, were obtained in water by simulation using the MCNP5 Monte Carlo code according to the methodology recommended in TG-43 and updated in TG-43U1. The dose rate constant was determined to be 0.937 ± 0.004 cGy h^{-1} U^{-1} (overall statistical uncertainty $\pm$ 2.7%). S_k per unity activity was calculated to be $0.671 \pm .0028$ cGy cm^2 h^{-1} mCi^{-1} by simulation of the seed in dry air using point detectors. Spectroscopic studies for both the new, and the model 6711 seed, were performed using an HPGe planar detector. The emission spectra of both seeds proved to be very similar. The anisotropy of the total photon intensity in air was measured in planes containing the seed's short and long axes using the HPGe detector. The minimum photon intensity for the new seed was 31.14 ± 3.11 % of the transverse intensity.

* This work is being supported by Argentine Atomic Energy Agency

MO-A3-6 12h15

In Vivo Magnetic Resonance Imaging of Quail Embryo Brain*. **Melanie Martin** [1], Douglas W. Storey [1], Richard Buist [2], Evan Balaban [3], [1] *University of Winnipeg*, [2] University of Manitoba, [3] McGill University — Quail embryos, which develop external to the mother, are good models for studying the developing brain. Here we present protocols for high spatial resolution T_2-weighted (T2W) magnetic resonance images (MRIs) and high temporal resolution T_2*-weighted (T2*W) MRIs of the brains of live quail embryos. Images were collected using a 7T horizontal bore MR scanner and an 11.7 T vertical bore MR scanner running Bruker Paravision software. All procedures were approved by the local ACC committees. Quail eggs were incubated at 37.7 °C and approximately 45% humidity for 14 days, after which the eggs were placed in a custom-made holder for imaging. During imaging, the quail eggs were maintained at 37.7 ± 1 °C while 2.5 % gaseous isoflurane was piped into the egg holder to limit head movement. T2W MRI were collected with a spin echo sequence with 4 cm field of view, 156 µm in plane resolution with 1 mm slice thickness, T_E = 60 ms, T_R = 1714 ms, and acquisition time of 29 min 15 s. T2*W MRI were collected with a SNAP_TOMO sequence with 4 cm field of view, 625 x 313 µm^2 in plane resolution with 1 mm slice thickness, T_E of 4.5/2.1 ms, T_R of 15/6.7 ms, and acquisition time of 959 ms or 474 ms. The images produced after 30 minutes of anesthesia showed clear definition of structures in the brain and no motion artifacts in the head. This study lays the foundation for anatomical and functional studies of the developing avian brain.

* This work is being supported by NSERC and CFI

MO-A3-7 12h30

Modeling of an Iterated Birth/Death Markov Process for Optimization of Radiotherapy Treatment Planning. **Eduardo Galiano-Riveros**, R. Castelino, O. Falou, A. El Kaffas, M. Rodrigues, O. Das, *Laurentian University* — In this work, an iterated birth/death Markov process is modeled. Recent publications show that such a process can mimic the behaviour of clonogenic tumour cells exposed to fractionated radiation treatments. The model consists of a sequence of birth/death Markov chains, separated by radiation fractions. The destruction of tumour cells during a fraction of radiation is described by the linear-quadratic cell model. The stochastic behaviour of the cell population between radiation fractions is then described by a birth/death Markov process in order to determine how many clonogenic cells are present prior to the next fraction of radiation. Numerical analysis of the model was conducted with a tumour size of 109 cells. Results from the model showed it would require a schedule of 27 radiation fractions at 2Gy per fraction delivered on every business day for a total of 38 days for the clonogenic population to reach zero. An advantage to such a model is that it can be used to study both constant as well as variable radiation intervals and dosages. Model construction, validation, results and its applications in optimizing radiotherapy treatment planning are discussed.

12h45 Session Ends / *Fin de la session*

[MO-A4] Relativity and Cosmology / *Relativité et cosmologie*

(DTP / *DPT*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
10h00 - 12h15

ROOM / SALLE Phys. 126 (48)

Chair: M.B. Paranjape, Université de Montréal

MO-A4-1 **10h00**

LUDOVIC VAN WAERBEKE, University of British Columbia

Observational Cosmology in the 21st century

Modern cosmology experienced a dramatic mutation in the past decade. The development of precision measurements remodeled our standard picture of the Universe with Dark Energy and Dark matter as the dominant ingredients of our world. I will discuss how the future cosmological observations might confirm or reject this new paradigm and how they may also probe new physics.

MO-A4-2 **10h30**

ANDREI FROLOV, Simon Fraser University

to be announced / à venir

Abstract not available at time of publication *Résumé non disponible à l'heure de la publication*

11h00 **Coffee Break / *Pause café***

MO-A4-3 **11h15**

LEVON POGOSIAN, SFU

The Integrated Sachs-Wolfe effect as a probe of dark energy and modified gravity

Recent detections of the Integrated Sachs-Wolfe effect through the correlation of the cosmic microwave background temperature anisotropy with traces of large scale structure provided independent evidence for the expansion of the universe being dominated by something other than matter. I discuss the extent to which future ISW measurements can help in testing the physics responsible for the observed cosmic acceleration.

MO-A4-4 **11h45**

VALERIO FARAONI, Bishop's University

f(R) Cosmology

Attempts to explain the current acceleration of the universe without exotic dark energy have led to modifying the Einstein-Hilbert action. This "f(R) gravity" will be briefly reviewed in both the metric and Palatini formalism, and a violent instability for the metric version (when f"(R)<0) will be discussed.

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

[MO-A5] Nuclear Astrophysics / *Astrophysique nucléaire*

(DNP / *DPN*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
10h00 - 12h15

ROOM / SALLE Phys. 130 (70)

Chair: B. Davis, TRIUMF

MO-A5-1 **10h00**

ANDREW CUMMING, McGill University

Nuclear Physics in Type I X-ray Bursts and Superbursts

On the surface of an accreting neutron star, hydrogen and helium burns at high temperatures and densities, often in a thermally unstable manner. The resulting flash of X-rays allows us to study the neutron star directly. In the last ten years, long term monitoring of these stars with X-ray telescopes has given us new opportunities to study how the burning occurs and to learn about the extreme conditions at the surface of the star. In this talk, I will describe what these systems look like to astronomers, how the accreted material burns - emphasizing the important role of the proton rich heavy elements involved in the rp-process - and what we are learning about neutron star physics.

MO-A5-2 **10h30**

RITUPARNA KANUNGO, St. Mary's University

*Lifetime of the 4.03 MeV State in ^{19}Ne and its Astrophysical Implications **

Explosive thermonuclear fusion reactions on surfaces of accreting compact objects in binary star systems cause the astronomical phenomena of novae and X-ray bursts. At these astrophysical sites explosive hydrogen burning proceeds through the hot CNO cycle. The ^{15}O(α,γ)^{19}Ne reaction has been identified as one of the potential breakout paths from the hot CNO cycle into the rp-process (a reaction network which synthesizes heavy nuclei in X-ray bursts). In stellar environments the ^{15}O(α,γ)^{19}Ne reaction

proceeds mainly through the resonances in ^{19}Ne that are located above the ^{15}O+α threshold. The lowest resonance located at 4.03 MeV is expected to play a dominant role in this breakout reaction. The reaction rate therefore depends on the decay widths for this resonance. We have measured the gamma decay width of this resonance at TRIUMF, using the Doppler shift attenuation method. The results will be presented.

* This work is being supported by NSERC

MO-A5-3 **11h00**

YONG-ZHONG QIAN, University of Minnesota

Neutrinos and The Origin of the Elements

The role of neutrinos in the production of the lightest to the heaviest nuclei will be reviewed. Solar, atmospheric, reactor, and accelerator neutrino experiments have demonstrated that neutrinos oscillate among different flavors. The recently discovered features of collective neutrino flavor transformation in supernovae and the associated effects on supernova nucleosynthesis will be discussed.

MO-A5-4 **11h30**

CHRISTOF VOCKENHUBER, TRIUMF

Ti-44 and Hf-182 - Two Nuclides in the World of Astrophysics *

One of the main fundamental questions in science is the origin of the elements. Nuclear astrophysics can provide some answers by a close interplay between astronomical observations, modeling of stars in their different stages and input from nuclear physics. Radioactive nuclides play an important role in that game: The reaction path in most of the processes follows short-lived nuclides. If the lifetime is long enough they are likely to survive the nucleosynthesis events and can be later traced to understand their origin. Two of them are Ti-44 and Hf-182 with half-lives of 58.9 years and 8.9 million years, respectively. Ti-44 has been identified by space-based satellites in Cassiopeia A, the youngest known supernova remnant, and gives direct observational proof that nucleo-synthesis is still ongoing. It also provides one of the best tools to understand the complexity of supernova explosions. At the recoil mass spectrometer DRAGON we measured the main production via the alpha capture reaction on Ca-40. However, there are still large uncertainties coming from other key reactions with short-lived nuclides where no experimental data exist so far. In contrast, Hf-182 is produced by neutron capture processes, as most of the heavy elements beyond iron. A high abundance of Hf-182 in the early solar system was found by tungsten isotopic anomalies in meteorites. This challenges stellar models, since Hf-182 can be produced by both, the s and the r process. In collaboration with the Forschungszentrum Karlsruhe we measured the destruction reaction of Hf-182 in the s process, which lead to a significant reduction in the uncertainty of contributions from AGB stars. This is particularly important since the dominant contribution by the less understood r process is inferred by subtracting the s process contribution from the solar system abundance. In this talk I want to show with these two examples what we can learn in astrophysics by studying certain nuclides.

* This work is being supported by NSERC

MO-A5-5 **12h00**

Mass Measurements of Proton Rich Isotopes in the Vicinity of ^{92}Pd Using the Canadian Penning Trap Mass Spectrometer*. **Jennifer Fallis** [1], J.A. Clark [2], K.S. Sharma [3], G. Savard [4], F. Buchinger [5], S. Caldwell [6], J.E. Crawford [5], S. Gulick [5], D. Lascar [7], J.K.P. Lee [5], H. Sharma [7], *et. al.*, [1] *University of Manitoba, Argonne National Laboratory*, [2] Yale University, [3] University of Manitoba, [4] Argonne National Laboratory, University of Chicago, [5] McGill University, [6] University of Chicago, Argonne National Laboratory, [7] Northwestern University, Argonne National Laboratory — The existence of elements beyond Fe has classically been thought to result from a combination of three processes. The first two are the well known r (rapid) and s (slow) processes involving neutron capture reactions. The third is the p-process, which involves proton capture reactions as well as other means of creating isotopes on the proton rich side of the valley of stability. ^{92,94}Mo are light p-nuclei (nuclei that cannot be created by neutron capture processes) whose observed abundances cannot be explained by the p-process alone. There are two other processes thought to contribute to the production of ^{92,94}Mo, these being the rp-process and the newly proposed np-process. Due to the large mass uncertainties that exist for nuclei in the vicinity of ^{92}Pd the contribution from each process is currently unknown. Recent measurements of the isotopes in this region performed with the Canadian Penning Trap are the first step in an ongoing program to help reduce these mass uncertainties.

* This work is being supported by NSERC and US DOE

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

[MO-A6] Atomic and Molecular Spectroscopy and Dynamics I / *Spectroscopie et dynamique des atomes et molécules I*

(DAMPhi / *DPAMIP*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
10h00 - 12h15

ROOM / SALLE Phys. 165 (137)

Chair: A.A. Madej, National Research Council

MO-A6-1 **10h00**

DAVID M. VILLENEUVE, National Research Council of Canada

Can We Image a Single Molecular Orbital Wave Function Using an Intense Femtosecond Laser?

The Copenhagen interpretation of quantum mechanics tells us that wave functions are not observable. Nevertheless, I will show that we can form an image of the highest occupied molecular orbital of dinitrogen within the Hartree-Fock framework. A gas phase molecular ensemble is first aligned using impulsive alignment, then high harmonics are generated by an intense femtosecond laser pulse for a range of molecular orientations. The high harmonic spectra contain interferences between the bound wave function and the continuum wave function, giving a measure of the transition dipole matrix elements. The amplitude, polarization state and phase of the xuv radiation are recorded. Multi-electron effects due to electron indistinguishability will be discussed. Since the whole measurement process takes only 30 fsec, pump-probe techniques can be used to observe bonds changing during chemical processes. We propose to observe the motion of electrons within molecules on an attosecond time scale.

MO-A6-2 10h30

Ion Heating Models in Conventional and Rotating rf-Electric Quadrupole Traps*. **Michael Cummings**, Phillip Ashby, Robert Thompson, *University of Calgary* — For the past five decades the confinement of ions in linear rf-electric quadrupole (Paul) traps has been accomplished via an oscillatory saddle potential that, due to its time varying form, is known as the flapping potential. Recent work [1, 2] has introduced the possibility of using a rotating saddle potential to contain ions in linear Paul traps. Although both theoretical and experimental attention has been focused on the multi-ion dynamics in conventional (flapping potential) ion traps, only the single particle behaviour in the rotating configuration has been explored in any detail. In this work we present a computational study of the many particle dynamics for both traps. By sampling a large range of ion and trap parameters a detailed comparison between the thermal characteristics of ion samples both traps is made. The rotating and flapping trap heating rates are then compared with the instability heating theory of Harmon [3] and theoretical rf-heating rate calculations. Reference: [1] T. Hasegawa and J.J. Bollinger, *Phys. Rev. A* **72**, 043403 (2005); [2] R.I. Thompson, T.J. Harmon, and M.G. Ball, *Can. J. Phys.* **80**, 1433 (2002); [3] T.J. Harmon, N. Moazzan-Ahmadi, and R.I. Thompson, *Phys. Rev. A* **67**, 013415 (2003).

* This work is being supported by NSERC

MO-A6-3 10h45

A New VISTA on the Infrared Spectrum of Ammonia in the 1.5 μm Region: Assignment of Combination Bands of $^{14}NH_3$ and $^{15}NH_3$ by Isotopic Shift Labeling*. **R.M. Lees**, Li Li, Li-Hong Xu, *University of New Brunswick, Saint John* — The infrared spectrum of ammonia in the 1.5 μm region contains a complex mixture of vibrational combination and overtone bands. By comparing spectra of $^{14}NH_3$ and $^{15}NH_3$ recorded with a external cavity tunable diode laser spectrometer, we have obtained new assignments for the $\nu_1+2\nu_4$ and $\nu_3+2\nu_4$ stretch-bend combination bands of both species through a Vibrational Isotopic Shift Technique for Assignment (VISTA) in which characteristic vibrational isotopic shifts are used to classify spectral lines into their respective vibrational absorption bands. Term values and approximate molecular parameters from single-state fits are reported for both bands of the two isotopomers.

* This work is being supported by NSERC

11h00 Coffee Break / *Pause café*

MO-A6-4 11h15

NASSER MOAZZEN-AHMADI, University of Calgary

Toward an Accurate Database for the 12 Micron Band of Ethane *

The ν_9 fundamental band of ethane occurs in the 12 μm region. It is the strongest band of ethane in a terrestrial window and is commonly used to determine ethane's abundance in the atmospheres of the Jovian planets and comets, and to determine their temperature. The $\nu_9 + \nu_4 - \nu_4$ hot band occurs in the same region; neither can be analysed as an isolated band, since both are embedded in the torsional bath of the ground vibrational state. Precise and accurate absolute intensities of these bands are crucial for correct interpretation of recent Cassini observations of ethane spectra in the atmospheres of Saturn and Titan. Although, our group has carried out a satisfactory frequency analysis of the ν_9 fundamental, a complete analysis of $\nu_9 + \nu_4 - \nu_4$ is hampered due to an interaction with the ν_{12} fundamental. This fundamental vibration is infrared inactive. It is also very weakly Raman active. To access this vibrational state, we have obtained a high resolution Fourier transform spectrum of the weak $\nu_{12} - \nu_9$ band using a Bruker IFS120HR. In this talk, I will describe a global frequency analysis of data including the four lowest vibrational states of ethane and the implication of the line parameters on the intensities of the bands in the 12 μm region.

* This work is being supported by NSERC

MO-A6-5 11h45

Collisional-Broadened and Dicke-Narrowed Lineshapes of Oxygen*. **Adriana Predoi-Cross** [1], Kyle Hambrook [1], Chad Povey [1], Ian Schofield [1], Georg Ch. Mellau [2], Reimund Keller [2], Daniel Hurtmans [3], [1] *University of Lethbridge, Physics Department, Lethbridge, AB, T1K 3M4, Canada*, [2] Justus-Liebig Universitat, Physikalisch-Chemisches Institut, D-35392 Giessen, Germany, [3] Université Libre de Bruxelles, Chimie Quantique et Photophysique, B-1050 Bruxelles, Belgium — In this talk we present a detailed spectroscopic study of oxygen in support of atmospheric remote sensing. The oxygen A-band located at 760 nm is the strongest of a series of weak absorption bands in the visible spectrum known as the "atmospheric oxygen bands". This band has been used to retrieve O_2 abundance from atmospheric solar absorption spectra, derive atmospheric temperature, pressure, retrieval of aerosol and cloud optical properties using active and passive remote sensing techniques. We have measured transitions in the oxygen A-band of oxygen at room temperature and pressures up to 3 atm. We have analyzed our laboratory spectra with spectral line profiles that reproduce the absorption features with high accuracy (Galatry, Voigt, speed-dependent Voigt and speed-dependent hard-collision profiles), all with an asymmetric component to account for weak line-mixing. For this band, we have been able to retrieve experimental line strengths, self-broadening, self-shift and weak line mixing parameters. The experimental precision is sufficient to reveal inherent variations of the widths and shifts according to transition quantum numbers. We have compared our experimental results for broadening and line mixing coefficients with theoretical results obtained using the Energy Corrected Sudden (ECS) and Exponential Power Gap (EPG) scaling models.

* This work is being supported by NSERC, BIOCAP, DAAD

MO-A6-6 12h00

Infrared Spectroscopy of OCS clusters*. **Mahin Afshari** [1], Mehdi Dehghani [1], Nasser Moazzen-Ahmadi [1], Robert McKellar [2], [1] *University of Calgary*, [2] Steacie Institute for Molecular Science, National Research Council of Canada — Previously, the non-polar lowest energy isomer of $(OCS)_2$ has been studied via infrared spectroscopy, while the polar form has only been deduced from qualitative beam "refocusing" experiments. The spectrum and the structure of OCS trimer are known from mm-wave spectroscopy. Infrared spectra of the $(OCS)_2$, $(OCS)_3$ and $(OCS)_4$ van der Waals complexes have been studied in the region of the C-O stretching fundamental using a tunable diode laser to probe a pulsed supersonic slit jet. We have measured a new infrared band at 2069.3 cm^{-1} and assigned it to the long-anticipated polar isomer of OCS dimer, helping to explain apparent discrepancies among earlier studies. A trimer band of OCS has also been assigned based on lower state combination differences. The upper state of this band is perturbed and the nature of the perturbations is not clear. Four other bands have also been observed and tentatively assigned to OCS tetramer. These bands are best described as an asymmetric top with an accidental spherical top structure. Isotopic studies of these bands are presently underway to clarify their origin.

* This work is being supported by NSERC

12h15 Session Ends / *Fin de la session*

[MO-A7] (DCMMP / *DPMCM*) DCMMP Best Student Paper Competition / *Compétition pour les meilleures communications étudiantes DPMCM*

MONDAY, JUNE 18
LUNDI, 18 JUIN
10h00 - 11h15

ROOM / SALLE Thor. 124 (80)

Chair: M. Sutton, McGill University

MO-A7-1 **10h00**

Structural and Electron Density Changes in Dense Ba8Si46: Results from X-ray Diffraction Data as Analyzed by the Maximum Entropy Method. **Roxana Flacau** [1], John S. Tse [2], Serge Desgreniers [1], [1] *Laboratoire de physique des solides denses, Université d'Ottawa*, [2] Department of Physics and Engineering Physics, University of Saskatchewan — Silicon clathrates have attracted increasing attention in the last few years because of their potential applications for thermoelectric and wide band gap devices. In particular, the discovery of supraconducting behaviour in Ba-doped Si_{46} clathrate has driven extensive studies of this compound and other related group IV clathrates at room conditions as well as at high pressures. Recent X-ray diffraction studies carried out on Ba_8Si_{46} using synchrotron radiation showed that an iso-structural phase transition, accompanied by a sudden reduction in the unit cell volume, occurs at about 14-17 GPa. Moreover, near-edge X-ray absorption and Raman spectroscopy experiments revealed an additional transition around 5 GPa. The physical origin of the two transitions is still not clearly understood. As the Maximum Entropy Method (MEM) for the analysis of X-ray diffraction data has been proven to give valuable insights for the structures and chemical bonding in a variety of materials, we used this model-independent method to extract, directly from the XRD data, the most probable electron density distributions in the Ba_8Si_{46} unit cell as a function of pressure; results from the MEM analysis allow further characterization of the two observed transitions. In this communication, we show that pressure dependent changes within the electron distribution maps are related to the structural transitions reported in earlier studies and we propose possible transition mechanisms. In addition, we also illustrate the use of MEM to improve the refinement of structural parameters, when combine with the Rietveld method.

MO-A7-2 **10h15**

Frustrated Heisenberg magnets: first or second order phase transition?*. **Mirsaeed Zelli**, Krista Boese, Byron Southern, *University of Manitoba* — The question of whether a first or second order phase transition occurs in the Antiferromagnetic Heisenberg model on a stacked triangular lattice is investigated using a short time dynamic Monte Carlo approach. The effective critical exponents are determined as a function of a constraint parameter which does not change the symmetry of the model.

* This work is being supported by NSERC

MO-A7-3 **10h30**

The high-pressure crystalline structure and lattice dynamics of the heavy alkali earth hydrides*. **Jesse S. Smith** [1], Serge Desgreniers [1], John S. Tse [2], Dennis D. Klug [3], Roxana Flacau [1], [1] *Laboratoire de physique des solides denses, Université d'Ottawa*, [2] Department of Physics and Engineering Physics, University of Saskatchewan, [3]Steacie Institute for Molecular Sciences, National Research Council of Canada — There has been much recent research interest surrounding metal hydrides in various contexts, including hydrogen storage, high-temperature superconductivity, and fundamental lattice dynamics. A recent study showed that magnesium hydride undergoes a series of pressure-induced structural phase transitions. Above 17 GPa it adopts a *Pnma* structure (cotunnite-type) which remains stable up to at least 57 GPa. In contrast, the heavy alkali earth hydrides MH_2 (M = Ca, Sr, and Ba) crystallize in the cotunnite-type structure under ambient conditions, suggesting that a pressure-dependent study of these hydrides may offer timely insight into the structural behavior of MgH_2 at pressures approaching 100 GPa. We present high-pressure powder x-ray diffraction data recently obtained at the Hard X-ray MicroAnalysis (HXMA) Beamline at the Canadian Light Source, together with Raman spectroscopy and computational results, investigating the stability of CaH_2 and BaH_2 at high pressure and at 300K. In both hydrides a new high-pressure phase was observed which can be indexed by a hexagonal unit cell, with a structure assigned to the space group $P6_3/mmc$. The results indicate that the high-pressure phase should also be observed in SrH_2, and suggest that the hexagonal phase may possibly be observed in MgH_2 at pressures above 57 GPa.

* This work is being supported by NSERC

MO-A7-4 **10h45**

Inside the Jovian atmosphere: Hydrogen and Helium at extreme conditions*. **Isaac Tamblyn** [1], Jan Vorberger [2], Burkhard Militzer [3], Stanimir Bonev [1], [1] *Dalhousie University*, [2] Centre for Fusion, Space and Astrophysics, University of Warwick, [3] Geophysical Laboratory, Carnegie Institution of Washington — The discovery of over 200 extra-solar planets during the past decade has challenged our understanding of the formation, structure, and evolution of solar systems. Most of these planets are gas giants, many of which are larger and hotter than Jupiter. In order to construct models of these planets, accurate equations of state (EOS) describing the properties of their constituents are needed. Inaccuracies in previous EOS have contributed to the number of open questions surrounding Jupiter and Saturn, such as the existence of a rocky core and anomalous cooling rates. We study the properties of hydrogen, helium, and their mixtures by means of first principle density functional molecular dynamics simulations. EOS are obtained for a wide range of pressures and temperatures relevant to Jupiter's interior [1]. We analyze the structure of the fluid and characterize the molecular to atomic transition. The role of helium as a stabilizing influence on the hydrogen molecules is described [2]. A comparison of our results with different EOS models shows deviations in the location and nature of the dissociation processes. We also test the popular linear mixing approximation for describing hydrogen-helium mixtures. These findings will be used to update planetary models, currently based on the widely used Saumon-Chabrier-Van-Horn EOS. References: [1] J. Vorberger, I. Tamblyn, B. Militzer, S.A. Bonev, *Phys. Rev. B* **75**, 024206 (2007); [2] J. Vorberger, I. Tamblyn, S.A. Bonev, B. Militzer, "Properties of Dense Fluid Hydrogen and Helium in Giant Gas Planets", in press, *Contrib. Plasma Phys.*, arXiv.org:cond-mat/0701313 (2006)

* This work is being supported by NSERC, NASA, Carnegie CAN, NSF

MO-A7-5 **11h00**

DFT Study of Band Structure of Polyacetylene and Fluorene-based Polymers*. **Lin Ling** , Jolanta Lagowski , *Memorial University of NFLD* — Alternating triphenylamine-fluorene, TPAFn (n=2, 3), and tris (4-dihydroxyboranylphenyl) amine (TBPA) copolymers and fluorene-oxadiazole copolymers OxFn (n=2, 3) are important components of novel high-efficiency multilayer polymeric blue light-emitting diodes. [J. Lu, Y. Jin, J. Ding, Y. Tao and M. Day, *J. Mater. Chem.*, 2006, **16**, 593]. In this work we investigate their electronic structure properties using computational approach. Their band structure including band gaps and band widths are studied with the Hartree-Fock (HF) and the density functional theory (DFT) approaches. The polymers are treated as infinite one-dimensional conjugated chains with period boundary condition applied to monomeric repeated units. In our study, we consider number of DFT approximations: LSDA, B3LYP, O3LYP, OB95, PBE and TPSS. We employ 6-31G* basis set in all of our calculations and vary number of k-points depending on the size of the system. Comparison of our results with experimental values is made whenever it is possible. For comparison and calibration purposes we also perform calculations for poly (acetylene), PA. The results show that HF method overestimates the band gap of trans-PA by 2.0 eV while the DFT theory underestimates it by 0.23 eV. In all cases of DFT calculations with various functionals, LSDA, B3LYP, O3LYP, OB95, PBE and TPSS,

the band gaps are indirect and the best agreement with experiment is obtained for the O3LYP functional. The variation of bond length alternation and dipole moments with band gaps will be discussed.

* This work is being supported by NSERC

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

[MO-A8] Atmospheric Processes of Climate Change I / *Processus atmosphériques et changements climatiques I*

(DASP / *DPAE*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
10h00 - 12h15

ROOM / SALLE Thor. 159 (80)

Chair: D.A. Degensein, University of Saskatchewan

MO-A8-1 **10h00**

TED SHEPHERD, University of Toronto

The role of the upper troposphere/lower stratosphere in the climate system *

The upper troposphere/lower stratosphere (UTLS) region has recently emerged as a frontier of atmospheric science, mainly because of its central role in chemistry-climate coupling. In this region, water vapour and ozone (and cirrus clouds) exert a particularly strong radiative forcing. Yet because of their relatively short lifetimes compared to the so-called "well-mixed" greenhouse gases, their spatial distributions are strongly affected by transport. In other words, the distribution of water vapour and ozone (and cirrus clouds) in the UTLS both shapes and is shaped by climate. Furthermore, the dynamical structure of the UTLS affects the global dynamics of the troposphere through its effect on baroclinic dynamics and planetary-wave structures. Finally, transport of ozone from the UTLS affects the oxidizing capacity of the troposphere and the lifetime of tropospherically dominated greenhouse gases such as methane. The UTLS is a frontier for space-based measurement because of the challenge presented by the small vertical and horizontal length scales of the relevant structures. This talk will present an overview of the UTLS and the various processes that shape its structure and composition. It will also delineate some key science questions and how these can be addressed by a combination of models and measurements.

* This work is being supported by NSERC/CFCAS/CSA

MO-A8-2 **10h45**

Extra-tropical stratosphere-troposphere exchange and dynamical structures at the tropopause. **Michel Bourqui** [1], Michael Sprenger [2], Heini Wernli [3], [1] *McGill University*, [2] ETHZ, [3] University of Mainz — Stratosphere-troposphere exchange (STE) in the extra-tropics is known to have important implications in the troposphere by injecting important masses of ozone. It also has important implications for the composition of the lowermost stratosphere. STE is likely to take place within episodic events of particular synoptic conditions at the tropopause, such as, for instance, stratospheric intrusions. In this talk, an investigation will be presented which attempts to describe the statistical relationship between STE events and dynamical structures at the tropopause. STE events are first identified in the Northern Hemisphere using a Lagrangian methodology. Dynamical structures at the tropopause are then identified on isentropic surfaces as positive and negative streamers and cut-offs, depending on whether they are associated with stratospheric or tropospheric intrusions, and whether they represent open or closed contours of isentropic potential vorticity. Linkages between individual STE events and individual tropopause structures are then analysed statistically. Northern Hemispheric climatologies of these linkages are calculated using the ERA15 for the 15-year period from 1979 and 1993.

MO-A8-3 **11h15**

Investigations of Relative Humidity in the UTLS with the ACE satellite*. **W.F.J. Evans** [1], R.E. Hughes [2], A. Bourassa [3], [1] *CRESS, York University*, [2] University of Waterloo, [3] University of Saskatchewan — The occurrence and role of contrails is important to global warming issues. Contrail clouds may contribute several per cent of the anthropogenic contribution to the radiative forcing of global warming. Future air traffic increases will increase this relative contribution. Satellite data can be used to study a related aspect of the problem. There is uncertainty as to the relative humidity required to form persistent contrails from jet wakes; this bears on the mechanism used in models of contrail formation. It is important to map the geographical regions of super saturation where contrails may persist or transform into cirrus cloud decks. These can be investigated by mapping the relative humidity with respect to ice and the relative humidity with respect to water. These quantities have been derived from the water vapor and temperature data from ACE in the altitude regime from 8 km to 20 km. High level cirrus can be obtained from the OSIRIS data. The results of our preliminary evaluation of satellite investigations of RHi with ACE data will be reported. A comparison with OSIRIS thin cirrus data will be conducted.

* This work is being supported by NSERC

MO-A8-4 **11h45**

Validation of Chemistry Climate Models in the UTLS using ACE satellite data*. **Michaela I. Hegglin**, Theodore G. Shepherd, *University of Toronto* — The upper troposphere/lower stratosphere (UTLS) plays a key role in the climate system due to strong interactions between chemical tracer distributions, radiation, and dynamics. Chemistry Climate Models (CCMs) are used to quantify feedbacks between chemical constituents and climate. It is therefore essential to validate models in this region by comparison with measurements in order to increase confidence in predictions of future climate. However, model-measurement – and, for that matter, measurement-measurement – comparison in the UTLS is especially complicated because of the high degree of spatio-temporal variability and the strong flow-dependence of chemical distributions, together with the relative lack of accurate, high-resolution measurements. We propose several diagnostics for characterizing the transport properties of CCMs in the UTLS, which minimize the effects of variability and should thereby provide a robust chemical climatology. The Canadian Atmospheric Chemistry Experiment (ACE) satellite measurements offer unprecedented accuracy and vertical resolution in the UTLS hence providing a promising reference data set for models, but have potential resolution and sampling limitations. On the other hand the model data set can be used to estimate the robustness of the proposed diagnostics and their sampling requirements. This then provides the basis for validation of ACE data against non-coincident aircraft measurements, even taken in different years. In this study we compare results from the Canadian Middle Atmosphere Model (CMAM) with both satellite and aircraft measurements in order to identify those diagnostics that are most useful for CCM validation in the extratropical UTLS and to test the representativeness of the ACE data.

* This work is being supported by CSA through C-SPARC programme

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

[MO-A9] Precision Frontier I / *Les limites de la précision I*

(PPD / *PPD*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
10h00 - 12h30

ROOM / SALLE Phys. 127 (48)

Chair: A. Bellerive, Carleton University

MO-A9-1 **10h00**

BENOIT VIAUD, Universite de Montreal

Overall status and physics highlights of the BaBar experiment *

The primary goal of the BaBar experiment is the systematic study of B mesons decays in order to increase our knowledge of CP violation and flavour physics. It uses data delivered by the SLAC PEPII asymmetric-energy e^+e^- storage ring at a center-of-mass energy near 10.58 GeV. I will give an overall status of the experiment and of the physics highlights. The detector and present running conditions will be presented. The presentation of our physics results will include in particular the measurements of the Unitarity Triangle angles and sides via the study of CP asymmetries and semileptonic decays, the search for new physics via penguin and rare B decays, and recent results on charm and tau physics.

* This work is being partially supported by NSERC

MO-A9-2 **10h30**

Is there NP in the UT?*. **Robert V. Kowalewski**, *University of Victoria* — The flavour physics program offers an opportunity to search for New Physics by probing the Standard Model description of quark mixing and CP violation. This talk will focus on two potential discrepancies with SM predictions, and speculate about whether they are related. The constraints on the apex of the Unitarity Triangle (a geometrical representation of the unitarity of the Cabibbo-Kobayashi-Maskawa quark mixing matrix) from determinations of the coupling strength $|V_{ub}|$ of the $b \to u$ quark transition, from measurements of the time-dependent CP-violating asymmetry in B^0 meson decays to charmonium, and from measurements of time-dependent CP-violating asymmetries in B^0 decays to charmless final states all overlap in the Standard Model. Current experimental results from the BaBar and Belle experiments suggest an intriguing hierarchy of (~2 sigma) discrepancies. Prospects for future improvements in the measurements and possible hints of new physics will be discussed.

* This work is being supported by NSERC

MO-A9-3 **10h45**

Exclusive branching fraction measurements of semileptonic tau decays into three charged hadrons. $\tau^- \to \phi\pi^- \nu_\tau$ and $\tau^- \to \phi K^- \nu_\tau$, **Ian Nugent**, *University of Victoria* — Using 342 fb^{-1} of data collected with the BABAR detector at the SLAC PEP-II electron-positron storage ring operating at a center-of-mass energy near 10.58GeV, we measure the branching fraction of $\tau^- \to \pi^-\pi^-\pi^+ \nu_\tau$, $\tau^- \to K^-\pi^-\pi^+ \nu_\tau$, $\tau^- \to K^-\pi^- K^+ \nu_\tau$, and $\tau^- \to K^-K^-K^+ \nu_\tau$ where events with $K^0_S \to \pi^+\pi^-$ decays are excluded. These are significant improvements over previous measurements, with the $\tau^- \to K^- K^- K^+ \nu_\tau$ result being the first inclusive measurement of this mode. We also report a first branching fraction measurement of $\tau^- \to \phi\pi^- \nu_\tau$ and a new branching fraction measurement of $\tau^- \to \phi K^- \nu_\tau$.

MO-A9-4 **11h00**

SuperB: New Physics Opportunities at a High Luminosity Flavour Factory. **Michael Roney**, *University of Victoria* — A new opportunity has recently emerged in response to the development of a novel technological solution for colliding electrons and positions at centre-of-mass energies around the $\Upsilon(4s)$ (~10.6 GeV) with extremely high luminosities ($>\mathcal{O}(10^{36}\ cm^{-2}s^{-1})$) in a low background environment. Such a research tool, known as SuperB, opens the exciting possibility of a program of high statistics heavy flavour physics 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. The time scale for this effort has first collisions occurring between 2012 and 2014 with the physics programme completed before an ILC is expected to begin collecting data. The Conceptual Design Report for the project will be discussed.

11h15 **Coffee Break** / ***Pause café***

MO-A9-5 **11h30**

ISSEI KATO, TRIUMF

The T2K experiment: study of neutrino oscillations *

Tokai-to-Kamioka long baseline neutrino experiment (T2K) is one of the next generation neutrino experiments, starting in 2009, to study oscillations of an off-axis muon neutrino beam between J-PARC accelerator complex and the Super-Kamiokande detector. With use of one to two order of magnitude more intense beam than previous experiments, which will be produced by a newly constructed intense proton accelerator at J-PARC, precise study of muon neutrino's disappearance oscillation and an intensive search for electron neutrino's appearance oscillation will be performed. The neutrino energy spectrum, flavor content and interaction rate of the beam before neutrinos have a chance to oscillate will be measured by a set of detectors located at 280 m downstream of the proton target, called ND280 detector, and used to predict the neutrino interactions at Super-Kamiokande. Understanding of properties of the primary proton beam and resulting secondaries is also indispensable to extrapolate the measurements at ND280 detector to Super-Kamiokande. Canadian contribution to the T2K experiment is primarily dedicated to both of them; namely design and construction of ND280 detector tracker and optical transition radiation (OTR) detector which directly measures the targeting of the proton beam. Besides an overview and physics cases of the T2K experiment, this talk will be more focused on the physics studies to be done at ND280 referring to the design and performance of the detectors.

* This work is being supported by NSERC and TRIUMF

MO-A9-6 **12h00**

Time Projection Chambers in the ND280m detector of the T2K neutrino oscillation experiment*. **Kyle Fransham**, Dean Karlen, *University of Victoria* — The T2K experiment is designed to precisely measure neutrino oscillation parameters in the PMNS matrix by comparing the flavour content of a neutrino beam before and after it has travelled some 295km between the source at JPARC in Tokai, Japan, and the large water Cerenkov detector, Super Kamiokande. Time Projection Chambers (TPCs) are a vital component of the near detector at JPARC, where they will be used to identify and measure the momenta of charged particles produced in neutrino interactions in adjacent

scintillator targets. This presentation reviews the performance goals of the three TPCs in the near detector, discusses Canada's role in the design and construction of the detectors, shows results that have been obtained by a large Canadian prototype, and gives the construction status of the full size modules.

* This work is being supported by TRIUMF

MO-A9-7 12h15

Background Estimates Using a Blind Analysis for the Rare Decay K+ to pi+, nu, nubar from E949*. **Joss Ives** — The background estimates for the decay K+ to pi+, nu, nubar for pion momentum below 199 MeV/c in a sample of 1.77e12 stopped K+ from E949 were performed using a bifurcated blind analysis. Results and discussion of the analysis technique will be presented.

* This work is being supported by NSERC

12h30 Session Ends / *Fin de la session*

[MO-A10] (DASP / *DPAE*) Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling I / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace I*

MONDAY, JUNE 18 / LUNDI, 18 JUIN

10h00 - 12h15

ROOM / SALLE Thor. 110 (90)

Chair: K.A. McWilliams, University of Saskatchewan

MO-A10-1 10h00

IAN MANN, University of Alberta

*The Earth's magnetosphere as a plasmaphysical particle accelerator: The geophysical synchrotron? **

The Earth's magnetosphere is continuously excited by the impact of the solar wind, exciting magnetic waves in the ultra-low frequency (ULF) band with global scales. In this talk I will review the mechanisms of ULF wave excitation in the magnetosphere, and examine the influence of ULF waves on energetic particles in the Van Allen radiation belts in the magnetosphere. It is clear that electrons in the Van Allen belts must be internally accelerated to relativistic speeds, and recent work has suggested that ULF wave fields might be responsible. Despite the fact that the Earth's magnetosphere might be considered quiescent in astrophysical terms, the per unit magnetic field Van Allen belt particle energisation appears to be quite efficient. This suggests that the acceleration process might have more general application to particle acceleration in magnetized astrophysical plasmas. Interestingly, due to periodic azimuthal drift motion of relativistic electrons around the Earth, the ULF wave acceleration process might be considered analogous to the action of a geophysical synchrotron. We examine the physics of ULF wave-particle acceleration, using examples including acceleration during the recent so-called "Halloween" 2003 geomagnetic storms period. To address the Van Allen belt particle acceleration problem, satellite missions as part of the NASA "Living with a Star" as well as the "International Living with a Star" programs will be flown into the relatively un-explored inner magnetosphere. Missions include the approved NASA Radiation Belt Storm Probes (RBSP), as well as the proposed Canadian Space Agency led ORBITALS mission. As PI for the ORBITALS mission, I will describe planning for the flight of this Canadian satellite mission during the next solar maximum with launch in 2012. These missions will address the fundamental and 50-year-old problem of how the apparently quiescent magnetosphere can accelerate particles to relativistic speeds in the Earth's Van Allen belts.

* This work is being supported by Canadian NSERC and the CSA

MO-A10-2 10h45

Observations of Steep Plasmapause Density Gradients*. **Zoe Dent**, Ian Mann, *University of Alberta* — Equatorial steep plasmapause density gradients can be identified using ground-based magnetometer data, via the cross-phase technique. Although the cross-phase signature of a steep plasmapause density gradient is theoretically expected, it has only rarely been observed. I will present results of a study of the cross-phase response at steep plasmapause density gradients which have been identified using RPI data from the IMAGE satellite. Steep plasma density gradients also occur at the edge of plasmaspheric drainage plumes. I will also describe how data from the IRM, SEI and MGF instruments on board the e-POP satellite may be employed to study such events from its Low Earth Orbit.

* This work is being supported by Canadian Space Agency.

MO-A10-3 11h00

Mode trapping and tunnelling in the plasma sphere. **Hava Turkakin** , *University of Alberta* — The Earth's plasmasphere is a dense and cold region of the magnetosphere that is populated by the outflow of ionospheric plasma along mid- and low-latitude magnetic field lines. It is characterized by a sharp decrease in density at the plasmapause, typically located from 4 to 6 earth radii in the equatorial plane. As a result of this step-like density profile, combined with the monotonically increasing dipole magnetic field close to Earth, compressional waves propagating outside the plasmapause can tunnel trough and be trapped in a narrow layer just inside the magnetopause. The general structure of the compressional wave equations is presented and an analogy is made with the trapping of a particle in a potential well, as described by the one-dimensional Shrödinger equation. The spectrum and spatial structure of these resonant localised modes is then discussed for representative plasma sphere parameters. Observations are presented from the CRRES and Polar spacecrafts, which support the existence of trapped fast compressional waves at the plasmapause. Finally, possible implications are considered of these trapped modes on particle energisation in the radiation belt region, and on observed low latitude very low frequency modes.

MO-A10-4 11h15

Investigation of Magnetospheric Field Line Resonances and Solar Wind Discrete Continuous Oscillations via Cross-Phase Techniques*. **Frances Fenrich** [1], Colin Waters [2], [1] *University of Alberta*, [2] University of Newcastle — Discrete field line resonances (FLRs) are a common occurrence in the magnetosphere and are readily observed with the Super Dual Auroral Radar Network (SuperDARN). The source of the stable, monochromatic FLR frequencies is still unresolved. Recent work has suggested the possibility that discrete continuous oscillations in the solar wind may be direct drivers of magnetospheric FLRs but have concentrated primarily on frequency and amplitude comparisons. Phase is an additional parameter which can be exploited. If solar wind oscillations are the source driving FLRs then they should exhibit phase coherence with the FLR for the duration of the wave event. We present Fourier Transform and wavelet cross-phase measurements to determine the degree of phase coherence between FLRs observed with SuperDARN and oscillations in solar wind parameters.

* This work is being supported by NSERC

MO-A10-5 **11h30**

Inner Magnetosphere Effects of Suprathermal Auroral Post-Secondary Ions*. **George J. Sofko**, Robert Schwab, Masakazu Watanabe, Kathryn McWilliams, *University of Saskatchewan* — As a result of bursts of energetic electron precipitation in the auroral zone, a population of secondary ions is created which can subsequently gain transverse energy or parallel energy or both to form a suprathermal ion population called the APS ions (Auroral Post-secondary Suprathermal ions). These ions undergo ExB drift while bouncing between the hemispheres. As such, they remain attached to the convecting magnetospheric flux tubes, whose convective motions in the ionosphere form the streamline patterns measured by radars such as those in the SuperDARN network. In the evening-postmidnight nightside sector, auroral streamlines on which the convection is initially eastward can undergo a convection reversal into the subauroral region where the westward SAPS (sub-auroral plasma stream) flows occur. In this talk, we discuss a simple model that shows how the original APS ion population in the auroral zone naturally evolves into the SAPS region dispersed-energy suprathermal ion structures measured by DMSP, AKEBONO and other satellites. It is also suggested that precipitation of APS ions could be the cause of radar scattering events in the SAPS/plasmatrough region, and could contribute to the SED (storm-enhanced density) events associated with dynamic convection structures such as plumes.

* This work is being supported by NSERC and CSA

MO-A10-6 **11h45**

How radiation belt electrons may be energised by ring current ions. via a particle-wave-particle interaction mechanism. **Louis Ozeke**, Ian Mann, *University of Alberta* — Satellites in the radiation belt can become damaged by enhanced fluxes of relativistic electrons, however it is not yet understood how these electrons are able to become energised to relativistic energies (>1 MeV). Ground-based magnetometer observations have shown that there is a strong correlation between ULF wave power and the flux of relativistic electrons. We examine how radiation belt electrons can be accelerated by the electric field of these standing fundamental mode ULF guided Alfven waves via a drift resonance interaction. The guided Alfven waves considered here are dominantly poloidal mode waves with moderate azimuthal wave numbers (m around 20). Results will be presented which show that when the plasmapause occurs on low L-shells (L<4) then it is possible for these fundamental mode guided poloidal waves to be excited by ring current H+ or O+ ions via a drift-bounce resonance interaction. On these low L-shells it may be possible for energy to be transferred from the ring current ions into the guided poloidal waves via a drift-bounce resonance interaction, and for the energy of the guided poloidal waves to be transferred to the radiation belt electrons via a drift resonance interaction. Consequently, the radiation belt electrons may be energised by the ring current ions via the intermediary action of ULF waves.

MO-A10-7 **12h00**

The generation of Pi2 pulsations. by magnetotail flow enhancements or characteristic eigenfrequencies of the night-side field topology*. **Kyle Murphy**, *University of Alberta* — Pi2s are a category of impulsive Ultra Low Frequency waves, which have periods of about 40 – 200 s (frequencies of 5 – 25 mHz). They are often associated with substorm activity and are believed to be caused by a near-Earth plasma sheet disturbance generating field-aligned currents in the substorm current wedge as well as generating a compressional disturbance within the magnetosphere which propagates Earthward. Recent work [Kepko *et al.*, 1999] suggests that bursty bulk flows (BBFs), that is, high velocity plasma flows emanating from the distant tail, may provide a directly-driven mechanism for the generation of Pi2s, with a reported correlation between an internal periodicity of flow enhancements known as flow bursts within the BBF and Pi2 pulsations observed by ground-based magnetometers. Using a favorable conjunction between the GEOTAIL satellite and the CARISMA ground-based magnetometer array on May 31st 1998, we investigate this possibility that BBFs may directly-drive Pi2 oscillations during a relatively isolated substorm during which plasma flows are observed in the tail region. We find that the structure of Pi2 waveforms observed during the flow period and the temporal causality of the Pi2-BBF relation does not agree with the directly-driven model; rather, the frequencies of the Pi2 waveforms appear to be natural frequencies of the night-side magnetosphere. We conclude that in this case study, the Pi2s have characteristics of a field line resonance of the night-side magnetosphere. Reference: L.E. Kepko, M.G. Kivelson, Generation of Pi2 Pulsations by bursty bulk flows, *J. Geophys. Res.*, **104**, 25021, 1999

* This work is being supported by Canadian NSERC and CSA

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

[MO-A11] Physics Demonstrations and Student Engagement / *Démonstration de physique et participation étudiant(e)*

(DPE / *DEP*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
10h00 - 12h15

ROOM / SALLE Phys. 103 (145)

Chair: S.P. Goldman, Ryerson University

MO-A11-1 **10h00**

CARL WIEMAN, University of British Columbia

Interactive simulations for teaching physics, a powerful (and dangerous) educational tool

Advances in hardware and software now make it possible to create sophisticated interactive simulations that run through a regular web-browser and hence are largely platform independent. Many people around the world are creating animations or simulations for educational purposes. The physics education technology project (phet.colorado.edu) has developed about 60 sophisticated simulations for teaching physics. These are available for free. During the development of these simulations we have carried out extensive studies as to how they are used by students, what features make them easy or difficult to use, and how students learn from them. We find simulations can be uniquely powerful learning tools, but only if they adhere to certain guiding principles [1]. Most of these principles agree well with principles for effective instruction that have been seen in very different contexts. I will demonstrate a number of PhET simulations and illustrate some of the powers of simulations for learning and some of our data on their effectiveness. One unexpected result was how simulations allow students with a very wide range of ages and backgrounds to become engaged in challenging physics topics and understand them. However, with the educational power of simulations also comes a danger. If not carefully designed and tested with real students, a simulation can be quite effective at teaching student the wrong things. I will discuss how this can happen and the lessons it holds for teaching physics more generally. Reference: [1]. W.K. Adams, S. Reid, R. LeMaster, S. McKagan, K. Perkins, and C.E. Wieman, A Study of Interface Design for Engagement and Learning with Educational Simulations. http://phet.colorado.edu/web-pages/research.html This work has been carried out by the entire PHET team.

MO-A11-2 **10:30**

JOHN ATHERTON, Eastern Commerce C.I.

Why bother teaching physics in high school at all?

Why do students think that "physics is hard"? Are physics' departments really closing? What is the past, present and future of physics in high schools? In answering these questions this presentation will give a high school teachers perspective of the state of physics education internationally and at home, take a quick look at what the latest in

education psychology has to say about physics learning and discuss the 'higher values' of learning physics. It will go on to look at what the Physics Education Research™ movement has to offer and how these offerings are currently being implemented. In closing there will be a discussion on how high schools and universities can work together to further the progress in physics education.

MO-A11-3 **11h00**

Role of Universities in K-12 Teachers' Preparation in the U.S.*. **Tetyana Antimirova**, *Ryerson University* — A strong K–12 physics education, where science teachers play a critical role, is the very first step in spreading scientific literacy and producing the new generation of researchers. The teacher's preparation and professional development in the U.S. is a close collaboration among Physics Departments at Universities, AAPT, AIP and APS, and is funded largely by the National Science Foundation (NSF) and the Fund for the Improvement of Post-Secondary Education (FIPSE). In this talk, I will outline the role of the Universities in recruitment, preparation and mentoring of new teachers as well as professional development of in-service teachers in the U.S. In particular, I will describe their major ongoing projects, such as the Physics Teacher Education Coalition (PhysTEC) with its major component, highly successful Teacher-in-Residence (TIR) program, and Physics Teaching Resource Agents (PTRA) program. The joint AAPT/PTRA program provides professional development to teachers of physics and physical sciences through a national network of high school teacher leaders trained to conduct series of workshops in their local regions.

* This work is being supported by Ryerson University

MO-A11-4 **11h15**

Modern Physics and Community Outreach: Radon Detection in Nova Scotia. **Svetlana Barkanova**, *Acadia University* — A significant fraction of homes in Nova Scotia have more that 4pCi/L of radioactivity due to radon, which Health Canada considers to be "elevated". Prolonged radon exposure is the second leading cause of lung cancer after smoking. Fortunately, radon is not unbeatable. Once detected, the problem can be mitigated. The talk will describe the new Acadia University project which allows physics students to collect radiation data and map radon levels across the province while gaining real-life hands-on research experience, exploring physics-geology links, improving their skills of group work, and helping their communities to alleviate the dangers of radon exposure. This multiple-purpose project simultaneously focuses on teaching, community outreach, and research. It is also interdisciplinary, involving faculty and students from Physics, Computer Science, Geology, as well as researchers from Nova Scotia Department of Natural Resources. Currently, we also involve high-school physics teachers across Nova Scotia. The teachers supervise their students in detecting radon in the homes around their region and contribute the data they collect to the university's research database. Community members volunteering their houses for testing contribute to the modern physics research as well as directly benefit from this research results. Everybody wins. Nuclear physics component is essential for the modern physics education. Now, it allows Acadia students to learn while serving the community. By participating in the community-based radon measurement project, students help to educate thousands of Canadians of the extent of the radiation danger, and the ways to mitigate the problem. Together, we can save lives.

MO-A11-5 **11h30**

Making your classes click: How to ask good clicker questions and get the most out of your teaching experience*. **Marina Milner-Bolotin**, *University of British Columbia* — Did you think you just gave the most perfect explanation of a new concept? Don't be so sure! You will be surprised how little your students understood or how much they misunderstood. Fortunately the new clicker technology can help you address this problem. This presentation will try to uncover the art of asking effective and informative clicker questions.

* This work is being supported by TLEF - UBC

MO-A11-6 **11h45**

Measuring the Effectiveness of "Clickers" in a Physics Lecture*. **Adam J. Sarty**, R.J. Konpasky, *Saint Mary's University* — The use of wireless responders (a.k.a. "clickers") in university classrooms has been increasing in popularity as instructors – including physics instructors – pursue new teaching technologies/methodologies to enhance the interactive engagement aspect of class taught in a large lecture theatre. While it seems intuitive that the use of clickers to improve the level of dialogue between students and instructor should improve the learning opportunities for students (because, for example, of being forced to respond and thereby process and synthesize information that would otherwise be only passively received), finding a method to directly measure the influence/impact of this one tool is challenging. A collaboration between the Psychology Department and the Department of Astronomy & Physics over the past four years has resulted in the development of two directed studies to attempt to measure the "effectiveness" of using clickers during a physics lecture. The first study was a pilot run in spring 2004, and the second (with greater participation numbers) was run in the fall of 2005. Both studies followed standard psychological testing protocols, and used one base lecture on the topic of special relativity which was delivered to groups of Introductory Psychology students. The "control groups" of students received the lecture without use of questioning or clickers; the "experimental groups" received an identical-content lecture except with the incorporation of questions requiring clickers to answer. Following their lecture, groups were tested on the content of the lecture, and also completed a subjective evaluation of the lecture and lecturer (much like a course evaluation). The results of our studies will be shown, and the effects (and non-effects) of clickers will be illustrated.

* This work is being supported by SMU Office of Instruct. Dev.

MO-A11-7 **12h00**

Training science graduate students how to teach*. **Greg Williams**, *McGill University* — Established in 2002, The Tomlinson Project in University-Level Science Education (T-PULSE) at McGill University has a mandate to improve the quality of science teaching at the post-secondary level. One initiative of this project has been a semi-annual graduate student teaching workshop. For busy science grad students, this two-day workshop provides valuable training and information to use as teaching assistants and in future academic careers. Under direction from the faculty of Science and the Tomlinson Chair in Science Education, the T-PULSE workshop has been developed by a team of graduate students to present and demonstrate effective teaching strategies and techniques. Participants are introduced to science education research and an approach to learner-centred teaching. Published empirical results from science education research are presented to illustrate the effectiveness of interactive teaching: students gain more conceptual understanding, further develop their ability to think critically, and achieve higher grades compared to students in traditional lecture-style classes. Beyond providing graduate students with tools and ideas that they can immediately apply as teaching assistants, the workshop also encourages students to recognize teaching as an opportunity for science research. A summary of the TPULSE workshop will be presented, including a brief interactive teaching demonstration.

* This work is being supported by TPULSE

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

[MO-A12] Thin Films / *Couches minces*

(DCMMP / *DPMCM*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
11h15 - 12h15

ROOM / SALLE Thor. 124 (80)

Chair: K.L. Kavanagh, Simon Fraser University

MO-A12-1 **11h15**

Structural Analysis of Y2O3 Films Grown by Molecular Beam Epitaxy*. **Shawn Penson** [1], Raveen Kumaran [1], Scott Webster [1], Alex Oleinik [2], Tom Tiedje [1], [1] *University of British Columbia*, [2] Zecotek Medical Systems, Singapore — We have grown yttrium oxide thin films by molecular beam epitaxy for planar waveguide laser structures. The films were deposited on silicon and sapphire substrates held between 700 and 1100 °C. Yttrium metal was evaporated from an effusion cell at temperatures between 1600 and 1750 °C in an oxygen pressure of 10^{-6} mbar, with and without an oxygen plasma source. Deposition rates of 1.7 to 13 nm/min were achieved. *In-situ* RHEED and light scattering measurements were used to monitor the growth of the films. Nd-doped Y_2O_3 films grown by this method are found to have photoluminescence similar to bulk-grown material. X-ray diffraction measurements of the Y_2O_3 films show orientations of (110) on silicon (001) and (111) on sapphire (0001) substrates. TEM and asymmetric x-ray measurements show the films to be twinned on the 30nm scale for both the Si and sapphire substrates. For the Si twin domains we observe in-plane alignment of the Y_2O_3 [001] axis along the Si [110] and [-110] axes. For the films grown on sapphire the Y_2O_3 [11-2] axis is aligned along the sapphire [10-10] and [-1100] axes. The films grown on Si have ~ 0.5% tensile strain indicating almost complete relaxation, given the 2.3% lattice mismatch. Atomic force microscopy of the Y_2O_3 (111) films grown on sapphire at 1100 °C show surface faceting. Results of films grown on R, M and A-plane sapphire will be presented.

* This work is being supported by NSERC and Zecotek

MO-A12-2 **11h30**

Comparison of BFO and BLT epitaxial thin film heterostructures and their possible applications*. **Olivier Gautreau**, Catalin Harnagea, Alain Pignolet, *INRS Énergie Matériaux et Télécommunications* — $BiFeO_3$ (BFO) is a multiferroïc (ferroelectric and antiferromagnetic) perovskite, with high Curie (850 °C) and Neel (370 °C) temperatures, and hence a good candidate for studying magnetoelectric coupling at room temperature. It also possesses remnant polarization (50-100 microcoulombs per square centimeter) for film thicknesses ranging from 70 to 400 nm, one order of magnitude higher than for the bulk (3-6 microcoulombs per square centimeter). These properties are of particular interest for device applications such as multiple-state memory elements and magnetic field sensors. La-doped $Bi_4Ti_3O_{12}$ (BLT) is a ferroelectric layered-perovskite exhibiting the best 'high remnant polarization / fatigue free' compromise (10-20 microcoulombs per square centimeter / up to 10^{10} cycles without fatigue) among ferroelectric candidates for ferroelectric memory devices. Both BFO and BLT are also lead-free compounds, therefore promising for applications in view of the recent ecological concerns and legal restrictions. We report here the comparison of the structural and ferroelectric properties of epitaxial BFO and BLT thin film bi-layers on $SrRuO_3$ coated $SrTiO_3$ substrates at both macroscopic and ultralocal scale. We show that the specific ferroelectric properties of the two materials have a certain degree of complementarity, in terms of spontaneous and remnant polarizations, leakage current, fatigue endurance and dielectric constant, providing a base for extending the range of their possible applications in future epitaxial oxide heterostructure- and nanostructure-based integrated devices.

* This work is being supported by NSERC-CA, Nanoquebec, INRS-EMT

MO-A12-3 **11h45**

Nanostructured organic thin films*. **Michael Fleischauer** [1], Shufen Tsoi [1], Bryan Szeto [2], Shawn Deis [1], Graeme Dice [1], Michael Brett [2], [1] *University of Alberta*, [2] University of Alberta / NINT — Controlled-porosity thin films are of interest for their unique optical, chemical, and mechanical properties. Porous nanostructured thin films fabricated using the Glancing Angle Deposition (GLAD) technique are of particular interest because of the wide range of possible morphologies and material choices. Hrudey et al recently demonstrated that the GLAD technique, commonly used for metals, semiconductors and oxides, can also be used for organometallics such as the luminescent material tris (8-hydroxyquinoline) aluminum (Alq_3). The GLAD-fabricated Alq_3 nanostructures show a self-ordered periodicity and do not broaden or bifurcate, unlike their inorganic counterparts. A solid wetting layer was also observed to form below the Alq_3 structures whose thickness varies with deposition conditions. A better understanding of wetting layer formation and control, self-ordering, feature morphology, and the effect of deposition conditions, is critical to the future realization of optical and optoelectronic devices utilizing GLAD-fabricated nanostructures of Alq_3 and other organic and organometallic materials of interest. Here, we will present our methods to control film morphology (including wetting layer thickness) via deposition conditions and substrate preparation, and compare and contrast the growth of Alq_3 thin films during glancing angle and normal deposition. Special attention will be paid to the initial growth stages with an eye towards predicting the behaviour of other organic and organometallic materials deposited in the glancing angle regime.

* This work is being supported by NSERC/iCORE/Micralyne/Killam

MO-A12-4 **12h00**

Reproducible Schottky Contacts by Electrodeposition*. **Karen L. Kavanagh**, Zhi Liang Bao, *Simon Fraser University* — In this talk the advantages of electrodeposition for fabricating reproducible and ideal metal/GaAs contacts will be discussed. We have experimented with Fe, Cu, NiFe, Bi, and Co deposited via aqueous salt solutions at temperatures between 20C and 80C. The metal films are pure to below the limits of detection of Auger spectroscopy and nuclear reaction analysis. The films are epitaxial, and the interfaces are atomically abrupt or have thin interfacial reaction layers, similar to interfaces formed in ultra high vacuum. Most diode properties vary with wafer orientation ((001), (111)B or (110)) except for Co/GaAs diodes, which curiously display identical barrier properties independent of the wafer orientation. This interface also has the lowest lattice mismatch and a higher reactivity for ternary alloy formation. Iron-rich FeNi diodes show composition-independent current-voltage transport, likely related to a preference for Fe nucleation compared to Ni. These films are magnetic and possibly useful for spin injection applications.

* This work is being supported by NSERC

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

[MO-HS-LUNCH] High School Workshop Luncheon / *Atelier des enseignement(e)s de la physique - dîner*

(CAP-DPE / *ACP-DEP*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

12h00 - 13h30

ROOM / SALLE T.B.A.

Chair: L. Marchildon, Université du Québec à Trois-Rivières

MO-HS-LUNCH-1 **12h45**

ROBERT FEDOSEJEVS, University of Alberta

Putting Photons to Work

The 21st century has been called the century of photonics where manipulation of light in all of its various forms will become an integral part of everything we do just as electronics has infiltrated our lives in the 20th century. We will see totally new ways of lighting homes with high efficiency light emitting diodes being built into ceilings, windows, displays etc. to totally new forms of optical sensors continually monitoring air quality, water quality, green house gas emission and other aspects of our daily lives. Optically based sensor systems will improve the efficiency and reduce the environmental impact of everything we do in our home and working lives. Already the use of light has revolutionized the communications and entertainment industries through fiber optics and DVD players. While we are surrounded by current and emerging examples of optical technologies in new applications the general public has little awareness of the increasing importance of the new field called photonics. The presentation will highlight the growing importance of photonics in modern society and opportunities for future careers in this area.

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

[MO-POS] Atmospheric and Space Physics Poster Session / *Session d'affiches - Physique atmosphérique et de l'espace*

(DASP / *DPAE*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

12h30 - 13h15

ROOM / SALLE Geol. 200 (atrium)

Chair: D. Degenstein, University of Saskatchewan

These posters will also be on display during the regular Monday evening poster session from 19h00 to 22h00. (See page 128 for posters). / Ces affiches feront aussi partie de la session d'affiches régulière le lundi soir de 19h00 à 22h00. (Voir page 128 pour les affiches).

13h15 **Session Ends / *Fin de la session***

[MO-DAMPhi] DAMPhi Business Meeting (with NSERC GSC-29 report at 13h10) / *Réunion d'affaires DPAMIP (avec rapport du GSC-29 du CRSNG à 13h10)*

(DAMPhi / *DPAMIP*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

12h30 - 13h15

ROOM / SALLE Phys. 165 (137)

Chair: A.A. Madej, National Research Council

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

13h15 **Session Ends / *Fin de la session***

[MO-DCMMP] DCMMP Business Meeting (with NSERC GSC-28 report at 13h10) / *Réunion d'affaires DPMCM (avec rapport du GSC-28 du CRSNG à 13h10)*

(DCMMP / *DPMCM*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

12h30 - 13h15

ROOM / SALLE Thor. 124 (80)

Chair: S. Idziak, University of Waterloo

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

13h15 **Session Ends / *Fin de la session***

[MO-DHP] DHP Business Meeting / *Réunion d'affaires DHP*

(DHP / *DHP*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

12h30 - 13h15

ROOM / SALLE Phys. 175 (40)

Chair: A. Griffin, University of Toronto

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

13h15 **Session Ends / *Fin de la session***

[MO-DIAP] DIAP Business Meeting / *Réunion d'affaires DPAE*

(DIAP / *DPAE*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
12h30 - 13h15

ROOM / SALLE Geol. 265 (40)

Chair: A. Kotlicki, University of British Columbia

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

13h15 **Session Ends** / ***Fin de la session***

[MO-DIMP] DIMP Business Meeting / *Réunion d'affaires DPIM*

(DIMP / *DPIM*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
12h30 - 13h15

ROOM / SALLE Geol. 155 (70)

Chair: K.H. Michaelian, CANMET, Natural Resources Canada

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

13h15 **Session Ends** / ***Fin de la session***

[MO-DNP] DNP Business Meeting / *Réunion d'affaires DPN*

(DNP / *DPN*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
12h30 - 13h15

ROOM / SALLE Phys. 130 (70)

Chair: G.M. Huber, University of Regina

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

13h15 **Session Ends** / ***Fin de la session***

[MO-DPE] DPE Business Meeting / *Réunion d'affaires DEP*

(DPE / *DEP*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
12h30 - 13h15

ROOM / SALLE Phys. 103 (145)

Chair: P.S. Goldman, Ryerson University

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

13h15 **Session Ends** / ***Fin de la session***

[MO-Plen3a] Achievement Medal Winner / *La médaille pour contributions exceptionnelles à la physique*

(CAP / *ACP*)

(David Dunlop, University of Toronto)

MONDAY, JUNE 18
LUNDI 18 JUIN
13h30 - 14h10

ROOM / SALLE Arts 146 (154)

Chair: M.C.W. Campbell, University of Waterloo

MO-Plen3a-1 **13h30**

DAVID J. DUNLOP, University of Toronto

In the Footsteps of Louis Néel: from Micromagnetism to the Moon and Mars *

In 1948, Louis Néel explained the origin of antiferromagnetism and ferrimagnetism, magnetic states of matter characteristic of iron oxides and sulphides in nature. The following year, he addressed the perplexing question of permanent magnetism in rocks. Using data gathered by Émile Thellier over the previous decade, he explained why fractions of thermoremanent magnetization (TRM) acquired over different temperature intervals are independent and additive – and phenomenally resistant to later changes. Today's permanent magnets and magnetic recording media are descendants of the single-domain particles Néel discovered in rocks and pottery clays. The largest repository of single-domain TRM is in the seafloor, where lavas that cooled at mid-ocean ridges preserve a record of seafloor spreading as a result of periodic reversals of the Earth's magnetic field. Fortunately this record survives oxidation of the TRM, as Özden Özdemir in our group showed in 1985. This binary magnetic recording on a colossal scale validated the theory of plate tectonics and changed forever ideas about our planet's inner workings. The seafloor is not very old, geologically speaking, and evidence about plate tectonics in much earlier times relies on TRM of rocks in ancient Precambrian shields. These magnetic recordings lack the beguiling simplicity of the seafloor. The rocks have been buried, then uplifted into mountain chains, eroded, redeposited, and changed chemically in the process. How then to decipher the chapters of their magnetic history? In some cases, the answer is as simple as separating different blocking temperature fractions of their TRMs and dating each by $^{40}Ar/^{39}Ar$ geochronology. This happy union was pioneered by Derek York's group and ours at Toronto in the 1980's. What if rocks are not ideal single-domain recorders? Landau and Lifschitz, and independently Kittel, correctly predicted the magnetic microstructure of larger multidomain particles, but more important in nature are in-between-size particles (around 100 nm for magnetite, Fe_3O_4) with transitional properties. Wyn Williams in our group in the early 1990's modeled their structures with three-dimensional arrays of coupled "super-

spins", each representing the net moment of several thousand atoms. The states he discovered – flower, vortex, double-vortex – have only recently been verified by off-axis electron holography. Some have stabilities to rival single-domain grains. The quest for ancient magnetic records from other planets began with the Apollo Moon landings and has resumed with remote sensing of Mars and the Moon from orbiting satellites and direct sampling by the Mars rovers. These bodies are magnetically dead today but once possessed global fields that magnetized volcanic basins and highlands rocks alike. In the era of major impacts 3.9–3.0 billion years ago, the Moon's field was steadily weakening and Mars had already lost its global field, judging by the magnetically barren giant impact craters on Mars. By contrast, at this time Earth's magnetic dynamo was just beginning to fire up. This survey talk gives examples of work in these areas by our group and others.

* This work is being supported by NSERC

14h05 **Discussion Break**

14h10 **Session Ends** / ***Fin de la session***

[MO-Plen3b] Teaching Medal Award / *La médaille d'enseignement* (Robert I. Thompson, University of Calgary)

(CAP / *ACP*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

13h30 - 14h10

ROOM / SALLE Arts 143 (350)

Chair: B.C. Sanders, University of Calgary

MO-Plen3b-1 **13h30**

ROBERT I. THOMPSON, University of Calgary

Simplifying the complex with familiarity: An approach to effective physics education at all scales

There are many challenges to the clear communication of physical principles, concepts, and calculation techniques at the university level, not the least of which is the sheer volume and complexity of the materials that we are required to convey to our students. Over the past number of years, an underlying principle that I have found to be particularly useful in my efforts at effective physics education is the importance of basing my efforts in the familiar, providing the students with a comfortable starting point from which we can journey into the new and at times complex worlds of physics. I have found that this principle is applicable at all "length scales" of education, including but not limited to the design of program structure, course content, class-time organization, lecture demonstrations, and even assignment problems. This presentation will elaborate on my ideas and applications of this familiarity approach to physics instruction, with examples such as the inclusion of orientation courses in physics curricula, the importance of the order of material presentation in undergraduate quantum mechanics, and the use of a structured "front end" component in physics classes, and will attempt to quantify the success of many of these ideas based on student performance and course evaluation.

14h00 **Discussion Break**

14h10 **Session Ends** / ***Fin de la session***

[MO-HS-2] High School Teachers' Workshop - p.m. / *Atelier des enseignant(e)s de la physique - après-midi*

(CAP-DPE / *ACP-DEP*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

14h30 - 17h00

ROOM / SALLE Biol. 106 (250)

Chair: L. Marchildon, Université du Québec à Trois-Rivières

MO-HS-2-1 **14h30**

CARL WIEMAN, University of British Columbia

Bose-Einstein condensation: quantum weirdness at the lowest temperature in the universe *

In 1924 Einstein predicted that a gas would undergo a dramatic transformation at a sufficiently low temperature (now known as Bose-Einstein condensation or BEC). In 1995, my group was able to observe this transformation by cooling a gas sample to the unprecedented temperature of less than 100 billionths of a degree above absolute zero. The BEC state is a novel form of matter in which a large number of atoms lose their individual identities and behave as a single quantum entity, the "superatom". This entity is the atom analogue to laser light, and, although large enough to be easily seen and manipulated, exhibits the nonintuitive quantum behavior normally important only at much tinier size scales. The study and use of the curious properties of BEC has now become an important subfield of physics. I will discuss what BEC is and how we create it. This talk uses interactive animations and is suitable for general audiences.

* This work is being supported by NSF, ONR, and NIST

15h15 **Coffee Break** / ***Pause café***

MO-HS-2-2 **15h30**

GARY W. SLATER, Université d'Ottawa

Science vs. Pseudo-Science and Junk Science

Is Science solely a method to generate new technologies, or is it also a method that can be used to learn about reality? The current anti-science movement in our society has numerous repercussions. In this talk, we will look at the scientific method and how it should be used in education to train our children to use critical thinking in their lives and to make decisions. We will then look at the differences between pseudo-science, junk science and science itself. Several famous cases will be examined. Finally, we will look at some of the resources that exist for teachers (certaines de ces ressources sont en français).

MO-HS-2-3 **16h15**

JEAN-PIERRE ST-MAURICE, University of Saskatchewan

The aurora borealis: what is it we know and don't know about it? *

We have achieved tremendous progress on our understanding of the aurora in the past fifty years. In this presentation, I will attempt to illustrate some of this progress. In the process, I will first discuss what the aurora is, namely, what the lights are telling us about their origin. I will use the perspectives that we have gained from modern technology, including satellites and high resolution cameras and other instruments to dig into this question a bit. Next, we'll cover the particulars: when and where is the aurora located, both on earth as well as on other planets. Once again, we'll go over what this reveals about the phenomenon. We will then ask our most challenging question, which is simply: "how does it work"? In the process we will have to think of the sun as a star that bombards us not just with radiation but also with a never-ending shower of high energy particles. I will then try to convey how this stream of charged particles ends up triggering the aurora by strangely indirect processes. I will end by describing the many challenges that still face us as we try to truly understand this wondrous natural phenomenon.

* This work is being supported by NSERC

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

[MO-P1] Novel Light Sources and their Applications to Optics and Atomic and Molecular Physics / *Nouvelles sources de lumière et applications à la recherche en optique et en physique atomique et moléculaire*

(DAMPhi-DOP / DPAMIP-DOP)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

14h15 - 16h45

ROOM / SALLE Phys. 165 (137)

Chair: W.-K. Liu, University of Waterloo

MO-P1-1 **14h15**

JORGE ROCCA, Colorado State University

High brightness table-top soft x-ray lasers at high repetition rate †,*

Recent advances in laser-pumped and discharge pumped high repetition rate soft x-ray lasers allow the generation of very high brightness soft x-ray beams using table-top set ups. The peak spectral brightness of some of these new lasers surpasses by several orders of magnitude that of third generation synchrotrons in the 25-100 eV spectral region, enabling new applications. We have demonstrated 5 Hz repetition rate operation of table-top soft x-ray lasers at wavelengths down to 10.9 nm. The results were obtained by collisional electron impact excitation of highly ionized atoms in dense plasmas efficiently heated with picosecond optical laser pulses of only 1 J energy. Further improvement in the brightness of these new soft x-ray sources was obtained seeding the soft x-ray amplifiers with high harmonic pulses. We have demonstrated the saturated amplification of high harmonic seed pulses in a dense transient collisional soft x-ray laser amplifier medium created by heating a solid titanium target. Amplification of the seed pulses in the 32.6 nm line of Ne-like Ti generated laser pulses of sub-picosecond duration that were measured to approach full spatial coherence. The peak spectral brightness of this seeded amplifier is estimated to be ~ 2×10^{26} photons/(s mm^2 mrad^2 0.01% bandwidth). The seeded soft x-ray laser scheme is scalable to produce extremely bright lasers at very short wavelength with full temporal and spatial coherence. These new high repetition rate soft x-ray lasers making possible table-top experiments such as the recent demonstration of broad area imaging with resolution down to 38 nm.

† In collaboration with Yong Wang [1], Bradley Luther [1], Mark Berrill [1], David Alessi [1], Miguel Larotonda [1], Eduardo Granados [1], Dinesh Patel [1], Carmen Menoni [1], V.N. Shlyaptsev [2], [1] Colorado State University, [2] University of California Davis at Livermore

* This work is being supported by National Science Foundation

MO-P1-2 **14h45**

DOMINIQUE APPADOO, Canadian Light Source

Commissioning of the Far-Infrared Beamline at the Canadian Light Source Inc. †

The far-infrared beamline (02B1-1) at the Canadian Light Source Inc. has been dedicated to spectroscopic investigations of gas-phase molecules at ultrahigh resolution, and of high-pressure condensed-phase systems at low resolution. The far-infrared synchrotron radiation (10 - 2000 μm or 5 - 1000 cm^{-1}) collected from a Bending Magnet, is steered using long wavelength optics to the experimental end-station, which is equipped with a Bruker IFS125HR spectrometer offering an optimum resolution of ~ 0.001 cm^{-1}. At this stage, two multipass optics cells (a 2m liquid nitrogen-cooled cell and a 29 cm ambient temperature cell) have been coupled to the spectrometer for the study of stable species; two additional cells to study radicals and long chain carbons will also be coupled to the IFS125 spectrometer. Characterization of the far-infrared portion of the synchrotron light started in January 2006, and the far-IR beamline is partially commissioned and is presently accepting proposals. To date, the quality of spectra recorded with the synchrotron has been shown to be superior to that of spectra recorded with the globar by a factor of 7-8 in the 450-700 cm^{-1} region of the far-IR; this translates in a reduction in acquisition time by a factor of approximately 60. A description of the optics and layout will be presented, as well as its status, capabilities and scientific program.

† In collaboration with Tim May [1], Robert McKellar [2], [1] Canadian Light Source, [2] Staecie Institute for Molecular Sciences, National Research Council

MO-P1-3 **15h15**

High resolution rovibrational spectra of five-membered rings with heteroatoms: New results from the far-infrared beamline of the Canadian Light Source*.
Dennis Wayne Tokaryk [1], Jennifer A. van Wijngaarden [2], [1] *University of New Brunswick*, [2] University of Manitoba — The ground state spectra and structures of five-membered ring molecules like pyrrole, furan and thiophene are well established via microwave spectroscopy. Some rotationally-resolved studies of the vibrational bands of these molecules have previously been conducted at high resolution by Fourier transform and infrared diode laser spectroscopy; however, the data obtained via Fourier transform spectroscopy suffers in quality due to the low light flux of conventional light sources (particularly at frequencies lower than ~600 cm^{-1}), and due to the requirement that the entrance iris must be very small to obtain spectra at high resolution. We report new rotationally-resolved vibrational spectra of five-membered ring molecules using the intense, spatially-confined infrared light produced by the Canadian Light Source synchrotron, which we have coupled into a Bruker IFS125 Fourier transform spectrometer. Spectra of exceptionally high quality were taken at the full resolution of the instrument (0.001 cm^{-1}), both with the synchrotron source (400-700 cm^{-1}) and the internal globar source (700-1000 cm^{-1}). Comparisons of the 400-700 cm^{-1} spectra with those taken with a conventional globar source are given, and analysis of the rotational structure of these bands is presented.

* This work is being supported by NSERC

15h30 **Coffee Break / *Pause café***

MO-P1-4 **15h45**

JEAN-CLAUDE KIEFFER, INRS-Énergie, Matériaux et Télécommunications, Université du Quebec

Ultrafast Structural Imaging and High Field Science at the Advanced Laser Light Source (ALLS) Facility *

A Canadian based International Research Facility has been established that will explore a completely new approach to dynamic investigation of matter. The National facility, called the Advanced Laser Light Source (ALLS), enables the combination of any or all of the most advanced laser technologies for exploiting light-matter interactions. The ALLS infrastructure is a new state-of-the-art multi-beam femtosecond laser National facility that is established at INRS and which will be fully commissioned early 2007. The central concept of ALLS is to use a plurality of laser interactions, spanning the X-ray to infrared spectral ranges, with sufficient peak power to manipulate matter at will and probe its dynamics. The ALLS workhorse is a new state-of-the-art multi-line laser system that is making use of the most recent ultrafast Ti:Sapphire laser technology. We will present this new laser system, which has been designed to achieve pulse duration of 25 femtoseconds or less for all the beam lines and to have various peak powers available (0.2TW at 5KHz, 4TW at 100Hz and 200TW at 10Hz), and the associated beam lines. Various light sources contribute a multi-line "rainbow" system that delivers high photon fluxes with extremely short duration pulses at various wavelengths. We will more specifically describe the high intensity ALLS laser system which is delivering simultaneously a peak power of 200TW (5J in 25fs pulses) and an average power of 50W (10Hz repetition rate). The scientific program of my group includes three major components that are inter-related. The first program component is the multiwavelength dynamic probing. This involves manipulation and control of target atoms, and the detection and diagnostics of the reactions. Structural dynamics of matter in different phases with different levels of complexity and in different kinds of environments have been explored with femtosecond time-resolved detection and diagnostics. The second program component is to extend frontiers of light sources needed for time resolved experiments. We aim to shorten the duration of light pulses down to the attosecond regime, to develop new measurement methods, and to make attosecond pulses much more intense and practical for applications. The third program component is to extend frontiers in high field physics - a very important issue for developing new light and particle sources concepts - taking advantage of the relativistic intensities (up to 10^{22} W/cm^2) that will be achieved with the ALLS facility. I will present experiments realized by my group at ALLS since the opening of the facility in September 2005 and will discuss our experimental program starting with the 200TW system.

* This work is being supported by CFI, INRS, NSERC, FQRNT

MO-P1-5 **16h15**

Laser Induced Breakdown Spectroscopy for Detection of Elemental Contaminants in Water*. **Yogesh Godwal**, Michael Taschuk, Siu-Lung Lui, Ying Tsui, Robert Fedosejevs, *University of Alberta* — Laser Induced Breakdown Spectroscopy (LIBS) is a fast non-contact technique for the analysis of the elemental composition of any sample. We are investigating LIBS for the detection of chemical constituents in fluids such as pollution contaminants in water or cell content analysis in microfluidic systems. For these studies the focus has been in using very low energy, microjoule pulses in order to give high spatial resolution and minimize the laser system requirements. This regime is referred to as microLIBS. Under such conditions it is important to maximize the signal detected to give the lowest limit of detection (LOD) possible. One technique to improve the signal to noise ratios is through the use of dual pulse excitation with the first pulse creating a vapor plume and the second pulse tuned to a resonant absorption line of the species of interest. We are investigating the performance of dual-pulse LIBS at low pulse energies (< 1 mJ for both pulses) for the detection of elemental contaminants in water. This technique allows reasonable performance compared to high energy single-pulse LIBS, but at a much reduced total energy expenditure. Elements such as Na, Al and Pb are being studied and LOD's well below the several ppm level have been demonstrated. Current results will be presented and scaling to future microjoule applications will be given.

* This work is being supported by MPB tech., NSERC

MO-P1-6 **16h30**

Optical Frequency Comb Measurements of Rb Reference lines in the Violet Region of the Spectrum*. **Alan Madej** [1], Andrew Shiner [2], John Bernard [1], Pierre Dubé [1], [1] *Institute for National Measurement Standards, National Research Council*, [2] Department of Physics and Astronomy, York University — The extreme precision and accuracy provided by a stabilized, mode-locked laser creating a comb of reference frequencies across the optical region of the spectrum has been extended to the violet through the measurement of reference Rb lines at 422 nm. These lines belong to the $5s\ ^2S_{1/2} - 6p\ ^2P_{1/2}$ electronic transitions of the ^{85}Rb and ^{87}Rb isotopes. A 422-nm diode laser-based saturated-absorption spectrometer has been developed to probe the Doppler-free lineshapes of the transition. Resolutions of 5 MHz (FWHM) for the transition hyperfine components were obtained and yielded a line center reproducibility of 40 kHz. A frequency link consisting of an 844-nm diode laser which is frequency doubled and frequency locked to the 422-nm probe source was implemented. In this way, the 422-nm frequencies could be determined via heterodyne frequency measurement of the frequency locked 844-nm source using a Ti-Sapphire frequency comb referenced to the NRC atomic clock ensemble. Results will be presented for the absolute frequencies of these transitions together with studies of sensitivity of the transition to operating parameters. The determined frequencies provide a 4-order of magnitude improvement in the knowledge of the absolute frequency of this transition and serves to aid in the understanding of alkali single electron systems. Moreover, the obtained reference frequencies provide a very useful series of known frequency values in the violet region of the electromagnetic spectrum where there are little or no known values at moderate accuracy.

* This work is being supported by NSERC

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

[MO-P2] (DMBP / *DPMB*) DMBP Best Student Paper Competition / *Compétition pour les meilleures communications étudiantes DPMB*

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 16h30

ROOM / SALLE Geol. 155 (70) ***Chair: A. Pejović-Milić, Ryerson University***

MO-P2-1 **14h15**

Particle Tracking Microrheology for the extraction of mechanical properties of water, glycerol and f-actin*. **Ahmed El Kaffas**, Joseph Carl Kumaradas, Michael C. Kolios, *Ryerson University* — Particle tracking microrheology (PTM) is a recently developed technique used to measure mechanical properties of small samples of complex fluids and soft materials on a local level. Tracer motion, activated by the thermal energy of the sample, is used to extract the viscoelasticity of the material using a generalized form of the Stokes-Einstein equation. PTM has been used to measure viscoelastic properties of complex environments, such as polymerized actin (f-actin) and the cytoplasm of cells. Recent use of high frequency ultrasound to detect structural and physical changes in cell ensembles during apoptotic cell death illustrates the potential of

determining the apoptotic index (the percentage of cells in a volume undergoing apoptosis) and quantifying patient response to cancer treatment. The aim of this work is to measure the viscoelasticity of healthy and apoptotic (a form of cell death) cells and to use these measurements in Finite Element Method (FEM) models of acoustic wave scattering in order to better understand this phenomenon. After set up and calibration of the equipment used in PTM, the viscosity of water and diluted glycerol was averaged over multiple tracers and found to be 1.1 cP and 7 cP respectively. These are in the range of previously measured viscosities using bulk rheology. PTM based measurements of viscosity and elasticity are now being developed for f-actin, which mimics cell cytoplasm. The final step will be to measure the mechanical properties of treated and untreated cells.

* This work is being supported by CRC, CFI

MO-P2-2 14h30

Application of Sample Volume Controlled-Fluorescence Correlation Spectroscopy to the Study of Anomalous Diffusion*. **Daniel Banks**, Robert Peters, Cecile Fradin — Sample Volume Controlled-Fluorescence Correlation Spectroscopy (SVC-FCS) is a recently developed modification to conventional FCS that is used to study the length-scale dependence of diffusion in complex media. In this study we show that by varying the radius of the observation volume by an order of magnitude, 0.2 – 1.5 μm, SVC-FCS offers an independent way to obtain the anomalous exponent, α, characterizing the diffusion via the diffusion law. For the diffusion of polymer beads in 1.4% agarose gels, we obtain values of α increasing from 0.82 to 0.97 as the observation volume is increased, and a value of $\alpha = 0.92$ from the diffusion law. This result is important as a proof of principle that the diffusion law obtained through SVC-FCS can confirm the same anomality of the diffusion predicted by the anomalous exponents obtained from fitting FCS data at fixed length-scales. The diffusion law obtained from protein diffusion in dextran solutions also has important implications for the interpretation of anomalous diffusion in that system. Further, the observation of additional photophysics in the correlation data when the length scale of the observation is increased is one of the challenges in using a variable length scale with FCS and this phenomenon is illustrated by our observations of EGFP blinking at large detection volumes. We argue that where the fixed length-scale FCS data suggests that the diffusion is length-scale dependent, SVC-FCS should be used whenever possible to confirm or falsify this prediction.

* This work is being supported by NSERC

MO-P2-3 14h45

The Calculation of the Potential of Mean Force between Lactoferricin B and Model Membranes from Molecular Dynamics Simulations*. **Victor Vivcharuk** [1], Chris Gray [1], Bruno Tomberli [2], Igor Tolokh [1], [1] *University of Guelph*, [2] Brandon University — The detailed microscopic molecular dynamics (MD) simulation have been used to understand the origin of the anionic palmitoyloleoylphosphatidylglycerol, or POPG, and zwitterionic phosphatidylcholine, or POPC, bilayers interaction with cationic amphiphilic peptide lactoferricin B, or LfcinB. Lactoferricin B is an antimicrobial 25-residue peptide with a single disulfide cross-linked and is highly enriched with aromatic and basic amino acids: two tryptophans, two phelanins and eight basic residues. We have, therefore, investigate the interaction of LfcinB with POPG and POPC, in order to use it as a model system for studying membrane protein selectivity and understanding the mechanism of the bilayer-peptide interaction leading to the membrane disruption. One hundred fifty 3 ns MD simulations with six orientations and different position of LfcinB near POPG and POPC membranes systems were carried out in a presents of NaCl to determine potential of mean force (PMF) for peptide versus distance between centers of mass (COM) of LcfcB and membrane. To calculate the PMF we employed the combination of the constrained MD technique and the thermodynamic integration method. The most favourable orientation of LfcinB towards the face containing most of the basic residues. The PMF has been used to predict binding coefficients for both membranes. New method for binding Free Energy simulation were developed and it was shown that the LCFC is attracted to the both membranes but the magnitude of the free energy of binding are -5.3 kcal/mol for negatively charged POPG bilayer and -2.1 kcal/mol for neutral POPC bilayer. We have discussed the role of membrane fluctuations, ions and solvent effects, as well.

* This work is being supported by University of Guelph

MO-P2-4 15h00

Diffusion in a Network of Square Cavities: Exact Numerical Results. **Francis Torres**, Michel Gauthier, Jean-Francois Mercier, Gary Slater, *University of Ottawa* — In this contribution, we use a previously developed exact calculation method to obtain diffusion coefficients of point-like particles in 2-dimensional periodic structures of square cavities with small openings connecting them. These results are compared to Monte Carlo and Brownian Dynamics simulations, as well as some analytical predictions from Berezkhovskii, Zitsermann and Shvartsman [*J. Chem. Phys.* **119**, 6991 (2003)]. We find an important difference between our results and the analytical predictions. Physical explanations are presented to explain this discrepancy. The erroneous hypothesis made in the theoretical model is underlined. Interestingly, the diffusion coefficient for a particle in such a system is inversely proportional to the logarithm of the ratio of the radius of the opening and the length of the cavity.

15h15 Coffee Break / *Pause café*

MO-P2-5 15h30

Nanoparticles and modified fluorescent proteins for imaging of transmembrane potential. **Rafael Khatchadourian**, Jay Nadeau, Annette Hollmann, Samuel Clarke, *McGill University* — The ability to visually observe membrane potential would be extremely advantageous for monitoring cell health and activity in any cultured neuron system. On sufficiently long time scales, it would be possible to quantify cell health in response to depolarization and/or hyperpolarization. Moreover, if the observer has sufficient time resolution, action potentials may be resolved, thus allowing for optical recordings from ensembles of neurons without growing cultures on microelectrode arrays. Creating such probes remains extremely challenging. Here we present preliminary results for two genetically-encoded systems: one based upon Forster Resonance Energy Transfer (FRET) between nanoparticles and an engineered channel, and the second based upon fluorescence complementation (FC). The results suggest that regular monitoring of neuronal potential is possible with these probes, at least on relatively long periods on the scale of hundreds of milliseconds.

MO-P2-6 15h45

Magnetic Resonance Imaging and Behavioural Test Comparisons in a Mouse Model of Alzheimer's Disease*. **Jonathan D. Thiessen** [1], Kathryn A. Collister [2], Laryssa M. Kurjewicz [3], Marc R. Del Bigio [4], Benedict C. Albensi [2], Melanie Martin [5], [1] *University of Winnipeg*, [2] University of Manitoba; St. Boniface Research Centre, [3] University of Winnipeg; University of Western Ontario, [4]University of Manitoba, [5]University of Winnipeg; University of Manitoba — Alzheimer's disease (AD), the most common form of dementia, can only be diagnosed definitively post-mortem. In order to establish methods for earlier detection, beta-amyloid (Aβ) plaques, the signature pathological feature of AD, were visualized in live transgenic mice from 6 to 13 months of age. 3D T_2*-weighted images (FLASH, 5 averages, (1.7 cm)^3 FOV, 133 μm isotropic resolution without zero padding, T_R 73 ms, T_E 4 ms, 15 degree flip angle, acquisition time 99 minutes) were acquired monthly on one group of mice on an 11.7T Bruker Avance spectrometer. 2D T_2-weighted images (5 slices, 8 echoes, 2 averages, (2.5 cm)^2 FOV, 98 x 98 x 750 μm^3 resolution, T_R 2.1 s, T_E 27 ms, acquisition time 21 minutes) spanning the hippocampus were acquired from a second group of mice at 9 and 10 months of age on a 7T Bruker spectrometer. Histology confirmed the presence of plaques at 10 and 13 months. The number of visible plaques increased with age. Spatial memory was tested between imaging sessions on the second group of mice using a Morris water maze (MWM). Spatial memory performance of transgenic mice in the MWM was diminished when compared with control mice. The first study to image Aβ plaques over time in parallel with behavioral tests, this work lays the foundation for future combinations of imaging and behavioral studies to determine whether Aβ plaques are associated with AD symptoms. Acknowledgements: The authors wish to acknowledge Richard Buist, Shelley Germscheid, Allan Turner and Susan Pylypas for technical assistance.

* This work is being supported by NSERC & Alz. Society of MB

MO-P2-7 **16h00**

Distinct Oncocytic Renal Cell Carcinoma with Immunohistochemical Properties of Renal Oncocytoma. **Cyrille Bicamumpaka**, *University of Ottawa* — Renal oncocytoma (RO) is a characteristic benign renal tumor. The existence of malignant RO is controversial, and anecdotal, partly due to a lack of specific markers for RO. With recent advances in immunohistochemistry, RO can be distinguished from other renal neoplasms with routine stains and characteristic immunoprofile of CD117+, Renal Cell Antigen negative and vimentin negative. In our laboratory it was found the RO were also reactive for progesterone receptor. We report two cases of renal neoplasms with oncocytic cytoplasm, numerous intra-cytoplasmic vacuoles, uniform round to oval hyperchromatic nuclei with remarkably thick nuclear membranes and prominent nucleoli. The tumor cells were closely packed and disposed in an alveolar pattern. The neoplastic cells were diffusely reactive for CD117, cytokeratin AE1/AE3 and progesterone receptor, and focally for CD10. The cells were non-reactive for renal cell carcinoma antigen, vimentin, CK7, S100, racemase, as well as neuroendocrine markers. Due to the remarkable cytological atypia , lymph node metastasis and similar immunological features of RO, the tumor likely represents a distinct subtype of RCC related to RO, which has not been previously described.

16h15 **Discussion Break**

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

[MO-P3] Experimental Nuclear Structure Physics with Radioactive Beams / *Structure nucléaire expérimentale avec faisceaux radioactifs*

(DNP / *DPN*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 17h00

ROOM / SALLE Thor. 124 (80)

Chair: R.A.E. Austin, St. Mary's University

MO-P3-1 **14h15**

ALFREDO GALINDO-URIBARRI, Oak Ridge National Laboratory

Polarization Observables and Radioactive Ion Beams *

Spin polarized probes are essential tools for a precise determination of S-matrix elements and nuclear structure parameters. Unambiguous resonance parameters from elastic resonance scattering and spectroscopic information from transfer reactions can be obtained through the use of polarized beams in nuclei far from stability with radioactive ion beams. To that end we are developing polarized proton targets consisting of plastic foils with thicknesses between ~1mg/cm^2 and 20mg/cm^2. The operation of such a target requires a moderately-high magnetic field of 2.5T and low temperatures ~200mK. Frozen spin mode operation of the target at magnetic fields ~0.4T will allow detection of the recoils in low energy experiments. Recently we have performed several tests aimed to characterize the target by measuring excitation functions of cross sections and analyzing powers of the p+^{12}C reaction at 38MeV using the thick target technique in inverse kinematics. The measurements have been performed with the Philips Cyclotron at the Paul Scherrer Institute with beam intensities between 10^4 and 10^7pps, which are in the range of currently available RIBs.

* This work is being supported by US Department of Energy

MO-P3-2 **14h45**

DOUG CLINE, University of Rochester

Coulomb excitation studies of radioactive ^{20,21}Na beams *

Radioactive beams from the new ISAC2 accelerator facility at TRIUMF, combined with the 4π γ-ray detector array TIGRESS, open exciting opportunities for probing the new physics manifest by nuclei far from stability. The commissioning in-beam experiment with TIGRESS used 1.7 MeV/A beams of ^{21}Ne and ^{20,21}Na from ISAC1 that were Coulomb excited by a 0.5 mg/cm^2 ^{nat}Ti target. The inelastically scattered ions that recoiled out of the thin target were detected by a highly-segmented heavy-ion annular silicon detector, BAMBINO, in coincidence with γ-rays detected by two TIGRESS modules. The coincident γ-ray yields were analyzed using the Coulomb excitation search code GOSIA to determine the B(E2) and B(M1) matrix elements connecting low-lying states in these nuclei. The results resolved a large discrepancy between shell model predictions and previously measured values of the B(E2) strengths for the presumed five nucleon configurations in the mirror nuclei ^{21}Ne and ^{21}Na. In addition, B(E2) and B(M1) transitions strengths were determined for the first time in the proton drip line nucleus ^{20}Na. The technical challenges and scientific implications of these initial experiments will be discussed. This highly successful initial experiment bodes well for the planned research program using the full TIGRESS array plus the higher energy and mass radioactive beams from ISAC2 to probe this burgeoning new frontier of nuclear science.

* This work is being supported by the Natural Science and Engineering Research Council, National Research Council of Canada, US Department of Energy, US National Science Foundation, and the UK Engineering and Physical Science Research Council.

MO-P3-3 **15h15**

Design Study of DESCANT - DEuterated SCintillator Array for Neutron Tagging*. **James Wong**, *University of Guelph* — Radioactive beam facilities allow for the study of nuclei on the neutron-rich side. For the past several decades, one of the most useful tools for studying nuclei has been the fusion-evaporation reaction. A particular advantage of using such reactions is that they probe nuclei at moderate-to-high angular momenta. These reactions involve a collision and subsequent fusion of a beam with a target, resulting in a compound system in a highly excited state that loses energy by "evaporating" particles. A programme of such reactions is being planned to take place at the TRIUMF facility in Vancouver, Canada using the TIGRESS array of gamma-ray detectors. Along with TIGRESS, additional powerful detectors will be necessary to extract the greatest amount of information as possible. Since neutron evaporation is the predominant decay mode from neutron-rich compound systems, neutron detectors must be included. However, neutrons being uncharged, are not easy to stop and usually scatter from one detector to another, called multiple scattering. Since the probability of multiple scattering of neutrons is quite high, a neutron-detector array must be able to differentiate between multiple neutrons evaporating from the reaction, and a single neutron that scatters multiple times. In order to address the issue we investigate the use of a novel detection system for TIGRESS – one based on an array of deuterated liquid scintillators as neutron detectors.

* This work is being supported by CFI, TRIUMF

MO-P3-4 **15h30**

TACTIC, an annular ionization chamber for the tracking and identification of charged particles from nuclear reactions pertinent to nuclear astrophysics*. **Patrick Lorne Walden** [1], Pierre Amaudruz [1], Lothar Buchmann [1], Simon Fox [2], Brian Fulton [2], Alison Laird [2], Paul Mumby-Croft [2], Robert Openshaw [1], Marcello Pavan [1], Jonathan Pearson [1], Götz Ruprecht [1], [1] *TRIUMF*, [2] University of York — TACTIC (TRIUMF Annular Chamber for Tracking Identification of Charged particles) is a cylindrical time-projection ionization chamber being developed by a collaboration of TRIUMF and the University of York (UK). TACTIC allows three-dimensional reconstruction of particle tracks by means of a two-dimensional anode array combined with a TOF measurement of the drift electrons. In addition, the integrated charge for each pulse

provides information about the energy loss of the particle and allows identification of the nuclear ion producing the track. The geometry of TACTIC covers a large angular range permitting the measurement of differential cross-sections over a large solid angle. 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. The design of TACTIC was a collaboration between TRIUMF and Daresbury Laboratory in the UK. The detector has been constructed by the mechanical and electronic workshops at York. Construction is almost complete and assembly will commence imminently. It is planned that all tests at York will be completed by the end of May 2007, and the detector will be transported to TRIUMF in preparation for in-beam tests. A test run of TACTIC with ^{11}B beam has been scheduled for August, with plans for an experimental run during late 2007 or early 2008.

* This work is being supported by NSERC

MO-P3-5 **15h45**

Mass Measurement of Neutron Rich Isotopes at the TITAN Experiment*. **Maxime Brodeur** [1], Jens Dilling [1], Vladimir Ryjkov [2], [1] *TRIUMF/University of British Columbia*, [2] TRIUMF — The TRIUMF's Ion Trap for Atomic and Nuclear science (TITAN) experiment at TRIUMF propose to measure the mass of 11 isotopes of K, Ca and Sc close to $N = 32$ and $N = 34$. In this region of the nuclear chart drastic changes in structure are expected, and even shifts for the well established neutron shell structure of magic numbers has been found. The TITAN experiment use a Penning trap coupled to an Electron Beam Ion Trap (EBIT) to perform precise mass measurements on highly charged short-lived isotopes at ISAC. The mass measurements give access to the binding energy of the nucleons, which can directly linked via one-or two-neutron separation energies to the underlying shell structure of this many-body quantum mechanical system. These measurements are uniquely possible at TITAN and the motivation to determine the mass of these neutron rich isotopes will be presented together with a status of the TITAN experiment.

* This work is being supported by NSERC

MO-P3-6 **16h00**

The search for a non-superallowed branch in the beta decay of ^{38m}K*. **Kyle Leach**, *University of Guelph* — The study presented is part of an experimental program exploring the properties of superallowed Fermi β-decays conducted at the Isotope Seperator and Accelerator (ISAC) facility at TRIUMF in Vancouver, BC, Canada. Using the 8πγ-ray spectrometer and the Scintillating Electron Positron Tagging Array (SCEPTAR), it was possible to set a new upper limit on an unobserved non-analogue branch in the decay of ^{38m}K. This non-analogue β decay branch would populate the second 0^+ state of ^{38}Ar. The subsequent emission of a 1210 keV γ-ray during the decay of ^{38}Ar from its second 0^+ state to the first 2^+ state characterizes the population of the second 0^+ state and allows a direct measurement of the non-analogue β branch. This branch is predicted to be extremely weak [1], and the removal of contaminant isobaric decays and background radiation in the spectra was thus exceedingly important during the analysis. Our work has reduced the previous upper limit of 19ppm [2] by more than a factor of two and is now approaching the theoretically predicted branching ratio for this, as yet, unobserved transition. References: [1] I.S. Towner, J.C. Hardy, *Phys. Rev.* **C66**, 035501 (2002); [2] E. Hagberg *et. al*, *Phys. Rev. Lett.*, **73** 396. (1994)

* This work is being supported by NSERC and NRC

MO-P3-7 **16h15**

High-Precision Branching Ratio Measurement for the Superallowed Beta+ Emitter ^{62}Ga*. **Paul Finlay**, *University of Guelph* — A high-precision branching ratio measurement for the superallowed β^+ emitter ^{62}Ga has been made using the 8πγ-ray spectrometer in conjunction with the SCintillating Electron-Positron Tagging ARray (SCEPTAR) as part of an ongoing experimental program in superallowed Fermi β-decay studies at the Isotope Separator and Accelerator (ISAC) facility at TRIUMF in Vancouver, Canada. The present work represents the highest statistics measurement of the ^{62}Ga superallowed branching ratio to date. Over 20 gamma rays emitted following non-superallowed decay branches of ^{62}Ga have been identified and their intensities (in ppm per β decay) determined. These data are expected to yield a superallowed branching ratio with 10^{-4} precision and will provide stringent tests of the isospin mixing component of the large isospin-symmetry-breaking correction for this nucleus.

* This work is being supported by NSERC and NRC

MO-P3-8 **16h30**

ALEXANDRA GADE, Michigan State University

Nuclear Structure Studies with Fast Exotic Beams *

Observations in exotic nuclei have demonstrated that the sequence and energy spacing of single-particle orbits is not as immutable as once thought: some of the familiar magic numbers disappear and new shell gaps develop. This talk will summarize some of the recent results on the changes of shell structure in the vicinity of neutron number N = 28 as probed with nucleon-removal reactions and inelastic scattering experiments at the NSCL.

* This work is being supported in part by the National Science Foundation grant PHY-0110253.

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

[MO-P4] Condensed Matter Theory - contributed / *Théorie de la matière condensée - contribués*

(DCMMP-DTP / *DPMCM-DPT*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 17h00

ROOM / SALLE Geol. 265 (40) ***Chair: S. Idziak, University of Waterloo***

MO-P4-1 **14h15**

Lanczos methods at finite temperature for the Hubbard Model and cluster quantum approaches*. **Dany Plouffe**, David Sénéchal, *Université de Sherbrooke* — In the last years, a lot of effort has been put in the study of the Hubbard model, particularly in the 2D case, which is believed to contain the key elements to explain high-temperature superconductivity. Despite its apparent simplicity, solving the Hubbard model can be very challenging both for analytical and numerical approaches. Among the numerical methods used, cluster perturbation theory (CPT) and its variationnal form (VCA) have been successful in reproducing some key features observed in high-Tc superconductors, such as the pseudogap, the antiferromagnetic phase near half-filling and d-wave superconductivity away from half-filling, all at zero temperature. This talk will present an extension of those two methods to finite temperature. Our approach is based on approximate diagonalizations of a small cluster using Lanczos methods.

* This work is being supported by CRSNG

MO-P4-2 **14h30**

Quantum and classical critical phenomena in the frustrated Heisenberg two-leg ladder*. **Mohamed Azzouz**, Brandon W. Ramakko, *Laurentian University* — The antiferromagnetic Heisenberg model on the two-leg ladder with frustration is investigated using the Jordan-Wigner transformation and bond-mean-field theory. Depending on the

relative strengths of the coupling constants, the ladder can adopt one of three possible magnetically-disordered gapped states. The zero-temperature phase diagram calculated in this mean-field approach is in very good agreement with the one found by Weihong and colleagues using the Lanczos exact diagonalization method. This phase diagram is characterized by quantum criticality induced when coupling parameters are varied. We also found that the system shows thermally-induced criticality for some values of the rung and diagonal coupling constants.

* This work is being supported by NSERC and LURF

MO-P4-3 **14h45**

Effects of hybridization of diffusive and ballistic bands on vortex structure in a multiband superconductor*. **Kaori Tanaka** [1], Matthias Eschrig [2], [1] *University of Saskatchewan*, [2] Universität Karlsruhe — We study the electronic properties of a two-band superconductor in the vortex state, in which quasiparticle motion is ballistic in one band and diffusive in the other. Motivated by recent experimental results on the two-band superconductor MgB_2, we assume that superconductivity is mostly induced in the diffusive band. We apply a unique model recently developed by us [1] that is appropriate for describing such a system, and study the intriguing effects of hybridization of ballistic and diffusive superconductivity. Although the order parameter in the diffusive band is induced, the characteristic length scales in the two bands differ due to Coulomb interactions. We find that the current density in the diffusive band has strong temperature dependence, exhibiting the Kramer-Pesch effect when hybridization is strong. A particularly interesting feature of our model is the possibility of additional bound states near the gap edge in the ballistic band that are prominent in the vortex centre spectrum. This contrasts the single-band case, where there is no gap-edge bound state in the vortex core. We find these unique features for parameter values relevant for MgB_2. The magnetic-field dependence of vortex structure will also be discussed. Reference: [1] K. Tanaka, D.F. Agterberg, J. Kopu, and M. Eschrig, *Phys. Rev. B* **73**, 220501(R) (2006).

* This work is being supported by NSERC, CFI, DFG

MO-P4-4 **15h00**

Electron-Phonon coupling in Spin Hall Effect systems*. **Frank Marsiglio** [1], C. Grimaldi [2], E. Cappelluti [3], [1] *University of Alberta*, [2] Ecole Polytechnique Federale de Lausanne, [3] Istituto dei Sistemi Complessi, CNR-INFM — Significant spin-orbit coupling can be found in various two and three dimensional systems. This can lead to a variety of interesting properties, including a novel spin Hall effect, and enhanced superconductivity. We use a linear Rashba model for the spin-orbit coupling and a dispersionless Holstein model for the electron-phonon coupling. We show that for the spin Hall effect, the presence of electron-phonon scattering leads to a non-trivial renormalization of the interband resonance, while for superconductivity, a significant spin-orbit interaction can lead to enhancements of the superconducting critical temperature.

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

MO-P4-5 **15h15**

Tunable Ground-State Degeneracies in Double Quantum Dots*. **Hong-Yi Chen** [1], Jaime Garcia[2], Tapash Chakraborty[1], Pekka Pietilainen[3], [1]*University of Manitoba*, [2]University of Oulu, [3]University of Manitoba / University of Oulu — We have studied the effect of electron-electron interactions on planar double quantum dots subjected to an external magnetic field. Contrary to all other earlier works on similar systems, our accurate results for the energy levels and the dipole-allowed transition energies reveal the absence of singlet-triplet crossing in the case when the dots occupy only two electrons. For a larger number of electrons, we find the expected crossing of the energy levels. The corresponding far-infrared optical absorption spectra show the effect of electronic interactions as well as the underlying symmetries of these systems.

* This work is being supported by NSERC Discovery grant

MO-P4-6 **15h30**

Topological Hunds rules and the electronic properties of a triple lateral quantum dot molecule in a magnetic field. **Pawel Hawrylak**, Fernando Delgado, Yun-Pil Shim, Marek Korkusinski, Luis Gaudreau, Sergei Studenikin, Andrew Sachrajda, *Institute for Microstructural Sciences, National Research Council Canada* — We analyze theoretically and experimentally the effect of the magnetic field on the electronic structure and charging diagram of three coupled lateral quantum dots filled with electrons. Using the Hubbard model, linear combination of harmonic orbitals coupled with configuration interaction (LCHO-CI), and real-space exact diagonalization techniques (RSP-CI) we show that the electronic properties of this artificial molecule can be understood using a set of topological Hunds rules [1,2]. These rules relate the multi-electron energy levels to spin and the inter-dot tunneling t, and control charging energies. We map out the charging diagram for up to $N = 6$ electrons and predict a spin singlet for two electrons, spin-polarized phase for two holes, and a magnetically frustrated ground state for three electrons. We show that one can engineer degeneracies in the single particle spectrum by the application of the magnetic field perpendicular to the triple dot device. These degeneracies result in spin polarized multi-electron states. We predict magnetic field induced transitions among different spin polarized phases and their impact on transport through a quantum dot molecule [3]. The theoretical charging diagram is compared with the measured charging diagram of the gated triple-dot device [4]. References: [1] P. Hawrylak and M. Korkusinski, *Solid State Commun.* **136**, 508 (2005); [2] Marek Korkusinski, Irene Puerto-Gimenez, Pawel Hawrylak, Louis Gaudreau, Sergei Studenikin, and Andrew Sachrajda, *Phys.Rev.B*, March 15 (2007) (in press); [3] Fernando Delgado, Yun-Pil Shim, Marek Korkusinski and Pawel Hawrylak, to be published; [4] L. Gaudreau, S.A. Studenikin, A.S. Sachrajda, P. Zawadzki, A. Kam, J. Lapointe, M. Korkusinski, and P. Hawrylak, *Phys.Rev.Lett.* **97**, 036807 (2006).

MO-P4-7 **15h45**

The Fock-Darwin States of Dirac Electrons in Graphene-based Artificial Atoms*. **Hong-Yi Chen** [1], Vadim Apalkov [2], Tapash Chakraborty [1], [1] *University of Manitoba*, [2] Georgia State University — We have investigated the Fock-Darwin states of the massless chiral fermions confined in a graphitic parabolic quantum dot. In the light of the Klein tunneling, we have analyzed the condition for confinement of the Dirac fermions in a cylindrically-symmetric potential. New features of the energy levels of the Dirac electrons as compared to the conventional electronic systems are dicussed. We have also evaluated the dipole-allowed transitions in the energy levels of the dots. We propose that in the high magnetic field limit, the band parameters can be accurately determined from the dipole-allowed transitions.

* This work is being supported by NSERC Discovery grant

MO-P4-8 **16h00**

Band splitting and transparent states in biperiodic superlattices (SL)*. **Donald Sprung** [1], Loretta Vanderspek [2], Vince Van Dijk [3], Joan Martorell [4], [1] *McMaster University*, [2] Redeemer University College, [3] Redeemer and McMaster, [4] Universitat Barcelona — Coquelin, Pacher *et al.* [1,2] have studied electron transmission through biperiodic SL's, which consist of alternating wide and narrow GaAs quantum wells, separated by equal strength AlGaAs barriers. When the wells are identical, it is a finite periodic system of $N = 2n$ cells, with $2n - 1$ transmission resonances in each allowed band. If every second cell is altered, it becomes a periodic system of n double cells, and each allowed band divides at the Bragg point into two disjoint allowed bands, with $n - 1$ resonances in each. In a Schrödinger model of the system, the missing state becomes a transparent state of the unit cell, giving a sharp resonance at a fixed energy in one of the bands. A tight-binding model of the same system is based on the $2n - 1$ site amplitudes of the quantum wells. In this case the Bragg state becomes a surface or edge state of the lower (upper) band, when the first (second) well has the lower quasibound state energy. A comparison of these two pictures of band splitting reveals interesting aspects of band structure. References: [1] M. Coquelin, C. Pacher, M. Kast, G. Strasser and E. Gornik, "Transport studies on doubly periodic superlattices by hot electron spectroscopy". Contribution P-154 to Int. Conf. Phys. of Semiconductors, Edinburgh (2002). Published on CD, IOP Conference Series, **171** eds. A.R. Long and J.H. Davies, (2003) ISBN: 7503-0924-5; [2] M. Coquelin, C. Pacher, M. Kast, G. Strasser and E. Gornik, "Wannier-Stark level anti-crossing in biperiodic superlattices", Physica Status Solidi B **243** (2006) 3692-5.

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

MO-P4-9 **16h15**

Interminiband carrier dynamics in presence of dissipation in biased superlattices*. **Pavel Abumov**, Donald Sprung, *McMaster University* — One of the challenges of quantum transport theory is a detailed description of carrier transport in a superlattice at an energy level anticrossing. We study electron dynamics in a biased semiconductor ideal superlattice near interminiband resonances [1], in the presence of tunneling due to homogeneous level broadening. In particular, we investigate mixed regime involving both Rabi oscillations and resonant Zener tunneling, and examine the dependence of wavepacket dynamics characteristics on electric field detuning. The results obtained can be used in the areas of microwave radiation generation and matter manipulation on particle level. Reference: [1] Pavel Abumov and Donald Sprung, cond-mat/0702227.

* This work is being supported by NSERC discovery grant RGPIN-31

MO-P4-10 **16h30**

Stochastic dynamics with nonlinear dissipation*. **Alex Plyukhin**, *University of Saskatchewan* — Stochastic processes with nonlinear dissipation are ubiquitous and challenging to describe theoretically. In general they require a truly dynamical approach when statistical properties of noise are deduced directly from underlying microscopic dynamics, rather than postulated phenomenologically. Physical consequences of nonlinear dissipation are rich and often counterintuitive. Even when nonlinearity appears as small corrections to dominating linear friction, it may lead to qualitatively new physical effects, such as rectification of thermal fluctuations. I shall outline recent progress in the area and present some new results on nonlinear Brownian motion.

* This work is being supported by NSERC

MO-P4-11 **16h45**

An Argument on the Existence of Sub-Exponential Enumeration of Inin Hard Potential Systems. **Ashwin S. Sampangiraj** , Richard Bowles , *University of Saskatchewan* — The enumeration of mechanically stable structures (inherent structures) of a liquid is the key quantity providing insight into the question of the existence of thermodynamic basis for the *Ideal glass transition*. Earlier arguments have been advanced in favor of an exponential multiplicity of inherent structures [1]. Using an extension of the recently proposed Hamiltonian like volume function for hard potential systems [2,3], we identify features related to the geometric incompatibility of these volume functions, which yields a series bounding the number of inherent structures and providing a possibility for a sub-exponential enumeration. Reference: [1] F.H. Stillinger, *Phys. Rev. E* **59**, 48 (1999); [2] R. Blumenfeld and S.F. Edwards, *Eur. Phys. J. E*, **19**, 23 (2006); [3] R. Blumenfeld and S.F. Edwards, *Phys. Rev. Lett.*, **90**, 114303 (2003).

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

[MO-P5] Mathematical Physics / *Physique mathématique*

(DTP / *DPT*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 16h30

ROOM / SALLE Geol. 255 (48) ***Chair: D. Brydges, University of British Columbia***

MO-P5-1 **14h15**

MARK WALTON, University of Lethbridge

Phase-space quantum mechanics of a particle on the half-line *

Phase-space quantum mechanics (a.k.a. deformation quantization) is of interest because it is an autonomous and general formulation of quantum mechanics, and because its methods are useful in non-commutative physics, such as that realized in string theory. Surprisingly, however, certain simple systems are problematic in (autonomous) phase-space quantization. One such system, arguably the simplest, is the particle on the half-line. Its status in phase-space quantum mechanics will be reviewed. Included will be an explanation of an alternative method found by Kryukov and the author. It has recently been shown to be much simpler than previously thought, and more generally applicable.

* This work is being supported by NSERC

MO-P5-2 **14h45**

PATRICK DESROSIERS, Universite Laval

Statistical properties of spectra and symmetric functions †,*

Complex quantum systems, such as heavy nuclei, cannot be described by standard statistical mechanics. One rather considers random matrix theory in which Hamiltonians are viewed as Hermitian matrices of random elements. Ensembles of random matrices are usually labelled by the Dyson beta index; that is, beta = 1, 2, or 4 if the ensembles are invariant under orthogonal, unitary, or symplectic transformations, respectively. However, their exist matrix ensembles for which beta can be any real and positive number. These ensembles are deeply connected to important functions of algebraic combinatorics, namely the Jack symmetric polynomials. In this talk, I will show how to calculate averages (physical observables) by using symmetric polynomials and their integral representations. The focus will be on the multivariate Hermite polynomials (special deformations of the Jack polynomials) and on the asymptotic expansion of the spectral density.

† In collaboration with Peter J. Forrester, Melbourne University

* This work is being supported by NSERC, ARC

15h15 **Coffee Break / *Pause café***

MO-P5-3 **15h30**

ARIEL EDERY, Bishop's University

The Casimir piston in 3+1 dimensions *

A few years ago (2004), in a seminal paper, it was shown that nonrenormalizable surface divergences that can appear in Casimir calculations cancel out in a scenario called a Casimir piston. The idea is that the contributions to the surface divergence coming from the interior and exterior regions cancel out. This was shown for the case of a scalar field in two spatial dimensions confined to a rectangular geometry under Dirichlet boundary conditions. In this work, we consider the full three-dimensional Casimir piston for a scalar field under Dirichlet boundary conditions in a rectangular box. We show explicitly that all surface divergences cancel and that the Casimir force on the

piston is always negative (attractive) for any ratios of the lengths of the sides. This is in contrast to results where the surface divergence is simply thrown out as part of an unphysically motivated renormalization procedure.

* This work is being supported by NSERC

MO-P5-4 **16h00**

JOEL FELDMAN, University of British Columbia

A Rigorous Variant of the Standard: Many Boson Functional Integral †,*

Functional integrals have long been used, formally, to provide intuition about the behaviour of quantum field theories. For the past several decades, they have also been used, rigorously, in the construction and analysis of those theories. I will talk about a rigorous variant of the standard functional integral representation for the (cutoff) partition function of a many Boson system that provides a suitable starting point for its construction.

† In collaboration with Tadeusz Balaban [1], Horst Knoerrer [2], Eugene Trubowitz [2], [1] Rutgers University, [2] Swiss Federal Institute of Technology

* This work is being supported by NSERC

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

[MO-P6] Precision Frontier II / *Les limites de la précision II*

(PPD / *PPD*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 17h30

ROOM / SALLE Thor. 110 (90)

Chair: R.V. Kowalewski, University of Victoria

MO-P6-1 **14h15**

FRANCOIS CORRIVEAU, McGill University

Electroweak Results from ZEUS *

Electroweak results from e-p scattering at ZEUS using the final data set with polarised electrons will be presented, with comparisons to Standard Model predictions. HERA will be in the last month of data taking during the time of the CAP. A brief outlook for the physics potential of the latest data set using low energy protons will be presented.

* This work is being supported by NSERC

MO-P6-2 **14h45**

CARSTEN KRAUSS, Queen's University

News From The Final Phase Of The Sudbury Neutrino Observatory

The Sudbury Neutrino Observatory (SNO) has conclusively shown that solar neutrinos oscillate on their way from the core of the sun to the earth. This groundbreaking observation was made during the first two phases of the experiment. The third phase of SNO used 40 newly installed counters to enable a systematically independent check of the previous SNO measurements. This phase came to an end in November 2006. The new counters are gas filled Nickel tubes filled mainly with ^{3}He. They are used to measure the number of neutrons from solar neutral current neutrino interactions in the heavy water with high accuracy. SNO has developed several methods to tell neutron events apart from alpha background events. This ability is crucial for the analysis of the third phase data. We will present results from this analysis.

MO-P6-3 **15h15**

Neutron calibration of the PICASSO detector for the search of dark matter. **Martin Auger**, *Université de Montréal* — Superheated droplet detectors are employed by the PICASSO collaboration at SNOLAB to detect neutralino induced recoils. The detection energy threshold varies with temperature and pressure. The detection efficiency for neutralino induced recoil nuclei is obtained through calibration with mono-energetic neutrons produced at the tandem accelerator facility of the Université de Montréal. A systematic study as a function of neutron energy, temperature and pressure was made for several detector samples. Fitting the obtained data to quantitative models yields a response function for the detector. Recent results of this neutron calibration will be presented.

15h30 **Coffee Break / *Pause café***

MO-P6-4 **15h45**

CDF's Measurement of the W Boson Mass*. **William Trischuk** [1], Oliver Stelzer-Chilton [2], Ian Vollrath [3], [1] *University of Toronto*, [2] Oxford University, [3] Fincad, Vancouver — The CDF collaboration has just produced the world's best, single-experiment, measurement of the W boson mass: (80413 +/- 48) MeV/c^2. Significant improvements in the calibration of the CDF tracker and calorimeters coupled with an improved understanding of the production of W bosons have significantly reduced the systematic uncertainties on this measurement. When combined with the most recent results from the LEP experiments this result constrains the Standard Model Higgs boson to have a mass of less than 153 GeV/c^2.

* This work is being supported by NSERC

MO-P6-5 **16h00**

MAURICIO BARBI, University of Regina

Towards the International Linear Collider *

The International Linear electron-positron Collider (ILC) is the next large high energy physics experiment after the Large Hadron Collider (LHC). It is a multi-purpose project aiming at shedding light on our understanding of the Universe. The high precision aspect and energy of the ILC will eventually allow it to improve the accuracy and confirm several measurements and potential discoveries at the LHC. But, ILC is also a discovery machine where searches for supersymmetric particles, dark-matter among other exciting physics are expected to take place. In this talk, I will summarize some of the main objectives of ILC and update on the progress towards the construction of this experiment, highlighting activities where the ILC Canada group plays an important role.

* This work is being supported by NSERC/University of Regina

MO-P6-6 **16h30**

Search for Dark Matter in the stau-neutralino Coannihilation Region at 800 GeV ILC. **Blair Jasper** [1], Mauricio Barbi [1], Bhaskar Dutta [2], Teruki Khamon [2], Vadim Khotilovich [2], Nikolay Kolev [1], [1] *University of Regina*, [2] Texas A&M University — In this talk, I will discuss the supersymmetry signals in the dominant stau-neutralino co-annihilation region at 800 GeV ILC. This region is consistent with the WMAP measurement of the cold dark matter relic density as well as all other current experimental bounds within the minimal supergravity framework. The signals are characterized by an existence of very low-energy tau leptons in the final state due to small mass difference between the stau and neutralino (5-15 GeV). I will present the current results of a study on our ability to measure this mass difference at the ILC.

MO-P6-7 **16h45**

ROBERT MACDONALD, University of Alberta

Measurements of the Muon Decay Spectrum from TWIST †,*

The TWIST experiment at TRIUMF measures with high precision the momentum and decay angle of the positrons from muon decay. The Michel parameters rho, delta, and P_mu*xi, which describe the distribution of decay positrons in energy and angle, are measured by studying the shape of high-statistics decay spectra, and these parameters have implications on the form of the weak interaction. TWIST has made significant improvements on our knowledge of these parameters, and is well on its way to its ultimate goal of an order of magnitude improvement over pre-TWIST limits. The experiment will be described, and results of the most recent analysis will be presented, with a discussion of the substantially reduced statistical and systematic uncertainties.

† In collaboration with TWIST Collaboration

* This work is being supported by NSERC, NRC, and the US DOE.

MO-P6-8 **17h15**

Results of the GlueX BCal Hall-B(JLab) beam test. **Blake Leverington**, *University of Regina* — In the fall of 2006 a 4m prototype module for the GlueX Electromagnetic Barrel Calorimeter (BCal), constructed of layers of lead and scintillating fibers, was placed in the photon beam in Hall B at Jefferson Lab for the purposes of measuring the energy, position and timing resolutions of the calorimeter. Results of that beam test will be presented showing comparable and even slightly improved resolutions over that of the KLOE calorimeter which was constructed by similar design.

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

[MO-P7] Industrial and Applied Physics / *Physique industrielle et appliquée*

(DIAP / *DPIAP*)

MONDAY, JUNE 18
LUNDI 18 JUIN
14h15 - 17h00

ROOM / SALLE Phys. 127 (48)

Chair: G.A. Beer, University of Victoria

MO-P7-1 **14h15**

LORNE WHITEHEAD, University of British Columbia

A Cost-Effective Approach to Core Daylighting *

We have developed a new system for piping sunlight deep into buildings, in order to reduce electrical energy use. This system has one component for capturing sunlight and another for distributing it within the building. Conventional light fixtures are replaced with specially-designed light guides that transport sunlight and distribute it deep within the building and simultaneously serve as efficient fluorescent fixtures to supplement the daylight when necessary. This system is designed to be used, without customization, in the most common workplace environment - substantially open-plan, multi-storey office buildings. The system will provide excellent lighting at all times, and can be truly cost-effective by significantly reducing power consumption when the sun shines. This presentation will describe the optical and electromechanical system in further detail, with an emphasis on the novel geometrical and physical factors that enable high efficiency for this hybrid system.

* This work is being supported by NSERC/BC Hydro Power Smart

MO-P7-2 **14h45**

ANDRE MARZIALI, University of British Columbia

Physics for CSI: Two dimensional non-linear electrophoresis for DNA extraction in forensics applications

Detection and purification of nucleic acids from complex and dilute samples remains a challenging task for many applications, including low-level pathogen detection, extraction of DNA from unculturable organisms in environmental samples, and forensic DNA analysis. We have developed a prototype instrument based on a non-linear molecular response to electric fields, for efficiently purifying and concentrating even very low levels of nucleic acids from complex samples where the majority of existing isolation techniques fail. This instrument uses a novel form of two-dimensional nonlinear electrophoresis to recover DNA or RNA from as low as zeptomolar concentrations. Virtually any fluid sample containing nucleic acids of interest, including fabrics or soil (without requiring any filtration to remove debris or particulates), can be placed in a loading chamber for concentration. Nucleic acids are then electrophoretically injected into a concentration medium, and time varying electric fields are applied using a novel method termed SCODA (Synchronous Coefficient of Drag Alteration) so that nucleic acids migrate towards a common focus location. Since this method acts only on molecules with highly nonlinear electrophoretic response, it preferentially concentrates nucleic acids over other organic and inorganic molecules including contaminants and salts. We demonstrate applications of this novel technology to extraction of DNA from low abundance or highly contaminated forensic samples.

15h30 **Coffee Break / *Pause café***

MO-P7-3 **15h45**

Development of Neutron-based Explosives Detection Technologies*. **Anthony Faust** [1], John McFee [1], Harry Ing [2], Robert Andrews [2], [1] *Defence R&D Canada*, [2] Bubble Technology Industries Inc. — Defence R&D Canada (DRDC) is the Department of National Defence's in-house R&D agency responsible for, among many other things, research and development of detection technologies addressing the broad threat of bulk explosives, with landmines and Improvised Explosive Devices (IEDs) of primary concern. Although a number of techniques for the detection of hidden explosives have been proposed over the years, penetrating radiation-based methods have often received the most promising reviews. Of these, neutron activation analysis methods provide a bulk material characterization capability, or finger-printing, based on the elemental-specific gamma rays emitted from Fast and Thermal inelastic neutron interactions. DRDC and Bubble Technology Ind. Have been developing neutron-based explo-

sives detection technologies since 1995. In this presentation we will discuss the development of the Canadian Force's (CF) Thermal Neutron Activation (TNA) anti-tank landmine detection system. More recent system improvements, including the evaluation of modern inorganic scintillators for faster detection times and the inclusion of a pulsed D-T neutron generator, provide the opportunity to include a Fast Neutron Analysis (FNA) capability to the next generation TNA. Previous assessment of FNA for landmine detection showed limited promise because of the enormous impact of the soil-induced backgrounds, which tends to mask the desired reactions in the explosive. However, calculations indicated that FNA might be an extremely powerful method to detect Vehicle-Borne IEDs (VBIEDs).

* This work is being supported by Defence R&D Canada

MO-P7-4 **16h15**

Governmental Catalysis for Industry-Academia Collaboration in Canada. **Mohammad Reza Shadnam**, *KPMG LLP* — Industry-Academia collaboration not only helps creation of economic value from research knowledge but also it can provide academia with a stream of scientific and technological problems and challenges. Canadian government provides significant financial support for R&D activities through the tax system; the support program is called Scientific Research & Experimental Development (SR&ED). The objective of the talk would be (1) to review basic concepts behind the federal and provincial incentive programs; (2) to discuss issues that arise during SR&ED technical audits with the scientific community; and (3) to explain qualifying projects and activities so that past and future SR&ED eligible project and activities can be identified. The SR&ED program will be introduced through reviewing the basics of the funding mechanism, benefits and program statistics. The SR&ED process and qualification criteria will also be reviewed. The SR&ED program covers industry funded industry-academia partnerships that satisfy eligibility criteria. Different types of eligible industry-academia partnership and the level of governmental support as well as advantages and disadvantages of each will be discussed. It will be emphasized that even unsuccessful trails for solving basic or applied problems are covered in the SR&ED program.

MO-P7-5 **16h45**

Predicted Noise Reduction from Asphalt Rubber Concrete in Urban Streets Using a Diffusion Theory Model*. **Graeme Drysdale**, Liming Dai, *Industrial Systems Engineering, University of Regina* — Asphalt rubber concrete, a porous pavement composed of recycled rubber tires, has been proven to reduce traffic noise on highways. Research is now shifting to urban environments where traffic noise is absorbed and reflected by pavement, buildings and obstacles. The steady state sound pressure levels of an impulsive noise source over conventional and asphalt rubber concrete pavements can be predicted using diffusion theory. A well established theoretical model is applied to account for porous pavement which absorbs sound and exhibits a reduction in sound pressure levels. The frequency dependent sound absorption coefficients are obtained using the impedance tube method and applied to the model's boundary conditions. The theoretical values can be used to predict the noise reduction benefits from the presence of sound absorbing material before resurfacing existing pavement.

* This work is being supported by Communities of Tomorrow

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

[MO-P8] Atmospheric Processes of Climate Change II / *Processus atmosphériques et changements climatiques II*

(DASP / *DPAE*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 16h30

ROOM / SALLE Phys. 126 (48)

Chair: E.J. Llewellyn, University of Saskatchewan

MO-P8-1 **14h15**

WILLIAM WARD, University of New Brunswick

Understanding the Role of the Middle Atmosphere: Canadian Contributions *

In the 50 years since rocket soundings established the temperature structure of the middle atmosphere and sounded the death knell for the resonance theory of tides, much has been learnt about the structure and dynamics of the middle atmosphere. The large scale zonal mean structure of this region of the atmosphere, the large scale spatial distribution and seasonal behaviour of the minor constituents and the amplitude and phase structure of the migrating diurnal tide and planetary waves have now been well established. General circulation models, such as the Canadian Middle Atmosphere Model, are now able to simulate these features with reasonable accuracy with a minimum of tuning of a few parameterizations. At the same time, this understanding remains without a full experimental confirmation. The complexity of the tidal structures are only starting to be appreciated and the spatial/temporal distribution and source characteristics of the gravity waves thought to drive much of the large scale meridional motion remain partially resolved. Furthermore, how this region of the atmosphere accommodates the energy and momentum propagating upward from the troposphere and downward from the ionosphere and thermosphere remains poorly understood. Canadian scientists have made significant contributions to our understanding of this region. Satellites such as WINDII, OSIRIS, and SciSat have all provided unique data sets on various aspects of the middle atmosphere. Radars, lidars and ground based optical instruments have also played a role in developing our understanding. Further advances require coordination between these various observing techniques and approaches, and modelling and data assimilation. The Canadian community is already playing a role in the development of this new approach as can been seen from initiatives such as CANDAC/PEARL, the CAWSES projects, the CMAM-FDAM effort, Chinook and the thrust of the Atmospheric Processes of Climate Change Mission.

* This work is being supported by CSA, NSERC

MO-P8-2 **15h00**

Semidiurnal tides from the Extended Canadian Middle Atmosphere Model (CMAM) and comparisons with TIMED Doppler Interferometer (TIDI) and meteor radar observations. **Jian Du** [1], William E. Ward [1], Jens Oberheide [2], Takuji Nakamura [3], [1] *Physics department, University of New Brunswick*, [2] Physics Department, University of Wuppertal, [3] Radio Science Center for Space and Atmosphere, Kyoto University — The Extended Canadian Middle Atmosphere Model (extended CMAM) is a general circulation model which extends from the surface to about 210 km. This high upper boundary allows dynamical processes to be studied from the ground to the lower thermosphere without the influence of sponge layers, which are often inserted in the mesosphere. The extended CMAM includes realistic tidal forcing due to radiative heating, convective adjustment and latent heat release and uses the gravity wave breaking parameterization of Hines. In this paper, spatial complex spectral analysis is applied to horizontal winds simulated by the extended CMAM to obtain semidiurnal tidal amplitudes and phases (from e5 to w5) in the mesosphere and lower thermosphere (MLT) region. The dominant w2 migrating component and the presence of nonmigrating tides (w3, e1, e2) in the mid-latitudes are identified. The migrating semidiurnal tide (w2) has amplitudes reaching 20 m/s for both zonal and meridional winds in mid-latitude region. The amplitudes of non-migrating semidiurnal tides are also non-negligible compared to the migrating semidiurnal tides, the amplitudes for w3 exceeds 12 m/s and e2 reaches 8 m/s. Comparisons are made with the TIMED Doppler Interferometer (TIDI) wind measurements, which are analyzed to obtain 6 nonmigrating tidal components (w4, w3, w1, s0, e1, e2) between 85 km and 105 km altitude and between 45°S and 45°N latitude. Overall, the modeled semidiurnal components agree very well with TIDI observations. The 11 semidiurnal components from the model are then superimposed to get the total semidiurnal winds which are compared to two equatorial MWR radar stations (Jakarta and Kototabang). The comparisons between CMAM and two radar stations show that the amplitudes and phases have generally good agreement for semidiurnal tide, with Jakarta station agreeing much better than Kototabang station.

MO-P8-3 **15h15**

Diurnal Variations of the MLT Horizontal Winds Observed by WINDII/UARS and Simulated by CMAM*. **Ding Yi Wang**, William Ward, Jian Du, Aaron Power, *University of New Brunswick* — The global temperature, density and wind fields induced by the daily cyclic absorption of solar energy in an atmosphere are referred to as solar thermal tides. The global experimental observations of the tides were not possible until the advent of satellite measurements at altitudes where the tidal signal is sufficiently large in comparison to other sources of atmospheric variability. This talk explores the solar diurnal tides in the MLT (mesosphere and lower thermosphere) region of 90-110 km by using the WINDII/UARS horizontal wind measurements taken during November 1991 through May 1997, and compares the observational results with the simulations of the extended Canadian Middle Atmosphere Model (CMAM). In addition to the well-known westward propagating migrating tide with zonal wave number s=1 (W1), our analysis also revealed the most prominent non-migrating diurnal tidal components in the MLT region: the eastward propagating diurnal tide with the wave number s=3 (E3), the standing diurnal oscillation with s=0 (D0), and the westward propagating diurnal tide with s=2 (W2). The combination of E3, D0, and W2 with W1 gives rise to significant longitude variations in the diurnal tide between 40S and 40N latitude. The global characteristics of these wave modes and their seasonal variabilities, as well as consistencies and differences between the WINDII observations and CMAM simulations are discussed in detail.

* This work is being supported by CSA, NSERC, CFCAS

MO-P8-4 **15h30**

Polar Vortex Evolution during Northern Hemispheric Winter 2004/05*. **Tatyana Chshyolkova**, Alan Manson, Chris Meek, *Institute of Space and Atmospheric Studies, University of Saskatchewan* — As a part of the project "Atmospheric Wave Influences upon the Winter Polar Vortices (0-100 km)" of the CAWSES program, data from meteor and Medium Frequency radars at 12 locations and MetO (UK Meteorological Office) global assimilated fields have been analyzed for the first campaign during the Northern Hemispheric winter of 2004/05. The stratospheric state has been described using the conventional zonal mean parameters as well as Q-diagnostic, which allows consideration of the longitudinal variability. The stratosphere was cold during winter of 2004/05, and the polar vortex was relatively strong during most of the winter with relatively weak disturbances occurring at the end of December and the end of January. For this winter the strongest deformation with the splitting of the polar vortex in the lower stratosphere was observed at the end of February. Here the results show strong latitudinal and longitudinal differences that are evident in the stratospheric and mesospheric data sets at different stations. Eastward winds are weaker and oscillations with planetary wave periods have smaller amplitudes at more poleward stations. Accordingly, the occurrence, time and magnitude of the observed reversal of the zonal mesospheric winds associated with stratospheric disturbances depend on the local stratospheric conditions. In general, compared to previous years, the winter of 2004/05 could be characterized by weak planetary wave activity at stratospheric and mesospheric heights.

* This work is being supported by NSERC, CANDAC-PEARL, U of Sask

MO-P8-5 **16h00**

Solar Tides at Arctic Polar Latitudes: PEARL, Eureka and Svalbard*. **Alan Manson** [1], Chris Meek [1], Tatyana Chshyolkova [1], Chris Hall [2], [1] *ISAS, University of Saskatchewan*, [2] University of Tromso — Winds from the mesopause region have now been analyzed for 12 months, Feb 2006-Jan 2007. Spectral and harmonic analyses have been used to obtain the amplitudes and phases of the solar tides (24-, 12-, 8-hrs) for each of the months and at heights of 80-100km. There are many surprises; in particular the amplitudes of the 12- and 24-hr tides are larger than expected, based upon the strong decrease in amplitudes of the winds with latitude for the Hough modes of the solar migrating tides. Similar tides occur at Svalbard, 78N, according to the similar VHF radar there. The 12-hr tide is actually quite intermittent at Eureka, and its side-lobes/bandwidths are remarkably large. The temporal correlation between the tides measured at the 52N radar (Saskatoon) and Eureka are interesting: bursts of larger tidal amplitudes often occur coincidentally, while at other times bursts occur at Saskatoon or Eureka. It is likely that the 80N tides are dominated by non solar-migrating tides, whose horizontal phase velocities are different from the migration of the solar-heating footprint over the earth. Longitudinal variations in the atmosphere, often neglected in discussion or theory, are clearly substantial.

* This work is being supported by NSERC, Canada

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

[MO-P9] History of Physics in Canada - invited / *Histoire de la physique au Canada - communications invités*

(DHP / *DHP*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 17h00

ROOM / SALLE Thor. 159 (80)

Chair: A. Griffin, University of Toronto

MO-P9-1 **14h15**

J. DAVID JACKSON, University of California Berkeley

Phil Wallace and theoretical physics at McGill in the 1950s: a personal perspective

The idea of theoretical physicists as legitimate members of a physics department was slow in coming to Canada. In the eastern part of the country, Phil Wallace, who came to McGill as an Associate Professor of Mathematical Physics in the Mathematics Department in 1946, led the way to make theoretical physics distinct from applied mathematics and an essential sub-field for a physics department aspiring to broad excellence in its subject. In the beginning it was not thus; only 16 years later, in 1962, did Phil and his group of young theorists transfer from Mathematics to Physics. I was part of the beginning years. I present a personal and anecdotal account of theoretical physics at McGill in the 1950s under Phil Wallace's leadership.

MO-P9-2 **14h45**

BÉLA JOÓS, University of Ottawa

Philip Wallace, Educator and Pioneer of the Canadian Theoretical Physics Community

Philip Russell Wallace, as a Professor of Physics at McGill University, made a huge impact on the training of theoretical physicists in the decades following the Second World War. He founded CAP's Division of Theoretical Physics, and McGill's Institute of Theoretical Physics, two initiatives which exemplify his leadership role. I will talk about his evolving role as a mentor and supervisor over the decades, focusing more on the later years, which, as Wallace's last graduate student, I am more familiar with.

15h15 **Coffee Break / *Pause café***

MO-P9-3 **15h30**

JOHN RIGDEN, American Physical Society

Physics History in Bronze

A few years ago, the American Physical Society launched the Historic Sites initiative whose purpose is to bring the history of physics in the USA into the public consciousness. Eleven sites/individuals have been selected by the Committee made up of well-known physicists who have an interest in the history of physics in America. These include the Michelson-Morley experiment in Cleveland, Henry Rowland's lab in Baltimore, Willard Gibbs at Yale, and Benjamin Franklin in Philadelphia. Several new sites including Research Institutions have been nominated. Bronze plaques are unveiled at recipient institutions in a public ceremony organized to reach the wider community beyond physicists. Current members of the Historic Sites Committee include Gordon Baym, Katharine Gebbie, Gerald Holton, and Steven Weinberg.

MO-P9-4 **16h00**

WILLIAM ROSS FRISKEN, York University

The History of the Institute of Particle Physics: Linking Small Groups to do Big Physics

In the early 1960s, experimental particle physics in Canada was an idea whose time had not yet come, yet by the early 1970s the Institute of Particle Physics (IPP) of Canada had been funded by NRC and was playing an active role. Professors from normally competitive universities had come to understand that it was in their best interest to collaborate, helping everyone to be a part of this rapidly growing field. IPP records, plus interviews with the principal players, from this beginning through the following 40 years show the activities of IPP members as evolving from the "suitcase physics" of the 1970s to the current strong presence of Canadian groups in residence, comprising graduate students, post docs and professors, at international particle physics laboratories around the world. As IPP grew, the efforts of its members helped change attitudes at NRC, assisted in the birthing and early development of NSERC, and established the idea of collaborative research in Canada. Progress towards archiving the history of IPP will be reviewed.

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

[MO-P10] Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling II / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace II*

(DASP / *DPAE*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 17h00

ROOM / SALLE Phys. 103 (145)

Chair: J-P. St-Maurice, University of Saskatchewan

MO-P10-1 **14h15**

CHRISTOS HALDOUPIS, Physics Department, University of Crete, Greece

An overview of mid-latitude sporadic E layers

The mid-latitude sporadic E layers, E_s, are dense layers of metallic ions which form in the lower thermosphere between 90 and 130 km. There is mounting evidence suggesting that E_s is the effect of a deterministic rather than a sporadic process, which involves regular wind shear plasma convergence and downward transport in the context of the global system of thermospheric tides. In addition, planetary waves are involved on E_s generation as well, a fact that went unnoticed for many years. Also, gravity waves with periods down to the Brunt-Vaisala period of 5 minutes must also play a role on E_s formation. The gravity waves, however, alter the regular tidal forcing of E_s and thus are likely accountable for the sporadic character of the layers. Furthermore, in recent years plenty of work is done on mid-latitude coherent radar backscatter which occurs in connection with destabilized sporadic E layer plasmas. These studies led to several new results, *e.g.*, the unexpected detection of Farley - Buneman waves, which implied the presence at times of electric fields at least an order of magnitude larger than typical dynamo electric fields at mid-latitude. These recent studies enhanced our knowledge on sporadic E but also revealed the presence of more physical processes operating at different scales that need to be understood. The present survey does not purport to give a complete account of the entire work done on this topic, but aims rather at presenting a synthesis of recent findings that offer a better physical understanding.

MO-P10-2 **14h45**

Suprathermal Particle Distributions in Space Physics: Kappa Distributions and Nonextensive Entropy*. **Bernard Shizgal**, *University of British Columbia* — The energization by wave-particle interactions of a charged test-particle of mass m in contact with a large excess of another charged particle system of mass M at equilibrium is studied with the Fokker-Planck equation for Coulomb collisions and a quasi-linear wave-particle diffusion operator. The distribution function is assumed to be isotropic and local. The variation of the features of the steady state nonthermal velocity distribution of the test-particle system is discussed versus the mass ratio m/M and the velocity dependence of the wave-particle diffusion operator. The relative strength of the diffusion operator for wave-particle interactions and the Coulomb collision operator also determines the extent of the departure from Maxwellian. It is shown that the steady distribution function can deviate from a Kappa distribution that is often used to fit observed energetic particle distributions. With the time dependent solutions of the Fokker-Planck equation, it is also demonstrated that the approach based on nonextensive entropy is not applicable. The time evolution of the distribution function with and without the energization by wave-particle interactions can be explained in terms of the Kullback relative entropy. It is also shown that for minor ions in the solar wind, the model predicts a greater than linear variation of the ion temperature with the mass ratio m/M.

* This work is being supported by NSERC

MO-P10-3 **15h00**

Characterizing the Imprint of the Ionospheric Alfvén Resonator on Ground Magnetometer Data. **Adrienne Parent**, Ian Mann, *University of Alberta* — It has been known since 1985 (Belyaev et al., 1987) that amplified harmonic bands in the dynamic power spectrograms of 0.1 to 10 Hz ground magnetometer data indicate the natural formation of a resonant cavity, called the Ionospheric Alfvén Resonator (IAR), in the local ionosphere above the observation point. Due to the nature of the plasma density profile in the upper ionosphere, two boundary regions of large Alfvén velocity gradients can arise, causing the partial reflection of shear Alfvén waves and the consequent establishment of a vertical standing wave resonance within the cavity. This excitation of the IAR has been documented over the years in studies that have primarily focused upon magnetic signatures occurring at a single site. At present, we report quantified observations of magnetic signatures of the IAR as they occur over a number of stations spread in L-shell and magnetic local time. In addition, the relationship between local IAR resonance bands and ionospheric parameters, in particular, the F2 region electron number density peak, is considered. Observations are compared to a basic model of the IAR, in order to infer characteristics of the resonant cavity and hence properties of the plasma structure in the upper ionosphere. Ultimately, the study of ground signatures of the Alfvén resonator are carried out in order to learn more about how signatures relate to topside ionospheric structure, for diagnostic purposes.

MO-P10-4 **15h15**

ABDELHAQ M. HAMZA, University of New Brunswick

Space Plasma Turbulence: Revisited *

In this talk a brief but concise review of some of the conventional approaches to neutral and plasma turbulence will be discussed through specific examples from the field of space plasma physics. A great emphasis will be placed on nonlinear instability mechanisms as well as on the development of nonlinear plasma structures and their impact on transport properties. A statistical approach used to characterize turbulence will also be discussed, and an attempt to quantify intermittency in space plasma turbulence will be presented. If time allows, a brief introduction to non-perturbative approaches to turbulence will be exposed.

* This work is being supported by NSERC

MO-P10-5 **15h45**

Excitation mechanism of extraordinary bright E-region radiowave-induced airglow observed above HAARP at 557.7 nm on 10 March 2004*. **Ludmila Kagan** [1], John MacDougall [1], Michael Kelley [2], [1] *University of Western Ontario*, [2] Cornell University, USA — Extremely bright 4-kR radiowave-induced airglow was observed between natural auroral bands in the green line of atomic oxygen on 10 March 2004 [1]. Artificial green aurora, a relatively recent discovery [2,3], is associated with E-region sporadic ionization and has been previously observed at midlatitudes where its highest intensity reached about 100 R. The E-region artificial aurora is due to excitation of O(1S) by energetic electrons resulting from nonlinear interactions of transmitted radiowaves with ionospheric plasma. Analyzing the ionograms before and during this event, we find that in addition to the cusp-type E layer produced by precipitation, and looking similar to the day-time E region, the HAARP digisonde showed a 10-15-km thick cloud of sporadic ionization between old and new auroral bands that mimics the so-called height-spread Es routinely observed in the polar cap during winter months [4], but not very often seen at the HAARP latitude. We think that this height-spread Es is the key to the mystery of this uniquely bright artificial aurora. Being much thicker than the 0.5-2 km mid-latitude Es, the overdense height-spread Es would result in a much stronger electric field near the reflection level. Therefore according to [3] the artificial aurora spots were the footprints of sporadic ionization clouds comprising the height-spread Es. References: [1] Pedersen & Gerken, *Nature*, 433(3/2/2005), 498, 2005; [2] Djuth *et al.*, *Geophys. Res. Lett.*, **26**, 1557-1560, 1999; [3] Kagan *et al.*, *Phys. Rev. Lett.*, **85**, 218, 2000; [4] MacDougall *et al.*, JASTP, 1155-1167, 2001.

* This work is being supported by CSA for ePOP/CASSIOPE & NSERC

MO-P10-6 **16h00**

Electron cyclotron waves observed on a sounding rocket. **Gordon James** [1], Donald Wallis [2], [1] *Communications Research Centre*, [2] Magnametrics — OEDIPUS-C (OC) was a two-point, active propagation experiment launched into the auroral ionosphere. The double payload included, on one end, a transmitter HEX that emitted rectangular 300-microsecond pulses whose carrier frequency was swept from 0.025 to 8 MHz in steps of 50 kHz on successive pulses. On the other end of the tethered payload, a receiver REX had an identical stepped sweep synchronized with that of the HEX. The antennas were double-V dipoles whose elements stayed perpendicular to the sub-payload separation vector, which was aligned along the direction of the Earth's magnetic field. The REX was at a lower altitude than the HEX. This geometry permitted an examination of electron cyclotron waves (ECW) that, when launched by monostatic sounders, are observed to reflect at distances of the order of 100 m below the sounder. During a 150-s period early in the OC flight upleg, dispersed pulses were detected by the REX at harmonics nf_c of the electron gyrofrequency f_c. The harmonic numbers observed were n = 2, 3 and 4, with f_c decreasing smoothly from 1.32 to 1.17 MHz. The received pulses were stretched with respect to the emitted 300-microsecond pulses by factors that varied from 2 upwards. The plasma frequency was scaled from characteristic frequencies in the REX data, while f_c was provided by an on-board magnetometer. The dispersion relation and ray optics of ECW have been investigated in the search for a model that accounts for the principal time- and frequency-domain characteristics of the observed pulses.

MO-P10-7 **16h15**

Ion Flow Measurements from the JOULE and JOULE II Sounding Rocket Missions*. **Laureline Sangalli** [1], David Knudsen [1], Miguel Larsen [2], Robert Pfaff [3], James Clemmons [4], Douglas Rowland [3], Lynette Gelinas [4], Johnathan Burchill [5], [1] *Dept of Physics and Astronomy, University of Calgary, Calgary, AB*, [2] Clemson University, Clemson, SC, [3] NASA, Goddard Spaceflight Centre, Greenbelt, MD, [4] The Aerospace Corporation, Los Angeles, CA, [5] Natural Resources Canada, Geomagnetic Laboratory, Ottawa, ON — The JOULE and JOULE II sounding rocket missions were designed to investigate (frictional) Joule dissipation in the auroral ionosphere on spatial scales much smaller (8 m) than can be resolved by ground-based radars. JOULE was launched by NASA on March 27, 2003 from Poker Flat, Alaska during an auroral substorm. The mission included two rockets instrumented to measure ionospheric parameters (charged particles and electric and magnetic fields), and two chemical releases (TMA) for tracing neutral wind flows. One instrumented payload carried a Suprathermal Ion Imager (SII) developed at University of Calgary. The SII measured 2-D (energy/angle) distributions of core (0-8 eV) ion populations in the lower ionopshere at a rate of 125 per second. From these distributions we derive one ion velocity components perpendicular and parallel to the magnetic field. We present results showing good agreement between these and plasma drifts inferred from an electric field (ExB) measurement, with signs of ion demagnetization as the payload descended into the upper E region (120 - 130 km). Also, the SII detected evidence of downward field-aligned ion flows and ion temperature enhancements at altitudes of 140 - 170 km inside an auroral arc. JOULE II was launched on January 19, 2007 from Poker Flat. It also consisted of four rockets, and benefited from the addition of the newly-operational AMISR incoherent scatter radar. This time, one of the JOULE-II payloads carried an SII oriented to measure both components of the ion drift velocity perpendicular to the magnetic field at 8-m resolution, which can be used as a direct measure of structured Joule heating. We will present preliminary results from that instrument and from the JOULE II mission in general.

* This work is being supported by NSERC, CSA

MO-P10-8 **16h30**

How Ionospheric Electrodynamics Affect Low-Earth-Orbiting Satellites (LEOS)*. **Jean-Marc Noel**, Albert Russell, Stefan Thorsteinson, Douglas Burrell, *Royal Military College of Canada* — A number of diverse and independent observations have shown the existence of extremely narrow structures in the auroral ionophere. By narrow, we mean structures that have widths of a few meters (ultra-thin arcs) up to widths of a few tens of meters (thin arcs). Observations using radars, satellites and rockets have pointed to the existence of very intense and highly localized electrodynamics in the vicinity of narrow auroral structures. Closure of FAC currents in the high latitude ionosphere can substantially alter the composition and energetics of the thermosphere resulting in significant changes in the drag that is felt by low-earth orbiting satellite (LEOS). In this talk we will set out to explore the conditions under which the ionosphere can sustain such large currents and how the ionospheric electrodynamics will affect orbiting satellites.

* This work is being supported by NSERC/ARP

MO-P10-9 **16h45**

Auroral ion velocity distributions in inhomogeneous cylindrical electric field geometries*. **John Zhen Guo Ma**, Jean-Pierre St.-Maurice, *University of Saskatchewan* — It is by now well understood that the sudden introduction of a large homogeneous auroral electric field in the ionosphere gives rise to a shifting and pulsating type of distribution in the collisionless case, to a toroidal distribution in the presence of collisions in the strongly magnetized case, and to "bean-shape" distributions in a collisional, weakly-magnetized situation. However, when very strong electric fields are observed in the auroral regions, they tend to be localized, which brings into question the assumption of homogeneity in velocity distribution calculations under strong electric field conditions. In the present work, we take a first step in relaxing the homogeneous assumption

by introducing an electric field that increases linearly in a cylindrical geometry. We consider both the collision-free (or short time scale response) and the collisional situations and show that the collision-free solution is still a pulsating Maxwellian, albeit one for which the temperature oscillates and for which the mean drift oscillates unevenly about the mean ExB drift. In the collisional and strongly magnetized case the strong electric field solutions introduce horseshoe-like distributions in velocity space. In future work we shall report on more general electric field configurations for which the solutions will have to be obtained by more numerical means.

* This work is being supported by NSERC

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

[MO-P11] Instrumentation at CLS (contributed) / *Instrumentation au CCRS (contribués)*

(DIMP / *DPIM*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 15h30

ROOM / SALLE Phys. 130 (70)

Chair: K.H. Michaelian, CANMET, Natural Resources Canada

MO-P11-1 **14h15**

Radiation shielding considrations against gas bremsstarhlung for a photon shutter and collimator unit of the VESPERS beamline at the CLS*. **Juhachi Asai**, Renfei Feng, *Canadian Light Source* — A radiation shielding study against primary and secondary gas bremsstrahlung for a tungsten collimator/stop is carried out, which is one of the components employed in the VESPERS beamline at the Canadian Light Source. The dose and dose rate are obtained by calculating the energy deposition in a water phantom which surrounds the collimator/stop unit. The dose rate behind a vacuum hole of the collimator/stop which leads to the experimental hutch is closely examined. Also examined are the dose rates when a tungsten photon shutter, which is positioned in front of the collimator/stop, is actuated.

* This work is being supported by CFI, NSERC, NRC

MO-P11-2 **14h30**

Design of a Soft X-Ray Emission Spectrometer for the REIXS Beamline at the CLS*. **David Muir** [1], Mark Boots [1], Mikhail Yablonskikh [1], Alexander Moewes [1], David Loken [2], [1] *University of Saskatchewan*, [2] Loken Engineering — Our group has completed the optical design of a soft x-ray (50-1100 eV) emission spectrometer for the Resonant Elastic and Inelastic X-Ray Scattering (REIXS) beamline at the CLS. Techniques and software tools were developed using ray-tracing and diffraction grating efficiency calculations to analyze and compare existing designs and to propose a new design with superior performance. This design employs Rowland circle geometry to achieve a resolving power in excess of 2,500 in our range of interest. In addition, a novel design for a larger extreme resolution spectrometer has been proposed providing resolving powers exceeding 10,000 throughout the higher end of the spectrum. The results of this analysis, the design constraints and resulting specifications, as well as the current status of the mechanical design and implementation, will be presented.

* This work is being supported by NSERC and CRC

14h45 **Coffee Break / *Pause café***

MO-P11-3 **15h00**

Mid Infrared Spectromicroscopy Beamline at the Canadian Light Source*. **Tim May** [1], Kirk Michaelian [2], Luca Quaroni [1], Thomas Ellis [1], [1] *Canadian Light Source*, [2] CANMET Energy Technology Centre, NRCan — A mid infrared (IR) beamline is in the commissioning phase of operation at the Canadian Light Source. It will be a user facility in areas of biological and materials science using diffraction limited IR spectromicroscopy. The beamline obtained first light in 2005 and beam transport to the spectrometer in 2006. The source is bending dipole magnet radiation from a special port on the ring vacuum. The beamline transports mid IR radiation (spanning 2.5 to 25 micron wavelengths) to a Bruker Optics IFS66vs FTIR spectrometer with a Hyperion microscope. The beamline instrumentation, performance and status of the facility are discussed.

* This work is being supported by NSERC, NRC, CIHR

MO-P11-4 **15h15**

Commissioning experiments in photoacoustic infrared spectroscopy at the Canadian Light Source. **Kirk H. Michaelian** [1], Tim E. May [2], Craig Hyett [2], [1] *CANMET, Natural Resources Canada*, [2] Canadian Light Source — The use of synchrotron radiation (SR) as a source in the measurement of photoacoustic (PA) infrared spectra of solids at the Canadian Light Source (CLS) is discussed in this presentation. PA spectroscopy is currently under development on the mid-infrared beamline at CLS, providing means for the characterization of industrial samples that are not amenable to traditional infrared methods. Aperture tests showed an exponential relationship between beam diameter and the wavenumber where PA spectra obtained using SR and thermal sources intersect. Intensity increased exponentially with aperture size using either source, with SR PA intensity attaining its maximal value more quickly. Estimates for the beam size of the SR in the spectrometer were derived from these tests. Signal averaging experiments revealed low-frequency SR noise features with intensities that depend on the method by which the average spectra are calculated. In most cases, the spectra calculated from the average of a series of interferograms are superior to those obtained by averaging the corresponding individual spectra.

15h30 **Session Ends / *Fin de la session***

[MO-P12] Soft Matter I / *Matière molle I*

(DCMMP / *DPMCM*)

MONDAY, JUNE 18
LUNDI, 18 JUIN
14h15 - 16h45

ROOM / SALLE Biol. 125 (70)

Chair: J. Forrest, University of Waterloo

MO-P12-1 **14h15**

STEPHEN MORRIS, University of Toronto

Some new rope tricks †

Some new rope tricks. A thread of viscous fluid, like honey, falling onto a surface undergoes a buckling instability known to science as the "rope coiling effect". The thread spontaneously wraps itself into helical loops before the fluid settles onto the surface. This effect, first analyzed by G.I. Taylor, depends entirely on the Newtonian

fluid properties and has a rich phenomenology as a function of the nozzle height. A recent generalization, known as the "fluid mechanical sewing machine" [1] replaces the surface with a moving belt. The belt breaks the rotational symmetry of the rope coiling, leading to an astonishing zoo of states as a function of the belt speed and nozzle height. We will tour this zoo, before focussing on the first bifurcation between the stretched thread and simple meandering. Recent theory gives a quantitative picture of this instability. Finally, we will discuss some new rope tricks that can be accomplished by rotating the nozzle. [1] S. Chiu-Webster and J. Lister, J. Fluid Mech., vol. 569, p. 89-111 (2006).

† In collaboration with Jon Dawes [1], John Lister [1], Stuart Dalziel [1], Neil Ribe [2], [1] DAMTP, Cambridge, [2] IPGP, Paris

MO-P12-2 14h45

Putting a spin on colloids: dynamic self-assembly of magnetic patterns*. **Anand Yethiraj** [1], Cristina Arcos-Martinez [2], Wenceslao Gonzalez-Vinas [2], Rafael Sirera [2], Kristin Poduska [1], [1] *Memorial University of Newfoundland*, [2] Universidad de Navarra — Hard sphere packings of colloids give close-packed crystal structures, but controlling the crystal orientation and domain size are often challenging, painfully slow, or show poor reproducibility. We report the combination of two cheap and robust techniques toward making patterned magnetic materials. We spin-coat colloidal crystals (in a matter of seconds), and electrodeposit magnetic materials through the colloidal template (in a matter of minutes). A combination of video photography, optical, scanning electron and atomic force microscopy, and visible-infrared spectroscopy is used to characterize the colloidal crystal, as well as its domain size, crystal thickness and magnetic properties.

* This work is being supported by NSERC

MO-P12-3 15h00

Phase statistics and correlations of multiply scattered ultrasonic waves in dynamic mesoscopic systems*. **Kurt Hildebrand** [1], Michael Cowan [1], Tomohisa Norisuye [1], Anatoliy Strybulveych [1], Domitille Anache-Ménier [2], Bart van Tiggelen [2], John Page [1], [1] *University of Manitoba*, [2] Université Joseph Fourier — In weakly scattering materials, imaging motion by measuring the change in phase of reflected ultrasonic waves forms the basis of the well-known technique of Doppler ultrasound. In strongly scattering media, these methods break down, motivating the development of the technique of diffusing acoustic wave spectroscopy (DAWS) [1]. To extend this DAWS technique, the temporal fluctuations in the phase of ultrasonic waves transmitted through time-varying mesoscopic samples have been measured, enabling the use of phase information to investigate the dynamics of multiply scattering media. We have compared statistics and correlations of the phase and phase derivatives with time to detailed theoretical predictions based on circular Gaussian (C1) statistics [2]. Excellent agreement is found. The cumulative phase is found to undergo a Brownian type process, described by a "phase diffusion coefficient". A fundamental relationship between the variance in the phase of the transmitted waves and the fluctuations in the phase of individual scattering paths is predicted theoretically and verified experimentally. This relationship not only gives deeper insight into the physics of the phase of multiply scattered waves, but also provides a new, mesoscopic way of probing the motion of the scatterers in the sample. Referrences: [1] Cowan *et al.*, (currently at the University of Toronto) *Phys. Rev. Lett.* **85**, 453 (2000). [2] Genack *et al.*, (currently at Kyoto Institute of Technology) *Phys. Rev. Lett.* **82**, 412 (1999).

* This work is being supported by NSERC

MO-P12-4 15h15

Localization of sound in a disordered three-dimensional system*. **John Page**, Hefei Hu, *University of Manitoba* — We report signatures of the Anderson localization of ultrasonic waves in a disordered three-dimensional network of aluminum beads. In the upper part of the intermediate frequency regime, where the wavelength is comparable with the sizes of the pores and beads, the intensity distribution of the speckle patterns shows clear departures from Rayleigh statistics, with a variance that increases with frequency. This intensity distribution can be fitted with a stretched exponential, consistent with recent predictions for localization [1]. In this frequency range, the time-of-flight profile of the intensity exhibits a non-exponential decay, which may be construed as a slowing down of the diffusion coefficient with propagation time. These results are interpreted using recent theoretical predictions based on the self-consistent theory of the dynamics of localization [2], providing further evidence that the elusive phenomenon of acoustic wave localization in three dimensions has finally been observed experimentally. References: [1] A.A. Chabanov, M. Stoytchev and A.Z. Genack, *Nature* **404** 850-853 (2000); [2] S.E. Skipetrov and B.A. van Tiggelen, *Phys. Rev. Lett.* **96**, 043902 (2006).

* This work is being supported by NSERC

MO-P12-5 15h45

ALEJANDRO MARANGONI, University of Guelph

Exploiting small-molecule self-assembly properties to create edible supramolecular structures †

The need for creating new food products with enhanced nutritional properties has forced researchers to seek new ways of structuring food materials. Of particular interest to our group is the modulation of the physiological effects of edible fats and oils via the the creation of novel nano and microstructures in the food material. Here we show how the the self-assembly properties of monostearin, a high melting point emulsifier, into lamellar liquid crystalline phases and conversion to crystal hydrates can help encapsulate oil into multilamellar monolgyceride microvesicles. These microvesicles interact via electrostatic interactions to form a plastic material with the functionality of a baking shortening. This oil microencapsulation was also shown to have a significant effect on lipid and insulin metabolism in humans: an attenuated increase in blood lipids as well as a decreased insulin release into the blood. This controlled release of lipids via structuring of the food material promises to lead to the development of more healthful foods and has profound implications for obesity and type II diabetes. Edible oils can also be gelled via judicious use of small-molecule organogelators. Hydroxystearic acid (HSA) is one such organogelators. This molecule will self-assemble into nanofibers, which themselves aggregate into long crystalline fibers of several hundred microns in length. This organogel network can form at concentrations as low as 0.5% w/w in the oil, creating a transparent and elastic gel. The mechanism of formation of this unique fractal fibrous network created via nucleation and crystal growth processes, rather than diffusion or reaction limited aggregation, will be discussed considering the structure of HSA. Other potential novel structuring strategies will also be discussed.

† In collaboration with Stefan Idziak, University of Waterloo

MO-P12-6 16h15

Elimination of the Intermediate Colloidal Product in Models of Periodic Precipitation Pattern*. **Ivan L'Heureux**, *Universite d'Ottawa* — Periodic precipitation patterns constitute a good example of self-organization in a chemical system. Typically, such patterns arise when two counter diffusing salt solutions A and B generate an intermediate colloidal compound C that can then form a precipitate P, resulting in a series of concentric rings or bands. These patterns are thought to occur in many complex geochemical natural environments. To understand the formation of periodic precipitation patterns in these systems, it is advantageous to simplify the models as much as possible. In this contribution, we investigate the simplifications resulting from eliminating the dynamics of the intermediate compound from the model. Two schemes are discussed: a steady-state elimination scheme and another one based on local equilibrium. The qualitative behavior of the numerical solutions is compared with the results obtained from more extensive models for which the intermediate compound is explicitly present. This allows a clearer control on the nature of the approximations involved when modeling periodic precipitation in complex natural systems.

* This work is being supported by NSERC

MO-P12-7 **16h30**

Microscopic dynamics of recovery in sheared glassy depletion gels. **James Harden** [1], Brian Chung [2], Dennis Liang [2], Ranjini Bandyopadhyay [3], Subramanian Ramakrishnan [4], Charles Zukoski [5], Robert Leheny [2], [1] *University of Ottawa*, [2] Johns Hopkins University, [3] Raman Research Institute, [4] Florida State University, [5] University of Illinois — We describe x-ray photon correlation spectroscopy and diffusing wave spectroscopy investigations of concentrated depletion gels formed from nanoscale silica colloids in solutions of nonabsorbing polymer. The experiments track the changing microscopic dynamics as these jammed, nonergodic systems recover following the cessation of large shear. The two techniques provide a quantitatively coherent picture of the dynamics as ballistic or convective motion of colloidal clusters whose internal motion is arrested. While the evolution of the dynamics possesses features characteristic of nonergodic soft solids, including a characteristic relaxation time that grows linearly with the time since cessation of shear, comparison with the behavior of quenched supercooled liquids indicates the dynamics in these colloidal gels are not directly related to traditional aging and rejuvenation phenomena in molecular glasses.

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

[MO-CEWIP] CEWIP Session / *Session CEFEP*

(CEWIP / *CEFEP*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

17h00 - 18h15

ROOM / SALLE Geol. 155 (70)

Chair: J.A. McKenna, University of British Columbia

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

17h30 **Discussion Break**

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

[MO-CINP-Gen] Canadian Institute of Nuclear Physics (CINP) General Meeting / *Assemblée générale de l'Institut canadien de la physique nucléaire (ICPN)*

(DNP / *DPN*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

17h00 - 18h00

ROOM / SALLE Thor. 124 (80)

Chair: G.M. Huber, University of Regina

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

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

[MO-PIC] Physics In Canada Editorial Board Meeting / *Réunion du Comité de rédaction de La Physique au Canada*

(CAP / *ACP*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

17h00 - 18h15

ROOM / SALLE Phys. 175 (40)

Chair: B. Joos, Université d'Ottawa

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

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

[MO-CJP] Canadian Journal of Physics Editorial Board Meeting / *Réunion du Comité d'édition du journal canadien de la physique*

(CJP / *RCP*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

18h30 - 21h00

ROOM / SALLE John's Saskatoon (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-NSERC] NSERC Liaison Committee Meeting / *Réunion du comité de liaison ACP-CRNSG*

(CAP-NSERC / *ACPCRSNG*)

MONDAY, JUNE 18 / LUNDI, 18 JUIN

18h30 - 21h00

ROOM / SALLE T.B.A.

Chair: B.D. Gaulin, McMaster University

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

21h00 **Session Ends** / ***Fin de la session***

[MO-POS] Monday evening Poster Session / *Session d'affiches le lundi soirée*

MONDAY, JUNE 18
LUNDI, 18 JUIN
19h00 - 22h00

ROOM / SALLE Geol. 200 (atrium)

(See page 128 for abstracts / Voir page 128 pour les résumés)

22h00 **Session Ends** / *Fin de la session*

TUESDAY, JUNE 19 - MARDI, 19 JUIN

[TU-CNILC] CNILC Breakfast Meeting / *Réunion du comité de liaison national canadien*

(CAP / *ACP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
07h00 - 08h05

ROOM / SALLE T.B.A.

Chair: G.W.F. Drake, University of Windsor

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

08h05 **Session Ends** / *Fin de la session*

[TU-Plen1] Plenary Session / *Session plénière* (Lee Smolin, Perimeter Institute)

(DTP-CAP-DHP / *DPT-ACP-DHP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
08h15 - 08h55

ROOM / SALLE Arts 143 (350)

Chair: M.B. Paranjape, Université de Montréal

TU-Plen1-1 **08h15**

LEE SMOLIN, Perimeter Institute for Theoretical Physics

The possibility of the emergence of elementary particle physics from quantum gravity

It used to be thought that loop quantum gravity was a theory purely of the gravitational field, however recently it was found that some versions of loop quantum gravity have emergent particle-like states which appear to correspond to chiral matter degrees of freedom. In one simple model the simplest of these emergent excitations appear to reproduce a preon model of the standard model fermions proposed originally by Bilson-Thompson. I will discuss recent work on the propagation and interactions of these states.

08h45 **Discussion Break**

08h55 **Session Ends** / *Fin de la session*

[TU-Plen2] Communication and Outreach with the Public I / *La politique scientifique (La communication avec le public I)* (Jay Ingram, Discovery Channel)

(CAP / *ACP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
09h00 - 09h45

ROOM / SALLE Arts 143/146 (504)

Chair: W.F. Davidson, National Research Council Canada

TU-Plen2-1 **09h00**

JAY INGRAM, Discovery Channel

It was the Best of Times ...

We are living in a glass half-full/half-empty epoch. On one side there is a growing chorus of interest in science outreach, the stimulation of innovation and the establishment of a science culture. Governments and funding agencies are talking that talk. But who is walking the walk? In fact, does anybody know WHAT to do to achieve any of these goals? Are these goals even the right ones? Well Jay Ingram doesn't have the answers, but at least he's willing to ask the questions.

09h35 **Discussion Break**

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

[TU-A1] String Theory and Quantum Gravity / *Théorie des cordes et gravitation quantique*

(DTP / *DPT*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h15

ROOM / SALLE Phys. 127 (48)

Chair: L. Smolin, Perimeter Institute

TU-A1-1 **10h00**

KESHAV DASGUPTA, McGill University

Lumps in the throat *

I will discuss classical lump solutions in a warped throat where brane inflation takes place. Some of the solitonic or lump solutions that I'll discuss here are the (p,q) cosmic strings and their junctions, cosmic necklaces and semi-local strings and generic semi-local defects. I'll show how various wrapping modes of D3-branes may be used to study all these defects in one interpolating set-up. This construction allows us to study (p,q)-string junctions in curved backgrounds and in the presence of non-trivial RR fluxes. I'll show how the junction construction can be extended to allow for the possibility of cosmic necklaces, and will discuss how these new lump solutions form a consistent picture in the inflationary brane models. I'll also give a generic construction of semi-local defects in these backgrounds, and argue that this construction encompasses all possible constructions of semi-local defects with any global symmetries. I'll end with a brief discussion of the cosmological implications of these configurations.

* This work is being supported by NSERC Grant

TU-A1-2 **10h30**

KADAYAM S VISWANATHAN, Simon Fraser University

Understanding QCD via AdS/CFT correspondence *

I'll review some aspects of the recent progress in the area of AdS/CFT correspondence that addresses the holographic dual description of QCD in 3+1 space-time dimensions. Although an exact dual string theory of QCD is not known, some remarkable progress has been made in understanding various strong coupling features in QCD. These involve, to name a few, study of Chiral symmetry breaking, Fermion condensates, Meson spectrum and the study of Quark-Gluon plasma through Gauge/String duality. The complexity and the difficulty of the problems forces the use of approximate constructions. On the string theory side of the duality these constructions involve adding open string degrees of freedom in the fundamental representation which can be achieved by adding extra D-branes to the supergravity background. If the number of added branes is small compared to the number of branes that creates the background we can neglect their back reaction on the geometry and consider the extra branes as probes. I'll describe my joint work with V Filev, Clifford Johnson, and R.Rashkov (hep-th/0701001) in which we consider D7 brane probes of $AdS_5 \times S^5$ in the presence of an external field to study some of the aforementioned problems.

* This work is being supported by NSERC

11h00 **Coffee Break** / ***Pause café***

TU-A1-3 **11h15**

VINCENT BOUCHARD, Perimeter Institute

Can string theory reproduce the Standard Model of particle physics? †,*

As a candidate for a unified theory of observed physics, string theory must be able to reproduce, in a certain limit, the observed Standard Model of particle physics. Surprisingly, finding such a limit explicitly is still a challenge, although it is widely believed to be possible. However, recently we introduced a compactification of heterotic string theory reproducing precisely the massless spectrum of the MSSM, with no exotic particles, and realistic tri-linear couplings. We also began a systematic mathematical search for other realistic models in a certain class of heterotic vacua. In this talk I would like to address physical properties of this model, and comment on the remaining questions that need to be addressed to test phenomenological viability. I would also like to describe early results from our search for other realistic heterotic models and discuss possible connections with other quasi-realistic string models.

† In collaboration with Ron Donagi, University of Pennsylvania
* This work is being supported by NSERC

TU-A1-4 **11h45**

GABOR KUNSTATTER, University of Winnipeg

Can Holographic Arguments Yield the 5-D Choptuik Scaling Exponent From 4-D Yang-Mills Theory? †,*

Recently, a holographic argument was used to relate the saturation exponent, γ_{BFKL}, of four-dimensional Yang-Mills theory in the Regge limit to the Choptuik critical scaling exponent, γ_{5d}, in 5-dimensional black hole formation. Remarkably, the numerical value of the former agreed quite well with previous calculations of the latter. I will present new results of an improved calculation of γ_{5d} with substantially decreased numerical error. Our current result is $\gamma_{5d} = 0.4131 \pm 0.0001$, which is close to, but not in strict agreement with, the value of $\gamma_{BFKL} = 0.409552$.

† In collaboration with Jason Bland, University of Manitoba
* This work is being supported by NSERC

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

[TU-A2] Biophysics / *Biophysique*

(DMBP / *DPMB*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h30

ROOM / SALLE Thor. 159 (80)

Chair: A. Linhananta, Lakehead University

TU-A2-1 **10h00**

RALF METZLER, University of Ottawa

Functional properties of DNA and its active role in DNA-protein interactions *

Thermal motion within the double helix plays a critical role in DNA structure and function. On a small scale, base-pair openings represent the most dramatic deviations from the double helix ground state. Although rare, the events of single stranded bubble formation make the active groups of DNA bases accessible for interaction with proteins or chemicals. The opening and closing dynamics of these bubbles can be monitored both by NMR techniques and fluorescence measurements on a single DNA level. A dynamical model will be presented, relating the sequence of base-pairs to the opening probabilities and the bubble dynamics. It will be shown how the bubble dynamics competes with the binding of proteins to DNA single-strand, and the connection between bubble dynamics and transcription initiation will be discussed. The majority of biological functions of DNA, and potential technological applications, rely on site-specific DNA-binding proteins finding their targets, and therefore searching efficiently through megabases of non-target DNA. A particular case is gene expression. I will introduce some recent advances in the understanding of the target search, and how it relates to the local and global conformations of the DNA molecule, such as DNA-looping and DNA-knots. References: [1] T. Ambjörnsson, S.K. Banik, O. Krichevsky, and R. Metzler, *Phys. Rev. Lett.* **97**, 128105 (2006). See also: Biophys J, published-ahead online, doi:10.1529/biophysj.106.095935; [2] M.A. Lomholt, T. Ambjörnsson, and R. Metzler, *Phys. Rev. Lett.* **95**, 260603 (2005)

* This work is being supported by NORDEN, NSERC, CRC

TU-A2-2 **10h30**

MIKKO KARTTUNEN, University of Western Ontario

Multiscale modeling of soft matter and biological systems

In this talk, I will discuss multiscale modeling in soft materials and biologically motivated systems, and the importance of identifying simple physical mechanisms in them. I will focus on some recent developments in coarse-graining [1], and use polymers [2], lipids [3] and micellar systems as examples. In particular, lipid rafts and the much debated problem of lipid diffusion will be revisted [4,5]. Finally, I will address the problem of polymer translocation through narrow nanopores. References: [1] "Novel Methods in Soft Matter Simulations", M. Karttunen, I. Vattulainen, and A. Lukkarinen (Eds.), Springer-Verlag, *Lecture Notes in Physics series* (2004); [2] "Reptational dynamics in dissipative particle simulations of polymer melts", P. Nikunen, I. Vattulainen, M. Karttunen, *Phys. Rev. E.*, in press; [3] "Coarse-Grained Model for Phospholipid/Cholesterol Bilayer Employing Inverse Monte Carlo with Thermodynamic Constraints", T. Murtola, E. Falck, M. Karttunen, and I. Vattulainen, *J. Chem. Phys.* **126**, 075101 (2007); [4] "Assessing the nature of lipid raft membranes", P.S. Niemela, S. Ollila, M.T. Hyvonen, M. Karttunen, I. Vattulainen, *PLoS Computational Biology* **3**, e34 (2007); [5] "Transient Ordered Domains in Pure Phospholipid Bilayers", T. Murtola, T. Rog, E. Falck, M. Karttunen, I. Vattulainen, *Phys. Rev. Lett.* **97**, 238102 (2006).

TU-A2-3 **11h00**

Neutron Diffraction Study of Pseudomonas aeruginosa Lipopolysaccharide Bilayers*. **John Katsaras** [1], Thomas Abraham [1], Sarah Schooling [2], Norbert Kučerka [1], Mu-Ping Nieh [1], Terry Beveridge [2], [1] *National Research Council*, [2] University of Guelph — Lipopolysaccharides (LPSs) are a major class of macromolecules populating the surface of Gram-negative bacteria. They contribute significantly to the bacterium's surface properties and play a crucial role in regulating the permeability of its outer membrane. We report on neutron diffraction studies performed on aligned, self-assembled bilayers of LPS isolated from *Pseudomonas aeruginosa* PAO1. From the construction of one-dimensional scattering length density profiles, we find that water penetrates into the hydrocarbon region up to and including the center of liquid-crystalline LPS bilayers. This permeability to water could have far-reaching implications as to how small molecules penetrate the outer membrane of Gram-negative bacteria.

* This work is being supported by AFMNet

TU-A2-4 **11h15**

Influence of Cholesterol on the Bilayer Properties of Mono-unsaturated Phosphatitylcholine Unilamellar Vesicles*. **Norbert Kučerka** [1], Jeremy Pencer[2], Mu-Ping Nieh[2], John Katsaras[2], [1]*CNBC - NRC, Canada and Comenius University, Slovakia*, [2]CNBC - NRC — The influence of cholesterol on the structure of a unilamellar vesicle (ULV) phospholipid bilayer is studied using small-angle neutron-scattering. ULV made up of short-, mid- and long-chain mono-unsaturated phospholipids (diCn:1PC, n=14, 18, 22) are examined over a range (0 – 45 mol%) of cholesterol concentrations. The bilayer structure is determined from SANS using a detailed model, which results, compared to a single-strip model, in a more realistic description of the water-lipid interface. Our approach allows us to extract structural parameters (e.g., bilayer thickness, lateral area and head group hydration) which are unaffected by changes due to water penetrating the membrane. Interestingly, increased levels of cholesterol manifest themselves in a monotonic increase, for all three lipids, of the evaluated parameters. While this result is expected for the short- and mid-length chain lipids, it is not in the case of the long-chain lipid. This result implies that cholesterol has a pronounced effect on the hydrocarbon chain organization even for 22-carbons long mono-unsaturated phospholipid.

* This work is being supported by NSERC Visiting Fellows program

TU-A2-5 **11h30**

Polaron tunneling in the DNA molecule*. **Julia Berashevich** [1], Vadim Apalkov [2], Tapash Chakraborty [1], [1] *University of Manitoba*, [2] Georgia State University — The phenomena of charge transfer in the DNA molecule is investigated with the semiclassical polaron model. The advantage of the polaron model is the opportunity to take into account the orbital overlapping in the molecular system, the energy gap between the states and the geometry fluctuations of the states. We estimate the charge-vibrational coupling constant χ_i which controls the geometry fluctuations of the states for polarons stretched over $(G\text{-}C)_N$ and $(A\text{-}T)_N$ complexes (N = 1...4) based on the inner-sphere reorganization. For these purposes, the inner-sphere reorganization energy is evaluated within the quantum-chemistry methods. We investigate the influence of the charge-vibrational coupling constant χ_i on the size of the polaron formed in different DNA chains. Moreover, the polaron tunneling dynamics is simulated in the mixed DNA molecules. We also discuss the conductance phenomena in mixed DNA sequences. Here we demonstrate that in mixed DNA molecules the rate of charge trapping and detrapping into the traps determines the efficiency of charge exchange between the donor and acceptor. The time of polaron tunneling through the molecule is found to be different by 10^7 times for the same length and similar potential profiles of the DNA geometry. We show that the slower transfer occurs when the charge trapping rate is much slower than the detrapping rate and the polaron can not occupy a trap. On the other hand, the fastest charge exchange occurs when all the rates are equal, i.e., the molecular bridge has identical traps divided by the same potential barriers.

* This work is being supported by CRC (T. Chakraborty)

TU-A2-6 **11h45**

Controlled-Release And Controlled-Size Spontaneous Unilamellar Vesicles with Low Polydispersities*. **Mu-Ping Nieh** [1], Jeremy Pencer [1], John Katsaras [1], Xiaoyang Qi [2], [1] *NRC, CNBC*, [2] University of Cincinnati, Cincinnati Children Hospital — Phospholipid mixtures of long- and short chain lipids can spontaneously yield unilamellar vesicles with a narrow size distribution. We have found these vesicles to be relatively robust and their radii are in the range of between 10 and 50 nm. In order to better control their size, we have examined several physical parameters, some of which are: 1) The chain length of long-chain lipid, 2) molar ratio of long- to short- chain lipids, 3) charge density and 4) membrane rigidity. We have also investigated the vesicle's encapsulation efficacy and the release of entrapped materials, triggered by temperature. Preliminary results show that these vesicles possess great potential as drug carriers.

* This work is being supported by NRC

TU-A2-7 **12h00**

Field Theoretic Computer Simulations of Two-Component Lipid Systems*. **Apichart Linhananta**, Jesse Boer, *Lakehead University* — The polymer self-consistent field theory (SCFT) is widely used to study various polymer systems such as melts, blends, and solutions. Recently, real-space implementations of SCFT have been used to study non-periodic phases in dilute solutions of homopolymers and copolymers. This method is often referred to as "Field-Theoretic Computer Simulations". This work considers two types of copolymers in solutions. This mimics solutions of two kinds of lipids in water (such as mixtures of DMPC and DHPC). Real-space SCFT is implemented in two- and three-dimensions to study formations of membranes, vesicles and micelles.

* This work is being supported by NSERC

TU-A2-8 **12h15**

Hydrophobic Wetting: Low field NMR study of the hydrophobic effect for water confined in pores of carbon nanohorns*. **Firas Mansour**, Peemoeller Hartwig, *University of Waterloo* — Carbon nanohorns present a unique confining medium for water molecules. The naturally hydrophobic pores show an exceptional affinity for the trapping of water. The water-Carbon nanohorns system is ideal for the study of the water molecule dynamics and structure within the nanohorns pores with NMR. Unlike systems where there is strong chemical/magnetic exchange with surface groups, the NMR results obtained from water confined in carbon nanohorns can in principle be used to extract the intrinsic molecular properties of water. This has remarkable implications for the interactions of water with biological macromolecular surfaces, and paves the way for a fundamental understanding of the nature of the hydrophobic effect using an ideal system. Low field NMR is used to study the unusually slow water molecule dynamics observed under such conditions. Current results are contrasted with earlier results obtained from water confined in hydrophilic mesopores. The water- pore surface coupling is thus examined and the origins of the modification of the NMR parameters of water in confinement are investigated. The process of wetting of the hydrophobic pores is also examined, as well as the incredible ability of the pores to absorb/retain water. The results already obtained will lay the ground work for further investigations using neutron scattering at the NRU reactor in Chalk River.

* This work is being supported by NSERC

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

[TU-A3] Electroweak SM Tests I: Leptonic / *Tests électrofaibles du MS I: leptoniques*

(DNP / *DPN*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h30

ROOM / SALLE Thor. 110 (90)

Chair: W.T.H. van Oers, University of Manitoba

TU-A3-1 **10h00**

ANDRZEJ CZARNECKI, University of Alberta

The Standard Model: A Critical Review *

Recent theoretical predictions and experimental tests of the Standard Model will be reviewed.

* This work is being supported by NSERC

TU-A3-2 **10h30**

JOHN NG, Triumf

Operator Analysis of Physics Beyond the Standard Model and Low Energy Electroweak Measurements *

In this talk we give a model independent study of physics beyond the Standard Model via higher dimension operators. In particular we concentrate on the dimension six four Fermi operators which can be probed by low energy electroweak precision measurements. The limits on the scales of new physics are given. An application to low energy Moller scattering is discussed.

* This work is being supported by NSERC

TU-A3-3 **11h00**

SHELLEY PAGE, University of Manitoba

Testing the Standard Model via a new measurement of the electron's weak charge in parity-violating Möller scattering at 12 GeV †,*

Precision measurements of parity violation have traditionally played an important role in guiding our understanding of the electroweak interaction. A key prediction of the Standard Model is the variation of $\sin^2\theta_W$ with momentum transfer Q^2, referred to as the running of the weak mixing angle. The latter may be tested to high precision by measuring the weak charges of the proton and electron in parity violating electron scattering (PVES) experiments. Jefferson Laboratory is renowned for its world-leading program of precise PVES measurements. We are currently in the final stages of preparing a weak charge measurement for the proton at $Q^2 = 0.03$ GeV^2 using a 1.2 GeV beam, which should have sensitivity at the $\pm$ 0.3% level in $\sin^2\theta_W$. A follow up experiment to measure the electron's weak charge in Möller scattering is in the initial planning stages to be run with a 12 GeV beam once the energy upgrade at Jefferson Laboratory has been completed. The electron and proton weak charge measurements have complementary dependences on new physics beyond the Standard Model. The 12 GeV Möller experiment is aimed at a $\pm$ 0.1% determination of $\sin^2\theta_W$ at $Q^2 = 0.008$ GeV^2. This would constitute a dramatically improved measurement of parity violation in Möller (electron-electron) scattering compared to the recently completed E158 experiment at SLAC. In the context of the Standard Model, the measurement would yield the best determination of $\sin^2\theta_W$ at low energy, and one of the best at

any energy scale. As a new physics search via the running of the weak mixing angle, the experiment would have unparalleled sensitivity to new parity-violating *e-e* interactions, probing electron substructure to 29 TeV (95% CL).

† In collaboration with D. Mack, e2ePV Collaboration , Jefferson Laboratory

* This work is being supported by NSERC

TU-A3-4 **11h30**

SCOTT OSER, University of British Columbia

Neutrino Interactions In, Around, and Beyond the Standard Model

Neutrinos in the Standard Model have simultaneously the strangest and most boring interactions, interacting only weakly and with maximal parity violation. Fortunately for us, we now know that the Standard Model description of neutrino interactions is incomplete, lacking the mass terms and mixing elements needed to describe neutrino oscillation. I will review Standard Model neutrino interactions, outline the additional structure required by the observation of neutrino oscillation, and discuss what neutrinos can tell us about physics beyond the Standard Model.

TU-A3-5 **12h00**

C. RANGACHARYULU, University of Saskatchewan

New Physics in the measurement of transverse muon polarization

An international team of physicists (Canada, Japan, Russia, USA and Vietnam) is preparing a proposal to search for New Physics in the measurement of transverse muon polarization in $K^+ \rightarrow \pi^0 \mu^+ \nu$ ($K^+_{\mu 3}$) decays at the high intensity proton accelerator J-PARC (http://j-parc.jp) facility under construction in Japan. This project is sequel to the KEK-PS- E246 [Abe *et al*, *Phys. Rev. Lett.* **93**, 131601(2004); *Phys. Rev.* **D73**, 072005 (2006)]. With upgraded detector systems and kaon beams of high intensity and high purity, the new measurement will improve our earlier result from the E246 by a factor of 20, bringing the discovery potential to $\delta P_T < 2 \times 10^{-4}$ in our quest for new physics. This experiment is being designed as a precision-frontier measurement with the power to constrain the exotic models competitive to the other projects being planned or prepared. My talk will address the physics, facility, experimental arrangement, time schedule and extend the invitation to Canadian physicists and physics students to join this exciting project, addressing the topical issue of particle physics.

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

[TU-A4] Materials / *Matériaux*

(DCMMP / *DPMCM*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h00

ROOM / SALLE Arts 146 (154)

Chair: J.S. Tse, University of Saskatchewan

TU-A4-1 **10h00**

Influence of Na2Se in melt-grown monocrystalline CuInSe2*. **Hadley Myers**, Clifford Champness, Ishiang Shih, *McGill University* — In photovoltaic solar cells using an absorber layer of p-type chalcopyrite semiconductors based on $CuInSe_2$, it is found that the presence of a small amount of sodium is beneficial in increasing fill factor and open circuit voltage under illumination. The reason for this is still not completely understood. Arising from this, ingots of $CuInSe_2$ were grown in our laboratory by a Bridgman method with an addition of 0, 0.1, 0.5, 1.0 and 3.0 mol. % of Na_2Se to investigate the effect in monocrystalline material. It was found that the electrical resistivity, from four point probe measurements, and hot probe voltages both increased with increase of added Na_2Se, in contrast to results in the literature for polycrystalline films, where resistivity is reported to decrease. The brittleness of the present ingots increased with sodium addition, which is consistent with external work on polycrystalline thin films. Within "metallic" spots found on the inner surface of the quartz ampoule, Cu_3Se_2 was detected along with $CuInSe_2$ by XRD. However, within the bulk ingots, no sodium or its compounds were detected. A copper-like film was found on the surface of the ingots with 1 and 3 mol. % Na_2Se and, in addition, on the quartz inner wall in all the ampoules, a white powder was deposited in an amount which generally increased with increased sodium addition. With analyses yet to be done, it is suspected that the coppery film is, in fact, precipitated copper and that the white powder contains most of the sodium.

* This work is being supported by McGill University

TU-A4-2 **10h15**

Optical Properties of Dilute Magnetic Semiconductors Sb1.97V0.03Te3 and Sb1.94Cr0.06Te3*. **David Crandles** [1], A. Madubuonu [1], G.S. Rao[1], M. Reedyk [1], C. Uher [2], P. Lostak [3], [1] *Brock University*, [2] University of Michigan, [3] University of Pardubice, Czech Republic — The reflectance single crystals of the narrow band gap semiconductor Sb_2Te_3 was measured from 100 to 20000 cm^{-1} at several temperatures between 4 and 300 K. These measurements can be compared to those made on samples that have been doped with V or Cr which exhibit ferromagnetic transitions near 20 K. Hall effect measurements at 300 K suggest that the carrier concentration does not depend on doping while the resistivity of $Sb_{1.97}V_{0.03}Te_3$ and $Sb_{1.94}Cr_{0.06}Te_3$ are five and three times greater, respectively, than the parent compound Sb_2Te_3. The temperature dependence of the optical plasma frequency and scattering rate will be compared to those suggested by the transport measurements.

* This work is being supported by NSERC

TU-A4-3 **10h30**

Structural and Electronic Properties of Pristine and Ba-doped Clathrate-like Carbon Fullerenes. **Jianjun Yang** [1], J.S. Tse [1], Y. Yao [1], T. Iitaka [2], [1] *Department of Physics and Engineering Physics, University of Saskatchewan*, [2] Computational Astrophysics Lab, RIKEN — We present *ab initio* calculations on the recently characterized polymerized 3D cuboidal C_{60} fullerenes and confirm its metallic property. However, inspection of the electron band structure reveals "steep band/flat band" near the Fermi level. Moreover, the observation of nearly parallel bands indicates strong possibility of nesting of Fermi surfaces which may lead to electronic instability. The unique features are indicative of possible superconducting behaviour in the pristine c-C_{60} phase. In addition, the doping of Ba in the center of the c-C_{60} cage leads to an unusual metal-semiconductor transition. The large change in the electronic structure upon Ba doping suggests that c-C_{60} may potentially be an important electronic material for technological applications with tunable electronic properties with metal doping. Although metal doped c-C_{60} has not been realized, the theoretical results reported here show that encapsulation of an alkaline-earth metal Ba atom, in the two possible sites considered here, cage and interstice, are both energetically favourable.

TU-A4-4 **10h45**

Progress on InAs/InP Quantum Dot Lasers emitting at 1.55 microns. **Sylvain Raymond**, Philip James Poole, Pedro Barrios, Greg Pakulski, Zhenguo Lu, Jiaren Liu, *Conseil National de Recherches du Canada* — Semiconductor self-assembled Quantum Dots (QD) are in the process of revolutionizing the field of semiconductor lasers.

Semiconductor lasers with the best properties have often been obtained with QD layers: low thresholds, low chirp, high modulation speeds. Many of these outstanding properties have been obtained for InAs QDs grown on GaAs substrates emitting in the range 1100-1300 nm. In the last few years InAs QDs grown on InP have been used to obtain emission around 1.55 μm. In this presentation, we review the recent progress in 1.55 μm QD lasers at the NRC's Institute for Microstructural Sciences. The performance of quantum well (QW) and QD laser diodes is compared, where the only difference between the two structures is that the InGaAsP QW emitting at 1.55 μm is replaced by a layer of QDs emitting at the same wavelength. It is found that a new layer design is needed to optimize the QD laser performance due to their low gain relative to the QWs, and indeed lower thresholds are obtained with a structure having a thicker core and modified doping profile. Other designs of the active layers were investigated, in particular a cold injection device where the electrons are injected directly from a QW into the QD ground state via a thin tunnel barrier. For as-cleaved ridge waveguide structures operating at room temperature, a minimum threshold current of 107 mA was obtained, while the best external quantum efficiencey observed was 19.3 % for a 0.5 mm device.

11h00 **Coffee Break** / ***Pause café***

TU-A4-5 **11h15**

Designing Electron Beams for In-Line Holography of Nanostructures*. **Lucian Livadaru**, Robert Wolkow, *NRC- National Institute for Nanotechnology, University of Alberta* — Point-source holography with low energy electrons has the potential to revolutionize the 3-dimensional lensless imaging of nanostructures. With recent advances in creating ultrasharp nanotips as electron emitters, the spatial coherence and the monochromatic quality of electron beams are greatly improved. We investigate the use of such nanotips as coherent sources for electron holography. Most reconstruction schemes for in-line point-source holograms assume the reference wave to be of spherical form and do not allow accounting for the precise beam shape. As the coherent beams from ultrasharp nanotips tend to have small angular openings, we investigate how this angle affects the resolution of the holographic method. We show that is it possible to increase the accuracy of hologram reconstruction by incorporating the profile of the beam used to record the hologram. The reconstruction method is formulated in the frame of Fresnel-Kirchhoff diffraction theory. The resulting algorithm can outperform existing reconstruction formulas, while being more versatile with respect to the holographic set-up. We simulate hologram formation and subsequent reconstruction for arbitrary nano-sized objects. Lens-free magnification of the order of 10^5 is routinely obtained in these simulations. We show the improvement in the reconstructed object with the use our reconstruction formula (accounting for beam shape) over the reconstruction with a spherical wave only. Imaging of nano-sized objects is achievable with such a holographic set-up using electron beams with energies in the range 50-200 eV.

* This work is being supported by iCORE

TU-A4-6 **11h30**

Resonant X-ray Emission Spectroscopy of transition metals in metallic alloys and compounds as an element-selective probe of spin character of d electrons*. **Mikhail Yablonskikh** [1], Jorgen Brown [2], Andrey Postnikov [3], Jonathan Denlinger [4], Elena Shreder [5], Yuri Yarmoshenko [5], Manfred Neumann [6], Ernst Kurmaev [5], Alexander Moewes [1], [1] *University of Saskatchewan*, [2] Physikalisches Institut, Westfälische-Wilhelms Universität Münster, [3] Department of Physics, Osnabrück University, [4] Lawrence Berkeley National Laboratory, [5] Ural Institute of Metal Physics, [6] Osnabruck University — Resonant X-ray Emission, Photoelectron and Absorption Spectroscopies are well known as useful tools for studying the electronic structure of materials in chemical physics and material science. Spectroscopy of transition metal (TM) magnetic materials is important both for fundamental studies of magnetism and in search of novel materials for spintronic applications. For Heusler alloys X_2MnZ, where X is Co, Ni and Z is the III, IV group element, it was shown that *2p* X-ray Photoelectron Spectra are useful to estimate the magnitude of atomic magnetic moment. TM $L_{\acute{a}}$ ($3d_{5/2,3/2} \rightarrow 2p_{3/2}$) Resonant X-ray Emission Spectra evidence the spin-splitting of *3d* electrons of Mn and the absence of such splitting in Co and Ni [1]. The magnitude of spin-splitting of *d* electrons of TM atom may be determined from density of states calculations and Resonant Inelastic X-ray Scattering (RIXS) spectra obtained with linearly polarized X-rays. Spin origin of spectral effect may be confirmed through Magnetic Circular Dichroism in Soft X-ray Emission [2]. Results obtained for chalcogenides Cr_xTiSe_2, Co_xTiSe_2 [3] illustrate the principal possibility of linearly polarized X-ray spectroscopy to probe TM magnetic moments and spin-dynamics in solids. More recent results and further opportunities of X-ray Emission Spectroscopy to probe TM electronic states will be discussed. References: [1] M.V. Yablonskikh, J. Braun, M.T. Kuchel, A.V. Postnikov, J.D. Denlinger, E.I. Shreder, Y.M. Yarmoshenko, M. Neumann, and Moewes, *Phys. Rev. B*. **74**, 085103 (2006) and Ref-s therein; [2] M.V. Yablonskikh, V.I. Grebennikov, Y.M. Yarmoshenko, E.Z. Kurmaev, S.M. Butorin, L.-C. Duda, J. Nordgren, S. Plogmann, and M. Neumann, *Phys. Rev. B* **63**, 235117 (2001); [3] T.V. Kuznetsova, M.V. Yablonskikh, A.V. Postnikov, G. Nicolay, B. Eltner, F. Reinert, Y.M. Yarmoshenko, A.N. Titov, and J. Nordgren, *J. of Electr. Spec. and Rel. Phen.* **137**, 481 (2004) and Ref-s therein.

* This work is being supported by NSERC

TU-A4-7 **11h45**

Progress towards a picosecond long x-ray source at the Advanced Photon Source*. **Eric Dufresne**, *Argonne National Laboratory* — The Advanced Photon Source is upgrading its beamline 7ID to generate picosecond-long x-ray bunches. The beamline straight section will be modified by inserting Radio Frequency Crab cavities that induce a correlation between the vertical divergence and the arrival time of the x-rays. By using a slit to select a small angular acceptance, a picosecond x-ray bunch will be generated. This presentation will review experiments planned for this new source and the technical progress towards its implementation.

* This work is being supported by US Department of Energy

12h00 **Session Ends** / ***Fin de la session***

[TU-A5] (DCMMP / *DPMCM*) Young Investigators in Condensed Matter and Materials Physics / *Jeunes chercheur(ses) en matière condensée et matériaux*

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h15

ROOM / SALLE Phys. 130 (70)

Chair: S. Desgreniers, University of Ottawa

TU-A5-1 **10h00**

STEFAN KYCIA, University of Guelph

The Future Brockhouse X-Ray Diffraction and Scattering Sector for Materials Science at the Canadian Light Source *

An overview of the layout and science driving the future Brockhouse Sector and the Canadian Light Source will be presented. The facility will enable structural characterization of many forms of materials systems. Some potential applications include structural studies of polymers, drugs, emulsions, biomaterials, novel batteries, petroleum products and quantum materials. The instrumentation will provide excellent performance over the 3-60keV x-ray energy range. To achieve this, two complimentary insertion device (ID) beamlines will be incorporated into the Canadian Light Source. An undulator beamline will cover energies from 3-20keV and a superconducting wiggler beamline will cover energies from 20-60keV. Sharing a single straight section, the two ID's will operate simultaneously. The first of three hutches will support micro and anomalous single crystal crystallography, high-resolution powder diffraction, *ab-initio* structure solution, Rietveld refinement, and combinatorial materials research. A sec-

ond hutch will aim at high-resolution PDF measurements at extreme environments. Diamond anvils, furnaces, and cryostats will create these environments. The third hutch will support SAXS/WAXS and have a diffractometer for inelastic scattering and reciprocal space mapping.

* This work is being supported by CFI, NSERC

TU-A5-2 **10h30**

GAP SOO CHANG, University of Saskatchewan

Ferromagnetism in Diluted Magnetic Semiconductors: Intrinsic or Extrinsic? †,*

Spin-electronics utilizing both spin-dependent and charge-dependent electric currents has been intensively exploited as a promising alternative to the semiconductor technology relying only on the binary states of electric current (bit of 1 or 0). In order to realize practical spintronic devices, the primary requirement is to develop new ferromagnetic semiconductors which allow a current of spin-polarized electrons to be generated and controlled, and preserve the spin-coherence over long time and distance in an existing semiconductor structure. Therefore making semiconductors ferromagnetic has been a long-standing goal in the area of semiconductor-based spintronics. One of widely used approaches is to dope magnetic elements such as Mn, Co, and Fe into conventional semiconductors. However, despite enormous research efforts devoted to incorporate diluted magnetic semiconductors (DMSs), a lack of consistency in experimental results has brought debates about the origin of ferromagnetism in DMSs and the demand of knowledge in local environment around magnetic impurities has increased. In this research, we have employed synchrotron-based x-ray absorption/emission spectroscopy to extensively investigate the local electronic structure of magnetic dopants and to shed light on the origin of ferromagnetism in the DMS materials. Recent experimental results of various magnetic semiconductors will be presented together with detailed discussion and analysis.

† In collaboration with Tor M. Pedersen, Alexander Moewes, University of Saskatchewan

* This work is being supported by NSERC

11h00 **Coffee Break** / ***Pause café***

TU-A5-3 **11h15**

STANIMIR BONEV, Dalhousie University

Liquid-liquid transitions and exotic melting behavior in dense alkali metals *

At ambient pressure and temperature, the alkali metals can be fairly well described by a nearly free electron model, and assume highly symmetric crystalline structures. Under sufficient compression, they undergo transitions to lower symmetry structures, driven by a Peierls-like mechanism. Our theoretical work indicates that similar type of symmetry breaking also takes place in the local order of the liquid phases of the alkalis, resulting in molten phases with unusual properties. Also surprisingly, the liquid-liquid transitions commence at much lower pressures than the corresponding solid-solid transitions, thus giving rise to anomalous melting behavior over extended pressure ranges. We explain why sodium melts at room temperature at 120 GPa, as recently measured, and predict that similar behavior could be observed in other materials.

* This work is being supported by NSERC

TU-A5-4 **11h45**

J. STEVEN DODGE, Simon Fraser University

A view of metals through the terahertz window *

As electrons move through a metal, interaction with their environment tends to slow them down, causing the Drude peak in the optical conductivity to become narrower. The resulting peak width is typically in the terahertz frequency range that sits between microwaves and the far infrared, too fast for conventional electronics and too slow for conventional infrared spectroscopy. With femtosecond laser techniques, however, coherent, broadband terahertz radiation can now be generated and detected with exquisite sensitivity, providing a new window onto electronic interactions in metals. I will discuss the application of this technique to a variety of metallic systems, including elemental lead, where the interactions are well understood, and ruthenium oxides, where they are not. Interactions can also induce gap formation that can be probed with terahertz spectroscopy; for example, a quantum phase transition from a spin density wave state to a paramagnetic metal can be induced in the metallic alloy $Cr_{1-x}V_x$ by varying the vanadium concentration x, and our results reveal a factor of two change in the Fermi surface volume that complements Hall effect observations.

* This work is being supported by NSERC, CFI, CIAR

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

[TU-A6] Energy Frontier and Phenomenology I / *Frontière énergétique et phénoménologie I*

(PPD / *PPD*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h30

ROOM / SALLE Thor. 124 (80)

Chair: W. Trischuk, University of Toronto

TU-A6-1 **10h00**

WENDY TAYLOR, York University

Recent Results from the D0 Experiment *

The D0 detector has recorded over 2.5 fb^{-1} of proton-antiproton collisions delivered by the Fermilab Tevatron collider. Operating at 1.96 TeV, the Tevatron remains at the energy frontier and continues to set luminosity records. The D0 collaboration is publishing a paper every two weeks, spanning such diverse topics as electroweak precision measurements, top and bottom quark physics, QCD studies and searches for physics beyond the Standard Model. The D0-Canada group has been instrumental in the two most important measurements to come out of the Run II D0 program: the measurement of the B_s^0 oscillation frequency and the observation of electroweak production of single top quarks, the first evidence for which was reported by D0 late 2006. After briefly discussing the D0 detector status, I will present the latest results for these two measurements and touch on other recent hot topics at D0.

* This work is being supported by NSERC, CRC, CFI, WestGrid Proj

TU-A6-2 **10h30**

Bs Mixing at D0 with J/ψ decays*. **Steven Beale**, *York University* — The B_s^0 meson mixes with its anti-particle ($\bar{B}_s^0$) with a frequency dependent on the mass difference between the two. Measurement of the mixing frequency is an important test of the CKM matrix and of the Standard Model contribution to CP violation. I will outline the D0 mixing analysis of the $B_s^0 \rightarrow D_s^- \mu^+ X$ ($D_s^- \rightarrow K^{*0} K^-$) semileptonic decay channel, highlighting recent improvements. In addition, I will present the latest mixing results from D0.

* This work is being supported by D0 Collaboration

TU-A6-3 **10h45**

Measurement of the di-b-jet cross section at CDF run-II. **Greg Williams**, *McGill University* — The production of jets of particles including bottom quarks in high energy hadron collisions is a well-established phenomenon. Bottom quarks are predicted to be involved in many exotic processes, including the decay of Higgs bosons. The specific production of pairs of b-quark jets is an important QCD (quantum chromodynamic) prediction. We present recent measurements of the di-b-jet cross section as a function of several variables using one inverse femtobarn of data collected by the Collider Detector at Fermilab (CDF) experiment from proton-antiproton collisions at a center of mass energy of 1.96 TeV. Results are obtained using numerous jet algorithms and b-quark jets are tagged by identifying a secondary vertex consistent with heavy flavour decay. The experimental measurements are compared to theoretical predictions.

TU-A6-4 **11h00**

Tau identification and tau energy correction at D0. **Zhiyi Liu**, *Simon Fraser University* — As one of decay products of a top quark, tau plays an important role in top quark physics in statistics-limited channels, for example searching for single top in the tau + jets channel. Tau is the heaviest lepton with a short lifetime ($2.91*10^{-13}$ s). However, tau identification is particularly difficult since hadronic tau looks like a jet, which forms one main background of tau in a hadron collider environment. The presentation will describe the identification of tau leptons produced in proton-antiproton collisions with center-of-mass energy 1.96 GeV at the D0 experiment. Also different approaches employed for discriminating taus against background particles will be discussed and their performance will be illustrated. Tau energy can be corrected by making use of tracks in order to improve tau energy resolution. The tau energy correction based on Monte-Carlo samples will be presented.

TU-A6-5 **11h15**

ROBERT SNIHUR, McGill University

Latest Results from the CDF Collaboration

The Tevatron collider at the Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois collides 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 studying the outcome of these high-energy hadronic collisions. The CDF collaboration has been pursuing a broad and exciting physics program and has now integrated over 2 inverse femtobarns of data. This talk will present recent results obtained by the CDF collaboration. Emphasis will be given in areas having Canadian contributions. Prospects will also be discussed for other interesting measurements made possible by future Tevatron running.

TU-A6-6 **11h45**

Top Quark Mass Measurement in Combined Lepton+Jets and Dilepton Decay Channels Using a Mass Template Method from pp Collisions at 1.96 TeV*. **Sebastian Carron**, Pekka Sinervo, *University of Toronto* — We present a measurement of the top quark mass in top quark pair production events decaying into the lepton + jets and dilepton channels. The measurement uses about 1.3 fb^{-1} of proton-antiproton collision data at $\sqrt{s}$ = 1.96 TeV collected by CDF Run II detector at Fermilab. We reconstruct a top quark mass in each event by using kinematic constraints on the pair of top quarks. The mass of the hadronic decaying W boson in lepton + jets events is used to calibrate the energy response of the detector. In the dilepton channel we use a neutrino weighting algorithm to integrate over the unknown neutrinos kinematical quantities. We determine the top quark mass and an in-situ measurement of the jet energy scale from a simultaneous likelihood fit to the reconstructed top quark mass, and W boson invariant mass distributions in lepton + jets events, in the data to distributions from Monte Carlo simulation.

* This work is being supported by University of Toronto

TU-A6-7 **12h00**

First Measurement of sigma(gg->ttbar)/sigma(ppbar->ttbar)*. **Shabnaz Pashapour**, Pekka Sinervo, *University of Toronto* — Following the discovery of top quark, various studies have been dedicated to understanding its properties. According to the Standard Model at $\sqrt{s} \sim 2$ TeV, we expect 15% of top quark pairs to be produced through gluon-gluon fusion and the other 85% through quark-antiquark annihilation. We present the first measurement of $\sigma(gg \rightarrow ttbar)/\sigma(ppbar \rightarrow ttbar)$. It provides a test of the QCD predictions for this pair-production mechanism, and a technique to test for unexpected sources of top quark production. The gluon-rich fraction of candidate ttbar events is measured using the low p_T charged particle multiplicity, which is then used to determine $\sigma(gg \rightarrow ttbar)/\sigma(ppbar \rightarrow ttbar)$. The correlation between the average number of gluons and the charged particle multiplicity is determined using W+n jet(s) and dijet data calibration samples and verified using Standard Model Monte Carlo calculations. We use 1 fb^{-1} of ppbar collisions collected with Collider Detector at Fermilab (CDF) and find a value of $0.01 \pm 0.16(stat) \pm 0.07(syst)$.

* This work is being supported by NSERC

TU-A6-8 **12h15**

Evidence for single top quark production at D0. **Dag Gillberg**, *Simon Fraser University* — This talk presents the first evidence for electroweak single top quark production observed at the D0 detector in the Fermilab Tevatron. The Tevatron is a proton-antiproton collider at centre of mass energy 1.96 TeV located close to Chicago, IL. The analysis uses a 0.9 fb^{-1} dataset and selects electron + jets and muon + jets events with one or two b-quark tagged jets. Thereafter three different methods are used to separate signal from background: Boosted Decision Trees, Matrix Elements, Baysian Neural Networks. This presentation will focus on the Boosted Decision Tree analysis which exhibits the most sensitivity. The measurement yields σ ($pp \rightarrow tb + X$, $tqb + X$) = 4.9 ± 1.4 pb. From this measurement the CKM matrix element that describes the Wtb coupling is determined to $0.68 < |Vtb| \leq 1$ at 95% C.L. within the standard model.

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

[TU-A7] Saskatchewan Plasma Physics and Tokamaks / *Physique des plasmas en Saskatchewan et tokamaks*

(DPP / *DPP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h45

ROOM / SALLE Biol. 125 (70)

Chair: J.E. Morelli, Queen's University

TU-A7-1 **10h00**

AKIRA HIROSE, Plasma Physics Laboratory, University of Saskatchewan

20 Years of STOR-M tokamak *

The STOR-M tokamak was built as a test bed for innovative tokamak operation scenarios (*e.g.*, alternating current operation), development of novel fueling technologies (Compact Torus injection) and diagnostics (*e.g.*, microwave reflectometry). In this talk, some experimental highlights in the past 20 years are reviewed. A unique feature of STOR-M is the relative ease in triggering improved confinement modes. Turbulent edge heating, plasma biasing and CT (compact torus) injection can all induce transition. Detailed diagnostics revealed that the radial profiles of density and toroidal flow undergo marked modification during transition. Theoretical and simulation studies are being pursued in parallel for further understanding of anomalous transport. A novel electron instability has recently been predicted in the regime of electron skin depth. Its identification and clarifying the role for electron thermal diffusivity is being investigated.

* This work is being supported by NSERC and CRC Pr

TU-A7-2 **10h30**

OSAMU MITARAI, Kyushu Tokai University

AC operation in the STOR-M tokamak *

A tokamak is an inherently pulsed machine from the view point of the plasma current generation. Although various non-inductive current drive techniques have been developed, all the current drive techniques have less efficiencies in the high density regime where fusion reactions take place. Therefore, the bootstrap current has to be maximized to reduce the externally driven plasma current and the re-circulation power in a tokamak reactor. When this scenario is not fully developed, an inductive alternating current (AC) operation can make a tokamak reactor quasi-continuous. Based on these perspectives on future tokamak reactor, we started the unique AC tokamak operation in University of Saskatchewan since 1984. One cycle AC operation with ±4 kA was first demonstrated in the STOR-1M tokamak (R=22 cm, a=3.5 cm) in 1984 using the LCR capacitor circuit. The successive larger STOR-M tokamak (R=46 cm, a=12 cm) was operated in 1987, which is powered by the electrolytic capacitors in the combined circuit for Ohmic heating and vertical field. After confirmation of the soft landing of the plasma current, we developed special AC circuits to perform multi-cycle operations in 1990s. Adjustment of the plasma position by applying the bias voltage in the second negative plasma current phase makes relatively smooth plasma current reversal, and up to 1.5 cycle AC operation had been achieved. Inductive AC operation can be a back-up option for a steady state tokamak reactor, and it can be used in a fast track reactor because no major physics problems are not seen.

* This work is being supported by NSERC Canada

TU-A7-3 **11h00**

MASAYOSHI NAGATA, University of Hyogo, Japan

Compact Torus Injection Experiments on JFT-2M Tokamak †

Compact Torus (CT) injection programs on JFT-2M were aimed at developing the scientific basis for the central particle fuelling for tokamak plasmas. In the past ten years, the significant advances in understanding CT particle fuelling process have been achieved through the CT injection experiments [1-2]. The improved CT injector made it possible for the CT to penetrate directly near the central region beyond the separatrix. A rapid increase of $\sim 2.0 \times 10^{18}$ m^{-3} in the core electron density within a fast time scale of 0.06 ms was clearly observed in the plasmas heated by NBI. Time-frequency and space distribution analyses of edge magnetic probe signals showed that the magnetic fluctuation induced by the CT has the spectral peak at 250 - 350 kHz and propagates in the toroidal direction at the Alfvén speed of the order of 10^6 m/s. These results indicate the excitation of Alfvén wave by CT injection. Decrease in Deuterium line intensity and the corresponding increase in the soft X-ray signals suggest that the CT causes a transition to H-mode-like discharges. This result is supported by the L-H transitions found in the CT injection experiments on STOR-M [3]. References: [1] M. Nagata, N. Fukumoto, H. Ogawa, *et al.*, *Nuclear Fusion* **41**, 1687 (2001); [2] M. Nagata, H. Ogawa, S. Yatsu, *et al.*, *Nuclear Fusion* **45**, 1056 (2005); [3] C. Xiao, A. Hirose and S. Sen, *Physics of Plasmas* **11**, 4041 (2004).

† In collaboration with N. Fukumoto [1], H. Ogawa [2], S. Yatsu [3], [1] University of Hyogo, Japan, [2] Japan Atomic Energy Research Institute, Ibaraki, Japan, [3] Hokkaido University, Hokkaido, Japan

11h30 **Coffee Break** / ***Pause café***

TU-A7-4 **11h45**

The role of the plasma current direction in plasma toroidal flows in the STOR-M tokamak*. **Chijin Xiao** [1], Geoffrey St. Germaine [1], Ajay Singh[1], Claude Boucher [2], Akira Hirose [1], [1] *University of Saskatchewan*, [2] INRS-EMT — Plasma flow profiles play an important role in plasma transport and H-mode transition in tokamaks. A movable Gundestrup probe has been used to measure both the toroidal and poloidal plasma flows in the edge region of the STOR-M tokamak. It has been found that the toroidal plasma flow direction reverses when the plasma current direction is reversed, independent of the toroidal magnetic field direction. In addition, the relationship between the plasma flow and plasma confinement has also been studied. During Ohmic discharges, there is no measurable gradient in plasma flows. During the improved confinement phase induced by a short turbulent heating current, a strong velocity shear is induced

* This work is being supported by NSERC

TU-A7-5 **12h00**

Design and evaluation of a repetitive-fire compact toroid fuelling system for ITER*. **Geoff Olynyk**, Jordan Morelli, *Queen's University* — A design is presented for a repetitive-fire compact toroid injection fuelling system for the ITER (2001) tokamak. Advantages of central over edge fuelling include plasma density control and higher deposition rates, implying lower tritium usage. The reference design offers 50 Pa m^3 s^{-1} of 90%D/10%T fuelling. 1.29 mg CTs are injected at a rate of 50 Hz (in order to synchro-

nize with the European power grid) and a speed of 300 km s^{-1}. A new six-degree-of-freedom model of CT trajectory in the tokamak is developed and applied to the proposed injector design. The fueller is intended to work in parallel with the 500 Pa m^3 s^{-1} edge gas puffing system and to replace the centrifuge pellet-injection system in the ITER (2001) reference design. Each injected CT adds only 0.68% to the plasma inventory, implying that the injection process will be non-disruptive. Power consumption will be approximately 15 MWe. The strengths of the design compared to the current pellet injection system are highlighted.

* This work is being supported by Queen's University

TU-A7-6 **12h15**

Generation of large scale structures in magnetized plasmas and geostrophic fluids*. **Andrei Smolyakov**, *University of Saskatchewan* — Two dimensional geostrophic fluids and magnetized plasmas have much in common so that Rossby waves in a shallow rotating fluid and drift waves in a magnetized plasma are often described by equations that have similar structure. It has been shown that small scale drift wave turbulence is unstable with respect to a long wavelength instability. As a result the propagation of wave packets formed by a background small scale turbulence is accompanied by the generation of low frequency long wavelength structures. We discuss the generic mechanism of this instability and its applications to the generation of shear flows in atmospheres of rotating planets and magnetized plasmas.

* This work is being supported by NSERC Canada

TU-A7-7 **12h30**

Magnetorotational instability in rotating conducting fluid*. **Ivan Khalzov** [1], Andrei Smolyakov[1], Victor Ilgisonis[2], [1]*University of Saskatchewan, Saskatoon, Canada*, [2]Kurchatov Institute, Moscow, Russia — Magnetorotational instability (MRI) – the instability of conducting fluid, rotating in magnetic field – is one of the most important processes in astrophysics. MRI is believed to be responsible for both angular momentum transport in numerous astrophysical objects (accretion disks, active galactic nuclei) and formation of magnetic field in stars and planets (magnetic dynamo). Great potential importance of MRI for astrophysics and its intensive theoretical studies naturally led to the efforts to simulate this instability in a laboratory experiment. Development of simple and effective experiment for observation of magnetorotational instability in laboratory is a problem of current importance. In our presentation we review the recent progress in this area and discuss the possibility of experimental detecting of MRI. Our main results are obtained for the experimental setup with electrically driven liquid metal flow in transverse magnetic field. The results include: numerical simulations of liquid metal flow structure in circular channel at the stationary state; analysis of spectral stability of stationary state (including non-axisymmetric modes with $m \neq 0$); examples of calculations of 2D nonlinear dynamics at different values of Hartmann and Reynolds numbers.

* This work is being supported by NSERC

12h45 **Session Ends** / *Fin de la session*

[TU-A8] Atmospheric Processes of Climate Change III / *Processus atmosphérique et changements climatiques III*

(DASP / *DPAE*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 11h45

ROOM / SALLE Geol. 155 (70)

Chair: A.H. Manson, ISAS/University of Saskatchewan

TU-A8-1 **10h00**

DYLAN JONES, University of Toronto

Space-based constraints on the global transport of pollution in the troposphere †,*

The recent satellite observations of trace gases in the troposphere provide a unique opportunity to obtain a better understanding of the impact of pollution on the composition of the global atmosphere and how changes in atmospheric composition, in turn, will influence air quality and climate. In this context, an improved description of the processes controlling ozone in the troposphere and lower stratosphere is critical as ozone in the lower troposphere is a harmful pollutant, while ozone in the upper troposphere and lower stratosphere (UT/LS) is an effective greenhouse gas. We have assimilated observations of O_3 and CO from the TES instrument, as well as observations of CO from MOPITT, in a global chemical transport model. In this presentation we examine the constraints that the satellite measurements provide on the pathways for transport of continental pollution to the global atmosphere, with a particular focus on the impact on tropospheric O_3 of pollution from biomass burning in the tropics and the boreal regions. We also examine the influence of tropospheric pollution on ozone in the lower stratosphere. Deep convective transport provides an effective means for injection of pollution into the UT/LS and assimilation of the satellite measurements enables us to better quantify this input of pollution into the lower stratosphere.

† In collaboration with Mark Parrington [1], Kevin Bowman [2], Brian David MacKenzie [1], John Worden [2], [1] University of Toronto, [2] Jet Propulsion Laboratory

* This work is being supported by CFCAS, NSERC

TU-A8-2 **10h45**

Stratospheric Sulphate Aerosols as Measured by OSIRIS on Odin*. **D.A. Degenstein**, A.E. Bourassa, *University of Saskatchewan* — Measurements of limb scattered sunlight at optical wavelengths made by the OSIRIS instrument on the Odin satellite are used to obtain global coverage of the vertical profile stratospheric aerosol extinction. Comparisons with extinction measured by SAGE II and SAGE III show agreement to within 15% throughout the lower stratosphere. As such these limb scatter measurements can be used to extend long-term trends in stratospheric aerosol. Distributions of the aerosol extinction measured by OSIRIS show features of stratospheric circulation, including evidence of the tropical stratospheric reservoir and a dependence on the phase of the quasi-biennial oscillation.

* This work is being supported by NSERC and CSA

TU-A8-3 **11h00**

The OSIRIS Ozone Database Created with the SASKMART Processing Code*. **C.Z. Roth**, D.A. Degenstein, *University of Saskatchewan* — The OSIRIS instrument that is currently in operation on the Odin spacecraft has made routine measurements of limb scattered sunlight since November, 2001. This paper presents the ozone number density database made using the OSIRIS measurements and the SASKMART retrieval technique. This OSIRIS climatology and its utility for studies in both the polar regions and the UTLS will be discussed in this paper.

* This work is being supported by NSERC and the Canadian Space A

TU-A8-4 **11h15**

A case study of a tropopause folding event observed by OSIRIS*. **N.D. Lloyd**, A. Gahein, D.A. Degenstein, *University of Saskatchewan* — A tropopause folding event occurred in Eastern Europe on April 3, 2004. A case study of this event is presented. The ability of OSIRIS to measure height profiles of ozone within the tropopause folding event is demonstrated.

* This work is being supported by NSERC and CSA

TU-A8-5 **11h30**

New Method for Sulfate $\delta^{17}O$ Measurements*. **Diana Mak**, Ann-Lise Norman, *University of Calgary* — Isotope analysis has been used in environmental studies and in particular, it has been used to determine the sources (anthropogenic or natural) of sulfate. Usually isotopic ratios of sulfur ($\delta^{34}S$) and oxygen ($\delta^{18}O$) of the sulfate samples are measured to obtain this information. Normally, due to the low abundances of the other isotopic ratios ($\delta^{33}S$, $\delta^{36}S$ and $\delta^{17}O$), these isotopes are assumed to fractionate mass-dependently and generally are not measured. However, recent studies have found some sulfate samples do not conform to the mass-dependant rule for oxygen ($\delta^{17}O \sim 0.52\ \delta^{18}O$). This anomaly provides further details in the oxidation pathways of sulfate. Current published methods for $\delta^{17}O$ measurements required thermal decomposition of sulfate samples to SO_2 and O_2 and analyzing both gases separately (SO_2 for $\delta^{34}S$ and O_2 for $\delta^{18}O$ and $\delta^{17}O$) using isotope ratio mass spectrometry (IRMS). An alternate method to obtain these values is proposed that concurrently uses SO_2 gas only. Assumptions made about sulfate samples are a) oxygen is uniformly distributed in the sample and b) sulfur fractionates mass-dependently. The method requires isotopic measurements of $^{64}SO_2$, $^{65}SO_2$ and $^{66}SO_2$ and application of mass fraction equations to determine the δ values for the sulfate sample which, in turn, provides a value for the oxygen anomaly ($\Delta^{17}O = \delta^{17}O_{mea} - 0.52\ \delta^{18}O$).

* This work is being supported by NSERC

11h45 **Session Ends / *Fin de la session***

[TU-A9] (DAMPhi / *DPAMIP*) Atomic and Molecular Spectroscopy and Dynamics II / *Spectroscopie et dynamique des atomes et molécules II*

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h30

ROOM / SALLE Biol. 106 (250) ***Chair: R.I. Thompson, University of Calgary***

TU-A9-1 **10h00**

WLADYSLAW KEDZIERSKI, University of Windsor

Studying Electron Collisions Using a Magneto-Optical Trap †,*

A new Magneto-Optical Trap, designed specifically for electron impact experiments, is described. Experimental results for electron impact total cross sections, involving 6 ^{2}S ground state Cs, are presented for electron energies between 5eV and 200 eV [1]. Also, experimental results are presented for electron impact total ionization cross sections (TICS) for ionization of the 6 ^{2}P excited Cs atom, between 7eV and 400eV [2]. The experimental results are compared with new theoretical calculations [2].
References: [1] M. Lukomski, J.A. MacAskill, D.P. Seccombe, C. McGrath, S. Sutton, J. Teeuwen, W. Kedzierski, T.J. Reddish, J.W. McConkey and W.A. van Wijngaarden, *J. Phys. B: At. Mol. Opt. Phys.*, **38**, 3535-3545, 2005; [2] M. Lukomski, S. Sutton, W. Kedzierski, T.J. Reddish, K. Bartschat, P.L. Bartlett, I. Bray, A.T. Stelbovics and J.W. McConkey, *Phys. Rev. A*, **74**, 2006

† In collaboration with J.W. McConkey [1], T.J. Reddish [1], W.A. van Wijngaarden [2], K. Bartschat [3], P.L. Bartlett [4], I. Bray [4], A.T. Stelbovics [4], M. Lukomski [5], J.A. MacAskill [6], C. McGrath [7], D.P. Seccombe [1], [1] University of Windsor, [2] York University, [3] Drake University, Des Moines, Iowa, [4] The ARC Centre for Antimatter-Matter Studies, Murdoch University, Perth, [5] Instytut Fizyki, Uniwersytet Jagiellonski, Krakow, Poland, [6] Jet Propulsion Laboratory, California Institute of Technology, [7] Northern Ireland Regional Medical Physics Agency, Royal Victoria Hospital

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

TU-A9-2 **10h30**

Exploring quantum statistics with ultracold neutral atoms*. **Lindsay J. LeBlanc** [1], Marcius H.T. Extavour [1], Jason McKeever [1], Amir Mazouchi [1], Alma Bardon [1], Dylan Jervis [1], Seth Aubin [2], Thorsten Schumm [3], Alan Stummer [1], Joseph H. Thywissen [1], [1] *University of Toronto*, [2] College of William and Mary, [3] Atominstitut der Österreichischen Universitäten — Using neutral atoms that have been cooled to quantum degenerate temperatures, we are able to study the effects of quantum statistics. We explore the nature of both Bose and Fermi statistics with ^{87}Rb, a boson, and ^{40}K, a fermion. By cooling the ^{87}Rb to ultracold temperatures, we observe Bose-Einstein condensation (BEC), while with ^{40}K we see the effects of Fermi pressure. Our "atom chip" experiment provides flexibility around creating unique trapping potentials and we use this to create a double-well structure with radio-frequency dressed potentials. By coherently splitting a degenerate cloud of atoms into these two wells, we observe the fluctuations in the phase between the two clouds, and we are currently exploring the conjugate fluctuations in number. We expect to see sub-poissonian statistics in the fermionic samples due to Pauli exclusion. Radio-frequency manipulation allows us to create species-specific magnetic potentials, where we can selectively deform the trap for one species and not another. A recent addition to the experiment is an optical trap, where atoms are trapped due to an induced dipole moment. This trap allows for the study of states not trapped in a magnetic trap and the tuning of interactions between states and species through a magnetically tunable Feshbach resonance. Combining these tools with an optical lattice, these atomic systems will provide opportunities for the simulation of specific Hamiltonians found in condensed matter systems.

* This work is being supported by NSERC, CFI, CIAR, OIT, CRC,PRO

TU-A9-3 **10h45**

Slow photons as charged quasi-particles, and photonic Aharonov-Bohm effect*. **Karl-Peter Marzlin**, Juergen Appel, Alex Lvovsky, *University of Calgary* — Recently we have proposed the method of Raman Adiabatic Transfer of Optical States (RATOS) to manipulate the optical state of light [1]. In this method a four-level atomic medium in double-Lambda configuration is interacting with two pump fields and a signal photon, which can be in a superposition of two modes with different frequencies. Depending on the intensity of the pump fields, only a particular superposition will experience electromagnetically induced transparency and thus can be slowed down. An adiabatic change in time of the pump fields can then change this superposition dynamically. Here we theoretically analyze the influence of an adiabatic change in the spatial form of the pump fields. We demonstrate that the signal photon then behaves like a charged quasi-particle: in paraxial approximation its dynamics is governed by a Schroedinger-like equation that includes a scalar and a vector quasi-potential whose form is determined by the shape of the pump fields. We suggest pump field configurations that generate potentials corresponding to a constant electric and a constant magnetic quasi-field and show that the magnetic quasi-field suppresses spatial dispersion of the signal

photon. Furthermore we devise a scheme of pump fields that generates a vector potential of Aharonov-Bohm type. This induces a topological phase shift on the signal field. Reference: [1] J. Appel, K.-P. Marzlin and A.I. Lvovsky, *Phys. Rev. A* **73**, 013804 (2006).

* This work is being supported by iCORE, NSERC, AIF, CIAR

11h00 Coffee Break / *Pause café*

TU-A9-4 11h15

Lanthanide fluorescence induced by radioluminescence. **René Roy**, Donald A. Peyrot, Roger A. Lessard, *Université Laval* — Two processes explain radioluminescence of organic and inorganic materials. Exposition of organic materials to ionising particles leads to the excitation of the molecules of the matrix. The relaxation leads to photons emission. In the case of the inorganic materials a self-trapped exciton (STE) propagates in the crystal until it reaches and excites an impurity; the relaxation of this impurity may be radiative. We observed that lanthanides (ErIV or NdIV) doped materials (porous or ED2 glasses) show some characteristic emission rays. The spectra are quite similar to the expected ones for inorganic materials, while these materials are organic. We developed a model explaining how the radioluminescence of the organic materials excites the lanthanide ions, and then the observed radioluminescence emission spectra can be explained by the Judd-Ofelt theory. Several materials have been studied: erbium doped porous glass (ErIV:PG), neodymium doped ED2 glass (NdIV:ED2), and also a sample of titan sapphire (Ti:Sa) as a comparison sample for inorganic materials. These samples have been exposed to H_2^+, $^4He^{++}$, $^{12}C^{++}$ ions accelerated up to 4.1MeV with a Van de Graaff accelerator. The emission spectra have been measured and a study of the luminescence lifetime of the material has been made. These observations allow us to conclude that the lanthanide ions are well excited by the standard radioluminescence of the undoped material. All these results will be presented and discuted.

TU-A9-5 11h30

High Accuracy Near-Infrared Spectroscopy of Carbon Dioxide for Atmospheric Applications*. **Adriana Predoi-Cross** [1], Anildev Vasudevan [1], Weiming Liu [1], Ian Schofield [1], Robert McKellar [2], William Neil [2], Daniel Hurtmans [3], [1] *University of Lethbridge, Physics Department, Lethbridge, AB, TIK 3M4, Canada* , [2] Steacie Institute for Molecular Sciences, National Research Council of Canada, Ottawa, ON, K1A 0R6, Canada, [3] Universite Libre de Bruxelles, Chimie Quantique et Photophysique, B-1050 Bruxelles, Belgium — The management of greenhouse gas emissions relies on having accurate measurements of their sources, sinks and balance of fluxes. Our spectroscopic results will enable accurate monitoring of tropospheric carbon dioxide through spectroscopic remote sensing in the 1.6 microns spectral range. In this spectral region the sun's output is nearmaximum, but the thermal emission from the ground is negligible. To exploit the advantages of near-infrared wavelengths, new global networks of up-looking ground-based Fourier transform spectrometers are being set up by others to record atmospheric spectra on a long term basis. In order to meet the requirements of current satellite remote sensing instruments, our laboratory Fourier transform measurements were performed with increased attention to details not usually considered in laboratory work and its analysis. These spectroscopic results may be used in the validation of data received by the OCO (Orbiting Carbon Observatory) satellite instrument. Our multispectral analysis of high signal-to-noise, high resolution near infrared spectra of the CO_2 30013 ← 00001 and 30012 ← 00001 bands shows that line mixing of spectral lines may be required to determine accurate line shape parameters for polyatomic molecular spectra used in high-sensitivity atmospheric retrievals.

* This work is being supported by NSERC, BIOCAP

TU-A9-6 11h45

New Terahertz Database of Astrophysical Interest: Methanol (CH_3OH & $CH_3{}^{18}OH$)*. **Li-Hong Xu** [1], Jonathan Fisher [1], Gregory Paciga [1], Hongyu Shi [1], Ronald M. Lees [1], John C. Pearson [2], Brian J. Drouin [2], [1] *University of New Brunswick, Saint John*, [2] Jet Propulsion Laboratory, California Institute of Technology, Pasadena — Methanol is an important interstellar molecule that was discovered in interstellar space in ~1970 and is abundant in a wide variety of astronomical sources. Because of the torsional motion, the methanol spectrum is extremely complex and represents a significant challenge for global modeling. Previous successful modeling efforts for CH_3OH treated the first two torsional states up to $J_{max} = 20$. Based on the model parameters, a microwave line list was compiled at that time which proved very useful for the radio astronomy community, and there have been calls for further extensions both in rotational and torsional quantum states. With major space missions and new telescopes coming on line in the near future, there are increased demands for methanol data both in terms of quality and quantity. For this reason, we have recently carried out systematic global modeling for CH_3OH and $CH_3{}^{18}OH$ including the first three torsional states up to $J_{max} = 30$. This represents a 50% increase in torsional and rotational coverage, and includes a large body of precision frequency measurements as well as Fourier transform data. Based on the global fit results, databases have been compiled for both CH_3OH and $CH_3{}^{18}OH$ containing transition frequencies up to 3 THz, quantum numbers, lower state energies and transition strengths. The databases will provide support for present and future astronomical studies, such as the on-going Orion surveys in preparation for the forthcoming launch of HIFI (Heterodyne Instrument for the Far-Infrared) on board the Herschel Space Observatory, the flying of SOFIA (Stratospheric Observatory For Infrared Astronomy) and the commissioning of ALMA (Atacama Large Millimeter/Submillimeter Array).

* This work is being supported by NSERC, CSA, and NASA

TU-A9-7 12h00

Infrared diode laser spectroscopy of N_2O clusters. **Mehdi Dehghani** [1], Mahin Afshari [1], Ziad Ahmad Abusara [1], Nasser Moazzen Ahmadi [1], A.R.W. McKellar [2], [1] *University of Calgary*, [2] National Research Council of Canada — Following our observation of the polar dimer of OCS, we searched the region of the N-N stretching fundamental of N_2O using a tunable diode laser to probe a pulsed supersonic slit jet. In addition to the relatively strong ν_3 band of the centrosymmetric lowest energy isomer of N_2O dimer, we observed a weak band at around 2226.45 cm^{-1} which we have assigned to the higher energy polar isomer of N_2O dimer. 140 transitions from an a/b type hybrid band were assigned and fitted to a planar asymmetric top structure. Our lower state parameters should enable the observation of the microwave spectrum of polar $(N_2O)_2$. A trimer band of N_2O has also been assigned based on lower state combination differences from previously published works. In contrast to OCS where we have observed four tetramer bands, only one tetramer band around 2237.4 cm^{-1} has been found to date. This band is best described as an asymmetric top with an accidental spherical top structure. Isotopic studies of these bands are presently underway.

TU-A9-8 12h15

The lowest frequency vibrational fundamental of disilane: A three-band analysis*. **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 has been analyzed to investigate torsional mediated vibrational interactions. We have carried out a three-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 $3\nu_4$ and transitions restricted to $-21 <= k\Delta k <= 21$ in the ν_9 fundamental band. An excellent fit to the included data was obtained. Two interactions are identified, a resonant Coriolis interaction between the ν_9 torsional stack 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

12h30 Session Ends / *Fin de la session*

[TU-A10] (DASP / *DPAE*) Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling III / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace III*

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h15

ROOM / SALLE Phys 165 (150)

Chair: R.K. Choudhary, University of Saskatchewan

TU-A10-1 **10h00**

Simulation of electron acceleration and wave propagation in the low-altitude magnetosphere*. **Dmytro Sydorenko**, Clare E.J. Watt, Robert Rankin, Konstantin Kabin, *Department of Physics, University of Alberta* — The acceleration of electrons by shear Alfvén waves on geomagnetic field lines is important for energy transfer from the magnetosphere to the ionosphere. Wave parallel electric fields predicted by two-fluid MHD theory are too weak to explain observations of electron acceleration, and it is necessary to treat the electron response to the wave using kinetic theory. We have developed an explicit electromagnetic Vlasov code for the kinetic study of Alfvén wave-induced electron acceleration. The code resolves one spatial dimension along the field line and uses the drift-kinetic Vlasov equation to describe the electrons. Simulations with this code have shown that nonlinear self-consistent electron dynamics amplify the parallel electric field and intensify the resulting electron acceleration. Model results have been favorably compared with *in-situ* spacecraft observations and applied to the study of the magnetospheric region above the Alfvén speed maximum. The gap between the ionosphere and the Alfvén speed maximum forms a resonator, where electron acceleration and the ionospheric feedback instability may occur. The self-consistent investigation of electron dynamics in the ionospheric Alfvén resonator (IAR) is being investigated using a 2D implicit hybrid electromagnetic code. At present time, the code is implemented with cold fluid ions and electrons, in order to verify expected properties of the IAR when excited by a solitary Alfvénic pulse. In future work, the code will combine fluid ions with the drift-kinetic Vlasov equation for electrons.

* This work is being supported by NSERC

TU-A10-2 **10h15**

Open-Closed Separatrix Determination using Global Magnetospheric Simulation and Observational Data*. **Jonathan Rae** [1], Konstantin Kabin [1], Jianyong Lu [1], Robert Rankin [1], Frances R. Fenrich [1], James A. Wanliss [2], Stephen E. Milan [3], Tamas I. Gombosi [4], Darren L. De Zeeuw [4], Aaron J. Ridley [4], Kenneth G. Powell [4], [1] *University of Alberta*, [2] ERAU, [3] University of Leicester, [4] University of Michigan — The development of global magnetospheric models that can accurately predict space weather processes is of great importance in Space Physics. However, it is difficult to compare and contrast the output of these global models with observational data, due to the scant coverage of measurements. The boundary between open and closed flux represents an ideal geomagnetic boundary with which to compare these Global models with a variety of observational proxies of this open-closed field line boundary (OCB). Using the BATS-R-US Global MHD model, we investigate local and global comparisons of the observed data and BATS-R-US under both steady-state and time-varying solar wind and IMF conditions, respectively. We study a ~2 hour interval incorporating a southward turning of the IMF, and find that the MHD model responds significantly faster than the observed boundary. Finally, by incorporating the inner magnetospheric physics of the Rice Convection Model into BATS-R-US, we evaluate the success of comparing global observations and MHD models. Studies of the open-closed field line boundary can be extremely useful in providing contextual information for ground-based observations.

* This work is being supported by CSA/NSERC

TU-A10-3 **10h30**

Test kinetic calculations as a tool for assessing model self-consistency*. **Richard Marchand**, *University of Alberta* — Space and laboratory plasmas are modelled with a variety of tools ranging vastly in complexity. Different approaches typically focus on different aspects of the physics and geometry of a problem. For example, fluid models based on an ideal MHD, Hall MHD, multi-fluid or multiple moment formulation of the system, are routinely considered to describe complex systems in three dimensions, while accurately accounting for their geometry and numerous physical processes. Another general approach uses a more rigorous kinetic description of the plasma. While being more detailed and accurate on the microscopic scale this approach has, thus far, been limited to systems with relatively simple geometries and physical processes. The test kinetic approach presents an interesting means of obtaining a first order description of the kinetics of particles, given an approximate solution obtained from a fluid model. The method relies on Liouville's theorem and on the integration of particle trajectories backward in time to calculate the particle distribution function at arbitrary positions in space and time. This approach is well suited for problems in which there exist well defined source regions, in which the distribution function is known, and from which all particles can be traced. In addition to providing a first estimate of particle kinetic effects, the test-kinetic method is useful in assessing the consistency of various macroscopic models. A general presentation of the test-kinetic method is made, and example results are given to illustrate its application to simple physical problems.

* This work is being supported by NSERC

TU-A10-4 **10h45**

Automated Forward Modelling and its Results for Substorms and Sawtooth Events*. **Martin Connors** [1], Gordon Rostoker [2], Robert McPherron [3], Tung-Shin Hsu [3], Jason Ponto [1], [1] *Athabasca University*, [2] University of Alberta, [3] UCLA — Automated Forward Modeling (AFM) inverts magnetic data to give physical parameters associated with electrojets and field-aligned currents. In a mode where data along a meridian is used, we show agreement between AFM parameters and those arising in other inversion techniques. Use of AFM parameters can have advantages even in that case, allowing correlative studies. AFM can be extended to model electric currents as detected by magnetic perturbations over scales from sub-continental to global, thus bridging a gap between meridian techniques and global models such as AMIE. Characteristic behaviors of substorms are readily seen in AFM output: the current strengthens rapidly and moves poleward at expansive phase onset, following a growth phase with equatorward motion. Average susbtorms show current increase for about 30 minutes to about 0.5 MA across the midnight meridian, and poleward border expansion progresses slightly faster. Recovery is accompanied by a current decrease, but, surprisingly, no poleward retreat of the auroral oval on up to a two-hour timescale. Average strength of the current closely follows that of the average AL index, and electrojet boundary motion is similar to that deduced for the electron aurora from satellite studies. Complete growth-expansion-recovery cycles of activity are absent in sawtooth events, and currents can reach 5 MA or more. We find that the extent of the electrojets in latitude becomes very large in sawtooth events, which the AE-type indices cannot reveal. Sawtooth events appear to lack a recovery phase, and this may be associated with strong ongoing solar wind driving.

* This work is being supported by NSERC, Canada Research Chairs

11h00 **Coffee Break / *Pause café***

TU-A10-5 **11h15**

Non-Classical Features of the Polar Wind*. **Andrew W. Yau** [1], Takumi Abe [2], William K. Peterson [3], [1] *University of Calgary*, [2] JAXA/ISAS, [3] University of Colorado — The polar wind is an ambipolar outflow of thermal plasma from the high-latitude ionosphere. Satellite-borne ion composition observations above 1000 km altitude reveal

several important features in the polar wind that are unexpected from "classical" polar wind theories and attributable to several "non-classical" ion acceleration mechanisms. These include day-night asymmetry in velocity, appreciable O^+ flow at high altitudes, and significant electron temperature anisotropy in sunlit polar wind. Significant questions, which the CASSIOPE/e-POP mission plans to address, remain on the relative contribution of the different sources of the high-altitude O^+ polar wind and the relative importance between classical and non-classical ion acceleration mechanisms.

* This work is being supported by NSERC IRC Program

TU-A10-6 **11h30**

SuperDARN radio wave power distribution characteristics in the ionosphere from an ePOP perspective*. **R.G. Gillies** [1], G.C. Hussey [1], H.G. James [2], G.J. Sofko [1], [1] *University of Saskatchewan*, [2] Communications Research Center — The Super Dual Auroral Radar Network (SuperDARN) radars monitor high-latitude ionospheric convection by measuring coherent backscatter from field aligned irregularities. These radars transmit linearly polarized High Frequency (HF) waves. From basic magnetoionic radio propagation theory it is known that two modes of propagation exist in an ionized medium with an external magnetic field, the Ordinary (O) and Extraordinary (X) modes. The propagation characteristics of the modes are significantly different when the local plasma frequency is comparable to the frequency of the wave, such as can be the case for SuperDARN observations. When a SuperDARN radio wave encounters the ionosphere, it splits into the two propagation modes and the amount of power that couples with either mode is dependent on both the propagation geometry and frequency. Modelling has been performed to calculate the fraction of transmitted power that goes into either mode as a function of these two variables. It has been found that for normal poleward propagation, where the waves propagate essentially perpendicular to the external magnetic field, the X mode dominates. There are several benefits that result from this modelling, including: angle of arrival determination for SuperDARN echoes, better propagation models to determine echo locations, determination of scattering irregularity scale sizes, and a better understanding of propagating radio signals to be used in analysis of the transionospheric experiments associated with instruments like the Radio Receiver Instrument (RRI) in the enhanced Polar Outflow Probe (ePOP) instrument suite on the Canadian CASSIOPE small satellite.

* This work is being supported by NSERC, CSA

TU-A10-7 **11h45**

The Threshold-Temperature effect in spacecraft charging and the sheath structure around the e-POP satellite in low-polar-orbit conditions*. **John C. McMahon**, James G. Laframboise, *York University* — An issue in the layout of a satellite's instrument payload is ensuring that the location of the sheath edge with respect to the locations of its plasma instruments is understood and accounted for. The extent of the sheath is governed in part by the potential at which the satellite floats, which is determined by a balance between its collected and its emitted currents. The collected currents are comprised of ions and electrons. The emitted currents are the secondary and backscattered electron emission from the spacecraft surface materials and any photoelectric current. The potential of a spacecraft surface can change greatly with small changes in the local plasma environment. Knowing the "Threshold" or "Critical" Temperature for the spacecraft's surface materials allows for the prediction of the floating potential which the spacecraft will reach under various plasma conditions. (This Temperature is defined as that above which secondary and backscattered electron emission from a spacecraft surface is less than incident electron collection, for a thermal distribution of incident electron velocities.) A three-dimensional self-consistent computer code has also been developed to model the interaction between a satellite floating at some given potential and a drifting plasma. We present results of charging calculations and the resultant sheath structure for the e-POP satellite in polar orbit under various plasma conditions between 350 and 1500 km altitude.

* This work is being supported by NSERC e_POP CRO grant

TU-A10-8 **12h00**

Proposed satellite radar instrument for top-side observations of the terrestrial ionosphere. **Glenn Hussey** [1], Gordon James [2], George Sofko [1], [1] *University of Saskatchewan*, [2] Communications Research Centre — There have not been any top-side soundings of the ionosphere since the termination of ISIS II sounder in the early 1990s. ISIS II collected high quality soundings during its approximately 20 years of operation since its launch in 1971. Previous to this the Alouette and ISIS I satellite missions had the most notable top-side sounding observations. Unfortunately the Alouette/ISIS data were recorded on film and due to archival issues the vast majority of these data has been lost. A new instrument with modern instrumentation and data storage would supply never before available uniform and complete global coverage of the top-side ionosphere on a regular basis. These observations would give better understanding of the structure and physics of the top-side ionosphere globally, complement tomography and TEC measurements make by GPS receivers or other radio beacon experiments, contribute to the IRI (International Reference Ionosphere) model, for example. Such a proposed instrument could also operate as a coherent scatter radar and such observations have rarely, if ever, been observed from a satellite platform, although they are routinely observed with ground-based radar systems such as the SuperDARN HF radars. Global coverage of rarely observed coherent backscatter from topside phenomena such as field aligned currents (FACs), ion beams, ion conics, density cavity depletions, equatorial bubbles, equatorial spread-*F*, for example, would provide new detailed observations. The Radio Receiver Instrument (RRI) experiment on the ePOP scientific payload of the upcoming CSA (Canadian Space Agency) CASSIOPE satellite mission has been the inspiration for this proposed satellite radar instrument.

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

[TU-A11] (CAP / *ACP*) Establishing a Successful Public Outreach Program I / *Établir un programme pour rejoindre le public avec succès I*

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h30

ROOM / SALLE Arts (143 (200)

Chair: W.F. Davidson, National Research Council Canada

TU-A11-1 **10h00**

BRIAN ALTERS, McGill University

Evolution & Intelligent Design Creationism: Big Failures of Science Outreach

The most important aspect of science outreach is helping the public understand the nature of science. Unfortunately, an alarming portion of North Americans so misunderstand science that they believe evolution is scientifically inaccurate, and that supernatural explanations are (or should be) a part of science and should be taught as part of science in schools. Last year, Brian Alters was the only Expert Witness from Canada in the largest, most important, and highest profile federal trial on science education in the past quarter-century. It was the landmark U.S. Federal case on the teaching of intelligent design versus evolution in public schools (aka: The Dover Pennsylvania Case, Scopes II, and Kitzmiller). The judge cited Professor Alters' testimony 20 times in his written verdict. Dr. Alters holds the Tomlinson Chair in Science Education, Faculty of Science, McGill University. He is also an associate member of the Harvard-Smithsonian Center for Astrophysics. He is the author of five books.

TU-A11-2 **10h30**

BILL PETERS, Canadian Association of Science Centers

The Joys and Challenges of Outreach

Funders are increasingly pressing for "outreach" as are university and laboratory administrators who see it as part of reputation building. All parties see it as an essential component of increasing public understanding, yet a member of the public's interests and needs for information may vary wildly from what a donor or administrator or scientist may want to convey. How do we deal with these forces, the costs and the time demands of outreach? How do we give it real "reach" so it is impactful and gets to lots of people? What are the options and ideas for giving wings to connection between our passion for knowledge and the needs and interests of the public? This session explores some experiences with outreach and will inspire discussion and dialogue to help all participants advance their efforts in this area.

TU-A11-3 **10h45**

NORMAND MOUSSEAU, Université de Montréal

Science! on blogue. Commentaires sur 2 ans de blogue scientifique

L'expérience de «Science! on blogue» a été lancée par l'Agence Science-Presse à l'automne 2005. Il s'agissait de permettre à des scientifiques en physique, en astronomie, en sciences de l'environnement et en génétique de s'exprimer librement sur un même site. Devant le succès de l'initiative, deux autres blogues ont été ajoutés sur l'histoire des sciences et la science sceptique. Participant à ce blogue depuis le début, je compte le présenter et discuter un peu de ma propre expérience.

TU-A11-4 **11h00**

MARGE BARDEEN, Fermilab

Education and Outreach at Fermilab: Ideas from the Field

What are the origins of mass? What are neutrinos telling us? Do all forces become one? What is dark matter? These and other questions can grab the attention of teachers and students, the family next door and the man in the street. We discuss what we have learned from 27 years of experience offering education programs. Ideas are adaptable for research labs and physics departments large and small.

TU-A11-5 **11h15**

EMIL HALLIN, Canadian Light Source

Outreach at the Canadian Light Source

Outreach has been an important part of the CLS development since the project began some eight years ago. An early goal of the outreach was to establish a presence for synchrotron based science in the secondary school curriculum, and tremendous progress has been made in this direction. In addition, the synchrotron is working to solidify its presence in the undergraduate curriculum at our host university, and some work has been done to bring our outreach into the local schools at much younger levels. An introduction to the outreach program and its initial philosophy is presented here.

11h30 **Discussion Break**

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

[TU-A12] Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling IV / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace IV*

(DASP / *DPAE*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
10h00 - 12h15

ROOM / SALLE Phys. 103 (145)

Chair: G.C. Hussey, University of Saskatchewan

TU-A12-1 **10h00**

JEAN-PIERRE ST-MAURICE, University of Saskatchewan

PolarDARN: a new window on magnetospheric processes at very high latitudes †,*

The new PolarDARN HF radar located in Rankin Inlet at 73.2 magnetic latitude has been in operation since mid-May 2006. The radar bore-sight is in the magnetic pole direction. The radar is functioning extremely well. For instance, there are many instances of echoes registered simultaneously on both sides of the polar cap, for instance during merging events on the dayside while the radar is positioned on the nightside. In addition, ionospheric scatter is sometimes observed over a very large portion of the polar cap, offering during such occasions an unprecedented window on that region with, a 1 min time resolution. In spite of the extremely quiet solar wind conditions during the first year of operation, the radar has had superior occurrence statistics, particularly during late fall conditions when, contrary to other SuperDARN radars, ground scatter all but disappeared to be replaced by ionospheric scattering instead. The initial results point to a very dynamic polar cap even during periods for which the interplanetary magnetic field (IMF) is small. We have also uncovered that the polar cap convection is extremely sensitive to the upstream solar wind driver and responds very rapidly to changing solar wind and IMF conditions.

† In collaboration with George Sofko, Kathryn McWilliams, Raj Kumar Choudhary, Alexandre Koustov, Jan Wild, Andre Dieter, Glenn Hussey, University of Saskatchewan

* This work is being supported by NRSEC

TU-A12-2 **10h30**

Space Weather - the Dark Side of Faradav's Law*. **Larry Newitt**, David Boteler, Donald Danskin, Peter Fernberg, Hing-Lan Lam, Lorne McKee, Larisa Trichtchenko, *Natural Resources Canada* — The phenomenon of electromagnetic induction described by Faraday's law figures extensively in modern technology. Any device that contains a transformer works because of it. On a grander scale Faraday's law allows the generation of electricity, its transmission over long, high-voltage lines and its transformation back to usable voltages. However, induction when and where it is not wanted is problematic. The large changes that occur in the geomagnetic field during magnetic storms induce electric currents in power systems that can overload power transformers and disrupt power system operation. Any long conductor – telegraph lines,

transoceanic cables, pipelines – can be adversely affected by these unwanted geomagnetically induced currents. Induced currents are just one manifestation of space weather disturbances. An additional problem associated with magnetic disturbances is the increased flux of energetic particles that can damage satellites and disrupt radio communications. The train of events associated with a space weather disturbance will be illustrated through cases studies of classic events.

* This work is being supported by NRCan, CSA

TU-A12-3 11h00

Implications of Global SuperDARN Convection Measurements for the Selection Criteria of Steady Magnetospheric Convection Intervals. **J.B. Pfeifer** [1], K.A. McWilliams [1], R.L. McPherron [2], [1] *University of Saskatchewan*, [2] University of California Los Angeles — Intervals of Steady Magnetospheric Convection (SMC) are loosely defined as times when convection is enhanced and no substorm signatures are observed. Several quantitative definitions have been developed to detect SMC events. These methods make use of AE indices, IMF conditions, in situ magnetotail observations, and the size of the auroral oval. None of these methods, however, relies on directly measured convection, and SMC events are, by definition, a convection phenomenon. The SuperDARN radar network is an ideal tool with which to study SMC intervals because it gives a direct measurement of convection on a global scale. In this study we assess previous definitions of SMC using the SuperDARN global convection maps, and we present a modified method of SMC selection, using AE indices. O'Brien *et. al.* (GRL, 2002) presented a technique using the AE and AL indices to identify SMC intervals. Enhanced convection was quantified by a constant miminum AE cutoff value. Global SuperDARN convection maps for SMC events based on the O'Brien *at al.* technique revealed a seasonal dependence of the polar cap voltage for these SMC events, with lower voltages measured in the summer months. It is believed to be due to increased ionospheric conductivity in the summer, since AE is derived from ionospheric currents. Thus, equilavent AE values in winter and summer correspond to different levels of convection. Using a method that has a constant minimum AE cutoff therefore results in the selection of intervals that may not satisfy the qualitative criterion of enchanced convection, typical of SMC events. We found an optimal function to quantify enhanced convection, and this function varies throughout the year. By using this function, the seasonal dependance of conductivity on SMC interval selection is minimized. In doing so, the SMC event selection then becomes based primarily on convection.

TU-A12-4 11h15

PCN magnetic index and its relevance to convection studies in the polar cap*. **Alexandre Koustov**, Robyn Fiori, *University of Saskatchewan* — The PCN magnetic index was introduced ~20 years ago to quantify the magnitude of the merging electric field. The index is derived from magnetometer data collected at the Thule station in Greenland (MLAT=85.4°). In the past, several attempts have been made to check the reliability and relevance of the PCN index for various conditions in the IMF but evaluations have been made by using highly averaged electric field data. In this study we compare Rankin Inlet PolarDARN radar velocity measurements in localized regions with PCN indices to evaluate the degree of correlation between the local velocity in various parts of the polar cap and the PCN. We show that the PCN index and radar velocities have the best correlation in the noon and midnight sectors with a correlation coefficient of ~0.7. The correlation seems to change with season, being better in the summer than the winter. We also present examples illustrating that the relationship between the PCN index and polar cap convection is complex and depends on the IMF conditions.

* This work is being supported by NSERC

TU-A12-5 11h30

Introduction of an analysis tool for observations of the Near-Earth space*. **Robyn Fiori**, David Boteler, Gerry Haines, Donald Danskin, David Calp, *Geological Survey of Canada* — The King Salmon SuperDARN radar regularly observes high-velocity flows (up to ~2000 m/s) in its most L-shell aligned beams. Such flows are located from 60-65^0 MLat in the 16-23 MLT sector. By examining two substorm events on December 5 and 15, 2001, we will show that there are two basic scenarios of fast flow formation. In the first scenario, velocity is enhanced at all auroral latitudes, and the greatest velocities are observed westward and equatorward of the auroral bulge near the substorm onset time. During the substorm expansion phase the enhanced convection moves eastward and equatorward. In the second scenario, velocity is significantly enhanced at the equatorward edge of the auroral oval. This occurs as the most intense auroral luminosity progresses poleward, leaving regions of low conductivity in the low latitude auroral and subauroral regions where the velocities form. This scenario is the most reminiscent of the traditional SAPS and we refer to these flows as being SAPS-like.

* This work is being supported by CSA

TU-A12-6 11h45

Using Riometers to investigate space weather*. **Donald Danskin** [1], David Boteler [1], Emma Spanswick [2], Eric Donovan [2], [1] *Natural Resources Canada*, [2] University of Calgary — Riometers have been typically used to measure ionospheric absorption in the D region due to particle precipitation events especially during substorms in the night sector. However, D-region absorption may also be caused on the dayside due to X-ray flares. Also polar cap absorption (PCA) events occur due to energetic protons emitted from the Sun. PCAs can last for many days and can obscure radio frequency (RF) communication especially in the high frequency (HF) band. Measurements of the absorption's spatial distribution show that absorption is maximized at auroral zone latitudes during periods of solar illumination. Absorption lessens in the night time period and at higher latitudes. In addition, Riometers can be used to identify periods of solar radio noise bursts (SRB). Type II and IV radio noise burst have often occurred during the creation of a coronal mass ejection (CME). The use of a large array of 30 MHz Riometers covering ~6 hours of local time, can quickly identify periods of common radio noise due to the spatially coherent nature of these bursts and the temporal and spatial distribution of absorption in the D region of the ionosphere.

* This work is being supported by Natural Resources Canada

TU-A12-7 12h00

Rapid Auroral Flow Intensifications in response to sudden increase in magnetic activity*. **D. Megan Gillies**, Jean-Pierre St.-Maurice, *University of Saskatchewan* — We have used SuperDARN radar data to study ionospheric convection when the geomagnetic activity suddenly picks up after a prolonged period of quiet conditions. Seven particularly clear events were studied. The bulk of the events were associated with shocks in the solar wind with one exception connected to a magnetic cloud event instead. In all cases, the sharp change in magnetic activity triggered an ionospheric response in the form of a Rapid Auroral Flow Intensification (RAFI). A RAFI is defined as a region where the ionospheric flow doubles from its ambient speed of around 1000 m/s to 2000 m/s or greater. RAFI's are also sometimes accompanied on their borders by regions of shears with extremely small spectral widths. The connection between RAFIs, solar wind parameters, and IMF conditions has been investigated. We will discuss the sets of circumstances that triggered RAFI's and the odd spectral widths associated with the shears.

* This work is being supported by NSERC

12h15 Session Ends / *Fin de la session*

[TU-DASP] DASP Business Meeting / *Réunion d'affaires DPAE*

(DASP / *DPAE*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
12h30 - 13h15

ROOM / SALLE Phys. 165 (137)

Chair: D.A. Degenstein, University of Saskatchewan

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

13h15 **Session Ends** / ***Fin de la session***

[TU-DMBP] DMBP Business Meeting / *Réunion d'affaires DPMB*

(DMBP / *DPMB*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
12h30 - 13h15

ROOM / SALLE Thor. 159 (80)

Chair: A. Pejović-Milić, Ryerson University

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

13h15 **Session Ends** / ***Fin de la session***

[TU-DOP] DOP Business Meeting / *Réunion d'affaires DOP*

(DOP / *DOP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
12h30 - 13h15

ROOM / SALLE Geol. 255 (48)

Chair: P. Ashrit, Université de Moncton

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

13h15 **Session Ends** / ***Fin de la session***

[TU-DTP] DTP Business Meeting / *Réunion d'affaires DTP*

(DTP / *DPT*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
12h30 - 13h15

ROOM / SALLE Phys. 127 (48)

Chair: M.B. Paranjape, Université de Montréal

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

13h15 **Session Ends** / ***Fin de la session***

[TU-PPD] PPD Business Meeting / *Réunion d'affaires PPD*

(PPD / *PPDT*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
12h30 - 13h15

ROOM / SALLE Thor. 124 (80)

Chair: A. Bellerive, Carleton University

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

13h15 **Session Ends** / ***Fin de la session***

[TU-DPP] DPP Business Meeting / *Réunion d'affaires DPP*

(DPP / *DPP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
12h30 - 13h15

ROOM / SALLE Biol. 125 (70)

Chair: T.W. Johnston, INRS-EMT

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

13h15 **Session Ends** / ***Fin de la session***

[TU-Plen3] Science Policy (Communication and Outreach with the Public II) / *La politique scientifique (La communication avec le public II)*

(CAP / *ACP*)

(Lawrence Krauss, Case Western University)

TUESDAY, JUNE 19
MARDI, 19 JUIN
13h30 - 14h10

ROOM / SALLE Arts 143/146 (504)

Chair: W.F. Davidson, National Research Council Canada

TU-Plen3-1 **13h30**

LAWRENCE KRAUSS, CWRU

Selling Science to Unwilling Buyers

You meet someone at a party and they ask what you do. You tell them you are a physicist. Quickly they change the topic. On the other hand, ask them whether they are interested in black holes, warp drives, or time travel, and they are fascinated. Most people perceive that they have little interest in physics, and yet at the same they are remarkably interested in many of the things that physics deals with. I will discuss some fun ways to overcome the former and exploit the latter, as well as discuss some of the challenges and obstacles to overcoming scientific illiteracy that come from the media and the political arena.

14h05 **Discussion Break**

14h10 **Session Ends / *Fin de la session***

[TU-P1] Quantum Optics, Information and Computation I / *Optique, informatique et calcul quantiques I*

(DOP-DAMPhi / *DOP-DPAMIP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
14h15 - 16h30

ROOM / SALLE Biol. 106 (250)

Chair: P. Ashrit, Université de Moncton

TU-P1-1 **14h15**

PAUL HALJAN, Simon Fraser University

Simulating Quantum Magnets with Trapped Ions *

Trapped ions are a promising experimental platform for preparing large amounts of quantum entanglement, eventually on a scale large enough for quantum computing applications. The laser and ion-trap technologies which have been developed so far offer the opportunity to apply them to more specialized and potentially less demanding applications in the short term. One of these applications involves using trapped ions and tailored laser-induced forces between them to perform 'quantum simulations' of designer Hamiltonians on the scale of tens of ions. The simulation of quantum systems represents an intriguing aspect of quantum information science; indeed, it provided one of the original motivations, put forward by Richard Feynman, for quantum computer development. In particular, laser-addressed arrays of ions are naturally adept at simulating networks of interacting spins, which can exhibit quantum magnetism analogous to familiar condensed matter models. The ultimate goal would be to reveal quantum fluctuations, correlations, and dynamics in a quantum magnet, all at the level of single atoms; measurements in the short term on small numbers of ions will provide a specific experiment framework with which to address several questions, including what the technical and fundamental limitations are to ion-trap simulation.

* This work is being supported by NSERC, CFI

TU-P1-2 **14h45**

Real Source Quantum Key Distribution Relays*. **Gina Howard** [1], Wolfgang Tittel [1], Barry C. Sanders [2], [1] *Institute of Quantum Information Science, University of Calgary*, [2] Quantum Information Science, University of Calgary — We have developed a model for relay-based quantum key distribution that incorporates multi-photon source events and dark counts at detectors. The model compares achievable quantum key distribution rates for configurations with different numbers of segments over a range of distances. Different photon source distributions and dark count rates are compared for given configurations to ascertain the impact of the source and detector imperfections on secure key rates.

* This work is being supported by iCORE

TU-P1-3 **15h00**

Experimental Demonstration of Magic State Purification*. **Stephanie Simmons**, Adam Hubbard, Camille Negrevergne, Raymond Laflamme, *Institute for Quantum Computing* — Fault tolerant tranversal gates and the reliable preparation of some pure, non-stabilizer states such as 'magic states' can change the problem of general, universal quantum computation into that of fault-tolerant circuits. These 'magic states', and the ability to reliably produce them are therefore of significant interest. Under protocols detailed by Bravyi and Kitaev, magic states within a given threshold purity factor can be purified, and this purification asymptotically approaches a pure 'magic' state. As a proof of concept, we experimentally demonstrate this purification procedure in liquid state NMR. The experimental results provide a picture of the procedural control required to implement such magic state purification in NMR systems.

* This work is being supported by University of Waterloo

TU-P1-4 **15h15**

Quantum Dynamics of an Atom trapped in a Lattice*. **Charles Meunier**, Daniel F.V. James, *University of Toronto* — The control of the quantum dynamics of atoms trapped in an optical lattice poses a challenging problem whose solution would help get us closer to realizing a quantum computer. A model, valid for a potential sufficiently deep, of the quantum dynamics of an atom trapped in a one-dimensional lattice displaced by a time-dependent function s(t) is presented. Different displacement functions are considered to obtain an effective π-pulse driving the atom from the ground state to the first-excited state. The lattice well can support three bounded states which are described by Mathieu functions. To simplify the calculations, the wave functions of the system are decomposed as summations of Hermite-Gauss wave functions where the coefficients are obtained by first-order perturbation theory. The equations of evolution of the system are obtained and solved analytically whenever possible. Numerical work allows the calculation of the fidelity of the π-pulse.

* This work is being supported by NSERC

TU-P1-5 **15h30**

A New Approach to Mutlipartite Squeezed States*. **Zahra Shaterzadeh Yazdi**, Peter S. Turner, Barry C. Sanders, *University of Calgary* — An efficient technique to characterize complex linear quantum optical networks comprised by passive and active optical devices is the use of the symplectic Lie group, Sp(2n, R). Such optical networks play a significant role in the context of quantum information processing, and have been used in a variety of quantum schemes such as quantum teleportation [1] and quantum state/secret sharing [2]. In general, the operation of a multiport network of this type on a Gaussian input state can be described by Sp(2n, R) transformations, which preserve Gaussian states. The key tool in such quantum optical experiments is the generation and application of squeezed states. Recently, three-mode squeezed states have been produced in several quantum schemes. For characterizing such schemes, we have established a three-mode realization of SU(1, 1), which is a subgroup of Sp(6, R), and consequently the three-mode squeezed states are the coherent states of SU(1, 1). The elegance of this approach helps us to generalize it to multi-mode realizations of SU(1, 1), and to use them for characterizing any multiport quantum optical network constructed by concatenating sections, each with one two-mode squeezer and several passive optical devices. Such realizations give us a new insight into the interesting properties of the multimode squeezed states generated by any complex quantum optical network of this type. References: [1] N. Takei *et al.*, *Phys. Rev. A*, **72**, 042304 (2005). [2] A.M. Lance *et al*, *Phys. Rev. A*, **92**, 177903 (2004).

* This work is being supported by iCORE

TU-P1-6 **15h45**

Overcoming the su(2^n) sufficient condition for the coherent control of n-qubit systems*. **Renan Cabrera**, Chitra Rangan, William E. Baylis, *University of Windsor* — We study quantum systems with even numbers N of levels that are completely state-controlled by unitary transformations generated by Lie algebras isomorphic to sp(N) of dimension N(N+1)/2. These Lie algebras are smaller than the respective su(N) with dimension N^2-1. We show that this reduction constrains the Hamiltonian to have symmetric energy levels. An example of such a system is an n-qubit system. Using a geometric representation for the quantum wave function of a finite system, we present an explicit example that shows a two-qubit system can be controlled by the elements of the Lie algebra sp(4) (isomorphic to spin(5) and so(5)) with dimension ten rather than su(4) with dimension fifteen. These results enable one to envision more efficient algorithms for the design of fields for quantum-state engineering, and they provide more insight into the fundamental structure of quantum control.

* This work is being supported by NSERC

TU-P1-7 **16h00**

ALAIN HACHÉ, Université de Moncton

Towards a new type of photonic device †,*

Optical media with spatial periodicity exhibit photonic stop bands that are sensitive to structural faults and disorder. It was recently found, however, that the changes caused by disorder depend on whether the disorder is truly random or not. For a finite-sized periodic device, random fluctuations in the periodicity yield transmission patterns that are different than when fluctuations possess some degree of correlation, in which case the spatial coherence of the structure is not fully destroyed. Based on these properties, we propose a new type of optical device capable of measuring information content and randomness in a signal. I will discuss our theoretical framework, two versions of an experimental demonstration of the concept, as well as recent developments towards a compact optical device using periodic media doped with quantum dots.

† In collaboration with Normand Beaudoin [1], Serge Doiron [1], Christophe Giller [1], Kurt Busch [2], Marcus Diem [2], Lasha Tkeshelashvili [2], [1] Université de Moncton, [2] Universität Karlsruhe

* This work is being supported by NSERC, Canada Research Chairs

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

[TU-P2] Electroweak SM Tests II: Semi-Leptonic / *Tests électrofaibles du MS II: semi-leptoniques*

(DNP / *DPN*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
14h15 - 16h30

ROOM / SALLE Biol. 125 (70)

Chair: J.W. Martin, University of Winnipeg

TU-P2-1 **14h15**

VINCENZO CIRIGLIANO, Los Alamos National Laboratory

Low Energy Tests of the Standard Model *

After a brief introduction on the relevance of low-energy [illegible] the search for physics beyond the Standard Model. I will discuss status and perspective of a selected number of observables. In particular I will focus on tests of weak interaction universality through the study of leptonic decays of strange and non-strange hadrons ($K \to \pi\, l\, \nu$, $n \to p e \nu$, $\pi^+ \to \pi^0 e \nu$) and the consequent precision determination of the quark mixing parameters V_{ud} and V_{us}; (ii) the ratio of purely leptonic decays of pseudoscalar mesons ($R^P_{e/\mu} = \Gamma(P \to e\nu) / \Gamma(P \to \mu\nu)$, with P = $K^\pm$, $\pi^\pm$). Throughout, the emphasis will be on improving the Standard Model prediction for these processes by using effective field theory techniques.

WITHDRAWN

* This work is being supported by US DOE

TU-P2-2 **14h45**

MICHAEL GERICKE, University of Manitoba

Testing the Standard Model with Cold Neutrons: (The Nab Experiment) *

Neutron β-decay is one of the basic processes in nuclear physics. Its experimental study provides a sensitive means to evaluate the ratio of axial-vector to vector coupling constants $\lambda = G_A/G_V$. The precise value of λ is important in many applications of the theory of weak interactions. An independent measurement of λ is necessary in order to determine the $|V_{ud}|$ matrix element and test CKM unitarity from neutron lifetime measurements. Precise measurements of neutron β-decay correlation parameters offer redundant consistency checks, whose failure can be an indication of new physics beyond the Standard Model. The *Nab* collaboration has developed a method for a simultaneous measurement of the neutron decay parameters *a*, the neutrino-electron correlation, and *b*, the Fierz interference term, with a precision of a few parts in 10^3. The experiment will run at the Fundamental Neutron Physics Beam Line at the spallation neutron source (SNS) at Oak Ridge National Laboratory, USA. The experiment makes use of a high intensity, unpolarized pulsed cold neutron beam and requires a dedicated 4π spectrometer with combined electric and magnetic fields, and a set of Si detectors.

At the proposed accuracy level, parameter *a* can be used to constrain certain left-right symmetric models (L-R models) as well as leptoquark extensions to the SM. The latter would also be constrained by our measurement of *b*, which is sensitive to a tensor weak interaction that has often been linked to leptoquarks. I will give an overview of the experimental setup and briefly discuss the underlying physics.

* This work is being supported by NSERC, DOE, NSF

TU-P2-3 **15h15**

DAN MELCONIAN, University of Washington/CENPA

Nuclear beta decay and the CKM mass-mixing matrix *

The Cabibbo-Kobayashi-Maskawa (CKM) matrix parameterizes the rotation between the weak and mass eigenstates of the quark families. If the Standard Model of electroweak interactions is complete, then unitarity requires that the sum of the square of the top row of elements is unity, *i.e.* $|V_{ud}|^2+|V_{us}|^2+|V_{ub}|^2 = 1$. By far the largest element, V_{ud}, is known from measurements of the comparative half-lives, or *ft*-values, of the nine precisely measured $0^+ \rightarrow 0^+$ super-allowed β^+ decays. Within the nuclear physics community, many groups around the world have research programs aimed at improving the measurement of V_{ud}. Some are extending the number of cases of precisely measured superallowed decays; others are testing the theoretical corrections needed to extract V_{ud} from the $0^+ \rightarrow 0^+$ decays. The neutron represents another exciting opportunity to measure V_{ud} because the theoretical corrections are simpler to calculate in this three-quark system. I will discuss the current status of the unitarity test and some of the nuclear β-decay experiments in progress. As examples, I will present progress in the UCNA experiment using ultra-cold neutrons as well as an experiment involving ^{32}Ar as a test of the theoretical corrections applied to the super-allowed β decays.

* This work is being supported by the DOE

TU-P2-4 **15h45**

CHRIS JILLINGS, SNOLAB

From Neutrino Oscillations to Nonproliferation: the amazing utility of proton inverse-beta decay *

The use of inverse beta decay of the proton, $\nu_e + p \rightarrow n + e^+$, for studies of neutrino properties and other phenomena will be reviewed. Reines and Cowan used this reaction to detect neutrinos for the first time; KamLAND uses it to measure the neutrino mixing angle ϑ_{12}, the mass splitting Δm^2_{12} and to detect geoneutrinos – antineutrinos from the Uranium and Thorium decay chains in the earth's mantle and crust. This reaction is and will be used in many exciting experiments: SNO+ will use this reaction to measure geoneutrinos (while making many other measurements with different reactions) and Hanohano is proposing to deploy a KamLAND-like detector under the ocean near Hawaii to measure geoneutrinos. Hanohano will exploit the fact that oceanic crust contains little Uranium and Thorium and thus it is ideally situated to measure the integrated geoneutrino flux from the mantle of the entire earth. Two new experiments are being built to measure the small mixing angle ϑ_{13} using antineutrinos from reactors. The Double Chooz experiment in France is at the site of the original Chooz experiment will be sensitive to approximately $\sin^2(2\vartheta_{13}) > 0.03$ (90% confidence). The Daya Bay experiment at the Daya Bay reactor complex near Hong Kong will be sensitive to $\sin^2(2\vartheta_{13}) > 0.008$ (90% confidence). Both of these experiments use multiple detectors to normalize the antineutrino flux from the reactors. Prospects for use of this reaction in nuclear proliferation will be discussed.

* This work is being supported by CFI, OIT, NSERC, DOE, NSF

TU-P2-5 **16h15**

First results with the ALPHA antihydrogen apparatus. **Richard Hydomako** [1], Robert I. Thompson [1], Makoto C. Fujiwara [2], Dave R. Gill [2], Leonid Kurchaninov [2], Konstantin Olchanski [2], Art Olin [2], James W. Storey [2], Walter N. Hardy [3], Mike E. Hayden [4], Scott Menary [5], ALPHA Collaboration [6], [1] *Department of Physics and Astronomy, University of Calgary*, [2] TRIUMF, Vancouver, [3] Department of Physics and Astronomy, University of British Columbia, [4] Department of Physics, Simon Fraser University, [5] Department of Physics and Astronomy, York University, [6] CERN — Antihydrogen is the simplest atomic system composed entirely of antiparticles. It can be used to test the *CPT* theorem through the comparison of the antihydrogen and hydrogen spectra, as well as being necessary for the study of gravitational interaction with antimatter. The ALPHA (Antihydrogen Laser Physics Apparatus) project is an international collaboration based at CERN's Antiproton Decelerator facility with the goal of trapping and performing high-precision measurements on antihydrogen. ALPHA has constructed an innovative and versatile apparatus that combines the technologies of ion trapping (nested Penning traps to accumulate and mix the positrons and antiprotons) and atom trapping (a magnetic bottle to confine the antihydrogen atoms) with the difficulties of working with antiparticles. This talk will describe the ALPHA apparatus and its operation. Results will be given from the first run, including the demonstration of antihydrogen production in the new apparatus and the storage of charged antimatter plasmas in the octupolar magnetic trapping field [1]. Reference: [1] G. Andresen *et al.* (ALPHA Collaboration) *Phys. Rev. Lett.* **98**, 023402 (2007).

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

[TU-P3] Magnetic Systems / *Systèmes magnétiques*

(DCMMP / *DPMCM*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
14h15 - 16h15

ROOM / SALLE Geol. 155 (70) ***Chair: B.D. Gaulin, McMaster University***

TU-P3-1 **14h15**

BRUCE GAULIN, McMaster University

Frustrated and Satisfied Ground States in Pyrochlore Magnets

Geometrical frustration arises quite generally when pairwise interactions in magnetic materials are incompatable with their local geometry. This often involves magnetic materials made up of assemblies of triangles or tetrahedra. The frustration is manifest by disordered low temperature states for the magnetic material - some of which are described by spin liquids, spin glasses, and spin ice. I will discuss (mostly) neutron scattering work on two magnetic pyrochlores $Tb_2Ti_2O_7$ and $Ho_2Ti_2O_7$, which can be thought of as Ising-like moments decorating a network of corner-sharing tetrahedra. $Tb_2Ti_2O_7$ displays a spin liquid, or cooperative paramagnetic ground state, but can be brought to order in an applied magnetic field. $Ho_2Ti_2O_7$ displays a static disordered "spin ice" state at low temperatures.

TU-P3-2 **14h45**

The effect of significant surface spin disorder on the magnetism of gamma-Fe_2O_3 nanoparticles*. **Johan van Lierop**, Tyler Shendruk, Ryan Desautels, *University of Manitoba* — The magnetism of highly monodisperse 7 nm γ-Fe_2O_3 nanoparticle dispersions with interparticle spacings ranging from 70 to 100 nm has been examined. The single particle limit, where interparticle interactions no longer alter the magnetism, occurs when nanoparticles are more than 80 nm apart. These 7 nm γ-Fe_2O_3 nanoparticles exhibit a large surface magnetocrystalline anisotropy. Field-cooling the nanoparticles causes the single-domain cores of the nanoparticles to align with the field, while

the surface spins form a disordered shell. This results in a large exchange bias field whose temperature dependence is shown to originate from competition between partial spin alignment in this shell and the shell thickness.

* This work is being supported by NSERC and Univ. of Manitoba

15h00 Coffee Break / *Pause café*

TU-P3-3 15h15

Muon Spin Rotation/Relaxation Study of Ba_2CoO_4*. **Peter Russo** [1], Jess Brewer [2], Jun Sugiyama [3], Scott Stubbs [4], Kim Chow [5], [1] *TRIUMF*, [2] UBC/TRIUMF, [3] Toyota CRDL, [4] UBC, [5] University of Alberta — A positive muon spin rotation and relaxation (μ^+SR) experiment on the single crystal Ba_2CoO_4 indicates the existence of a magnetic transition occurring at ~25K. Weak transverse field measurements (wTF-μSR) show that the paramagnetic volume fraction of the sample decreases rapidly at the magnetic transition indicating a bulk effect which cannot be due to the presence of impurities. Zero field measurements (ZF-μSR) show the presence of a magnetically ordered state below 25K with three crystallographically inequivalent muon sites. Comparison and contrast with recent magnetic susceptibility measurements are discussed.

* This work is being supported by NSERC, NRC, CIAR, KEK-MSL

TU-P3-4 15h30

The Magnetic and Transport Properties of Single Crystal Manganites - Appearance of a Griffiths Phase*. **Gwyn Williams** [1], Wanjun Jiang [1], Xuezhi Zhou [1], H.P. Kunkel [1], Y.M. Mukovskii [2], D.A. Shulyatev [2], [1] *Department of Physics & Astronomy, University of Manitoba*, [2] Moscow Steel and Alloys Institute, Moscow 119991, Russia — Detailed magnetic and transport measurements on Colossal Magnetoresistance (CMR) single crystal $La_{1-x}Ca_xMnO_3$ (x=0.21) at the composition close to the boundary between the ferrometallic and ferromagnetic insulating ground state indicate the presence of Griffths phase. The Griffiths phase, characterize by both ac and dc inverse temperature dependent magnetic susceptibility exponent lower than unit at Random Curie Temperature T_C (209.2K) < T< T_G (254K).

* This work is being supported by NSERC

TU-P3-5 15h45

Polarized neutron reflectometry study on thin AuFe spin glass films*. **Mouna Saoudi** [1], Helmut Fritzsche [1], G.J. Nieuwenhuys [2], M.B.S. Hesselberth [3], [1] *Canadian Neutron Beam Centre, NRC*, [2] Paul-Scherrer-Institut, Villigen, Switzerland, [3] Leiden University, The Netherlands — Polarized neutron reflectometry (PNR) studies of a 10 nm, 20 nm, 50 nm and 500 nm thick $Au_{97}Fe_3$ film performed on the C5 spectrometer at Chalk River are reported. The magnetization is determined in a vertical magnetic field of 6 T in a temperature range from 295 to 2 K, using a split-pair cryomagnet. The temperature dependence of the magnetization indicates the same value of the magnetic moment (~ 0.37 μ_B per Fe atom) at 2 K independently of the film thickness. As our earlier PNR study on a 29 nm thick $Au_{93}Fe_7$ [1], the magnetization can be described with a Brillouin type behavior from 295 K down to 50 K, assuming the magnetic moment of isolated Fe atoms, *i.e.* 4 μ_B per Fe atom. This is in contrast to bulk measurements showing a saturation value of 2.8 μ_B per Fe atom [2]. Below 50 K, a strong deviation from that Brillouin type behavior of isolated atoms is observed for all investigated films. The onset of the spin glass behavior is clearly observed below 50 K where the magnetization at 6 T stays constant within the error bars. We do not observe any cusp at low temperatures as reported earlier on a 78 nm thick $Au_{97}Fe_3$ film [3]. References: [1] H. Fritzsche, M. Saoudi, K. Temst, C. Van Haesendonck, *Physica B* (accepted); [2] J.J. Smit, G.J. Nieuwenhuys, L.J. de Jongh, *Solid State Comm.* **32**, 233 (1979); [3] H. Fritzsche, J. Root, K. Temst, C. Van Haesendonck, *Physica B* **385-386**, 378 (2006).

* This work is being supported by NSERC visiting fellowship

TU-P3-6 16h00

Out-of-plane magnetization reversal in an (110)-oriented epitaxial ($ErFe_2$ / $DyFe_2$) Laves-phase superlattice. **Helmut Fritzsche** [1], Mouna Saoudi [1], Zahra Yamani [1], William Buyers [1], Roger Cowley [2], Roger Ward [2], [1] *National Research Council*, [2] Oxford Physics — We studied the magnetization reversal of a (110)-oriented (6 nm $ErFe_2$ / 6 nm $DyFe_2$) superlattice with unpolarized neutron diffraction and polarized neutron reflectometry in magnetic fields up to 7.5 T applied along the in-plane [1 – 1 0] direction at a temperature of 4 K and 100 K. The superlattice consists of two exchange-coupled hardmagnets with different easy axes. The crystal anisotropy favours the <111> directions as easy directions in $ErFe_2$, whereas the <001> directions are the easy axes for the $DyFe_2$ magnetization. By measuring the intensity of the (004) and (220) Bragg peaks during the reversal we could reveal that the magnetization of the (110)-oriented superlattice reverses by passing through the easy direction for $ErFe_2$ thin films, which lies between the [110] and [111] direction. By using Polarized Neutron Reflectometry we determined the magnetization profile and could distinguish between the magnetization of the $ErFe_2$ and $DyFe_2$ layers. So, we were able to measure element-specific hysteresis loops and could follow the magnetization reversal behaviour of the two layers independently.

16h15 Session Ends / *Fin de la session*

[TU-P4] General Plasma Physics / *Physique des plasmas*

(DPP / *DPP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
14h15 - 16h15

ROOM / SALLE Geol. 255 (48) ***Chair: T.W. Johnston, INRS-EMT***

TU-P4-1 14h15

Advances in Plasma Processing for Photonic Applications*. **Michael Bradley**, Marcel Risch, *University of Saskatchewan* — The ever-increasing demand for faster computer processing speeds and higher information bandwidths is putting continuous pressure on conventional CMOS chip architectures. One of the most promising ways around these obstacles is the development of hybrid optoelectronic/photonic chips. The fabrication of such chips and devices will require new types of materials processing techniques, many of which can be implemented with plasma technologies. The research group of Prof. Michael Bradley at the University of Saskatchewan is aggressively pursuing the photonics applications of a variety of advanced plasma processing techniques. Chief among these is plasma ion implantation using an ICP plasma source and a custom-designed advanced high-voltage modulator. In addition we have recently acquired a new plasma ion implantation machine funded by the CFI and designed and built by Plasmionique, Inc. of Varennes, QC. This talk will discuss the various plasma processing technologies used by my research group and the research program we are pursuing, which includes bandgap engineering efforts directed towards silicon-based photonics as well as work on direct-bandgap materials such as GaAs and GaN.

* This work is being supported by NSERC, CFI

TU-P4-2 14h30

Plasma ion implantation for band gap engineering of dilute $GaAs_{1-x}N_x$ alloys*. **Marcel Risch**, Michael Bradley, *University of Saskatchewan* — Dilute alloys of $GaAs_{1-x}N_x$ are important semiconductors for short wavelength photonic devices having band gaps between 1.42eV for Gallium Arsenide (GaAs) and 0.95eV for $GaAs_{0.955}N_{0.045}$.

Growing those alloys conventionally is costly due to a large lattice mismatch. Low dose nitrogen ion implantation into GaAs is a promising method to manufacture a thin film of 70nm width below the surface featuring the desired band gap. We implant the ions at various energies to tailor a trapezoidal concentration distribution with a concentration plateau at x, the percentage of nitrogen in the alloy. In order to predict this depth profile, we obtained the plasma parameters using a Langmuir probe and calculated the dose of the ions impinging the sample. Data of the Monte Carlo simulation SRIM is used to obtain a prediction of the concentration as a function of the depth. The band gap and the width of the tailored layers will be characterized experimentally.

* This work is being supported by NSERC

TU-P4-3 14h45

Plasma Ion Engine Development for Spaceflight Applications*. **Darren Hunter**, Michael Bradley, *University of Saskatchewan* — This talk will present new concepts in ion engine development currently being pursued at the University of Saskatchewan Plasma Physics Laboratory (PPL) under the direction of Prof. Michael Bradley. This research program is directed toward the design and construction of new types of plasma ion engines for satellite spaceflight manoeuvring applications. A plasma ion engine is essentially an ion source consisting of stacked electrodes separated by insulating components; when appropriate high voltages are applied to the electrodes and the engine is feed with propellant gas, a plasma is ignited. Energetic plasma ions ejected from the back of the engine provide the motive thrust. In general some provision must be made for neutralizing the net negative charge acquired by the engine due to ejection of positive ions. In terms of thrust per unit of fuel gas used plasma ion engines are the most efficient space propulsion engines currently available. This makes them particularly suitable for long-duration satellite missions or deep space probes. The exact design and arrangement of the engine electrodes is crucial for the performance of the engine. At the same time, advances in plasma production technologies as well as advances in the development of new types of insulating materials make the prospect of significantly improved plasma ion engines an exciting possibility, which we are now aggressively pursuing.

* This work is being supported by USTEP

TU-P4-4 15h00

Synthesis of nanocrystalline diamond thin films at high gas flow rate in a microwave plasma reactor*. **Weifeng Chen** [1], Chijin Xiao [1], Xianfeng Lu [1], Qiaoqin Yang [2], Ramaswami Sammynaiken [3], Jason Maley [3], Akira Hirose [1], [1] *Department of Physics and Engineering Physics, University of Saskatchewan*, [2] Department of Mechanical Engineering, University of Saskatchewan, [3] Saskatchewan Structural Sciences Center, University of Saskatchewan — Diamond thin films have been deposited on mirror-polished silicon substrates in a microwave plasma chemical vapor deposition reactor under fixed pressure but different flow rates of the mixed methane and hydrogen gas supply. Microcrystalline diamond (MCD) thin films were obtained at relatively low gas flow rates (30 sccm to 300 sccm), while nanocrystalline diamond (NCD) thin films with cauliflower-like morphology were obtained at higher gas flow rates (above 300 sccm). The formation of NCD at the high flow rates may be attributed to the enhancement of diamond secondary nucleation arising from the increase in the flux rate of carbon containing radicals reaching the diamond growth surface. Measurements of field electron emission from the diamond films have shown that the NCD films exhibit lower field emission threshold and higher current density compared with the MCD films. Furthermore, the surface roughness of the NCD thin films grown at high gas flow rate is effectively reduced by applying positive biasing on the diamond growth stage. The study reveals an effective processing route to deposit smooth NCD films which are desired in tribological and optical applications.

* This work is being supported by NSERC and CRC

TU-P4-5 15h15

Resonant transparency of opaque materials*. **A. Smolyakov** [1], M. Lazar [1], E. Fourkal [2], N. Sternberg [3], [1] *University of Saskatchewan*, [2] Fox Chase Cancer Center, Philadelphia, PA USA, [3] Clark University, MA USA — It is shown that the transparency of opaque material with negative permittivity exhibits resonant behavior. The resonance occurs as a result of the excitation of the surface waves at slab boundaries. Dramatic field amplification of the incident evanescent fields at the resonance improves the resolution of the the sub-wavelength imaging system (superlens). A finite thickness plasma slab can be totally transparent to a p-polarized obliquely incident electromagnetic wave for certain values of the incidence angle and wave frequency corresponding to the excitation of the surface modes. At the resonance, two evanescent waves have a finite phase shift providing non-zero energy flux through the non-transparent region.

* This work is being supported by NSERC Canada

15h30 Coffee Break / *Pause café*

TU-P4-6 15h45

Wakefield Acceleration of Quasi-Monoenergetic 20 MeV to 200 MeV Electrons in Nitrogen and Helium Gas Targets*. **Robert Fedosejevs**, Zheng Lin Chen, Juzer Chakera, Aleyamehu Woldesenbet, Atif Ali, Ying Tsui, Neda Naseri, Wojciech Rozmus, *University of Alberta* — Laser electron acceleration is considered as a possible new approach for the development of next generation electron accelerators. Experiments have been carried out on wakefield acceleration of electrons using the 10 TW laser beamline at the Canadian Advanced Laser Light Source facility. The 800 nm horizontally polarized laser pulses with energies up to 300 mJ were compressed to 30 fs, 200 mJ pulses and focused by a 150 mm focal length off-axis parabolic mirror in an f/6 cone angle into a 13 micron diameter spot onto a 2 mm diameter supersonic gas jet. A calibrated magnetic electron spectrometer was used to measure the electron energy spectrum in the forward laser direction. For nitrogen gas, in most shots, one obtains an electron beam with quasi-monoenergetic bunch energies ranging from 12 MeV to 50 MeV, overlapped with a continuous energy spectrum. The highest energy shot recorded for nitrogen showed a weaker electron beam with energy over 200MeV. Stronger and somewhat higher energy quasi-monoenergetic electron beams were produced by the use of helium gas as expected because of the lower interaction electron densities and longer dephasing lengths. The angular spread of higher energy quasi-monoenergetic beams was typically of the order of 10mrad or less. However, considerable variation in energy characteristics and beam direction was observed from shot to shot. In order to better understand these results, we have initiated a theoretical study using 2D PIC simulations to model the interaction processes in this strongly relativistic regime. For higher electron densities, at first, the laser plasma interaction is dominated by a combination of relativistic self focusing and strong forward and side ways stimulated Raman scattering (SRS). Plasma pulse erosion due to SRS and the short dephasing length result in the relatively short effective interaction length of the laser pulse in the plasma. As a result for the typical nitrogen densities we observe acceleration of electrons to energies on the order of 30-40 MeV similar to the typical nitrogen gas shots. The experimental results and our present understanding of the interaction will be presented.

* This work is being supported by NSERC and CIPI

TU-P4-7 16h00

Kinetic modeling of the stimulated Raman scattering*. **Paul-Edouard Masson-Laborde** [1], Zhongling Peng, Valery Bychenkov [2], Clarence Capjack [1], Wojciech Rozmus [1], [1] *University of Alberta*, [2] Lebedev Physics Instiute, RAS, Moscow — Results of particle-in-cell (PIC) simulations of the stimulated Raman scattering (SRS) in one and two spatial dimensions are discussed. Depending on the $k\lambda_D$ values of the SRS driven Langmuir waves different regimes of nonlinear evolution are investigated in one spatial dimension. With the focus on plasma conditions corresponding to the intermediate regime of $k\lambda_D \sim 0.2$ the role of secondary instabilities such as Langmuir decay and modulational instability are re-examined in the presence of trapped particle effects. New effects are examined in two spatial dimensions where large fraction of trapped particles

corresponds to electric current of fast electrons generating magnetic field and the return current. Effects of magnetic field generation and ion wave instability due to return current are examined in the context of nonlinear SRS evolution. Comparison with 1D simulations shows the importance of detrapping effects. Experimental signatures of the 2D effects are discussed.

* This work is being supported by NSERC

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

[TU-P5] (DASP / DPAE) Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling V / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace V*

TUESDAY, JUNE 19 / MARDI, 19 JUIN
14h15 - 15h45

ROOM / SALLE Thor. 159 (80) ***Chair: D.M. Gillies***

TU-P5-1 **14h15**

The Swarm Canadian Electric Field Instruments*. **David J. Knudsen**, *University of Calgary* — The dynamical behavior of the ionosphere is dominated at high latitudes by coupling to the magnetosphere, and at low latitudes by coupling to neutral winds. Magnetospheric forcing leads to highly structured plasma flows on spatial scales of a kilometer or less, particularly in the vicinity of auroral arcs; intrinsic plasma instabilities impose further plasma structure at all latitudes. All of these phenomena can be clarified through direct observations of the electric fields that mediate them. The European Space Agency's Swarm mission will make continuous global measurements of geo-electromagnetic fields during a four-year mission to begin in 2010. Canadian Electric Field Instruments (CEFI's) on each of Swarm's three satellites will measure electric fields through vector ion drift measurements having a precision of 5 m/s and at rates of up to 16 vectors/second, or every 500 m along the orbit. The combination of precision electric and magnetic fields will be used to estimate low-frequency Poynting flux with a resolution of 1 microWatt/m^2, sufficient to detect outward-propagating electromagnetic disturbances generated by gravity waves in the neutral atmosphere, for example, or to clarify the subtle interplay between electric and magnetic fields that leads to auroral arcs. This talk will overview the scientific potential of Swarm's electric field measurements, along with the technical innovations that underlie them. The Swarm CEFI instruments are currently undergoing development by a consortium that includes the European Space Agency, the Canadian Space Agency, COM DEV, Inc., the Swedish Institute for Space Physics (Uppsala) and the University of Calgary.

* This work is being supported by Canadian Space Agency

TU-P5-2 **14h30**

Prospective Swarm CEFI studies of high-latitude auroral electrodynamics*. **Johnathan K. Burchill** [1], David J. Knudsen [2], [1] *Natural Resources Canada* , [2]University of Calgary — Canadian Electric Field Instruments (CEFI) will be flown on three polar-orbiting satellites beginning in 2010. This mission, Swarm, is a European Space Agency Earth Explorer whose purpose is to advance understanding of the Earth system by accurately mapping the geomagnetic field from space. The CEFI's will help to detect and characterize ionospheric currents, which are signatures of the electrodynamic coupling between the thermosphere, ionosphere and magnetosphere. We describe how the CEFI data might be combined with ground-based instruments to improve our ability to investigate high-latitude auroral electrodynamics. Specifically we explore methods of combining magnetometer, optical, or radar data with in-situ electric and magnetic field measurements for determining field-aligned currents, height-integrated Pedersen and Hall conductivities, and their morphologies. We also explore the possibility of an auroral activity index based on CEFI observations.

* This work is being supported by Canadian Space Agency

TU-P5-3 **14h45**

New Auroral Studies from the South Pole*. **Donald James McEwen** [1], Abas Sivjee [2], Irfan Azeem [3], [1] *University of Saskatchewan*, [2] Embry Riddle Aeronautical University, [3]Embry Riddle Aeronautical UniversityNew — A 6-channel meridian scanning photometer was installed at the US Amundsen-Scott research station at the South Pole in early 2006 and operated continuously through the Austral dark winter April-September, 2006. Auroral results from this southern 75 deg CGL will be discussed in relation to earlier Antarctic studies.

* This work is being supported by NSF and NSERC

TU-P5-4 **15h00**

The Fast Auroral Imager Experiment on the Canadian ePOP Satellite*. **Leroy Cogger** [1], Andrew Howarth [1], Marc Lessard [2], Brent Sadler [2], [1] *University of Calgary*, [2] University of New Hampshire — The Fast Auroral Imager (FAI) consists of two CCD cameras: one to measure the 630 nm emission of atomic oxygen in aurora and enhanced night airglow; and the other to observe the prompt auroral emissions in the 650 to 1100 nm range. High sensitivity will be realized through the combination of fast lens systems (f/0.8) and CCDs of high quantum efficiency (>90% max). The cameras have a common 27 field-of-view to provide nighttime images of ~650 km diameter from apogee at 1500 km. The near infrared camera will provide up to 1 image per second with a spatial resolution of a few km when the camera is pointing in the nadir direction, making it suitable for studies of dynamic auroral phenomena. The 630-nm camera has been designed to provide 1 image of 0.5 s exposure every 30 sec. With operational flexibility and a variety of pointing modes it will be possible to observe a range of features. The instrument has been developed and calibrated in preparation for a late 2008 launch. The main purpose of this presentation is to make the community aware of the capability of this novel instrument and to suggest a range of space science applications that hold great promise for advancing our knowledge of the space environment

* This work is being supported by NSERC,CSA

TU-P5-5 **15h15**

CIMON - The Royal Military College of Canada's proposed nanosatellite mission for the purpose of space based magnetometry. **Jaclynn Beaudette** [1], Jean-Marc Noel [1], Don Wallis [2], David Lavoie [1], Steve Pellerin [1], Jean-Michel Racine [1], Martin Tetrault [1], [1] *Royal Military College of Canada*, [2] University of Calgary — Space based magnetometry is an important science with many applications in the space industry. Magnetic fields are omnipresent in nature and our ability to understand and properly model them has a great impact on many facets of space exploration. With the advances in technology over the past few decades, there is now an abundant amount of high-quality data available from current space missions to create sophisticated models for the average high latitude field-aligned currents (FAC). However, large uncertainties still exist in predicting actual FAC intensities due to the lack of knowledge about the precise temporal and spatial developments of the current in relation to the highly variable solar wind parameters and the unpredictable effects of magnetospheric substorms. The Royal Military College of Canada (RMC) has proposed a nanosatellite mission (CIMON

– **C**anadian nanosatell**I**tes for **M**agnetometric **O**bservatio**N**) consisting of two satellites each carrying magnetometers to further investigate the spatial and temporal variations in the FACs. In this talk, a brief description of the proposed mission will be presented.-

TU-P5-6 **15h30**

A Frequency Modulated Continuous Wave (FMCW) VHF radar for E-region plasma irregularity studies*. **Glenn Hussey**, Joel Cooper, *University of Saskatchewan* — A Frequency Modulated Continuous Wave (FMCW) 50 MHz VHF E-region radar has been developed and deployed by researchers at the University of Saskatchewan. The FMCW technique has never been applied to ionospheric studies of the E-region and offers, simultaneously, both good temporal and spatial resolution. The physics responsible for E-region coherent backscatter is very dynamic in both time and space. Continuous wave (CW) radar systems have excellent temporal resolution, but have spatial resolution defined by the intersection of the transmitting and receiving antenna patterns. Pulsed radar systems have excellent spatial resolution, but can lack the temporal resolution needed to study the dynamic and complex spectral nature of E-region backscatter. The application of the FMCW technique provides a compromise between pulsed and CW radar techniques and was the motivation for constructing the present FMCW radar system. Such a system will allow for a more detailed study of the physical processes responsible for the radar coherent backscatter from the plasma irregularities naturally occurring in lower E-region. This presentation will give an overview of the FMCW technique, the design and construction of the radar, and present initial results.

* This work is being supported by NSERC

15h45 **Session Ends / *Fin de la session***

[TU-P6] Atmospheric Processes of Climate Change IV / *Processus atmosphériques et changements climatiques IV*

(DASP / *DPAE*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
14h15 - 16h30

ROOM / SALLE Thor. 124 (80)

Chair: N.Lloyd, University of Saskachewan

TU-P6-1 **14h15**

An Overview of the CAWSES Global Observing Campaign on Tides*. **William Ward** [1], M. Gerding [2], L. Goncharenko [3], P. Keckhut [4], D. Marsh [5], J. Oberheide [6], D.N. Rao [7], J. Scheer [8], W. Singer [2], [1] *University of New Brunswick*, [2] Leibniz-Institute of Atmospheric Physics, Kuhlungsborn, Germany, [3] MIT Haystack Observatory, USA, [4] Service d'Aéronomie, Institut Pierre et Simon Laplace, France, [5] Atmospheric Chemistry Division, NCAR, USA, [6] Physics Department, University of Wuppertal, Germany, [7] National Atmospheric Research Laboratory, India, [8] Instituto de Astronomía y Física del Espacio, Universidad de Buenos Aires — The CAWSES Global Tidal Campaign was initiated to encourage collaboration between satellite and ground based observations and to identify features in various observation types consistent with specific components. This project is one of several sponsored under Theme 3, Atmospheric Coupling Processes, of the international Climate and Weather of the Sun Earth System program (CAWSES, a SCOSTEP sponsored program). The overall goal of the campaign is to provide global data sets for several concentrated time periods over the next few years which includes coordinated ground-based and satellite measurements and modeling efforts. Three campaign periods have been identified to date. The first tidal campaign took place from September 1 to October 31, 2005 to coincide with the "World Month" campaign undertaken by the Incoherent Scatter Radar community. This year two campaigns, March 1 to April 31, and June 1 to August 15 have been scheduled. These campaigns will allow the characterization of the heating sources, tidal components (migrating and nonmigrating), and tidal effects from the surface of the Earth to the ionosphere, and support and stimulate the use of models to simulate the conditions during these campaigns. Radar, microwave, optical, and ionospheric observations and satellite data are essential to the success of these campaigns and are now starting to be analysed. In this paper, we describe the organization of this effort, plans for the incorporation of various observation types, and early results from the campaigns.

* This work is being supported by NSERC, CAWSES, SCOSTEP

TU-P6-2 **14h45**

The Measurement of Mesospheric Water Vapour, Ozone and Temperature with OSIRIS*. **A. Bathgate**, E.J. Llewellyn, D.A. Degenstein, R.L. Gattinger, S.V. Petelina, *University of Saskatchewan* — The OSIRIS instrument on the Odin satellite, which is an 1800 LT sun-synchronous orbit, includes both an optical spectrograph that provides spectra of scattered sunlight over the wavelength range 280 – 810 nm and an imager section that measures the oxygen infrared atmospheric band airglow emission at 1.27 micron. The spectra include the OH (A-X) airglow, which can be inverted to derive the mesospheric water vapour profile, while the OSIRIS measurements of the oxygen atmospheric A-, B- and gamma- bands provide information of the atmospheric temperature profile. These temperature determinations are possible in both the presence and absence of PMCs. The OSIRIS measurements provide an unambiguous indication of the presence of PMCs. In this paper we discuss the variability of atmospheric temperature profile observed with OSIRIS and the temperature in the vicinity of PMCs. When these measurements are combined with the oxygen infrared atmospheric band airglow emission, which serves as a proxy for the ozone content, it is possible to compare the distribution of water vapour, ozone and temperature in the vicinity of PMCs.

* This work is being supported by NSERC and CSA

TU-P6-3 **15h45**

Interannual and interhemispheric variability in properties of Polar Mesospheric Clouds detected by Odin/OSIRIS*. **Svetlana Petelina**, Edward Llewellyn, Douglas Degenstein, *University of Saskatchewan* — Polar Mesospheric Clouds (PMCs) typically form at high latitudes during the local summer at 82-86 km altitudes where the atmosphere is cold enough for ice particles to exist. It is presently believed that PMC occurrence and brightness serve as a sensitive indicator of climate-related changes and trends in that remote region of the atmosphere. That is why our attention to this phenomenon has been steadily increasing during the last decades. More than 100 years of ground-based visual observations of PMCs are now complemented by high quality lidar, rocket and satellite measurements. The Optical Spectrograph and InfraRed Imager System (OSIRIS) instrument on the Odin satellite has observed PMCs in both hemispheres since November, 2001. The OSIRIS PMC database created from all available Odin mesospheric observations between November 2001 and September 2006 is used to study different PMC properties, including interseasonal, interannual and interhemispheric differences in cloud brightness, altitudes and detection frequency. The high sensitivity of the limb-scattering technique and the low signal-to-noise ratio at PMC altitudes also permits OSIRIS to observe very faint clouds that are only about 20% brighter than the corresponding Rayleigh background and are not easily seen by many other techniques. As a result, faint PMCs have been detected at unusually low latitudes of 44-46 degrees not only in the NH, but also in the SH. The latter finding challenges our present understanding of mesospheric properties and their interhemispheric difference and is important for the improvement of existing atmospheric models and understanding the global change.

* This work is being supported by CSA, NSERC

TU-P6-4 **16h00**

Calibration of a 20μm Water Vapour Monitor (IRMA) for TMT site testing operations*. **Richard Querel** [1], David Naylor [1], Regan Dahl [1], Matthias Schoeck [2], [1] *University of Lethbridge*, [2] Thirty Meter Telescope — The Infrared Radiometer for Millimetre Astronomy (IRMA) is a compact, relatively low cost, 20 μm water vapour radiometer

which monitors a narrow 2 μm band containing only water vapour molecular transitions. Coupled with an accurate atmospheric model, it is possible to determine the absolute precipitable water vapour (PWV) in a column of atmosphere within the TMT's specification of 0.1mm at 1.0mm PWV. Since January 2007, three IRMA units have been deployed in Chile as part of a site testing effort for the Thirty Meter Telescope (TMT) project. The relative responsivities of these units are calibrated using a reference external blackbody. The flux of the internal blackbody source in each unit is then calibrated to the external blackbody to allow for periodic recalibration while on site. We present the calibration process for the TMT IRMA units, a study of fit parameters and goodness of fit of the coefficients, and the resulting uncertainties in the effective sky temperatures and measured PWV.

* This work is being supported by NSERC, NRC-HIA, TMT

TU-P6-5 **16h15**

The Waves AND Coupling Theme of the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Canada*. **William Ward** [1], Alan Manson [2], Young-Min Cho [3], Tatyana Chshyolkova [2], Dragan Veselinovic [1], Ding Yi Wang [1], Tom Duck [4], Gordon Shepherd [3], Marianna Shepherd [3], Robert J. Sica [5], Kimberly Strong [6], Jim Whiteway [7], [1] *University of New Brunswick*, [2] ISAS, University of Saskatchewan, [3] CRESS, York University, [4] Dalhousie University, [5] University of Western Ontario, [6] University of Toronto, [7] ESSE, York University — The Polar Environment Atmospheric Research Laboratory (PEARL) is the first observatory supported under the CANDAC (Canadian Network for the Detection of Atmospheric Change) initiative. It is a sophisticated observatory in the Canadian Arctic which houses a suite of instruments including radars, lidars, spectrometers, radiometers and imagers which allow measurements of Arctic conditions from the ground to the lower thermosphere. The Waves and Coupling theme is one of several scientific themes around which activity is organized. This theme involves the investigation of the wave environment above the observatory and the coupling of the dynamics between atmospheric layers and other locations. Instrumentation pertinent to these investigations include the E-Region Wind Interferometer, the meteor radar, the Spectral Airglow Temperature Imager, the PEARL All-Sky Imager, the ozone and Rayleigh/Mie/Raman lidar, the VHF and cloud radar, the Fourier Transform Spectrometer and the Atmospheric Emitted Radiance Interferometer. Together these instruments provide the means to determine the mean fields, and wave signatures associated with tides, planetary waves and gravity waves from the stratosphere to the mesopause region. Interpretation of these results will be supported with satellite observations, model results and analyses from data assimilation. Collaborations are being developed with other polar observatories so that a global view of these processes in the Arctic middle atmosphere can be developed. This effort will peak during International Polar Year. In this paper the capabilities of the observatory will be described and some early results presented.

* This work is being supported by CFCAS, NSERC, CSA

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

[TU-P7] Energy Frontier and Phenomenology II / *Frontière énergétique et phénoménologie II*

(PPD-DTP / *PPD-DPT*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
14h15 - 17h00

ROOM / SALLE Phys. 165 (137)

Chair: W.J. Taylor, York University

TU-P7-1 **14h15**

Search for Large Extra Dimension with the CDF detector at the Tevatron*. **Pierre-Hugues Beauchemin** [1], Pierre Savard [1], Kevin Burkett [2], Eric James [2], [1] *University of Toronto*, [2] Fermilab — We present preliminary results of a search for excess of jets plus missing transverse momentum events in 1 fb-1 of ppbar data collected by the Collider Detector at Fermilab. A wide range of kinematic regimes are investigated. The results are interpreted in terms of exotic phenomena, including Large Extra Dimensions scenarios.

* This work is being supported by University of Toronto

TU-P7-2 **14h30**

Search for Charged Higgs Boson Using the DZero Experiment*. **Gustavo Kertzscher**, Brigitte Vachon, Chris Potter, *McGill University* — The existence of a charged Higgs boson is hypothesized in different extensions of new physics beyond the Standard Model of particle physics. To date, no evidence for this particle has been found. A search for the charged Higgs boson decaying to a top and a bottom quark was carried out using data collected by the DO experiment at Fermilab. Preliminary results obtained using nearly 1 fb^{-1} of data will be presented.

* This work is being supported by NSERC, FQRNT and CRC

TU-P7-3 **14h45**

Longitudinal WZ scattering at the LHC in the Littlest Higgs Model. **Kenneth Moats**, Stephen Godfrey, *Carleton University* — Little Higgs Models have been proposed relatively recently as a mechanism for Electroweak Symmetry Breaking. These models predict that quadratic divergences in the Higgs boson mass are cancelled by introducing new particles, assumed to exist at the TeV scale. In particular, a distinctive feature of the Littlest Higgs model is a triplet of heavy Higgs bosons, which can be produced at the LHC by vector boson fusion. The production of the singly-charged member of the Higgs triplet through scattering of longitudinally polarized W and Z bosons will be discussed. The calculations were carried out using the full longitudinal polarization vectors as well as using the Goldstone Equivalence Theorem. The relevant backgrounds will then be discussed, along with prospects for detection at the LHC. This process does not exist in two Higgs doublet models such as Supersymmetry, so this would be a smoking gun signature of Little Higgs models.

TU-P7-4 **15h00**

News from the CMS Experiment and Results from the 2006 Cosmic Challenge*. **Dominique Fortin**, *University of California Riverside* — The Compact Muon Solenoid (CMS) detector is one of two multipurpose detectors being assembled at CERN to study collisions from the Large Hadron Collider. In late June 2006, the CMS detector was closed for the Magnet Test and Cosmic Challenge (MTCC). After several weeks of cooling, the solenoid temperature reached 4.7 K. The current was then gradually ramped up to 19.15 kA to successfully achieve the designed field of 4 Tesla in August. Beside testing the solenoid and mapping the field, this was a unique opportunity to test the various CMS subsystems: CSC, DT, ECAL, HCAL and tracker, and over 230 million cosmic events were recorded. In this talk, results from the MTCC will be presented, with an emphasis put on the performance of the muon system, and the latest news from the CMS Experiment will be shared.

* This work is being supported by DOE

TU-P7-5 **15h15**

Detection of SUSY signals in the stau-neutralino coannihilation region at the LHC*. **Nikolay Kolev** [1], Richard Arnowitt [2], Adam Aurisano [2], Bhaskar Dutta [2], Teruki Kamon [2], Paul Simeon [2], David Toback [2], Peter Wagner [2], [1] *University of Regina*, [2] Texas A & M University — Supersymmetry (SUSY) provides a leading candidate for cold dark matter (CDM) in the Universe, neutralino. The recent measurement of the CDM relic density along with other experimental measurements suggests a stau-

neutralino co-annihilation region of the SUSY parameter space is consistent with the CDM content. Given its energy and large statistics, the Large Hadron Collider (LHC), which is expected to start operating in 2007, is an ideal place to search for SUSY particles and to study the relevant processes that can lead to the estimation of the neutralino contribution to the CDM content. In this talk, I will show our analysis of the neutralino-2->tau+stau->tau+tau+neutralino-1 decay in the co-annihilation region within the minimal supergravity model. I will also demonstrate the analysis can lead to an accurate measurement of the stau-neutralino mass difference which is the relevant observable used to estimate the neutralino relic density in the Universe.

* This work is being supported by DOE, NSF, NSERC

TU-P7-6 **15h30**

HEATHER LOGAN, Carleton University

*LHC Phenomenology **

This year's start-up of the Large Hadron Collider will open a new era in particle physics, in which we can hope to learn the answers to the grand questions that drive the field: the origin of mass, the remarkable weakness of gravity, and the nature of dark matter. To make best use of the data will require theory and experiment working in parallel. I will review recent developments in LHC phenomenology and outline possible directions for future progress.

* This work is being supported by NSERC

TU-P7-7 **16h00**

ISABEL TRIGGER, TRIUMF

*ATLAS in Canada: International Solutions to Universal Questions **

The ATLAS detector at the CERN Large Hadron Collider (LHC) near Geneva is nearing completion, and will be ready to take data when the first LHC proton beams collide at the end of this year. Most of its subdetector systems are already taking cosmic ray data. The LHC centre-of-mass energy of 14 TeV will be an order of magnitude higher than any prior accelerator. The LHC will operate at unprecedented luminosity. The detectors must therefore be capable of working in a high-rate, radiation-hard environment, requiring exceptional robustness and extraordinary complexity. The goal of the ATLAS collaboration is to detect new particles too massive to have been produced at other accelerators, which will resolve the long-standing question of why matter is massive. It is hoped and expected that enough different new particles will be detected to answer other major questions. What is the dark matter in the universe? Why are there three families of fermions in the Standard Model of particle physics, and why do they have such a complicated hierarchy of masses? What is the connection between gravity and the other forces, and why is the Planck scale so much higher than the electroweak scale? Canadian groups built large portions of the liquid argon calorimeters in ATLAS, which will be critical for measuring hadronic jets, and for calculating missing transverse energy - key ingredients in the signatures of a great variety of new physics processes. As the daily activities of the group members move from construction to commissioning and preparation for data analysis, the ATLAS-Canada group is positioning itself to be a major participant in the discoveries that will soon be made at the LHC.

* This work is being supported by NSERC

TU-P7-8 **16h30**

JOHN NG, Triumf

*Radiative Neutrino Mass Generation as an Alternative to the Seesaw Mechanism **

We present a model with Standard Model (SM) gauge symmetry in which lepton number is triggered by a dimension 4 hard breaking term in the scalar potential. The minimal model contains a weak isotriplet and a pair of doubly charged isosinglet scalar fields in addition to the SM Higgs doublet. The model is technically natural. Neutrino masses are controlled by the triplet vacuum expectation value which is < 5.78 GeV as demand by phenomenology. In general the theory gives rise to normal hierarchy of neutrino masses. We expect weak scale singly and doubly charged Higgs scalars to make their appearances at the LHC and ILC.

* This work is being supported by NSERC

17:00 **Session Ends / *Fin de la session***

[TU-P8] (CAP / ACP) Establishing a Successful Public Outreach Program II / *Établir un programme pour rejoindre le public avec succès II*

TUESDAY, JUNE 19 / MARDI, 19 JUIN

14h15 - 16h30

ROOM / SALLE Arts 143 (350) ***Chair: W.F. Davidson, National Research Council Canada***

TU-P8-1 **14h15**

JAMES PINFOLD, University of Alberta

*Forging a Cosmic Connection Between High-Schools and Science **

A large number of projects in North America and across the world are forging a connection between cosmic ray research and practical, inspirational, scientific experience in schools. The first of these was the ALTA-project in Alberta – a very large cosmic ray array with a scientific cultural and educational outreach component. The nature and aims of these projects will be briefly described and future developments outlined.

* This work is being supported by Promoscience

TU-P8-2 **14h30**

MARCELLO PAVAN, TRIUMF

*TRIUMF's experience with creating computer animation-intensive educational videos **

Over the last year TRIUMF has begun creating a series of physics education videos for high schools. These videos will use a mix of animation and live-action to demonstrate how high school physics is manifest in the everyday operation of TRIUMF. A professional team of animators and video producers were hired to create the videos,

and teacher consultants were retained to advise on the educational content. This talk will discuss TRIUMF's experience with this process and offers a "how-to' guide for others contemplating videos of their own.

* This work is being supported by NSERC PromoScience, TRIUMF

TU-P8-3 **14h45**

TRACY WALKER, Canadian Light Source

Educational Outreach Programs at the Canadian Light Source

Since its inception, Educational Outreach at CLS has progressed from tours to the development of curriculum resource materials, active participation in experiments, and interactive connections between students and researchers. An overview of the program, and opportunities therein, is presented here.

TU-P8-4 **15h00**

ALAN NURSALL, Science North

Setting the stage for science: fun is learning

A simple definition for learning: 'a relatively permanent conceptual change'. This is a respectable goal for any science education initiative, whether in the formal system or the informal. Research into what we call free-choice learning – the sort of learning that happens in museum, science outreach, documentary films, and so on – tells us that an individual's willingness and ability to learn is strongly governed by the physical, social, and cultural context of the experience. What is the context for physics in most people's lives and how do we use that to foster understanding? How do we make physics both intellectually and emotionally engaging? How do we make it fun?

TU-P8-5 **15h15**

DAMIEN POPE, Perimeter Institute for Theoretical Physics

Educational Outreach at Perimeter Institute for Theoretical Physics

Located in Waterloo, Ontario, Perimeter Institute for Theoretical Physics (PI) is world-class establishment devoted to research in foundational theoretical physics. Its areas of focus include string theory, quantum gravity, quantum information theory, the quantum foundations, cosmology and particle physics. In addition to this, PI's second core mission is to educate and engage the wider community through its educational outreach program. To this end, it stages a two-week long summer camp for Grade 11 students from around the globe, a week-long teacher workshop on modern physics, a well-attended monthly public lecture series, numerous visits to schools locally and throughout the nation, and informal discussion sessions for the general public. This presentation will give an overview of PI's educational outreach program and details its efforts to bring physics to the general public.

15h30 **Discussion Break**

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

[TU-P9] Surface Science / *Science des surfaces*

(DSS / *DSS*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
14h15 - 17h00

ROOM / SALLE Phys. 127 (48)

Chair: L.D. Wilson, University of Saskatchewan

TU-P9-1 **14h15**

Holographic Imaging of Nanostructures and Interfaces with Low Energy Electrons*. **Lucian Livadaru** [2], Robert Wolkow [2], [1] *NRC- National Institute for Nanotechnology, University of Alberta.* [2]NRC- National Institute for Nanotechnology, University of Alberta, — The lensless holographic in-line point source microscope was envisioned more half a century ago, but its realization with electron waves has come short due to not only difficulties inherent in Fresnel-type reconstruction methods, but also to the lack of an adequate (spatially and temporally coherent) point source. With the recent creation of ultra sharp nanotips, which can field emit electrons from a single atom at their apex, an extremely coherent electron source is available that provides a great boost to holographic imaging. In this work we ascertain the advantages of such a microscope for the imaging of nanoscale structures and interfaces. The method is suitable for the three-dimensional imaging of solid nanoparticles and surfaces, but also for biological entities, such as macromolecules and membranes. Magnetic nanostructures can be visualized by retrieving the phase information from electron holograms. We show how improvements in the reconstruction method can be made by applying the Fresnel-Kirchhoff diffraction theory adapted to Electron Optics. Due to very narrow energy dispersion of the electron beam from ultrasharp nanotips (~ 0.1 eV), the chromatic resolution of the method is about 0.05nm for a beam energy of 100 eV. A full holographic procedure including phase retrieval is possible if distortion effects of magnetic fields via the Aharonov-Bohm effect on hologram formation is rigorously controlled. Thus, the main contribution to the resolution limit is dictated by the degree of magnetic field shielding of the microscope.

* This work is being supported by iCORE

TU-P9-2 **14h45**

Au-induced faceting a vicinal Si(111) surface*. **Wei Wu**, Mark Gallagher, *Lakehead University* — The deposition of small amounts of Au onto vicinal semiconductor surfaces can dramatically alter the surface morphology on a nanometer scale. Often, Au adsorption can stabilize off-axis facets not stable on the clean surface. Recently this restructuring has been exploited to self-assemble novel nanostructures with intriguing one-dimensional (1-d) metallic behaviour [1]. Submonolayer deposition of Au onto samples tilted towards [11-2] can produce a regular array of atomic chains running along the [1-10] direction. To investigate the mechanism underlying chain formation we have investigated the surface morphology as a function of Au coverage for samples tilted 3.8 degrees from [111] towards [11-2]. We find that the surface morphology is exquisitely sensitive to Au coverage. The clean surface consists of large (~700 Å wide) atomically flat (111) terraces separated by bunched steps running along [1-10]. The large terraces are eliminated by the deposition of as little as 0.04 monolayers (ML) of Au. On further deposition 1-d chain structures nucleate at step edges and grow to form (775)-Au facets. The (775) facet is oriented 8.5 degrees from [111] and is characterized by 1-d chains spaced 21.3 Å apart running along the [1-10] direction. Adsorption also transforms the 7x7 reconstructed terraces to Si(111)5x2-Au. This result is in contrast to earlier results on 8 degree samples on which the initial Au migrates exclusively to the steps [2]. At 0.44 ML the transformation is complete and the surface consists of (111)5x2 terraces separated by (775) facets. Beyond 0.45 ML the (775) facets are replaced by (553) facets oriented 12.5 degrees from [111] with a 14.8 Å chain spacing. References: [1] Crain *et al.*, *Phys. Rev. B* **69**, 125401 (2004); [2] Pedri *et al.*, *Surf. Sci.* **601**, 924 (2007).

* This work is being supported by NSERC

TU-P9-3 **15h00**

Direct growth of adherent diamond films on steel*. **Yuanshi Li**, Chijin Xiao, Qiaoqin Yang, Akira Hirose, *University of Saskatchewan* — Coating of dense, continuous and adherent diamond films on steel substrates can provide significantly modified surface properties such as enhanced hardness, lowered friction coefficient, and enhanced corrosion-wear resistance. However, in practice, diamond coating on steel is prevented primarily due to very low nucleation density and early adhesion failure of the diamond produced. We will report our new findings that by alloying the conventional steel substrates with element Al, even at a small fraction as low as 2~5 wt.%, the growth of high quality diamond films on them can be greatly facilitated. The nucleation, growth, and adhesion ability of diamond films directly fabricated on the corresponding steels have been examined. The fundamental mechanism is clarified based on delicate competition and balance between the roles played by base element Fe and alloying element Al.

* This work is being supported by NSERC and CRC

TU-P9-4 **15h15**

Canadian Photoelectron emission Research Spectromicroscope (CaPeRS) for materials characterization*. **Stephen Urquhart** [1], Uday Lanke [1], Brian Haines [1], Stephen Christensen [1], Peter Hitchcock [2], Jacob Stewart-Ornstein [2], Remy Coulombe [3], Eric Christensen [3], Chithra Karunakaran [4], Konstantine Kaznatcheev [4], Adam Hitchcock [2], [1] *University of Saskatchewan*, [2] McMaster University, [3] Université de Sherbrooke, [4] Canadian Light Source — The CaPeRS microscope is a surface sensitive photoelectron emission microscope (PEEM), which can be illuminated with tunable soft x-ray photons from beamlines at the Canadian Light Source or from a standalone UV lamp as a photon source. The CaPeRS microscope is capable of delivering x-ray absorption and photoemission spectroscopy as well as microscopy at the submicron resolution scale. The best spatial resolution, so far obtained, with this microscope is better than 25 nm, in realistic working conditions. An imaging energy filter has recently been added to this microscope, which allows us to perform X-ray and ultraviolet photoelectron spectroscopy (XPS and UPS) and imaging. The CaPeRS users' community is expanding fast and covers application areas ranging from Chemistry, Physics, and Materials science to geochemistry. Embrittlement in stainless steel alloys, oxide nano-rods, carbon speciation in ores, and phase separated organic thin films, are the few research areas that are under investigation in this microscope. Further, we are exploring the use of x-ray magnetic circular dichroism for the study of nano-structured magnetic materials. This presentation will present recent scientific results from research performed at the Canadian Light Source.

* This work is being supported by NSERC, CFI

15h30 **Coffee Break / *Pause café***

TU-P9-5 **15h45**

Nucleation, growth and properties of diamond films on Ti_3SiC_2 by chemical vapor deposition*. **Songlan Yang** [1], Qiaoqin Yang [1], Zhengming Sun [2], Yongji Tang [1], Wenwen Yi [1], [1] *Department of Mechanical Engineering, University of Saskatchewan*, [2] AIST, Japan — In the present study, diamond nucleation and growth on a newly developed metallic-ceramic material, Ti_3SiC_2, were investigated by microwave plasma enhanced and hot-filament CVD in hydrogen and methane gas mixtures. For comparison, diamond deposition on Si wafers, the most frequently used substrate material for CVD of diamond films, under the same conditions was also investigated. Scanning electron microscopy (SEM), atomic force microscopy (AFM), Raman spectroscopy and synchrotron near edge extended X-ray absorption fine structure spectroscopy (NEXAFS) were used to characterize the synthesized films. The adhesion of the diamond film to the substrate was evaluated by indentation tests using MVK-H1 microhardness testing machine with Vickers diamond pyramid as the indenter. A much higher diamond nucleation density and a much higher film growth rate were obtained on Ti_3SiC_2 compared with on Si. The deposition time for the formation of fully dense diamond film was much shorter on Ti_3SiC_2 than on Si. Nanocrystalline diamond films can be deposited on Ti_3SiC_2 under typical microcrystalline diamond growth conditions. Furthermore, the diamond films on Ti_3SiC_2 exhibit better adhesion than those on Si. These results indicate that Ti_3SiC_2 has great potentials to be used as both substrate materials and interlayers on metals for diamond thin film deposition and application. It may greatly expand the tribological applications of both Ti_3SiC_2 and diamond thin films.

* This work is being supported by Canada Research Chair Program

TU-P9-6 **16h00**

Nucleation and post growth relaxation of tetracene thin films on silicon oxide*. **Jun Shi**, Xiaorong Qin, *Physics Department, University of Guelph* — For the first time, we demonstrate that layered morphology of tetracene films on silicon oxide can be achieved at room temperature via vacuum evaporation, which is significantly different from what reported recently in literature. Island size distribution analysis shows that tetracene nucleation in a high-flux growth regime is diffusion-mediated with a critical island size i =3, similar to that in pentacene growth. A novel layer-dependent post-growth relaxation has been observed on a time scale of minutes. It is suggested that the high flux rate is crucial in the growth kinetics of forming the layered morphology and also important in overcoming the effect of post-growth relaxation which is sensitive to the film coverage and substrates.

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

TU-P9-7 **16h15**

Structure of tetracene films on hydrogen-passivated Si(001) studied via STM, AFM and NEXAFS*. **Andrew Tersigni**, Jun Shi, De-Tong Jiang, Xiaorong Qin, *University of Guelph* — Scanning tunneling microscopy (STM), atomic force microscopy (AFM) and near-edge x-ray absorption fine structure (NEXAFS) have been used to study the structure of tetracene films on hydrogen-passivated Si(001). STM imaging of the films with nominal thickness of three monolayers (3 ML) exhibits the characteristic "herringbone" molecular packing known from the bulk crystalline tetracene, showing standing molecules on the *ab*-plane. The dimensions and orientation of the herringbone lattice indicate a commensurate structural relationship between the lattice and the crystalline substrate. The corresponding AFM images illustrate that at and above the third layer of the films, the islands are anisotropic, in contrast with the submonolayer fractals, with two preferred growth directions appearing orthogonal to each other. The polarization dependent NEXAFS measurements indicate that the average molecular tilting angle with respect to the surface first increases with the film thickness up to 3 ML, then stabilizes at a value close to the bulk tetracene case afterwards. The combined results indicate a distinct growth morphological change that occurs around a few monolayers of thickness.

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

TU-P9-8 **16h30**

Surface science in a jar: Preferential adsorption and exclusion of salts impregnated into activated carbon*. **Philippe Westreich**, Hubert Fortier, Stan Selig, Stephanie Flynn, Stephen Foster, T.R. Dahn, J.R. Dahn, *Dalhousie University* — The impregnation of a variety of salts into activated carbon pores is categorized into three groups – those that exhibit preferential adsorption (attraction to the carbon), exclusion (repulsion from the carbon) and non-preferential adsorption (no attraction or repulsion). Repulsion is simply observed by measuring the concentration of salt in solution, which increases for K_2CO_3, K_2HPO_4, and K_3PO_4 upon the addition of carbon. This means that the concentrations of solutions of K_2CO_3, K_2HPO_4, and K_3PO_4 inside the pores are less than in the bulk solution outside the pores, which suggests that these salts are repelled by the carbon surface. Incipient wetness experiments confirm that the three salts which are most strongly repelled do not enter the carbon at solution concentrations greater than ~1 M. These findings are correlated with measurements of contact angles of the salt solutions on highly oriented pyrolitic graphite and polished resin-impregnated

graphite surfaces. The contact angles of the K_2CO_3, K_2HPO_4, and K_3PO_4 solutions on highly oriented pyrolitic graphite and polished resin-impregnated graphite surfaces rise with concentration and approach 90°, which suggests that these solutions would not enter activated carbon pores above a critical concentration. This agrees with the incipient wetness results. By contrast, soaking, incipient wetness and contact angle measurements for salts like $ZnCl_2$ and $Cu(CH_3COO)_2$ show preferential adsorption by soaking (the salt is depleted from the solution), high maximum incipient wetness volumes at high solution concentrations and a reduction of contact angle with increase in concentration.

* This work is being supported by NSERC and 3M Canada

TU-P9-9 **16h45**

A Monte Carlo simulation study of CO on KCl (001). **Abdulwahab Sallabi** [1], Laila H. Obied [1], David Jack [2], [1] *Physics Dept. , 7th October University, Misurata,Libya,* [2] Department of Chemistry, University of British Columbia – Okanagan, 3333 U — In response to recent Low Energy Electron Diffraction (LEED) and Polarization Infrared Spectroscopy (PIRS) results, Monte Carlo (MC) simulations has been performed for CO on KCl(001) surface. These simulations predict that a single CO molecule adsorbs with a binding energy of 4.0 kcal/mol and sits above a K^+ ion site with the carbon atom down. In agreement with experiments [1], MC results show that at monolayer coverage, all K^+ ion sites are occupied by CO molecules and adopt orientationally disordered structure consisting of molecules tilted by ~45° from the surface normal and no preferred azimuthal orientation with residual short range order in the form of small islands of *p(2×1)* structure. Our results explain perfectly and reconcile the experimental LEED and PIRS results for Monolayer of CO/KCl system [1]. Reference: [1] J. Vogt and Helmut Weiss, *Zeitschrift für Physikalische Chem* **218,** 973 (2004)

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

[TU-P10] Biomedical Instrumentation / *Instrumentation biomédicale*

(DIMP-DMBP / *DPIM-DPMB*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
14h15 - 16h30

ROOM / SALLE Phys. 103 (145)

Chair: K.H. Michaelian, CANMET, Natural Resources Canada

TU-P10-1 **14h15**

ANDREAS MANDELIS, University of Toronto

Dental Thermophotonics : Laser Photothermal Methods vs. X-rays in the Race for Dental Caries Diagnostics in Clinical Dentistry †

In this talk I will review the state-of-the-art of dental biothermophotonics and I will discuss progress to-date in this exciting field where photothermal radiometric methods, diffusion-wave physics and dental research practices converge in a race to supplement or replace X rays (radiographs) as primary diagnostic tools in clinical dentistry. The purpose of the talk is to show clear sensitivity advantages of dental biothermophotonics in a variety of dental configurations where the presence of demineralization caries is expected. The presentation will commence with some applications of photothermal radiometry to dental diagnostics of natural carious and artificial sub-surface lesions in human teeth. The extent of sub-surface penetration in the enamel and dentinal layers will be determined and results of statistical sensitivity and specificity analyses will be compared to X rays and dental luminescence. Then, studies of shallow and deep etched enamel lingual, buccal and interproximal (mechanical and chemically etched artificial caries) lesions will be presented including results on demineralization / remineralization experiments akin to processes occurring naturally in the mouth. The photothermal results will be compared with dental X rays, scanning electron microscopy (SEM), micro-computed tomography (u-CT) and transverse micro-radiography (TMR). I will continue with quantitative biothermophotonic studies using a coupled diffuse-photon-density and thermal-wave formalism which allows the measurement of optical and thermal properties of intact and etched (or carious) teeth and thus facilitates the monitoring of the progression of caries in patients. I will conclude with a brief instrumental discussion of an engineering design prototype currently being tested in the CADIFT to serve as a first-generation hand-held photothermal inspection unit in clinical settings.

† In collaboration with Raymond Jeon, Anna Matvienko, Stephen Abrams, University of Toronto

TU-P10-2 **14h45**

FRANCOIS LEGARE, INRS

Nonlinear Optical Microscopy for Biomedical Imaging

Nonlinear optical microscopy is a highly promising imaging approach for biomedical applications since optics can be easily integrated in the context of in vivo imaging. One striking application of nonlinear optical microscopy in biomedical imaging is in neuroscience where fluorescence is used as contrast mechanism to image neuronal activity with sub-micron spatial resolution near millimetre depth. Despite its success in biomedical imaging, not every biological structure contains fluorophores or can be easily tagged with artificial fluorophores (staining), limiting the use of fluorescence as imaging contrast mechanism. To circumvent this limitation, other nonlinear optical imaging approaches are currently investigated, such as second harmonic generation (SHG), third harmonic generation (THG) and coherent anti-Stokes Raman scattering (CARS). The main advantage of those three techniques is that they do not require fluorophores. However, they are more complex since they are based on coherent nonlinear optical phenomena. The results presented will (1) address the impact of the coherent nature of SHG, THG and CARS process in the context of tissue imaging and (2) demonstrate the benefit of combining those imaging approaches within a unique imaging platform since they are complementary to fluorescence microscopy and to each other for the biological and structural information they provide.

15h15 **Coffee Break** / ***Pause café***

TU-P10-3 **15h30**

HAISHAN ZENG, BC Cancer Research Centre

Fast Raman Spectroscopy for Real-time in vivo Tissue Analysis for Early Cancer Detection †,*

Raman spectroscopy is a noninvasive, nondestructive analytical method capable of determining the biochemical constituents based on molecular vibrations. It does not require sample preparation or pretreatment. However, the use of Raman spectroscopy for *in vivo* applications will depend on the feasibility of measuring Raman spectra in a relatively short time period (a few seconds). In this work, a fast dispersive-type near-infrared (NIR) Raman spectroscopy system and a skin Raman probe were developed to facilitate real-time, noninvasive, *in vivo* human skin measurements. Spectrograph image aberration was corrected by a parabolic-line fiber array, permitting complete CCD vertical binning, thereby yielding a 16-fold improvement in signal-to-noise ratio. Good quality *in vivo* skin NIR Raman spectra free of interference from fiber fluorescence and silica Raman scattering can be acquired within one second, which greatly facilitates practical noninvasive tissue characterization and clinical diagnosis.

Currently, we are conducting a large clinical study of various skin diseases in order to develop Raman spectroscopy into a useful tool for non-invasive skin cancer detection. Intermediate results will be presented. Recently, we have also started to develop a technically even more challenging endoscopic Laser-Raman probe for early lung cancer detection. The probe has passed test on lung biopsy samples. Planning of *in vivo* test is underway. Preliminary *in vivo* results from endoscopic lung Raman measurements will be presented if available at the conference time.

† In collaboration with Jianhua Zhao [1], Michael Short [1], David I. McLean [2], Stephen Lam [1], Zhiwei Huang [1], Iltefat Hamzavi [2], Abdulmajeed Alajlan [2], Hana Alkhayat [2], Ahmad Al Robaee [2], Annette McWilliams [1], Harvey Lui [2], [1] BC Cancer Research Centre, [2] University of British Columbia

* This work is being supported by NCIC, CIHR, CDF

TU-P10-4 **16h00**

NANCY FORD, Ryerson University

Retrospectively gated imaging using a high-speed, flat-panel equipped cone beam micro-CT scanner †,*

Micro-computed tomography provides a non-invasive method of investigating human diseases in rodent models. Projection images are acquired from all angles around the animal and reconstructed to produce high-resolution, volumetric images of the rodent anatomy. High-speed cone beam micro-CT scanners have been developed and are commercially available. Equipped with a flat-panel x-ray detector, this type of scanner is capable of acquiring the projection data in 4 - 60 seconds, with 0.15 mm isotropic voxel spacing in the reconstructed images. Physiological motion during the scan causes artefacts that are particularly evident in images containing the thorax and upper abdomen. For lung imaging, eliminating respiratory motion will reduce these artefacts. I will present a method for retrospectively sorting the projection views based on the respiratory phase during which they were acquired, and reconstructing only the in-phase projection views to provide volumetric lung images of anaesthetized, free-breathing rodents at a desired point in the respiratory cycle. This technique will also allow dynamic imaging to show the respiratory mechanics of the animal by producing a series of lung images throughout the respiratory cycle. Quantitative measurements of lung volume, CT density, functional residual capacity and tidal volume can all be obtained from the volumetric images. Respiratory gating is a necessary step towards cardiac-gated micro-CT imaging. Our retrospective gating technique has also been extended to include cardiac gating. Dynamic images of the rodent heart can be produced throughout the cardiac cycle, and measurements of ejection fraction and cardiac output are obtained using image-based techniques.

† In collaboration with Andrew Wheatley [1], Sarah Detombe [2], David Holdsworth [2], Maria Drangova [2], [1] Robarts Research Institute, [2] Robarts Research Institute, University of Western Ontario

* This work is being supported by HSFO, ORDCF

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

[TU-P11] (DASP / *DPAE*) Geospace Physics Through Coordinated Ground-Based and Space-Based Observation and Modelling VI / *Physique géospatiale par observation et modélisation coordonnées sur terre et dans l'espace VI*

TUESDAY, JUNE 19 / MARDI, 19 JUIN
14h15 - 16h30

ROOM / SALLE Thor. 110 (90) ***Chair: D.M. Gillies***

TU-P11-1 **14h15**

PolarDARN observations of sunward convection under strong interplanetary magnetic field B_y conditions*. **Raj Kumar Choudhary**, J.-P. St.-Maurice, G.J. Sofko, *University of Saskatchewan* — The interplanetary magnetic field (IMF) is known to have a profound influence on the ionospheric convection pattern at high latitudes. In particular when the IMF has a dominant southward (B_z) component, the convection over the polar cap is anti-sunward and closes through the dawn and dusk sectors to produce a familiar 2-cell convection pattern. For strong northward IMF conditions, the pattern is thought to break into four cells, with sunward convection taking place over the noon sector of the polar cap. For strong IMF B_y conditions the standard 2-cell convection pattern is believed to rotate from its basic alignment with the noon-to-midnight meridian to a more dusk-to-dawn or dawn-to-dusk alignment. With the help of the PolarDARN radar we are now able to observe the details of the changes occurring deep into the polar cap. In this talk, we will focus on changes in the convection pattern with changing B_z, during a period when B_y was positive and dominant. In so doing, we will show some unexpected features of both the lobe cell and merging cell structures.

* This work is being supported by NSERC

TU-P11-2 **14h30**

The origin of the interhemispheric potential mismatch of merging cells for IMF BY-dominated periods*. **Masakazu Watanabe** [1], George J. Sofko[1], Konstantin Kabin [2], Robert Rankin [3], Aaron Ridley [4], C. Robert Clauer [4], Tamas Gombosi [5], [1] *University of Saskatchewan*, [2] University of Alberta, [3] Unversity of Alberta, [4] University of Michigan, [5] Unversity of Michigan — When the dawn-to-dusk component of the interplanetary magnetic field (IMF B_Y) is dominant, ionospheric convection exhibits a basic two-cell pattern with significant dawn-dusk and interhemispheric asymmetries. For IMF $B_Y > 0$, the duskside merging cell potential in the Northern Hemisphere is much higher than that in the Southern Hemisphere, and the dawnside merging cell potential in the Southern Hemisphere is much higher than that in the Northern Hemisphere. The situation is reversed for IMF $B_Y < 0$. This interhemispheric potential mismatch originates from reconnection of overdraped lobe field lines and closed field lines. This type of north-south asymmetric reconnection does not affect the merging cell potentials in the same hemisphere as the reconnection point, whereas in the opposite hemisphere, it diminishes the potential of the dawnside (or duskside) Dungey-type merging cell. Thus the total dawnside (or duskside) merging cell potential in one hemisphere is smaller than that in the other hemisphere by the reconnection voltage associated with the asymmetric reconnection.

* This work is being supported by NSERC and CSA

TU-P11-3 **14h45**

Observations of Dipolarization at Geo-Synchronous Orbits and its Response in the Polar Cap Convection*. **Thayyil Jayachandran** [1], John MacDougall [2], A. Hamza [1], M. Henderson [3], [1] *University of New Brunswick*, [2] University of Western Ontario, [3] Los Alamos National Laboratory — Dipolarization events represent a topological change in the magnetotail from a stretched tail like topology to a more dipole like topology, and are usually associated with substorms. Analysis of the polar cap convection and geosynchronous magnetic field measurements, in the context of dipolarization events, is presented in the paper. Clear dipolarization events at geosynchronous orbits are always followed by an increase in the polar cap convection with a time delay. The distribution of the time delay between the onset of dipolarization at geosynchronous orbit and polar cap convection response varied between 6 and 15 minutes with an average of 9 minutes. The polar cap convection response to the dipolarization events

enabled the deduction of the dipolarization time scales at geosynchronous orbits and in the ionosphere. A comparison of these two time scales revealed that the time scales of dipolarization events deduced from geosynchronous magnetic field measurements were always shorter (avg. 11 minutes) than the time scales deduced from the polar cap convection measurements (avg. 33 minutes). Implications of these results in the context of Magnetosphere-Ionospheric coupling are presented.

* This work is being supported by NSERC

TU-P11-4 15h00

A New Era of Ground-Based Auroral Remote Sensing. **Eric Donovan**, *University of Calgary* — The last five years have seen a remarkable convergence of programs that are enhancing and adding new ground-based instrumentation in North America. These instruments include imaging and single-beam riometers, meridian scanning photometers, and as many as 40 all-sky imagers, the which taken together represent a new era in auroral observation. In this talk I will use data from riometers, MSPs, and ASIs for a several hour period to highlight these new capabilities, focusing on the time-evolving spatial distribution of auroral "type" during a particularly dynamic event. This talk will in addition highlight new challenges we as a community are facing which include integrating data and derived parameters such as boundaries from different instruments, and the more general problem of how to make such large data sets both readily searchable and accessible.

15h15 Coffee Break / *Pause café*

TU-P11-5 15h30

The Study of Solar Wind-Magnetosphere-Ionosphere Coupling Using Multiple Instruments. **Kathryn McWilliams** [1], T.K. Yeoman [2], J.A. Davies [3], H.U. Frey [4], T. Nagai [5], M. Lockwood [3], J.A. Wild [6], [1] *University of Saskatchewan*, [2] University of Leicester, [3] Rutherford Appleton Laboratory, [4] University of California Berkeley, [5] Tokyo Institute of Technology, [6] Lancaster University — Multi-instrument studies have proved to be an excellent way to study the direct coupling of the solar wind-magnetosphere-ionosphere system. In the Canadian sector, the vast and diverse combined data that will soon be available from e-POP, THEMIS, and AMISR, in conjunction with CGSM, will include many excellent instrument conjunctions. An example of the type of study that will be possible in the Canadian sector will be discussed. Often transient features associated with magnetic reconnection are observed at the magnetopause, in the high- and low-altitude cusp, and in the ionosphere near the footprint of the cusp and well into the polar cap. The challenge is to detangle the temporal and spatial effects in the multi-point observations from such a diverse data set. There was an excellent and rare conjunction of spaceborne instrumentation monitoring the dayside magnetosphere and ground-based instruments in the European sector. Geotail was in the vicinity of the postnoon magnetopause, all Cluster spacecraft traversed the high-altitude cusp, there were several DMSP crossings of the low-altitude cusp, and the IMAGE spacecraft passed over the northern polar cap during the interval. To take advantage of the instrument conjuction, EISCAT and ESR were run in a CP4-type mode, providing simultaneous measurements of electron densities and temperatures over a range of latitudes through the auroral zone and well into the polar cap. DMSP and Cluster both measured energy-dispersed cusp ions, and these will be compared to transient poleward-moving features measured by EISCAT and ESR. The reconnection transients at different altitudes, along with the density and temperature signatures from EISCAT and ESR, will be examined in the context of the large-scale convection velocities measured by the SuperDARN radars, as well as the global ultraviolet auroral emissions.

TU-P11-6 15h45

Substorm timing and location using the combined CARISMA and THEMIS GMAG magnetometers*. **David Milling**, Ian Mann, Andy Kale, Jonathan Rae, *University of Alberta* — The growing array of ground-based magnetometers deployed in North America will provide important substorm location and timing information in support of the THEMIS mission objectives. We present our plans to use the expanded CARISMA array together with the THEMIS GMAG magnetometers to produce data products cataloguing the substorm onset time and estimated location of the substorm current wedge. A Pi2 detection algorithm (Nose *et al.*, 1998) will be applied to the realtime CARISMA data to generate a database of substorm onset events. Subsequent analysis of the associated Pi1B pulsations across the combined array should allow substorm onset timing to within an accuracy of about 10 seconds. We also propose to apply the York substorm location modeling algorithm (Cramoysan *et al.*, 1995) to the mid-latitude data to produce initial estimates of the locations of the upward and downward field aligned currents and the Westward electrojet. The timing and location results will be published on the Canadian Space Science Data Portal.

* This work is being supported by CSA

TU-P11-7 16h00

Global ULF Wave Energy Transport in the Magnetosphere*. **Jonathan Rae**, Ian Mann, *University of Alberta* — With the launch of the THEMIS mission, there are several remarkable opportunities to investigate the transport of ULF wave energy via large-scale wave modes which are a key element of solar wind-magnetosphere-ionosphere coupling. During the cruise phase of the mission, the string of pearls configuration will allow for multiple passes through the magnetopause on MHD scales, giving us unprecedented opportunities with which to study magnetopause motion. In the main phase of the mission, we have the luxury of an upstream solar wind monitor, together with near-simultaneous dawn and dusk flank coverage of the magnetopause. We present a THEMIS main phase test case, whereby the Cluster spacecraft were traversing the dusk-side magnetopause, whilst Polar and the 4 GOES spacecraft were sampling the equatorial electric- and magnetic fields of the outer magnetosphere under high solar wind speed and a favourable conjunction with the North American sector. This talk will highlight the opportunities available for ULF wave science using ground-spacecraft conjunctions and using ULF wave power maps generated from ground-based magnetometer data

* This work is being supported by CSA

TU-P11-8 16h15

Gravity waves near the polar cap boundary*. **John MacDougall** [1], Glen Hussey [2], [1] *University of Western Ontario*, [2] University of Saskatchewan — On days in February 2007 the Canadian Advanced Digital Ionosonde at Rankin Inlet (72.5°mag. lat.) observed very clean examples of gravity waves propagating southward at speeds 300-400 m/s. Examination of magnetic data from Cambridge Bay and Taloyoak (both ~780 km north of Rankin Inlet) shows what appear to be eastward and westward electrojets that could be the source of these waves. Because of the relatively high latitude of Rankin where these waves were observed, the wave sources are less ambiguous than tracing back to the source from waves observed at low latitudes. However, examining SuperDARN data shows what could be coincident features coming from poleward of Cambridge/Taloyoak so the wave sources might not be the observed electrojets.

* This work is being supported by NSERC/CSA

16h30 Session Ends / *Fin de la session*

[TU-AGM] CAP Annual General Meeting / *Assemblée générale de l'ACP*

(CAP / *ACP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
16h45 - 18h00

ROOM / SALLE Arts 146 (154)

Chair: M.C.W. Campbell, University of Waterloo

TU-AGM-1 **16h45**

MELANIE CAMPBELL, University of Waterloo and **LOUIS MARCHILDON**, Université du Québec à Trois-Rivières

CAP's Partnerships in the Promotion of Canadian Physics / Les partenariats de l'ACP dans la promotion de la physique canadienne

We will outline CAP's accomplishments over the past year, the challenges that we face, and the importance of our partnerships. Our most important partners are you, our members, Canadian physicists. / Nous ferons un survol des réalisations de l'ACP au cours de la dernière année, des défis auxquels nous faisons face et de l'importance de nos partenariats. Ce sont vous, nos membres physiciennes et physiciens canadiens, qui sont nos partenaires les plus importants.

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

[CAP-Banq] Reception / Banquet / *Réception et banquet*

(CAP / *ACP*)

TUESDAY, JUNE 19
MARDI, 19 JUIN
19h00 - 22h30

ROOM / *SALLE* Western Development Museum

Chair: M.C.W. Campbell, University of Waterloo

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

WEDNESDAY, JUNE 20 - MERCREDI, 20 JUIN

[WE-Plen1] Plenary Session / *Session plénière*

(DCMMP-CAP *IDPMCM-ACP*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
08h15 - 09h00

ROOM / SALLE Arts 143 (350)

Chair: B.D. Gaulin, McMaster University

WE-Plen1-1 **08h15**

DAVID A. WEITZ, Harvard University

Dripping, Jetting, Drops and Wetting: the Magic of Microfluidics

This talk will discuss some of the new opportunities that arise by precisely controlling fluid flow and mixing using microfluidic devices. I describe studies to elucidate the instabilities that lead to drop formation and use these to create new materials that are difficult to achieve with any other method. I also show how the exquisite control afforded by the microfluidic devices provides the enabling technology to use droplets as nanoreactors to qualitatively increase the rate of combinatorial screening of chemical reactions.

08h50 **Discussion Break**

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

[WE-Plen2] Plenary Session / *Session plénière*

(PPD-CAP *IPPD-ACP*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
09h00 - 09h45

ROOM / SALLE Arts 143 (350)

Chair: A. Bellerive, Carleton University

WE-Plen2-1 **09h00**

JONATHAN FENG, University of California, Irvine

The Dark Universe and Microphysical Cosmology

Cosmological data now imply that the known particles make up only about 4% of the universe, with the rest composed of dark matter and dark energy. The dark components provide not only fascinating mysteries, but also outstanding opportunities to study central problems in particle physics with cosmology and vice versa. I will describe

some of these opportunities, recent progress, and the prospects for shedding light on the dark universe through upcoming experiments in particle physics, astrophysics and cosmology.

09h00 **Discussion Break**

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

[WE-A1] Atmospheric Processes of Climate Change (APOCC): Concept Working Groups I / *Processus atmosphériques et changements climatiques: groupes de travail sur le concept I*

(DASP / *DPAE*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
10h00 - 12h15

ROOM / SALLE Thor. 159 (80)

Chair: D.A. Degenstein, University of Saskatchewan

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

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

[WE-A2] e-POP Mission Meeting I / *Rencontre de la mission e-POP I*

(DASP / *DPAE*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
10h00 - 12h15

ROOM / SALLE Arts 146 (154)

Chair: D.A. Degenstein, University of Saskatchewan

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

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

[WE-A3] Instrumentation for Nuclear and Medical Physics / *Instrumentation pour la physique nucléaire et médicale*

(DNP-DMBP / *DPN-DPMB*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
10h00 - 12h15

ROOM / SALLE Biol. 106 (250)

Chair: G.S. Hackman, TRIUMF

WE-A3-1 **10h00**

DAVID CHETTLE, McMaster University

Nuclear & Atomic Physics Techniques for the Elemental Analysis of Living Human Subjects *

Elements can be characterized as essential or toxic, or sometimes both. Elemental content is frequently measured in fluids or other samples taken from the body. This often provides the required information. In some circumstances, it is the stored mass of an element that is important for health. A biopsy taken from the storage organ is neither popular nor a satisfactory sampling strategy. To measure the mass of an element stored within the body non invasively, three criteria must be satisfied. An incident probe must reach the storage site, an interaction must produce a signal characteristic of the element in question and the resultant signal must exit the body and be detected. In practice, neutron activation or x-ray fluorescence are most widely employed, with occasional use of nuclear resonance absorption. Cadmium (toxic) can be measured by detecting gamma rays emitted promptly following neutron absorption. The radioactive isotope ^{56}Mn of Manganese (essential, toxic in excess) is created by neutron absorption and gamma rays emitted following the 2.6 hour half life decay are detected in a 4π NaI counter. Lead (toxic) is measured in bone, using gamma rays from the radioisotope ^{109}Cd to excite characteristic x-rays. In proof of principle experiments to measure nitrogen (essential) using nuclear resonance absorption, gamma rays characteristic of ^{14}N are produced by accelerating protons onto a ^{13}C target. Resonance is achieved by selecting the angle at which recoil losses are overcome by the Doppler shift. The radiation dose is always carefully controlled, as with other diagnostic procedures.

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

WE-A3-2 **10h30**

Bone Aluminum Measurement with Accelerator-based *In Vivo* Neutron Activation Analysis*. **Kanakam Davis** [1], Aslam [2], Ana Pejovič -Milič [1], Soo-Hyun Byun [2], David Chettle [2], [1] *Ryerson University*, [2] McMaster University — The harmful biological effect of excessive Aluminum (Al) load in humans has been an important area of research in recent decades. Al stored in bone can interfere with normal bone remodeling and can be expected to relate to osteoarthritis. The relationship between chronic Al exposure and the risk of Alzheimer's disease remains controversial. The non-invasive technique of *in vivo* neutron activation analysis has been under development for measurement of Al in the bones of the hand. Pejovič-Milič *et al.* (2005) reported on the projected performance of an upgraded system. This was to include a high current Tandem accelerator based neutron source, an irradiation/shielding cavity based on Monte Carlo design, a 4π NaI(Tl) detector system and γ ray spectral decomposition. We report the results of a set of Al doped, human hand phantom measurements that were carried out for a 20 mSv dose with 100 μA proton beam current, 2 MeV proton energy and 180 seconds irradiation time. We also discuss a new generation of hand phantoms that closely resembles spectra recently collected from a hand of normal, non-exposed subject. Furthermore, a new protocol of bone Al measurement will be presented as well as the minimal detectable limit achieved in the context of measuring bone Al levels in both exposed and non-exposed subjects, while keeping the radiation dose as low as possible. Reference: A. Pejovič-Milič, S.H. Byun, D.C. Comsa, F.E. McNeill, W.V. Prestwich, and D.R. Chettle (2005), *In Vivo* measurement of Bone Aluminum: Recent Developments, *Journal of Inorganic Biochemistry,* Vol. **99 (9)**, pp. 1899-1903.

* This work is being supported by NSERC

WE-A3-3 **10h45**

In Vivo Assessment of Mg Status in Human Body using Accelerator-based Neutron Activation Measurement of hands: A feasibility study*. **Aslam** [1], Ana Pejović-Milić [2], Fiona McNeill [1], Soo Byun [1], David Chettle [1], [1] *McMaster University*, [2] Ryerson University — Magnesium (Mg) is an essential element for many enzymetic reactions in the human body. Various human and animal studies suggest that changes in Mg status are linked to diseases such as cardiac arrhythmias, coronary heart diseases, hypertension, premenstrual syndrome, diabetes mellitus etc. Thus knowledge of Mg levels in human body is needed. A direct measurement of human blood serum, which contains only 0.3% of the total body Mg, is generally used to infer information about the status of Mg in the body. However, in many clinical situations Mg stored in large levels, for example in bones, muscles, and soft tissues, needs to be monitored either to evaluate the efficacy of a treatment or to study the progression of diseases associated with the deficiency of total body Mg. This work presents a feasibility study of a non-invasive, *in-vivo* neutron activation analysis (IVNAA) technique using the ^{26}Mg (n,γ) ^{27}Mn reaction to measure Mg levels in human hands. This technique employs the McMaster University high beam current Tandetron accelerator hand irradiation facility and a 4π NaI (Tl) gamma ray spectrometer for delayed counting of 844 and 1014 keV gamma rays emitted when ^{27}Mg decays in the irradiated hand. A brief summary of Mg levels measured in volunteers' hands is also included in the discussion to demonstrate the application of this technique for possible use in clinical environment.

* This work is being supported by Thode Fallowship and NSERC

WE-A3-4 **11h00**

LEONID KURCHANINOV, TRIUMF

Liquid Xenon Detector for Medical Imaging *

Liquid xenon is very promising medium for ionizing particles detection. It is very bright and fast scintillator. Ionization yield is significant and electrons drift fast at reasonable electric field. Xenon has high energy resolution which can be improved by weighting ionization and scintillation signals. Because of its short radiation length, liquid xenon detectors are attractive for various fields of experimental physics. They are used in nuclear physics, astrophysics, astronomy, nuclear medicine. In my talk I'll present a status of ongoing R&D project aimed to build a liquid xenon detector for full-scale prototype of micro-PET scanner.

* This work is being supported by CFI and TRIUMF

WE-A3-5 **11h30**

Development of a System for Bio-medical Carbon-14 Analysis by Accelerator Mass Spectrometry*. **William E. Kieser** [1], Kissena Leung [1], Natasha Krestina [1], Roelf P. Beukens [1], Xiaolei Zhao [1], Albert E. Litherland [1], Jack Cornett [2], [1] *IsoTrace Laboratory, University. of Toronto* , [2] Health Canada, Radiation Protection Bureau — New applications in which ^{14}C labelled compounds are used as tracers in bio-medical measurements have greatly increased the requirements for analysis by accelerator mass spectrometry (AMS). In particular, the technique of microdosing, by which the bio-availability, pharmacokinetics and dynamics of experimental pharmaceutical compounds can be assessed at low levels in human subjects before extensive animal testing, can only be done with AMS for ^{14}C-based measurements. Typically, AMS analyzes solid samples, requiring the graphitization of the sample material. For the large numbers of samples needed for most bio-medical experiments, this adds to both the cost and turnaround time. With the recent availability of gas-fed AMS ion sources, the elimination of the graphitization stage and the integration and automation of combustion and analysis is possible. At IsoTrace, we are developing 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 required to accommodate the 200 ml per minute discharge rate of CO_2 in the 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. Design and testing of this system will be discussed and details of its application for pharmaceutical measurements, as well as for environmental monitoring in the event of accidental or malicious release of ^{14}C, will be presented.

* This work is being supported by CRTI, Health Canada and NSERC

WE-A3-6 **11h45**

Measurement of total linear attenuation coeffecients of tissues using energy dispersive transmission measurements with a CdTe detector*. **Robert LeClair**, *Laurentian University* — In the field of medical x-ray diagnostics the linear attenuation coefficients (µ) are used to describe the probabilities per unit length of matter that x rays will interact. Our group although interested in measuring diffraction signals of breast tissues must also measure these µ coefficients. Energy dispersive transmission measurements performed with a CdTe detector is our method of choice for extracting the values of µ. The CdTe detector is known to have poor hole transport properties and also problems with the escape of fluorescence. An initial analysis with polymethyl methacrylate (PPMA) targets was performed using 30 kV polychromatic beams. Thicknesses of 5 mm, 4 mm, 3 mm, 2 mm, and 1 mm were used. The µ values can be determined via a single thickness measurement or by using all thickness measurements and calculating µ via the slope method. The values compare well either method. Also it is found that a correction for the detector's response has little effect on the extraction of µ values.

* This work is being supported by NSERC

WE-A3-7 **12h00**

Conception d'un système de pulsation lumineuse comme point de référence interne pour le multidétecteur HÉRACLES*. **René Roy** [1], Marc Olivier Frégeau [2], [1] *Groupe de recherche sur les ions lourds de Laval (GRILL)*, [2]Université Laval- Groupe de recherche sur les ions lourds de Laval (GRILL) — Le multidétecteur HERACLES est utilisé par notre groupe pour détecter les fragments émis lors de collision d'ions lourds aux énergies intermédiaires. Lors de la précédente expérience en 2001 à la Texas A&M university d'importantes variations de gain sur les PMT de certains anneaux ont rendu ceux-ci inutilisables. Pour être en mesure de tenir compte de cette variation du gain il importe de construire un système pouvant mesurer en temps réel la variation du gain. Il existe plusieurs systèmes qui ont été utilisés dans ce but. Tous fonctionnent de la même manière: ils envoient une impulsion lumineuse dans le PMT pour créer un signal de référence. Cette impulsion peut être générée de plusieurs manières: le groupe INDRA a choisi d'utiliser un laser tandis que le groupe de MSU miniball a travaillé avec plusieurs diodes. Aujourd'hui la puissance des diodes ayant dramatiquement augmenté il est maintenant possible d'utiliser une seule diode pour plusieurs détecteurs. Dans le but d'obtenir une plus grande résolution en énergie de notre signal de référence ainsi qu'une plus grande latitude lors du positionnement dans un diagramme rapide-lent nous avons choisi d'utiliser deux impulsions indépendantes d'intensité la plus grande possible et les plus courtes possible. Ces deux impulsions sont respectivement positionnées dans la fenêtre rapide et lente dans le but de produire un pic qui sera traité de manière standard par le système d'acquisition.

* This work is being supported by CRSNG

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

[WE-A4] Soft Matter II / *Matière molle II*

(DCMMP / *DPMCM*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
10h00 - 12h15

ROOM / SALLE Phys. 130 (70)

Chair: J. Katsaras, National Research Council Canada

WE-A4-1 **10h00**

JOHN BECHHOEFER, Simon Fraser University

How frog embryos replicate their DNA reliably *

Frog embryos contain three billion base pairs of DNA. In early embryos (cycles 2-12), DNA replication is extremely rapid, about 20 min., and the entire cell cycle lasts only 25 min., meaning that mitosis (cell division) takes place in about 5 min. In this stripped-down cell cycle, there are no efficient checkpoints to prevent the cell from dividing before its DNA has finished replication - a disastrous scenario. Even worse, the many origins of replication are laid down stochastically and are also initiated stochastically throughout the replication process. Despite the very tight time constraints and despite the randomness introduced by origin stochasticity, replication is extremely reliable, with cell division failing no more than once in 10,000 tries. In this talk, we discuss a recent model of DNA replication that is drawn from condensed-matter theories of 1d nucleation and growth (of solids). Using our model, we discuss different strategies of replication: should one initiate all origins as early as possible, or is it better to hold back and initiate some later on? Using concepts from extreme-value statistics, we derive the distribution of replication times given a particular scenario for the initiation of origins. We show that the experimentally observed initiation strategy for frog embryos meets the reliability constraint and is close to the one that requires the fewest resources of a cell.

* This work is being supported by NSERC

WE-A4-2 **10h30**

Characterization of biocompatible polymer thin films, grafted poly-(methacrylate) with oligo(ethylene glycol) and phosphorylcholine side chains, by neutron reflectometry*. **Mu-Ping Nieh** [1], Wei Feng [2], Shiping Zhu [2], John Katsaras [1], Thad Harroun [3], John Brash, [1] *National Research Council*, [2] McMaster university, [3] Brock University — Poly[oligo(ethylene glycol) methyl ether methacrylate] [poly(OEGMA)] and poly(2-methacryloyloxyethyl phosphorylcholine) [poly(MPC)] thin films have been reported to be capable of reducing protein adsorption. Here, we have used neutron reflectometry to investigate the structure of polymer brushes covalently bonded to a Si wafer, in both dry and wet states. We also studied different molecular weight and graft densities of both polymers in order to gain insight into the interplay between the polymer density profile normal to the surface and protein adsorption. Since the polymer films are reasonably smooth, a three-layer model (SiO_2 + initiator + polymer film) was sufficient to fit the data in dry state, while in the cases of wet samples, a stretched parabolic model was successful in describing the polymer profile.

* This work is being supported by McMatster University and NRC

WE-A4-3 **10h45**

Self-assembling, bioactive protein hydrogels via engineered coiled-coil aggregation. **James Harden** [1], Stephen Fischer[2], Lixin Mi[3], [1]*University of Ottawa*, [2]Johns Hopkins University, [3]Georgetown University — We describe associating triblock proteins with that self-assemble into reversible, hydrogels with a regular network structure and specific biofunctional attributes. These fibrilar, telechelic designs consist of a hydrophilic random coil (denoted R) flanked by associating coiled-coil end domains (denoted A, B, C). The central R domain also encodes specific cell binding and signaling functions of extracellular matrix (ECM) constituents. We will discuss a series of proteins with complimentary associating end blocks that preferentially form heterotrimer aggregates of A, B, and C domains. Mixtures of symmetric triblocks ARA, BRB, and CRC in aqueous solution self assemble into reversible viscoelastic network structures, which we characterize using microscopy, light scattering techniques and computer simulations. Supporting circular dichroism and analytical ultracentrifugation studies of the secondary structure and association behavior of the A, B, C domains will also be presented. Through the use of microscopic and cell proliferation assays, we also show that these hydrogels are capable of inducing biomimetic responses of ECM constituents in cell culture experiments.

WE-A4-4 **11h00**

JAMES FORREST, University of Waterloo

Protein denaturing on nanospheres

The interaction of proteins with surfaces is a fundamental problem in biomaterials. In particular the interaction with surfaces can have a strong effect on proteins stability. Properties such as surface charge and hydrophobicity have been studied in detail, but much less is known about the effect of local surface curvature. We use gold nanoparticles as a model system with uniform curvature, and study the thermal denaturing of Bovine Serum albumin, which has been adsorbed to the nanospheres. The denaturing of the proteins is studied by the effect it has on the localized surface plasmon resonance extinction spectrum of the nanosphere. The results are compared to detailed calculations that allow us to infer properties such as density and thickness of the adsorbed protein layer with very high sensitivity. While the protein on larger spheres (>30 nm diameter) exhibits behavior similar to bulk protein, molecules adsorbed onto smaller spheres show evidence for a different path of denaturing. Studies of denaturing kinetics were used to estimate the activation barrier for denaturing, and reveal a strong nanoparticle size dependent stabilization of the adsorbed protein. Together the results indicate that proteins adsorbed onto nanoparticles may denature by a different mechanism than they do in bulk.

WE-A4-5 **11h30**

Curvature Effect on the Structure of Phospholipid Bilayers*. **Norbert Kucerka** [1], Jeremy Pencer [1], Jonathan Sachs [2], John Nagle [3], John Katsaras [1], [1] *National Research Council*, [2] University of Minnesota, [3] Carnegie Mellon University — High-resolution small-angle X-ray scattering (SAXS), complemented by small-angle neutron scattering (SANS) and dynamic light scattering (DLS) experiments, was used to study the effect of curvature on the bilayer structure of varying diameter (600 – 1800 Å) dioleoylphosphatidylcholine (DOPC) unilamellar vesicles (ULVs). Unilamellarity of large DOPC ULVs was achieved by the addition of small amounts (up to 4 mol %) of the charged lipid, dioleoyl-phosphatidylserine (DOPS). In all cases, both the inner and outer leaflets of DOPC bilayers were found to be indistinguishable. However, 1220 Å diameter pure DOPS ULVs formed asymmetric bilayers whose structure can most likely be rationalized in terms of geometrical constraints coupled with electrostatic interactions, rather than curvature alone.

* This work is being supported by NIST/NSF/CNBT

WE-A4-6 **11h45**

Discontinuous molecular dynamics for fluids composed of rigid molecules*. **Sheldon B. Opps** [1], Lisandro H. de la Pena[2], Ramses van Zon[2], Jeremy Schofield[2], [1]*University of Prince Edward Island*, [2]University of Toronto — Discontinuous molecular dynamics simulations are carried out on rigid body systems which differ in the

symmetry of their molecular mass distributions. First, simulations of methane in which the molecules interact via discontinuous potentials are compared with simulations in which the molecules interact through standard continuous Lennard-Jones potentials. It is shown that under similar conditions of temperature and pressure, the rigid discontinuous molecular dynamics method reproduces the essential dynamical and structural features found in continuous-potential simulations at both gas and liquid densities. Moreover, the discontinuous molecular dynamics approach is demonstrated to be between 3 to 100 times more efficient than the standard molecular dynamics method, depending on the specific conditions of the simulation. The rigid discontinuous molecular dynamics method is also applied to a discontinuous-potential model of a liquid composed of rigid benzene molecules, and equilibrium and dynamical properties are shown to be in qualitative agreement with more detailed continuous-potential models of benzene. The few qualitative differences in the angular dynamics of the two models are related to the relatively crude treatment of variations in the repulsive interactions as one benzene molecule rotates by another. Preliminary studies are also performed on water, where the molecules are given a methane-like structure (treating the lone electron pairs as point particles) thus adopting the symmetry of a spherical rotor. An effective hydrogen-bonding potential is also incorporated into this model in order to capture the correct packing and overall structure.

* This work is being supported by NSERC

WE-A4-7 **12h00**

Self-organized criticality of elastic networks*. **Normand Mousseau**, Mykyta V. Chybynsky, Marc-André Brière, *Université de Montréal* — We consider a model of elastic network self-organization inspired by studies of covalent glasses [1,2]. In the model, networks self-organize by avoiding stress whenever possible, but otherwise are random. Instead of a single rigidity percolation transition, with percolation always absent below a certain bond concentration and always present above, we find that the percolating rigid cluster exists with a probability between 0 and 1 in a finite range of bond concentrations, the intermediate phase. A power-law distribution of non-percolating cluster sizes, normally observed at a single critical point in percolation transitions, is seen everywhere in the intermediate phase. There is also a finite probability of percolation appearing and disappearing upon the application of a microscopic perturbation (addition or removal of a single bond). These properties indicate that in this phase the network maintains itself in a critical state on the verge of rigidity, a signature of self-organized criticality, but in a system at equilibrium. Reference: [1] M.V. Chubynsky, M.-A. Brière and N. Mousseau, *Phys. Rev. E* **74**, 016116 (2006); [2] M.-A. Brière, M.V. Chubynsky and N. Mousseau, cond-mat/0610557.

* This work is being supported by MÉQ, NSERC, CRC

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

[WE-A5] Instrumentation for Particle Physics / *Instrumentation en physique des particules*

(PPD / *PPD*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
10h00 - 12h00

ROOM / SALLE Geol. 155 (70) ***Chair: K.J. Ragan, McGil University***

WE-A5-1 **10h00**

LEONID KURCHANINOV, TRIUMF

Development of instrumentation for particle physics in TRIUMF *

Recent developments of instrumentation for particle physics at TRIUMF are reviewed. Last years, the CFI-based Laboratory for Advanced Detector Developments supported a number of R&D projects in particle detectors and associated electronics. One of them is plastic scintillators with fiber readout originally developed for KOPIO experiment and later adopted for T2K Near Detector. Another example is liquid xenon TPC with both scintillation and ionization signals readout developed for medical imaging. Extensive studies of novel photodetectors – Si photomultipliers and large area avalanche photodiodes have been performed last year. Some results are summarized in this review.

* This work is being supported by TRIUMF, CFI

WE-A5-2 **10h30**

Construction of the Fine Grained Detector for the T2K long baseline neutrino oscillation experiment*. **Thomas Lindner**, T2K Canada, *UBC* — T2K is a leader in the next generation of long baseline neutrino oscillation experiments and is scheduled to come online in mid-2009. The FGD is part of the near detector designed to characterize the neutrino beam close to the production site, before any oscillation occurs. The FGD is composed of finely segmented plastic scintillators, read out by wavelength shifting fibre and Silicon Photon Counters. This talk will focus on the expected capabilities of FGD, as well as its ongoing construction and testing.

* This work is being supported by NSERC and CFI

WE-A5-3 **10h45**

An Optical Transition Radiation Beam Monitor for the T2K Beamline. **Alysia Marino** [1], [1] *University of Toronto*, [2] T2K Collaboration — This talk will describe the design of an Optical Transition Radiation (OTR) Monitor for the T2K long-baseline neutrino experiment. The T2K neutrino beam is initiated by a beam of protons striking a graphite target. The purpose of the OTR monitor is to measure the position and width of the beam just before the target. The intensity of the proton beam and the proximity to the target result in a high flux of radiation in this area, making it difficult to place conventional beam monitoring devices there. In the OTR monitor, transition radiation is generated by the proton beam as it passes through a thin titanium foil, and these photons are transported several metres through shielding to a camera that will record the image. The principal advantage of this technique is that the camera and readout electronics sit outside of the target-area shielding, in an environment that has a more manageable radiation level.

WE-A5-4 **11h00**

Large-Area Silicon Photo Multipliers for the GlueX Project*. **Zisis Papandreou**, George Lolos, *University of Regina* — A silicon photomultiplier (SiPM) is an array of limited-Geiger-mode avalanche photodiodes on a common substrate and with a single output. Such devices commonly have an area of 1 mm ^{2}. While avalanche photodiode technology has been in existence since the 1960s, the concept and development of arrays of these devices is relatively new. Cutting-edge R&D for the GlueX Project at Jefferson Lab, in collaboration with the Irish commercial firm SensL, aims at producing large-area arrays consisting of several 3x3mm ^{2} SiPMs, for a total area of 1.3 cm ^{2} for each readout device. Test results from prototype devices will be reported.

* This work is being supported by Jefferson Lab/DOE, USA

11h15 **Coffee Break / *Pause café***

WE-A5-5 **11h30**

MARK G. BOULAY, Queen's University

DEAP liquid argon dark matter particle search at SNOLAB *

The DEAP-1 experiment is a 10 kg prototype liquid argon scintillation detector for dark matter particles, with a projected sensitivity to a WIMP (Weakly Interacting Massive Particle)-nucleon spin-independent cross-section of 10^{-44} cm^2. Unique to the detection technique employed by DEAP-1 is the exclusive use of scintillation pulse-shape discrimination for reduction of beta and gamma-ray backgrounds. The technique of background rejection in this single-phase detector, which is expected to allow an essentially background-free dark matter particle search and scaling to very largest target masses, will be presented. The current results from the prototype detector and the status of the experiment deployment at SNOLAB will be discussed. Beyond the DEAP-1 experiment, we are pursuing R&D for a 1000 kg dark matter search with liquid argon. The current R&D program and status of the 1000 kg detector will also be presented.

* This work is being supported by NSERC, CFI

WE-A5-6 **11h45**

Recent developments and status of the DEAP liquid argon WIMP detector. **Jeff Lidgard**, *Queens University* — Recent developments on the DEAP liquid Argon WIMP detector will be presented, including construction, current status and preliminary (above ground) data showing the current pulse shape discrimination and currently achieved background rates. DEAP-1 utilises a 7 kg target mass of liquid argon. Pulse shape analysis on the produced scintillation pulse of the argon interaction is used to effectively discriminate WIMP events.

12h00 **Session Ends / *Fin de la session***

[WE-A6] Condensed Matter Theory - invited / *Théorie de la matière condensée - invités*

(DCMMP-DTP / *DPMCM-DPT*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
10h00 - 12h15

ROOM / SALLE Thor. 124 (80)

Chair: D. Sprung, McMaster University

WE-A6-1 **10h00**

ROBERT KONIK, Brookhaven National Laboratory

A Numerical Renormalization Group for Continuum One Dimensional Systems

I present a renormalization group (RG) procedure which works naturally on a wide class of interacting one-dimension models based on perturbed (possibly strongly) continuum conformal and integrable models. This procedure integrates Wilson's numerical renormalization group with Zamolodchikov's truncated conformal spectrum approach. The key to the method is that such theories provide a set of completely understood eigenstates for which matrix elements can be exactly computed. In this procedure the RG flow of physical observables can be studied both numerically and analytically. Furthermore the method is sufficiently flexible that it can be extended to the study of arrays of coupled one dimensional systems through a density matrix renormalization group procedure. To demonstrate the approach, I presents results on the spectrum and correlation functions of single quantum Ising chains and coupled arrays thereof.

WE-A6-2 **10h30**

SERGEI ISAKOV, University of Toronto

Fractionalized Mott insulating phases in hard-core boson models on the kagome and pyrochlore lattices †,*

We study hard-core boson models on the kagome and pyrochlore lattices. Using quantum Monte Carlo numerics, we find that these models exhibit superfluid-insulator quantum phase transitions. We show that, in the case of the kagome lattice, the insulating phase is a Z_2 fractionalized Mott insulator with short-ranged density and bond correlations, topological order, and exponentially decaying "vison" correlations. In the case of the pyrochlore lattice, the insulating phase is a U(1) fractionalized Mott insulator. Equal time and static density correlation functions in this phase are well-described by "electric field" correlators in the Coulomb phase of an effective U(1) lattice gauge theory.

† In collaboration with Argha Banerjee[1] , Kedar Damle [1] , Yong Baek Kim [2] , Arun Paramekanti [2] , [1] Tata Institute, India, [2] University of Toronto

* This work is being supported by NSERC, CRC, CIAR

11h00 **Coffee Break / *Pause café***

WE-A6-3 **11h15**

DAVID SÉNÉCHAL, Université de Sherbrooke

Progress on strongly correlated electron systems with the variational cluster approximation *

High-temperature superconductors and layered organic superconductors are examples of materials in which electron-electron interactions have strong effects. These interactions are thought to be essential in order to understand the magnetic and superconducting phases of these materials, and their competition. Materials such as the above are commonly described in a simple manner by the one-band Hubbard and much effort has been devoted to find approximate solutions to this model in the last 20 years. I will present one of the most promising approximate methods for this. The variational cluster approximation, proposed by M. Potthoff in 2003. In this method, the one-electron Green function of the model is approximated using the exact self-energy calculated on a small cluster of lattice sites, but this self-energy is chosen with the help of a rigorous variational principle involving a few relevant variational parameters. The method itself will be summarized and its application to high-Tc cuprates and kappa-BEDT

organic superconductors will be reviewed. In particular, the latter system exhibits many phases simply by varying the interaction strength and the diagonal hopping term: Néel antiferromagnetism, two kinds of d-wave superconductivity, a spin liquid phase and 120 antiferromagnetism. The inclusion of phonons will also be discussed.

* This work is being supported by NSERC, CFI & partners

WE-A6-4 **11h45**

MONA INESA BERCIU, University of British Columbia

Green's function of single Holstein polarons *

We present a new, highly efficient yet accurate approximation for the Green's functions of dressed particles, using the Holstein polaron as an example. Instead of summing a subclass of self-energy diagrams (*e.g.*, the noncrossed ones, in the self-consistent Born approximation), we sum all the diagrams, but with each diagram averaged over its free propagators' momenta. The resulting Green's function satisfies exactly the first six spectral weight sum rules. All higher sum rules are satisfied with great accuracy, becoming asymptotically exact for coupling both much larger and much smaller than the free particle bandwidth. The way to systematically improve this approximation, as well as generalizations to other models, will also be discussed.

* This work is being supported by NSERC, Sloan Foundation, CIAR

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

[WE-A7] CAP Best Student Presentations Final Competition / *Compétition finale de l'ACP pour les meilleures communications étudiantes*

(CAP / *ACP*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
10h00 - 12h00

ROOM / SALLE Phys. 103 (145)

Chair: W.F. Davidson, National Research Council Canada

The list of students participating in this competition will be announced at the Annual General Meeting on Tuesday, June 19th. / Les participants seront annoncés pendant l'assemblée générale mardi, le 19 juin.

12h00 **Session Ends / *Fin de la session***

[WE-A8] General Instrumentation / *Instrumentation générale*

(DIMP / *DPIM*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
10h00 - 11h45

ROOM / SALLE Phys. 127 (48)

Chair: K.H. Michaelian, CANMET, Natural Resources Canada

WE-A8-1 **10h00**

JUN SHEN, NRC Institute for Fuel Cell Innovation

Photothermal-deflection measurements of thermophysical and mass-diffusion properties of gases †,*

With an in-house made gas diffusion cell, continuous-wave transverse photothermal-deflection technique was employed to measure thermophysical and mass-diffusion properties of gases. A diffraction theory of photothermal deflection spectroscopy was used to process the experimental data. Before the measurement of the gas properties, the distance between a solid sample surface and the probe beam was precisely determined. With the determined distance, the thermal diffusivity α_g and the temperature coefficient of the refractive index dn/dT of pure gases (O_2, N_2, and CO_2) and binary gas mixtures (CO_2–O_2 and CO_2–N_2) were measured as a function of a gas concentration in molar fraction. The measured α_g and dn/dT of pure gases are in very good agreement with literature values, and furthermore the measured dn/dT values of the pure gases have one more significant figure than the literature ones, demonstrating the high precision of this method. The concentration dependences of α_g and dn/dT could be explained by thermodynamic theory and Lorentz-Lorenz formula, respectively, providing theoretical bases for the predictions of α_g and dn/dT versus the concentration for a binary gas mixture. The concentration dependences of α_g and dn/dT can be employed for the real-time monitoring of the gas concentration in a binary mixture and the determination of mass-diffusion coefficient. Mass-diffusion coefficients of CO_2 in O_2 and CO_2 in N_2 were measured using the concentration dependences, resulting in good agreement with literature values. The experimental results showed that photothermal deflection could be useful in terms of precise measurements of gas thermophysical and mass-diffusion properties.

† In collaboration with Jurandir Rohling, James Zhou, Caikang Gu, NRC Institute for Fuel Cell Innovation

* This work is being supported by NRC

WE-A8-2 **10h30**

ALAIN PIGNOLET, INRS - Energie, Materiaux et Telecommunications

Voltage Modulated Piezoelectric Response Scanning Force Microscopy of Ferroic Oxide Films and Structures †

Thin films and nanostructures of functional complex oxides, especially of piezoelectric, ferroelectric and multiferroic materials, have a huge potential for applications in integrated devices in microelectronics and photonics. A powerful technique to *locally* investigate the polar properties of these ferroic materials will be described, which is essential to investigate polar micro- and nanostructures. *Voltage modulated piezoelectric response scanning force microscopy* in contact mode (or *piezoresponse force microscopy*) allows investigating the piezoelectric and ferroelectric properties at the nanoscale and provides interesting information the polar and ferroelectric domain configuration. However, a complete and quantitative analysis is a very challenging and complex task. The possibilities of the method for the analysis of the local ferroelectric properties as well as its limitations resulting from the complex interactions between the ferroelectric films investigated and the testing probe will be discussed. This novel technique has been successfully used to investigate thin films and nanostructures of functional oxides, in particular ferroelectric and multiferroic perovskite oxides and non-*c*-oriented epitaxial bismuth-layered perovskites grown by pulsed laser deposition. Their growth, structural properties and microstructure investigated by XRD, TEM, and

scanning force microscopy (SFM) as well as their various ferroic global and local properties (for instance the ferroelectric properties) will be discussed and some structure-properties relationships established. Then the issue of *size effects in ferroelectric and ferroic materials* will be addressed, which is both of fundamental importance and critical for down-sizing integrated devices. Examples of fabricating ferroelectric nanostructures and their local characterization will be presented, included some novel approaches investigated at the *Ferroic-Lab*, such as nanostencilling.

† In collaboration with Catalin Harnagea, Cristian-Victor Cojocaru, Olivier Gautreau, Riad Nechache, INRS - Energie, Materiaux et Telecommunications

11h00 **Coffee Break** / ***Pause café***

WE-A8-3 **11h15**

Fine Grained Detector Electronics for the T2K Experiment*. **Brian Kirby** [1], Thomas Lindner [1], Douglas Maas [1], Pierre Amaudruz [2], Daryl Bishop [2], Leonid Kurchaninov [2], Fabrice Retiere [2], Nicolas Braam [3], Reece Hasanen [3], Neil Honkanen [3], Dean Karlen [3], Paul Poffenberger[3], [1] *University of British Columbia*, [2] TRIUMF, [3] University of Victoria — The T2K project is a long baseline neutrino oscillation experiment that will measure oscillation parameters with an order of magnitude better precision than previous experiments. The Canadian T2K group is responsible for the design and construction of the tracker section of the T2K 280m near detector, which consists of alternating layers of Time Projection Chambers (TPCs) and Fine Grained Detectors (FGD). The FGD detector is composed of alternately oriented layers of scintillator bars and will provide target mass for neutrino interactions as well as particle tracking. The FGD scintillator bars will be read out with a wavelength shifting fibre coupled to Silicon Photomultiplier light detectors (SiPMs). Readout electronics are implemented with the AFTER ASIC chip produced at SACLAY in order to shape and digitally sample the SiPM waveform so that fitting can be used to accurately determine pulse times. The system will be sensitive to Michel electrons to ensure accurate pion identification. This talk will review the design and performance tests of the FGD electronics system.

* This work is being supported by NSERC

WE-A8-4 **11h30**

A low energy isobar separator for Accelerator Mass Spectrometry (AMS)*. **Albert Litherland** [1], Ilia Tomski [2], Xiaolei Zhao [1], Lisa Cousins [2], John Eliades [1], Jonathan Doupe [3], Reza Javahery [2], Liam Kieser [1], [1] *University of Toronto*, [2] Ionics Mass Spectrometry, [3] University of Alberta — The separation of the positive ions of isobars at eV energy, using "chemical" reactions with vapour in a radio-frequency quadrupole (RFQ), is well known. This has implications for the measurement of rare long-lived radioactive isotopes by AMS, as the interfering atomic isobars must be eliminated. However, the intense anion beams needed for such analyses are initially at tens of keV energy. These must first be mass separated, retarded to eV energy and cooled further before separation in an RFQ reaction cell. This has been done previously for F^- & O^- ions in connection with radioactive ion beam studies. A system has now been constructed and is being tested for the analysis of rare $^{36}Cl^-$ using these principles. Cl^- has the largest binding energy of the atomic anions and it has been known since 1972 that Cl^- and S^- could be separated in NO_2 at eV ion energies. This has been confirmed using an RFQ recently. After retardation and cooling the Cl^- and S^- ions can be trapped in the several eV deep potential well of an RFQ, which suppresses the multiple scattering of the Cl^- during the removal of the S^- ions by reactions with the NO_2. So the gas reactions suppress the S^- and finally, after re-acceleration of the Cl^- ions, they can be analysed by a conventional AMS system. It is expected that this type of isobar separation device will have widespread use in AMS. The first tests will be discussed.

* This work is being supported by NSERC

11h45 **Session Ends** / ***Fin de la session***

[WE-A9] (DASP / *DPAE*) Canadian Geospace Monitoring Mission Meeting / *Rencontre de la mission de surveillance géospatiale canadienne*

WEDNESDAY, JUNE 20 / MERCREDI, 20 JUIN
10h00 - 12h15

ROOM / SALLE Phys. 165 (137) ***Chair: D.A. Degenstein, University of Saskachewan***

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

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

[WE-NSERC] (CAP-NSERC / *ACP-CRSNG*) Young/New Faculty Luncheon with NSERC / *Dîner-rencontre des jeunes ou nouveaux professeurs avec le CRSNG*

WEDNESDAY, JUNE 20 / MERCREDI, 20 JUIN
12h00 - 12h30

ROOM / SALLE Phys.175 (48) ***Chair: B.D. Gaulin, McMaster University***

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

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

[WE-Workshop] (CAP-NSERC / *ACP-CRSNG*) NSERC Workshop / *Atelier du CRSNG*

WEDNESDAY, JUNE 20 / MERCREDI, 20 JUIN
12h30 - 13h30

ROOM / SALLE Biol. 106 (250) ***Chair: B.D. Gaulin, McMaster University***

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

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

[WE-Plen3a] CAP/CRM Medal Winner / *La médaille ACP-CRM*

(CAP-CRM / *ACP-CRM*)

(Joel Feldman, University of British Columbia)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
13h30 - 14h10

ROOM / SALLE Arts 143 (350)

Chair: M.B. Paranjape, Université de Montréal

WE-Plen3a-1 **13h30**

JOEL FELDMAN, University of British Columbia

Perturbation Theory for Many Fermion Systems *

Much of our understanding of the behaviour of crystals at low temperatures comes from quantum field theory models for many fermion systems. Perturbation theory has long been one of the main tools used to extract predictions from such models. I will discuss some of the rigorous results, concerning those perturbation expansions, that have been achieved in the past decade or so.

* This work is being supported by NSERC

14h05 **Discussion Break**

14h10 **Session Ends** / ***Fin de la session***

[WE-Plen3b] Industrial and Applied Medal Winner / *Le récipiendaire de la médaille industrielle et appliquée*

(CAP / *ACP*)

(Roman Maev, University of Windsor)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
13h30 - 14h10

ROOM / SALLE Arts 146 (154)

Chair: M.O. Steinitz, St. Francis Xavier University

WE-Plen3b-1 **13h30**

ROMAN MAEV, University of Windsor

How Advanced Acoustic Imaging will Benefit Modern Industry

The role of nondestructive materials characterization, evaluation and tests (NDT) is changing and will continue to change dramatically. It has become increasingly evident that it is both practical and cost effective to expand the role of NDE and quality control to include all aspects of modern industry's production and to introduce it as early as possible in the manufacturing cycle. Today, any modern manufacturing process requires special importance. In addition to the novel NDT technologies requested for new materials evaluation, the manufacturing process requires almost the same quality control for any joining and bonding technologies. Thus, the whole NDT procedure is always being re-evaluated for both technical and economic reasons. The goal of this review is to introduce recent advances in high-resolution acoustic imaging for material evaluation and NDT and to examine the advantages and limitations of our approaches. The major part of review is related to recent developments of high-resolution imaging techniques for practical uses for various industrial applications. We will describe fundamentals and principles for quantitative imaging characterization of the contrast response in acoustic imaging. New principles for rapid 2D and 3D image quantitative evaluation of bulk and sub-surface acoustical properties and microstructure based on a new concept of portable electronic system, together with matrix and phase array technique, will be reviewed. Based on the most successful experimental results, examples of different applications will be provided including evaluation of advanced material structure, quality control of joints, adhesive bonding, and layer structures, etc. Such techniques have the potential to provide reliable, rapid and cost effective methods to visualize high contrast small scale failures and defects at different depths within inspected parts. Provided this technology can be adapted to high volume manufacture, it has considerable promise for application to the advance manufacturing quality control inspection. The new materials structures, joints, parts, components made from various materials demand the innovative applications of modern NDE techniques to monitor and control as many stages of the production process as possible. Simply put, intelligent advance manufacturing is impossible without integrating modern non-destructive evaluation into the modern production system.

14h05 **Discussion Break**

14h10 **Session Ends** / ***Fin de la session***

[WE-P1] Atmospheric Process of Climate Change (APOCC0: Concept Working Group II / *Processus atmosphérique et changements climatiques: groupes de travail sur le concept II*

(DASP / *DPAE*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
14h15 - 17h00

ROOM / SALLE Thor. 159 (80)

Chair: D.A. Degenstein, University of Saskachewan

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

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

[WE-P2] e-POP Mission Meeting II / *Rencontre de la mission e-POP II*

(DASP / *DPAE*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
14h15 - 16h45

ROOM / SALLE Arts 146 (154)

Chair: D.A. Degenstein, University of Saskatchewan

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

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

[WE-P3] Advances in Nuclear Theory/ *Progrès en théorie nucléaire*

(DNP-DTP / *DPN-DPT*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
14h15 - 16h30

ROOM / SALLE Phys. 130 (70)

Chair: R. Mackenzie, Université de Montréal

WE-P3-1 **14h15**

BYRON JENNINGS, TRIUMF

The Nuclear Shell Model, the Renormalization Group, and the Projection Operator Formalism *

The shell model solves the nuclear many-body problem in a restricted model space and takes into account the restricted nature of the space by using effective interactions and operators. In this talk I discuss two different aspects of the shell model. First the shell model can be cast in the form of a renormalization group procedure. The only significant difference with the usual renormalization procedure is that a discrete basis (usually the harmonic oscillator states) is used rather than a plane-wave basis. Second there are two different approaches to the projection unto the model space: Bloch-Horowitz and Lee-Suzuki. The Bloch-Horowitz method is based on a partial solution of the Schrödinger equation while the Lee-Suzuki method is based on linear algebra. The two methods can be derived in a parallel manner so that the difference and similarities between them become apparent.

* This work is being supported by NSREC, NRC

WE-P3-2 **14h45**

JURIS P. SVENNE, Department of Physics and Astronomy, University of Manitoba, Winnipeg

Coupled-channel study of scattering from and structure of nuclei on and off the line of stability †,*

An algebraic formulation of multi-channel scattering theory (MCAS) has been developed and applied to the study of nucleon scattering from light nuclei. The procedure allows inclusion of the Pauli principle, even when the target nucleus is defined by a collective model. Results for the scattering of both neutrons and protons from ^{12}C compare favourably to data concerning bound states of the compound nucleus (^{13}C or ^{13}N) with the same nucleon-nucleus interactions. Excellent concordance with data is achieved for total and differential scattering cross sections and analysing powers. This method has recently been extended to allow the calculation of nuclei away from the line of stability, even particle-unstable nuclei. These necessitated extending the procedure for treating the Pauli principle to include the concept of "Pauli hindrance". It is thus possible to account for three situations: Pauli allowed states (no Pauli violation could occur), Pauli blocked (excluding states where projectiles would scatter into already filled single-particle orbits of the target), or Pauli hindered (where projectiles go into partially filled orbits). MCAS results presented will include two systems involving unstable nuclei. From considering p + ^{14}O scattering, information extracted for the particle unstable ^{15}F. Congruity is achieved with recent data that exhibit two shape resonances at low energy in scattering of radioactive ^{14}O from hydrogen. Another study investigates all mass-7 nuclides between proton and neutron drip lines. Again using Pauli hindrance, a quite satisfactory account of all these nuclei with only one and nucleon-nucleus interaction matrix for all.

† In collaboration with Luciano Canton [1], Gualtiero Pisent [1], Kenneth Amos [2], Paul Fraser [2], Steven Karataglidis [3], Dirk van der Knijff [4], [1] Istituto Nazionale di Fisica Nucleare, sezione di Padova e Dipartimento di Fisica dell'Universitá di Padova, Italy, [2] School of Physics, University of Melbourne, Australia, [3] Dept. of Physics and Electronics, Rhodes University, South Africa, [4] Advanced Research Computing, University of Melbourne, Australia

* This work is being supported by NSERC and MIUR-PRIN (Italy)

WE-P3-3 **15h15**

ALEKSANDRS ALEKSEJEVS, Saint Mary's University

Impact of Radiative Effects on Parity-Violating Electron-Nucleon Scattering †,*

Parity-violating electron-nucleon scattering has become an important tool not only for the studies of internal structure of the nucleon (SAMPLE,G0 and HAPPEX experiments), but also for precision tests of the Standard Model (Qweak). The weak nature of the parity-violating interaction in e-N scattering requires a careful analysis of all radiative effects arising from the next-to-leading order (NLO) interactions. Although the corrections associated with these effects have been under constant review over the past few years, there is still a substantial amount of uncertainty coming from the hadronic sector. We will discuss the various approaches to calculations of the radiative corrections and the degree of influence hadronic radiative effects have in e-N scattering.

† In collaboration with Svetlana Barkanova, Acadia University

* This work is being supported by NSERC

WE-P3-4 **15h45**

SANGYONG JEON, McGill University

Jet energy loss in hot Quark Gluon Plasma †,*

When a high energy parton (a jet) traverses the Quark Gluon Plasma (QGP) created in relativistic heavy ion collisions, it loses a chunk of its energy by interacting with the hot and dense medium. The changes in jet properties then reflect the properties of this new state of matter which naturally existed only within a few microseconds after the

Big Bang. So far several jet energy-loss scenarios have been proposed that can explain the current data from the Relativistic Heavy Ion Collider (RHIC). Among them, the approach taken by Turbide, Gale, Jeon and Moore is the only one that takes into account full leading order thermal quantum chromodynamics effects. In this talk, I will summarize the strong points as well as the weak points of this approach and explain the way we calculated the jet energy loss in a QGP. I will also talk about photon (real and virtual) production rate which can be naturally incorporated in our calculation fully consistently to the leading order in the fine structure constant and how it fares with the experimental results.

† In collaboration with Simon Turbide, Charles Gale, Guy Moore, McGill University

* This work is being supported by NSERC, FQRNT

WE-P3-5 **16h15**

Power Spectrum Analysis of the Average-Fluctuation Separation in Interacting Particle Systems. **Rizwan Haq** [1], Robert LeClair [1], V.K.B. Kota [2], [1] *Laurentian University*, [2] Physical Research Laboratory, Ahmedabad, India. — The normal mode decomposition of the density of states for interacting particle systems such as a nucleus exhibits, in the level motion, a sharp separation between spectral averages and fluctuations with increasing particle number. This distinct separation between the two parts is essential for the applicability of statistical nuclear spectroscopy and the Embedded Gaussian Orthogonal Ensemble of two-body interactions [EGOE(2)], representing Hamiltonians for both fermion and boson systems, provides a theoretical framework for this separation. The power spectrum analysis, introduced many years ago by one of the authors (RJL) and emphasized more recently by Gomez *et al.* in terms of a 1/f-noise signature for quantum chaos, is used to investigate the nature of the average-fluctuation separation in EGOE(2) and in the nuclear shell model. The statistic $\lambda = (1 - F)$ where F is the false alarm probability shows that an optimized Gram-Charlier expansion of the density to orders 4 - 6 results in a sharp separation. These calculations, carried out so far for fixed fermion number (for bosons with fixed number of single particle states), when extended to a series of particle numbers (say 4 - 8 fermions in 16 single particle states) might provide a full test of the EGOE(2) theory for the separation.

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

[WE-P4] Non-Accelerator Particle Physics / *Physique des particules sans accélérateur*

(PPD-CAP / *PPD-ACP*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
14h15 - 17h00

ROOM / SALLE Phys. 165 (137) ***Chair: Z. Papandreou, University of Regina***

WE-P4-1 **14h15**

ANTHONY NOBLE, Queen's University

The PICASSO Dark Matter Search Experiment *

Increasingly precise data on galaxy rotation curves, supernovae, and the cosmic microwave backgrounds indicates a significant fraction of the Universe is comprised of cold dark matter, held in the gravitational potential of galaxies and clusters. A number of experiments worldwide are attempting to discover dark matter in the form of Weakly Interacting Massive Particles, (WIMPS), via the recoil nuclei produced in rare WIMP-nucleon scattering. The PICASSO dark matter experiment uses superheated Freon droplets as a detector medium. WIMP-nucleon interactions cause dramatic phase transitions that may be recorded acoustically. In 2005, PICASSO released results that provided some of the best limits for spin-dependent interactions. PICASSO is now installing and operating the next phase which will ultimately have a significantly improved sensitivity. The PICASSO detector and the current status will be discussed in this presentation.

* This work is being supported by NSERC

WE-P4-2 **14h45**

Fabrication and characterisation of PICASSO detectors*. **Guillaume Giroux**, Marie-Cécile Piro, *Université de Montréal* — The PICASSO project is using superheated droplets detectors in order to achieve the direct detection of cold non-baryonic dark matter particles. We will discuss the different steps leading to the fabrication, purification, calibration and characterisation of detectors used in the actual 3 kg phase at SNOLAB.

* This work is being supported by NSERC

WE-P4-3 **15h00**

A Method for the Determination of the Droplet Distribution of the PICASSO Detectors*. **Patrick Nadeau**, *Laurentian University* — The PICASSO dark matter search experiment employs special bubble detectors (SBD). The detectors are composed of superheated liquid Freon (C_4F_{10}) droplets dispersed uniformly in an aqueous gel matrix. The sensitivity of the detectors to radiation depends on the droplet diameter distribution, which is determined by direct observation of thinly sliced gel samples under a microscope, and the amount of active mass. A method of freezing cubes of the gel in order to bring them to an ideal temperature and surface tension for cutting thin slices (1-2 mm) to be used in the determination of the droplet distribution is discussed, as well as the results obtained through the use of this method.

* This work is being supported by Laurentian University

15h15 **Coffee Break** / ***Pause café***

WE-P4-4 **15h30**

KENNETH RAGAN, McGill University*

Status of and first results from the high energy gamma-ray experiment VERITAS

The VERITAS experiment is an array of four 12-m imaging air-Cherenkov telescopes dedicated to gamma-ray astronomy in the 50 GeV – 50 TeV energy range. The instrument, located at Mount Hopkins in southern Arizona, has recently been completed and has started its scientific program. VERITAS observations are centred around four Key Science Projects including a dark matter search, a sky survey, observation of supernova remnants and pulsar wind nebulae, and investigation of the blazar class of black-hole driven Active Galactic Nuclei. Here, we give a brief introduction to the instrument and its performance, and highlight some of the early science results.

* for the VERITAS collaboration.

WE-P4-5 **16h00**

KEVIN GRAHAM, Carleton University

From Neutrinos to Dark Matter

The SNOLAB underground experimental facility, located approximately 2 km underground in Creighton mine, Sudbury, is one of the deepest sites available for the study of low background, rare-process physics. Construction to greatly increase the available experimental space and support facilities is nearing completion and SNOLAB will soon be ready to host a variety of new experiments ranging from precision neutrino measurements to direct searches for dark matter. The current status of the SNOLAB facility will be presented including a detailed description of the experimental space and support available. An overview of the physics program will be provided with summaries of the various experimental efforts that will be pursued including search for neutrinoless double beta decay, precision solar neutrino measurements, and direct searches for dark matter. Descriptions of specific experimental efforts underway to pursue these measurements at SNOLAB will be given.

WE-P4-6 **16h30**

Search for Dark Matter with CDMS and SuperCDMS. **Wolfgang Rau**, *Queen's University, (on behalf of CDMS and SuperCDMS collaborations)* — We have compelling observational evidence for the existence of large amounts of invisible non-baryonic matter in the Universe. Weakly Interacting Massive Particles (WIMPs) are among the best motivated particle candidates to solve this dark matter problem. The Cryogenic Dark Matter Search experiment (CDMS) employs cryogenic detectors to search for interactions of dark matter WIMPs with atomic nuclei. Since the expected interaction rate is very small, background events from environmental radioactivity and cosmic radiation are a major concern. Operation in an underground laboratory, extensive shielding and careful selection of materials together with a very efficient background discrimination technique make CDMS the experiment with the best sensitivity for coherent WIMP-nucleon interaction. With the data presently being collected, CDMS will improve the sensitivity by another order of magnitude and test a first set of promising theoretical models. As a next step we plan to further increase the target mass to ~25 kg and move to the newly built underground laboratory near Sudbury, Ontario (SNOLab) for a further background reduction. The technique, status, and plans of CDMS and SuperCDMS will be reviewed.

WE-P4-7 **16h45**

Can Gravity Distinguish Between Dirac and Majorana Neutrinos?*. **Dinesh Singh**, Nader Mobed, Giorgio Papini, *University of Regina* — We present the possibility that spin-gravity interaction can distinguish between Dirac and Majorana neutrino wave packets propagating in a weakly curved space-time background described by the Lense-Thirring metric, which respresents the gravitational field around a star. The spin-gravity interaction is represented by a perturbation Hamiltonian and the techniques of time-independent perturbation theory. The difference between Dirac and Majorana neutrinos is demonstrated in terms of significant spin-gravity corrections to the neutrino oscillation length for a two-flavour system, as shown explicitly for SN1987A as a test case. We show how the absolute neutrino masses can, in principle, be determined for a two-flavour oscillation, and explore the observational possibilities based on current attempts to study low-energy neutrinos by SNO and other solar neutrino observatories.

* This work is being supported by NSERC

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

[WE-P5] Quantum Optics, Information and Computation II / *Optique, informatique et calcul quantiques II*

(DAMPhi-DOP / *DPAMIP-DOP*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
14h15 - 15h30

ROOM / SALLE Phys. 103 (145)

Chair: P. Haljan, Simon Fraser University

WE-P5-1 **14h15**

GREGOR WEIHS, University of Waterloo

Entangled Photon Pairs for Quantum Communication *

Quantum communication comprises techniques like quantum key distribution, quantum teleportation, and quantum repeaters. All of them profit from intense and integrable sources of entangled photon pairs. Entangled photon pairs, with their inherent strong correlations, were instrumental in tests of the foundations of quantum physics and are an important resource for future communication and even computation. Conventionally, they are produced in bulk nonlinear optical crystals in a process called spontaneous parametric down-conversion. However, this process is very inefficient, typically converting only one in a billion pump photons to an entangled pair. In my talk, I will present our work on using novel nano-structured materials to boost the production rates and the spectral properties of entangled photon pairs. Certain semiconductors like AlGaAs display a strong optical nonlinearity and yet, many of the traditional ways of exploiting the nonlinearity fail. Therefore, we employ nano- and micro-structuring of the material in order to achieve the desired functionality. In addition, using a common optoelectronics material allows integration of the nonlinear device with lasers, detectors and optical circuits for quantum photonics on a chip.

* This work is being supported by NSERC, CFI, CIAR, QuantumWorks

WE-P5-2 **14h45**

Towards the Production of Entangled Photon Pairs in Optical Fiber via Four-Wave Mixing*. **Joshua Slater** [1], Ahdiyeh Delfan [1], Félix Bussières [2], Nicolas Godbout [3], Wolfgang Tittel [1], [1] *IQIS, University of Calgary*, [2] IQIS, University of Calgary; COPL Polytechnique Montréal, [3] COPL, Polytechnique Montréal — Previous experiments on the production of entangled photon pairs directly in optical fiber via four-wave mixing (FWM) have used a single pump laser and produced signal and idler photons with similar wavelengths. We will present the first results of our investigation into the production of widely separated entangled photon pairs via FWM in optical fiber using multiple pump lasers also at widely separated wavelengths. This source will have important applications in quantum cryptography and computation. As fiber optic and free space quantum communication networks require photons at different wavelengths (1550 nm and around 800 respectively) this source will make hybrid quantum cryptography networks achievable and could also be used as a heralded optical fiber source of single photons.

* This work is being supported by iCORE, GDC, CFI, AAET, NSERC

WE-P5-3 **15h00**

Hybrid Photonic Entanglement Using a PPLN Crystal*. **Félix Bussières** [1], Nicolas Godbout [2], Wolfgang Tittel [3], [1] *IQIS, University of Calgary and COPL, Polytechnique Montréal*, [2] COPL, Polytechnique Montréal, [3] IQIS, University of Calgary — We propose a scheme to generate hybrid photonic entanglement, defined as entanglement

between photonic qubits with different encodings, using quasi phase-matched parametric downconversion in a periodically-poled lithium niobate (PPLN) crystal. The hybrid entanglement is obtained by first generating two time-bin entangled qubits at 810 and 1550 nm. Then, using standard fibre telecom components, the 810~nm qubit is deterministically converted to a polarization qubit which can be transmitted in free-space. We report on our progress towards building and characterizing such a source and discuss its utility in creating hybrid quantum networks.

* This work is being supported by iCORE, GDC, CFI, AAET, NSERC

WE-P5-4 **15h15**

Towards Fast Quantum Key Distribution*. **Itzel Lucio Martinez** [1], Philip Chan [2], Steve Hosier [3], Xiaofan Mo[1], Wolfgang Tittel [1], [1] *IQIS, University of Calgary*, [2] ATIPS, University of Calgary, [3] SAIT — Quantum Key Distribution invented in 1984 is an alternative solution to the Key Establishment problem. QKD enables two parties to establish a secret key with secrecy guaranteed by the laws of quantum mechanics. An ideal implementation of QKD requires a practical single photon source which is currently not available. The decoy state protocol uses faint laser pulses with different intensities and allows Alice and Bob to discard key obtained from multi-photon pulses. The remaining of the key is obtained from single photon pulses which are the only ones guaranteed to be secure. The decoy state protocol can increase the distance of transmission and also the rate of secret key generation. In this talk I will present the experimental implementation of a decoy state protocol used for polarization base QKD.

* This work is being supported by iCORE, GDC, CFI, AAET, CONACYT

15h30 **Session Ends** / ***Fin de la session***

[WE-P6] Canadian Geospace Monitoring and e-POP Mission / *Surveillance géospatiale canadienne et mission e-POP*

(DASP / *DPAE*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
14h15 - 17h00

ROOM / SALLE Arts 143 (350)

Chair: D.A. Degenstein, University of Saskatchewan

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

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

[WE-Counc] Council Meeting (Old and New) / *Réunion du conseil (nouveau et ancien)*

(CAP / *ACP*)

WEDNESDAY, JUNE 20
MERCREDI, 20 JUIN
17h00 - 19h00

ROOM / SALLE Phys. 175 (40)

Chair: L. Marchildon, Université du Québec à Trois-Rivières

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

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

2007 CONGRESS POSTER SESSION ABSTRACTS
RÉSUMÉS DE SESSION D'AFFICHES - CONGRÈS 2007

The poster session abstracts presented here will be on display in this order in the atrium (2nd level) of the Geology Building, at the University of Saskatchewan in Saskatoon, SK, 19h00 - 22h00 on Monday, June 18th.
Les résumés présentés en affiches publiés ci-après seront en montre de 19h00 à 22h00, le lundi, 18 juin dans l'atrium (deuxième étage), édifice de géologie à l'Université de la Saskatchewan, Saskatoon, SK.

[MO-POS] ATMOSPHERIC AND SPACE PHYSICS / *PHYSIQUE ATMOSPHÉRIQUE ET DE L'ESPACE* — Monday / *Lundi*

MO-POS-1

High-resolution simulations of the auroral thermosphere during disturbed conditions*. **Jean-Marc Noel** [1], Albert Russell [1], Jean-Pierre St.-Maurice [2], Robert Sica [3], [1] *Royal Military College of Canada*, [2] University of Saskatchewan, [3] University of Western Ontario — The closure of magnetospheric currents in the high latitude ionosphere makes the high latitude thermosphere a very dynamic environment. The composition and dynamics of this region become even more complex during geomagnetic disturbances as the electric fields from the magnetosphere now have the ability to substantially alter the winds and composition of this region. High resolution simulations obtained with the recently upgraded Chang and St.-Maurice model suggest that vertical winds in excess of 150 m/s are possible and that the changes in molecular oxygen number densities are much larger than those inferred from mass spectrometers. The implications of these results to our understanding of the thermosphere-ionosphere system will then be discussed.

* This work is being supported by NSERC

MO-POS-2

On the nature of the so called HAIR echoes*. **Alexandre Koustov**, James Gorin, *University of Saskatchewan* — SuperDARN HF coherent radars often detect short-range echoes whose Doppler velocity is very low (<100 m/s) and inconsistent with the **E** x **B** drift of electrons in the ionosphere. It has been suggested that these echoes are high aspect angle scatter from electrojet heights and the velocity of the echoes is close to the drift of ions in an external electric field. In this report, low velocity data collected by the Stokkseyri SuperDARN radar are investigated to explore this hypothesis. **E** x **B** drifts were estimated by considering Doppler velocities of simultaneously detected F-region echoes at farther ranges and, for several events, ion drift measurements from the DMSP satellites were available. Observations are presented that cannot be explained by ion drifts due to electric field. These data can be explained if neutral wind influences are allowed.

* This work is being supported by NSERC

MO-POS-3

Flow angle variation for the velocity of short-range SuperDARN echoes under strongly driven conditions*. **Sasha Koustov**, James Gorin, *University of Saskatchewan* — SuperDARN HF coherent radars regularly detect short-range echoes presumably coming from electrojet heights of ~ 110 km. Previous observations showed that characteristics of these echoes could be quite different from observations at VHF. In this report, data collected by the Stokkseyri SuperDARN radar are investigated to explore variation of the Doppler velocity with the flow angle. The emphasis is on events with very strong E x B drifts (> 1000 m/s) and relatively high velocity E-region echoes, of the order of 300-400 m/s. We show that some of the high-velocity events turned out to be a scatter from above the electrojet layer. Detailed analysis of other events shows that the Doppler shifts are consistently below the expected ion-acoustic speed at ~ 110 km for the observed E x B drifts. One possible explanation of this result is that the heights of HF short-range echoes are regularly below 100 km. Observations that do not support this hypothesis are presented, requiring other explanations.

* This work is being supported by NSERC

MO-POS-4

Two scenarios of substorm-related fast flow formation as seen by the King Salmon SuperDARN radar*. **Robyn Fiori**, Alexandre Koustov, *University of Saskatchewan* — The King Salmon SuperDARN radar regularly observes high-velocity flows (up to ~2000 m/s) in its most L-shell aligned beams. Such flows are located from 60-65^0 MLat in the 16-23 MLT sector. By examining two substorm events on December 5 and 15, 2001, we will show that there are two basic scenarios of fast flow formation. In the first scenario, velocity is enhanced at all auroral latitudes, and the greatest velocities are observed westward and equatorward of the auroral bulge near the substorm onset time. During the substorm expansion phase the enhanced convection moves eastward and equatorward. In the second scenario, velocity is significantly enhanced at the equatorward edge of the auroral oval. This occurs as the most intense auroral luminosity progresses poleward, leaving regions of low conductivity in the low latitude auroral and subauroral regions where the velocities form. This scenario is the most reminiscent of the traditional SAPS and we refer to these flows as being SAPS-like.

* This work is being supported by NSERC

MO-POS-5

Energy exchange rate in the inelastic electron cooling process. Case study of the multi-frequency observations of Farley-Buneman waves based on recent theoretical approach*. **Ludmila Kagan**, Randy Kissack, *University of Western Ontario* — The Balsley and Farley experiment [1] remains the only one that performed multi-frequency observations of the type-1 radar echoes. This experiment was aimed at investigating properties of Farley-Buneman (FB) waves in relation to the radar frequency (wavelength). The radar was operated at frequencies of 16.25, 49.92 and 146.25 MHz that were run sequentially probing the same atmospheric volume. In contrast to the classical theory predictions that all wavelengths travel at the same ion acoustic speed, Balsley and Farley observed that the phase velocity increased with increasing radar frequency. We do a case study of the Balsley and Farley data using our recently developed theory [2,3] that predicts the wavelength dependence of FB waves. We show that in order to have the observed alignment of phase velocities Vph@146MHz > Vph@50MHz > Vph@16MHz, a calibrated proportionality constant in the important inelastic electron energy exchange process should be about three times higher than 0.003 that has been routinely used to describe this otherwise complex process. To independently check this conclusion we also calculate this calibrated proportionality constant following the complex procedure from [4] and using the MSIS and GRI models. We find it to be 0.006-0.009 for the given case study and thus being consistent with our theoretical predictions. References: [1] Balsley and Farley, JGR, **76**, 8341, 1971; [2] Kagan and St-Maurice, JGR, 109 (A12), A12302, 2004; [3] Kissack, Kagan and St Maurice, JGR, submitted, 2007; [4] Shunk and Nagy, Ionospheres: Physics, Plasma Physics and Chemistry, Cambridge University Press, 2000.

* This work is being supported by NSERC

MO-POS-6

A Dual Frequency Transmitter for ePOP Tomography. **Guowei Li**, John Macdougall, *University of Western Ontario* — In order to measure the ionosphere and demonstrate the performance of ionospheric tomography technique in the HF band, a new dual-frequency transmitter has been designed and developed. In each transmitter, a 16-bit microcontroller can control DDS chips to generate two pulsed closely spaced frequency signals. Several coding methods, such as Barker and Legendre, can be chosen for modulation. GPS system and TDMA scheme are applied to synchronize and accommodate transmitters in different locations. The prototype of the transmitter has been developed and tested in the lab, and an improved second version is in development. Field experiments with the Canadian Advanced Digital Ionosonde (CADI) system will be done in April and May, 2007. Future experiments with the Enhanced Polar Outflow Probe (ePOP) payload on CASSIOPE satellite are expected after the satellite is launched in 2008.

MO-POS-7

Present and Future Magnetometer Arrays in Canada*. **Larry Newitt**, *Natural Resources Canada* — Because of its location relative to the auroral oval and polar cap Canada is an attractive location for magnetometer arrays. We present a map showing the location of all permanent and semi-permanent fluxgate magnetometer installations currently operating in Canada and those that are likely to be installed in the near future. These include the permanent network of magnetic observatories operated by Natural Resources Canada, the CARISMA, Themis, and MACCS arrays plus many others.

* This work is being supported by Natural Resources Canada

MO-POS-8

Solar wind influence on high-level clouds and extratropical cyclones. **Paul Prikryl**, *Communications Research Centre Canada* — The high-level cloud area index (HCAI) based on infrared cloud amounts (cloud top pressure < 440 mb) is constructed for various geographic sectors from the International Satellite Cloud Climatology Project (ISCCP) D1 dataset covering 22 years. Time series of HCAI are used in superposed epoch analysis keyed by the arrival time of co-rotating solar wind streams from coronal holes. A statistically significant decrease of the mean HCAI around the arrival of high-speed solar wind followed by an increase in HCAI to a maximum a few days later is found. The HCAI response to solar wind forcing depends on season, geographic latitude and longitude, and on the phase of the quasi-biennial oscillation of the zonal winds in the tropical stratosphere. It is suggested that solar-wind-generated auroral atmospheric gravity waves seed convective instabilities leading to cloud bands and growth of extra tropical cyclones and, if ducted to low latitudes, influence the development of tropical cyclones. The auroral-gravity-wave-induced vertical lift combined with an upward tilting flow in the warm frontal zone may release the moist symmetric instability, thus initiating slantwise convection and mesoscale cloud bands. Latent heat release associated with the mesoscale slantwise convection has been linked to explosive cyclogenesis. It is observed that major extratropical storms tend to occur within a few days of the arrival of the high-speed solar wind, which is a source of magnetohydrodynamic waves that couple to the magnetosphere and generate auroral atmospheric gravity waves.

MO-POS-9

Drift Resonant Generation of Peaked Relativistic Electron Distributions by Pc-5 ULF Waves*. **Louis Ozeke**, Alex Degeling, Robert Rankin, Ian Mann, Konstantin Kabin, *University of Alberta* — The adiabatic drift-resonant interaction between relativistic, equatorially mirroring electrons and Pc-5 ultra-low frequency (ULF) waves in the magnetosphere is investigated using a time-dependent magnetohydrodynamic (MHD) wave model. In this model, compressional waves with a fixed frequency from an imposed external, time-dependent driver at the boundary are launched into a dipole magnetic geometry with a specified Alfvén speed profile. The compressional waves are partly reflected at the compressional wave turning point, and couple part of their energy to an Alfvénic field line resonance (FLR). Finite Pedersen conductivity at the ionosphere allows the attenuation of the injected wave power. Attention is focused on the effect of a ULF wave packet with finite duration on the equatorially mirroring, relativistic electron phase space density (PSD) profile. It is demonstrated that a burst of narrow band ULF waves can give rise to the growth of strong localised peaks in PSD with L-shell by coherent radial transport, which contrasts with the usual paradigm that transport from ULF waves is diffusive, and therefore cannot produce peaks in PSD that increase with time. Observations of locally growing PSD peaks are usually attributed to very low frequency (VLF) wave acceleration by resonant interactions with lower-band chorus [1,2]. However, we show that in situations where large amplitude, narrow bandwidth ULF waves giving rise to field line resonances are also observed, these time-limited coherent ULF waves can also generate growing PSD peaks. References: [1] J.C. Green and M.G. Kivelson (2004), Relativistic electrons in the outer radiation belt: Differentiating between acceleration mechanisms. *J. Geophys. Res.*, **109**, A032113, doi:10.1029/2003JA010153; [2] R.B. Horne, *et. al.* (2005), Wave acceleration of electrons in the Van Allen radiation belts. *Nature* **437**, 227-230, doi:10.1038/nature03939.

* This work is being supported by Canadian Space Agency

MO-POS-10

Drift-resonance energisation of relativistic electrons by Pc5 ULF waves during magnetic storms*. **Eun Ah Lee**, Ian Mann, *University of Alberta* — There has been increased interest in relativistic electrons in the inner magnetosphere mainly due to the correlation between the occurrence of enhancing relativistic electron flux and spacecraft operation anomalies or even failures [e.g., Joseph *et al*, 2000]. However, the dominant processes which accelerate magnetospheric electrons to MeV energies are not well understood. Several candidate mechanisms have been proposed for the build up of the MeV electrons in the magnetosphere such as acceleration of energetic electrons by VLF/ELF waves [Horne and Thorne, 1998], magnetic pumping by ULF waves [Liu *et al.*, 1999], transit time damping by fast mode MHD waves [Summers and Ma, 2000] or resonant diffusion of electrons by whistler-mode chorus [Horne *et al.*, 2003]. Many recent observations show that rapid enhancement of energetic electrons are closely associated with ULF waves in Pc4 (7-22 mHz) or Pc5 (2-7 mHz) frequency ranges. Elkington *et al.*, [1999] suggested that electrons are accelerated via a drift-resonance interaction with Pc5 ULF toroidal mode waves in the asymmetric compressed magnetic dipole when the ULF frequency is close to the electron drift frequency. Our goal is to show the electron drift-resonance interaction with Pc5 ULF waves during magnetic storms. Here, we will show the results of observations from ground based magnetometers, LANL geosynchronous satellites and the CRRES Medium Energy A (MEA) spectrometer. We observed very strong toroidal Pc5 oscillations during the great magnetic storm of March 24, 1991 [Lee *et al.*, 2007] and electron flux simultaneously oscillating with the same frequencies in time domain. We have further characterised a number of events showing the time-domain relationship between the MeV energy electron fluxes and Pc5 ULF pulsations, and we present evidence for the close connection between Pc5 ULF waves and relativistic electron dynamics.

* This work is being supported by University of Alberta

MO-POS-11

Coordinated ground-based and Cluster satellite studies of structured Pc1 pulsations. **Maria Usanova**, Ian R. Mann, Richard D. Sydora, *University of Alberta* — Pc1-2 pulsations are continuous geomagnetic waves with a period of 0.2 - 10 s. Structured pulsations observed at these frequencies are believed to be generated by the electromagnetic ion cyclotron (EMIC) instability, these waves also often being called pearl pulsations. We report observations of these waves made on the ground by the Canadian Array for Real-time Investigations of Magnetic Activity (CARISMA; www.carisma.ca) using improved 8 Hz resolution fluxgate magnetometer data. Magnetic field Pc1-2 pearl pulsations with an average repetition period of 180 s were registered for several hours. We identified intervals of pearls during magnetic conjunctions with the Cluster satellites. During the events the Cluster spacecraft crossed the magnetically conjugate region in the southern hemisphere detecting the bursts of Pc1 waves in the same frequency range. By comparing observations from multiple stations on the ground, which recorded pearl activity with the measurements from the four Cluster satellites, we

investigate the generation and propagation of EMIC waves and focus on understanding the processes leading to pearl modulation. With the availability of data from the network of ground stations we can also examine the relative role of direct field-guided propagation and ducting in the Earth-ionosphere waveguide in generating the observed wave packets. One suggested mechanism for the excitation of EMIC waves is the ion temperature anisotropy near the magnetic equator. Further studies will involve the determination of the EMIC wave energy source using multiple Cluster satellite ion temperature distribution data.

MO-POS-12

Case study of Farley-Buneman waves at 50 and 430 MHz over Jicamarca in March 2005*. **Ludmila Kagan** [1], Randy Kissack [1], Michael Kelley [2], Rodolfo Cuevas [2], [1] *University of Western Ontario*, [2] Cornell University — We present a case study of the daytime equatorial electrojet two-stream instability observed over Jicamarca with the 50 MHz Julia system and 430-MHz the Advanced Modular Incoherent Scatter Radar [1]. Based on our recently developed theory of Farley-Buneman waves our analysis includes thermal corrections and neutral winds for non-zero aspect angles [2] and for non-zero flow angles (the angle between the radar wave vector and the electric field for the secondary two-stream processes) [3] to account for oblique transmissions. Both 50-MHz and 430-MHz radar systems transmit vertically and obliquely. For theoretical simulations we use our advanced linear theory based on Grad's set of fluid equations which is closed at the heat flow level [2,3]. This theory self-consistently describes the effects of collisions using, in part, Burgers' [5] expressions for collision terms and appears to be correct even for sub-meter scales. This is important since 430 MHz corresponds to irregularity scales of 0.35 m which is shorter than the traditional hydrodynamic limit. In running our codes which generate theoretical phase velocities, the calibrated proportionality constant describing inelastic electron energy exchange has been corrected accordingly to [4]. Unlike classical theories, our simulation shows very good agreement with the observations. References: [1] Cuevas, Kelley, Chau, Heinselman, GRL, submitted 2007; [2] Kagan and St-Maurice, JGR, 109(A12), A12302, 2004; [3] Kissack, Kagan and St-Maurice, JGR, submitted, 2007; [4] Kagan and Kissack, CAP-2007, #2499; [5] Burgers, Flow equations for composite gases, 1969.

* This work is being supported by NSERC

[MO-POS] ATOMIC AND MOLECULAR PHYSICS AND PHOTON INTERACTIONS / *PHYSIQUE ATOMIQUE ET MOLÉCULAIRE ET D'INTERACTIONS AVEC LES PHOTONS* — Monday / *Lundi*

MO-POS-13

Controlling atomic motion in optical billiards*. **Josette Lépine** [1], Guillaume Painchaud-April, Julien Poirier, Louis J. Dubé [2], [1] *Université Laval*, [2] Université Laval et Université Pierre et Marie Curie — We present different scenarios to control atomic motion in optical billiards [1] under conditions where classical chaos is present. Since the billiard boundary is drawn with appropriately deflected beams of light, giving rise to an effective static potential barrier, the motion of the enclosed atoms can be influenced by judiciously chosen small dynamical deviations of the scanning beams. We in fact demonstrate, by realistic numerical simulations, that the, otherwise chaotic behaviour, can be controlled and made stable and predictable. By selecting different cavity shapes (stadium, multipolar deformations of the circle, (smoothed) polygons etc.), we study our stabilization approaches under conditions ranging from mixed to fully chaotic dynamics and analyse the effects of soft boundaries and imperfections on the robustness of the control techniques. This acquired controlled ability offers a new tool for testing fundamental questions at the border of classical and quantum chaos. Reference: [1] V. Milner *et al., Phys.Rev. Lett.* **86**, 1514 (2001); N. Friedman *et al.*, **Phys. Rev. Lett**. **86**, 1518 (2001).

* This work is being supported by NSERC

MO-POS-14

Quantum Electrodynamics of Surface Plasmons*. **Jérémie Choquette** [1], Karl-Peter Marzlin [1], René Stock [2], Barry C. Sanders [1], [1] *Institute for Quantum Information Sciences, University of Calgary*, [2] University of Toronto — Surface plasmons are electromagnetically induced charge-density waves that appear at the interface between dielectrics and a thin metal film and can enhance optical field intensities by two to three orders of magnitude. Despite their fast decay surface plasmons have been shown to preserve optical entanglement and may be useful for optical quantum information. We present a detailed theoretical analysis of the interaction of photons and atoms in the presence of a dielectric interface permitting surface plasmons. We use a Green's function technique to quantize the electromagnetic field in planarly multi-layered lossy and absorbing dielectrics to give an accurate description of the noise induced near the metal film. We calculate the modified spontaneous emission rate of an atom near the interface and study the radiation characteristics of the emitted light. Furthermore we analyze the propagation of a single photon pulse through the interface. We discuss applications of our results to enhance nonlinear effects in quantum optics.

* This work is being supported by iCORE, NSERC, CIAR, AIF

MO-POS-15

Polarization of a beryllium-11 beam by collinear optical pumping. **Richard Labbé**, Phil Levy, *TRIUMF* — The collinear laser polarizer in use at the radioactive beam facility ISAC at TRIUMF was built in order to efficiently nuclear-spin polarize alkali isotope ion beams. We describe modifications to the polarizer making it suitable for polarizing other elements for experiments at ISAC. For instance, a polarized $^{11}Be^{+}$ beam is required for condensed matter β-NMR experiments and polarized F^{+} beams have been requested for nuclear moment measurements and other studies. In order to adapt the polarizer for such paramagnetic species, the beam line between the polarizer and the experiments has been put under a guide field to prevent spin precession and thus conserve the polarization during transport. A segmented extension of the deceleration electrodes has been fabricated in order to divide the optical pumping zone into slightly different beam energies, thus allowing a single fixed frequency laser to address the entire Doppler broadened absorption profile of an ion beam. Finally, the dye ring laser system now includes an external frequency doubler producing 313 nm light for optical pumping on the BeII $^{2}S_{1/2} \rightarrow {}^{2}P_{3/2}$ transition. A measurement of $^{11}Be^{+}$ beam polarization and emittance is planned for autumn 2007.

MO-POS-16

Time and Concentration Study of Surface Enhanced Raman Scattering (SERS) of Acridine Orange dye in silver colloid*. **Archana Kandakkathara** , Ilya Utkin, Robert Fedosejevs, *University of Alberta* — Surface Enhanced Raman Scattering (SERS) is a Raman spectroscopic technique in which greatly enhanced Raman signals are obtained from molecules adsorbed onto nano-size metal colloids or specially prepared metal surfaces. Recently the SERS technique has been implemented in microfluidic channel to increase the sensitivity for detecting signatures of proteins and other bimolecular compounds of interest. For practical applications it is important to optimize the conditions to get the maximum SERS signal. The aim of our present study is to investigate the SERS response of acridine orange (AO) dye in silver colloid and to find the optimum conditions for maximum Raman Signal. The concentration and time dependence of SERS signal of AO dye in sliver colloid has been investigated. It has been found that at high concentration of colloidal particles the intensity of Raman signal changes with time in a non–monotonic manner. For example under some conditions the signal rapidly decreases to zero during the first 5 minutes and there is little signal during next 60-100 minutes. Then it returns to its original value only to decrease again during the next 10 hours. We are in the process of trying to understand the fundamental mechanisms leading to the behavior observed and their impact on using SERS as a quantitative diagnostic of molecular concentration. Optimum concentrations of colloidal silver particles and sodium chloride buffer ions have been found. Thus far, a minimum detectable concentration of AO, less than 10^{-8} M has been demonstrated. The experimental results will be presented and discussed.

* This work is being supported by CIPI and NSERC

MO-POS-17

Towards Hybrid Quantum Key Distribution*. **Félix Bussières** [1], Joshua Slater [2], Ahdiyeh Delfan [2], Allison Rubenok [2], Nicolas Godbout [3], Wolfgang Tittel [2], [1] *IQIS, University of Calgary and COPL, Polytechnique Montréal*, [2] IQIS, University of Calgary, [3] COPL, Polytechnique Montréal — We present a scheme for quantum key distribution based on hybrid entanglement. The idea is to couple a free-space link with an optical fibre link by generating polarization qubits in the visible spectrum entangled with time-bin qubits in the telecom window. We discuss two ways to generate this type of entanglement: Using parametric downconversion in a periodically-poled crystal or using four-wave mixing in optical fibres. We also discuss how hybrid entanglement is an interesting way to extend the range of quantum key distribution.

* This work is being supported by iCORE, GDC, CFI, AAET, NSERC

MO-POS-18

Distinguishability of a Tripartite Unextendible Product Basis using Local Operations and Classical Communication*. **Michael Durocher** [1], Barry C. Sanders [1], Jonathan Walgate [2], [1] *University of Calgary*, [2] Perimeter Institute for Theoretical Physics — Quantum states must be distinguished every time we need to obtain information from a system. Here, we quantify multi-partite state distiguishability with different measurement settings; this leads to important results in the case of an important tripartite system. Specifically, we analyze the smallest tripartite Unextendible Product Basis (UPB). This UPB has interesting symmetries and is not entangled, hence interesting here. Our work is an important step towards full quantitative analysis of local information available in locally indistinguishable sets of states. We consider the case in which the parties are restricted to Local Operations and Classical Communication (LOCC), which makes perfect distinguishability impossible in this situation. We also expose our discovery of optimal (maximum extraction of information as given by the Shannon entropy decrease) protocols for distinguishing our UPB.

* This work is being supported by iCORE

MO-POS-19

Towards Fast Quantum Secured Communication*. **Itzel Lucio Martinez** [1], Philip Chan [2], Steve Hosier [3], Xiaofan Mo [1], Wolfgang Tittel [1], [1] *IQIS, University of Calgary*, [2] ATIPS, University of Calgary, [3] 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. An ideal implementation of QKD would employ a perfect single photon source which is currently not available. The decoy state protocol uses faint laser pulses with different intensities that allows the two end points (Alice and Bob) to eliminate cryptographic key data created from multi-photon pulses. The remaining cryptographic key data is obtained from single-photon pulses making it absolutely secure. The decoy state protocol can increase the distance of transmission and also the rate of secret key generation. In this poster we discuss the implementation of a decoy state protocol using polarization encoding in a standard telecommunication fibre Alice generates laser pulses which are then intensity modulated and attenuated to produce either signal or decoy states. Alice then uses phase modulators to create four polarization states which she sends, via a fibre link, to Bob. Bob uses two polarization beam splitters and four single photon detectors to separate and measure the polarization states. The implementation of the decoy state protocol and the advances in single photon detectors expected in the next few years, will result in a significant increase in the achievable raw key rate. It is thus necessary to develop high speed solutions for the classical post-processing required for QKD. To this end, a FPGA implementation of low-density parity-check codes utilizing a set of precomputed codes is being investigated.

* This work is being supported by iCORE, GDC, CFI, AAET, CONACYT

MO-POS-20

A Multiplet Table with Transition Rates for Neutral Helium (4He I). **Donald Morton** [1], Gordon Drake [2], [1] *National Research Council*, [2] University of Windsor — We have combined the precise determination of the energy levels of ^{4}He I from calculations and experiments with theoretical transition probabilities to present multiplet tables for the fine structure of the helium atom. We have included all electric dipole transitions between levels with n = 1 to 10, L = 0 to 7 unless the wavenumber is less than 1 cm^{-1}. The tabulated transition rates, lifetimes, and oscillator strengths include singlet-triplet mixing and spin-orbit coupling, but not the higher-order relativistic terms nor the corrections for finite nuclear mass, though the latter are listed for future use. Our calculations should be accurate to about 0.2%. Comparisons with previous calculations indicate very little difference for S - P and P - D transitions, but many of the earlier numbers for D - F and F - G require significant revisions. Our results are consistent with almost all published laboratory lifetimes and oscillator strengths, but very few are accurate enough to be stringent tests. In the course of considering the corrections for finite nuclear mass we have generalized the Thomas-Reiche-Kuhn sum rule to include unusual systems such as antiprotonic helium (^{4}He$^+$), positronium (Ps), or the negative ion (Ps$^-$).

MO-POS-21

Interaction of model atom and molecular ion with few-cycle laser pulse*. **Wing-Ki Liu** , Zi-Jian Long, Xiaodan Xu , *University of Waterloo* — Using simple one-dimensional models for a hydrogen atom and a hydrogen molecular ion, we study the dynamics of strong field ionization of these systems by few-cycle laser pulses. *Ab initio* calculations of the ionization probabilities are carried out using the split-operator technique. A theoretical approach to strong field ionization can be based on the S-matrix formalism and tractable results can be obtained using the Strong Field Approximation (SFA). In the tunnelling limit (low frequency, high intensity), simple asymptotic expressions can be derived for the ionization probabilities. We will compare our *ab initio* results with those obtained from the SFA and the tunnelling limit. We will also present results for the high harmonic generation when these systems interact with the few-cycle laser pulses.

* This work is being supported by NSERC of Canada

MO-POS-22

Methane Speed-dependent Line Mixing Profiles*. **Adriana Predoi-Cross** [1], Anildev Vasudevan [1], Henry Heung [1], Malathy Devi [2], Linda Brown [3], [1] *University of Lethbridge, Physics Department, Lethbridge, AB, T1K 3M4, Canada*, [2] College of William and Mary, Physics Department, Williamsburg, VA, USA, [3] Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA — Over the past few decades, the quantification of spectral lineshape parameters in gases has consisted almost entirely of measurements of linewidths, linestrengths, and lineshifts. In the "atmospheric" literature the most commonly used spectral models are the Voigt and Lorentzian profiles. However, these models are neglecting speed dependence in the collisional broadening and other effects. As a consequence, given sufficient signal to noise, these models may be shown not to fit measured profiles. In this work the width and position of a line were determined by fitting a speed-dependent Voigt profile to the absorption spectrum using a multispectrum nonlinear least squares fitting technique. The spectral lines discussed here were slightly asymmetric, with the asymmetric component shaped as a dispersion curve. We quantify the interference between spectral lines using the line mixing parameters. The line mixing parameters are the ratios between the amplitude of the asymmetric components and the corresponding symmetric Voigt components. We have retrieved the line mixing parameters from our measurements of 19 spectral lines using the off-diagonal relaxation matrix element formalism for line mixing. The line mixing effects are small at pressures below one atmosphere and hence these spectroscopic measurements have significant errors. These are first direct measurements of line mixing coefficients in methane in the $\nu_2 + \nu_3$ band.

* This work is being supported by NSERC

MO-POS-23

Climbing Up the Vibrational Ladder of HC^{15}N*. **Nnamdi Okeke** [1], Adriana Predoi-Cross [1], Eric Johnson[1], Darrel Hemsing [1], Georg Mellau [2], [1] *Physics Department, University of Lethbridge, Lethbridge, AB, Canada*, [2] Justus-Liebig University Giessen, Giessen, Germany — We present extended assignments in the near-infrared emission

spectrum of $HC^{15}N$. Several levels containing more than one quanta of bending vibration were observed for the first time. High rotational levels up to J = 60 were observed as well as vibrational levels up to 8. The spectra were analyzed with the spectroscopic analysis software package Symath running using Mathematica as a platform. The lineshape analysis feature of the software allowed us to uniquely identify overlapping transitions.

* This work is being supported by NSERC and the University of Lethbridge

MO-POS-24

Infrared Studies of the C-N Stretching Band of Methylamine by Laser Microwave Sideband and Fourier Transform Spectroscopy*. **R.M. Lees**, Zhen-Dong Sun, Li-Hong Xu, *University of New Brunswick, Saint John* — The C-N stretching infrared fundamental band of CH_3NH_2 has been investigated with a high-resolution CO_2-laser/microwave-sideband spectrometer and by Fourier transform spectroscopy. The spectrum is complicated by the two coupled large-amplitude motions in the molecule, namely the CH_3 torsion and the NH_2 inversion, which lead to a wide range of energy level splittings and relative line intensities. The rich spectral structure displays considerable line overlapping at the 0.002 cm^{-1} resolution of the FT spectrum, hence the sub-Doppler Lamb-dip mode of the sideband spectrometer with 0.4 MHz resolution was of great importance. Subband assignments are fairly complete up to $K = 6$ for the *a*-species with spin weight 3 for the ground torsional state. Observations and analysis will be presented. as well as line assignments that have been determined for several optically pumped far-infrared laser transition systems.

* This work is being supported by NSERC

MO-POS-25

Synthesis of a novel polymer containing gadolonium and investigation of spin lattice relaxation time for its potential use as a contrast agent. **Özgür Alver**, Ridvan Say [2], Izzet Sener [3], Mustafa Senyel [4], [1] *University of Anadolu, Plant Drug and Scientific Research Centre*, [2] University of Anadolu,Plant Drug and Scientific Research Centre, [3] University of Pamukkale, Department of Chemistry, [4] University of Anadolu, Department of Physics — In this study a novel gadolinium containing polymer chelate (Gadolonium-Methacrylamidoantipyrine) has been synthesized and characterization process has been performed via FT-IR (Fourier Transform Infrared Spectrometer), ICP-OES (Inductively Coupled Plasma Optical Emission Spectrometer). Spin lattice relaxation times were calculated to search for its possible usage as a contrast agent using FT-NMR (Fourier Transform Nuclear Magnetic Resonance) spectrometer at 2.1 Tesla.

MO-POS-26

FT-IR spectroscopic study on some 2-(1-Cyclohexenyl)ethylamine metal (II) tetracyanonickelate complexes. Tekin Izgi, **Cemal Parlak**, Meryem Türkay Aytekin, Mustafa Senyel, *University of Anadolu Science Faculty Department of Physics* — New Hofmann type complexes in the form of $M(CyHEA)_2Ni(CN)_4$ (where CyHEA = 2-(1 Cyclohexenyl)ethylamine; M = Ni or Co) have been prepared in powder form and their infrared spectra have been reported in the range of (4000-400) cm^{-1}. The thermal behaviour of these complexes has been investigated by differential thermal analysis (DTA) and thermo-gravimetric analysis (TGA). The results suggest that these compounds are similar in structure to Hofmann type complexes and their structures consist of polymeric layers $|\ M\text{-}Ni(CN)_4\ |_\infty$ with the CyHEA molecule bound to the metal atom (M).

MO-POS-27

^1H, ^{13}C and ^{15}N NMR Investigation of 4,4'-Diaminooctafluorobiphenyl: A Combined Experimental and Theoretical Study. **Cemal Parlak** [1], Özgür Alver [1], Mustafa Senyel [2], [1] *Plant, Drug and Scientific Research Centre, University of Anadolu*, [2] Department of Physics, Science Faculty, University of Anadolu — ^1H, ^{13}C, ^{15}N cross-polarization magic-angle spinning NMR and liquid phase NMR spectra of 4,4 -diaminooctafluorobiphenyl (DAOFB) have been reported for the first time. ^1H, ^{13}C and ^{15}N NMR chemical shifts of DAOFB ($C_{12}H_4F_8N_2$) have been calculated by means of the Hartree-Fock (HF) and Becke-3-Lee-Yang-Parr (B3LYP) density functional methods with 6-311++G(d,p) basis set. Comparison between the experimental and the theoretical results indicates that density functional B3LYP method is superior to the scaled HF approach for predicting NMR properties.

MO-POS-28

Experimental and theoretical ^{15}N NMR and $^1J(C,H)$ spin-spin coupling constant measurement of 1-phenylpiperazine. **Arslan Ünal** [1], Özgür Alver [2], Cemal Parlak [2], Mustafa Senyel [1], [1] *University of Anadolu, Department of Physics*, [2] University of Anadolu, Plant Drug and Scientific Research Centre — The magnitude of one bond $^1J_{CH}$ coupling constants, proton coupled ^{13}C NMR and ^{15}N NMR spectra for 1phenylpiperazine have been reported for the first time. ^{15}N NMR chemical shifts and $^1J_{CH}$ coupling constants of pp have been calculated by means of the Becke-3-Lee-Yang-Parr (B3LYP) density functional method with 6-311++G(d,p) basis set. Comparison between the experimental and the theoretical results indicates that density functional B3LYP method is in good agreement with the experimental NMR data.

MO-POS-29

Theoretical and experimental ^{15}N NMR and $^1J_{CH}$ spin-spin coupling constants investigation for 2-(1-Cyclohexenyl)ethylamine and 4-(3-Cyclohexen-1-yl)pyridine. Mustafa Senyel [1], **Özgür Alver** [2], Cemal Parlak [2], Arslan Ünal [1], [1] *Department of Physics, Science Faculty, University of Anadolu*, [2] Plant, Drug and Scientific Research Centre, University of Anadolu — The magnitude of one bond $^1J_{CH}$ coupling constants, proton coupled ^{13}C NMR and ^{15}N NMR spectra for 2-(1-Cyclohexenyl)ethylamine (CyHEA) and 4-(3-Cyclohexen-1-yl)pyridine (4-Chpy) have been reported for the first time. ^{15}N NMR chemical shifts and $^1J_{CH}$ coupling constants of CyHEA and 4-Chpy have been calculated by means of the Becke-3-Lee-Yang-Parr (B3LYP) density functional method with 6-311++G(d,p) basis set. Comparison between the experimental and the theoretical results indicates that density functional B3LYP method is in good agreement with the experimental NMR data.

MO-POS-101

Photochemistry of Matrix Isolated 3-Acetamidocoumarin*. **Nihal Kus** [1], Susana Breda[2], Rui Fausto[2], Erol Tasal[3], [1]*Anadolu University* , [2]Coimbra University, [3]Osmangazi University — Recently, we have described the photochemistry of matrix-isolated coumarin [1]. The UVinduced ($\lambda > 200$ nm) unimolecular photochemistry of the matrix isolated compound was shown to proceed by three main reaction channels: *(a)* decarboxylation of the compound and formation of bicyclo[4.2.0]octa-1,3,5,7-tetraene and CO_2, with the Dewar form of coumarin as intermediate; *(b)* polymerization of the compound likely via production of a conjugated ketene; *(c)* decarbonylation, leading to formation of CO and benzofuran compounds. Further decomposition of benzofuran to ethynylketene was also suggested. Photochannels *(a)* and *(b)* correspond to those previously observed for matrix isolated α-pyrone [2], while the route *(c)* is similar to the UVinduced photochemistry of coumarin in the gaseous phase [3]. Because there is accummulated indication that the photochemistry of the α-pyrone moiety is strongly influenced by the substituents present in the ring [4], in the present study the photochemistry of 3-acetamidocoumarin is described. An ultraviolet light-induced photochemical changes of 3-acetamidocoumarin (3AC) have been studied by photolysis technique at low temperature (T= 11K). Photoreaction started to occur, only when the sample was irradiated with $\lambda > 215$ nm through the outer quartz window of the cryostat. Upon UV irradiation of the sample an intense band at 2138cm^{-1} appears, which is typical of the antisymmetric stretching vibration of ketene (-C=C=O) group. The infrared (IR) spectra were obtained using a Mattson (Infinity 60AR Series) Fourier transform infrared spectrometer, equipped with a deuterated triglycine sulphate (DTGS) detector and a KBr beamsplitter, with 0.5 cm^{-1} spectral resolution. Interpretation of the experimental data is supported by extensive DFT calculations performed with the B3LYP functional and the 6-311++G(d,p) basis set. References: [1] N. Kus, S. Breda, I. Reva, E. Tasal, C. Ogretir and R. Fausto, Photochem.Photobiol, **2007** (in press);

[2] S. Breda, I. Reva, L. Lapinski and R. Fausto, Phys.Chem.Chem.Phys., **2004**, *6*, 929; [3] T. Yatsuhashi and N. Nakashima, J.Phys.Chem. A, **2000**, *104*, 1095; [4] I. Reva, M. Nowak, L. Lapinski and R. Fausto, Chem.Phys.Lett., **2007** (submitted).

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[MO-POS] CONDENSED MATTER AND MATERIALS PHYSICS / PHYSIQUE DE LA MATIÈRE CONDENSÉE ET MATÉRIAUX — Monday / Lundi

MO-POS-30

Prediction of Transport Coefficients in Fermi-Pasta-Ulam Chains. **Geoffrey R. Lee-Dadswell** [1], Bernie Nickel [2], Chris Gray [2], [1] *Cape Breton University*, [2] University of Guelph — Transport in one-dimensional (1D) chains has presented an unresolved puzzle to theorists for several decades. While most 1D chains have infinite thermal conductivities there are a few models that are known to have finite thermal conductivities. The criteria for a system to have a finite thermal conductivity are not known. The bulk viscosity of 1D systems is thought to be infinite in all or most systems, but has been so little studied that few statements can be made with any certainty. In the cases of both the bulk viscosity and thermal conductivity, the frequency dependent transport coefficients are seen to diverge as a power law of the frequency as the frequency approaches zero. It is not known whether the power law of this divergence is universal or system dependent. We have developed a simple theory which allows the thermal conductivity of some 1D systems to be quantitatively predicted from information about the system's bulk viscosity. The theory is able to make accurate predictions of the thermal conductivity with no adjustable parameters. We are, thus, able to predict the power law with which the thermal conductivity diverges as the frequency approaches zero. It appears that there are at least two universality classes for the power law divergence of the thermal conductivity. A model for the mechanism of heat transport in these systems is contained in the theory. The proposed mechanism suggests what the criteria may be for a system to have a finite thermal conductivity.

MO-POS-31

Structural and morphological properties of the ZnO nanofiber thin films prepared by sol-gel spin coating method*. **Saliha Ilican**, Yasemin Caglar, Mujdat Caglar, Abidin Hacioglu, D. Burak Culcu, Sukru Ardali, *Anadolu University, Turkey* — ZnO nanofiber thin films were prepared by the sol-gel spin coating method. The structural and morphological properties of the ZnO nanofiber thin films were investigated. Zinc acetate dehydrate ($Zn(CH_3COO)_2.H_2O$), 2-methoxethanol and monoethanolamine (MEA) were used as a starting material, solvent and stabilizer, respectively. The surface morphology of the films was investigated by Scanning Electron Microscopy (SEM). The crystal structure and orientation of the films were investigated by X-ray diffraction (XRD) patterns. The XRD spectra of the films reveal that the existence of a ZnO single-phase with a hexagonal wurtzite structure. The grain size, texture coefficient, dislocation density and lattice constants of the films was calculated.

* This work is being supported by Anadolu University CSRP. Reference: Project No: 061039.

MO-POS-32

Comparison of the physical properties of Fluorine doped ZnO thin films deposited by sol-gel spin coating and spray pyrolysis*. **Saliha Ilican**, Yasemin Caglar, Mujdat Caglar, *Anadolu University, Turkey* — Zinc oxide (ZnO) is a versatile and important semiconductor, which has attracted significant attention because of its characteristic catalytic properties such as transparency in the visible range, direct band gap (about 3.3 eV), absence of toxicity, abundance in nature, etc. These properties find wide technological applications. Fluorine doped ZnO (ZnO:F) is a good candidate to be used as a high quality transparent electrode in solar cell. ZnO:F thin films were deposited using two processes: sol-gel spin coating and spray pyrolysis. The influence of F on structural and optical properties of ZnO:F thin films was investigated. The crystallographic properties of all the films were analyzed by X-ray diffraction (XRD). The grain size of these films was calculated using the Debye-Scherrer formula. The optical absorption studies reveal that the transition is direct band gap energy. The optical band gap and the optical constants of the F-doped ZnO thin films were determined. The important changes in absorption edge, refractive index and the dielectric constant were observed due to deposition method.

* This work is being supported by Anadolu University CSRP. Project No: 061039.

MO-POS-33

Effects of Ni on nucleation of Si nanocrystals in silica. **Jean-François Desjardins** [1], François Schiettekatte [1], David Barba [2], Guy G. Ross [2], [1] *Groupe des Couches Minces de l'Université de Montréal*, [2] Institut national de la recherche scientifique-ÉMT — Early studies have shown that the introduction of a Ni interlayer enhance the phase separation and silicon nanocrystal (nc-Si) growth in Si-rich silica films. Here, we investigated nanocrystal growth in nc-Si obtained after co-implantation of Ni and Si in silica. We implanted fused silica samples with excess Si concentrations between 9% and 15% and Ni concentrations of 0.03% to 3%. The samples were annealed at temperatures between 950°C and 1100°C for 1 or 2 hours. Photoluminescence (PL) intensity between 750 and 920 nm is 3 to 5 times higher for samples containing 0.1-0.3% Ni than for samples without Ni after 950-1000°C annealing. Ni therefore appears to be efficient at forming nc-Si nucleation sites, promoting PL intensity after relatively low temperature annealing, without being detrimental to PL as an impurity at these concentrations. However, Ni concentrations of 1% and 3% strongly reduce PL intensity at all annealing temperatures. Investigations with low Ni concentrations after annealing at 1100°C, as well as time-resolved PL and transmission electron microscopy are underway.

MO-POS-34

Novel superconductivity in metallic SnH4 under high pressure*. **Yansun Yao**, John Tse, *Department of Physics and Engineering Physics, University of Saskatchewan* — Superconductivity is ubiquitous in high-pressure elemental and molecular solids. Recently it was proposed that hydrogen dominant metallic alloys could be high T_c superconductors [1]. It was argued that the lattice dynamics of these systems compose of high frequency proton vibrations and low frequency vibrations of the massive ions. In combination with overlapping electron bands which provide high density of states and large electron-ion interactions yield the essential features of a high temperature superconductor. To investigate this possibility, a combination of static and dynamical first-principles simulation techniques was employed to study the high-pressure structure and properties of SnH_4. A high-pressure metallic phase of SnH_4 with a novel layered structure intercalated by 'H_2' units is revealed [2]. This structure is stable at pressure between 70 and 160 GPa. A remarkable feature of this structure is the presence of soft modes in the phonon band structure induced by Fermi surface nesting and Kohn anomalies that lead to very strong electron-phonon coupling. Application of McMillan equation with the calculated electron-phonon coupling (EPC) parameter l shows that a superconducting critical temperature close to 80 K can be achieved at 120 GPa. References: [1] N.W. Ashcroft, *Phys. Rev. Lett.* **92**, 187002 (2004); [2] J.S. Tse, Y. Yao and K. Tanaka, *Phys. Rev. Lett.* (in publishing).

* This work is being supported by NSERC

MO-POS-35

Quantum phase transitions in the Bose-Hubbard model in the presence of time-dependent hopping*. **Denis Dalidovich**, Malcolm Kennett, *Simon Fraser University* — We study the Mott-insulator/superfluid quantum phase transition in the Bose-Hubbard model in the presence of a harmonically time-dependent addition to the boson hopping between the sites. The phase diagram as a function of parameters of the Hamiltonian, is determined from the solution of the corresponding saddle point equations that minimize the Schwinger-Keldysh action for this fully non-equilibrium problem. A particular emphasis is placed on the role that a modulation with a given amplitude and frequency plays in the change of the form of the Mott lobes of the conventional phase diagram. We discuss also the consequences of the applied strong modulation of hopping to experimental implementations of the Bose-Hubbard model on a lattice in systems of trapped cold atoms.

* This work is being supported by NSERC

MO-POS-36

Applied Organic Spintronics*. **Tor Pedersen** [1], Gap Soo Chang [1], Jung Hwa Seo [2], Alexander Moewes [1], [1]*University of Saskatchewan*, [2] Yonsei University — Our research is focused on studying organic semiconducting materials that show promise for use in spin-electronics (spintronics) applications. The materials investigated need to generate spin-polarized carriers with desirable spin/charge transport properties, while also maintaining minimal spin relaxation effects. One method to create the desired properties is to dope the organic semiconductor with transition metal elements. These impurities change the magnetic and electric properties of the material which can then be characterized using synchrotron based x-ray absorption (XAS) and x-ray emission spectroscopy (XES). XAS and XES results will be presented for doped pentacene along with comparisons made to density functional theory (DFT) calculations.

* This work is being supported by NSERC

MO-POS-37

Functional Thin Films and Nanoscale Patterned Multiferroic Perovskite Oxides: Synthesis and Characterization*. **Alain Pignolet**, Cristian Victor Cojocaru, Riad Nechache, Olivier Gautreau, Catalin Harnagea, Federico Rosei, *INRS - EMT, Université du Québec* — Complex oxides with a perovskite-type structure demonstrate great potential for technological applications since they display a range of interesting properties and useful responses to various stimuli such as electric, magnetic, and stress fields. In general, for application purposes, multi-component oxide thin films, grown either by chemical or physical vapor deposition techniques, such as pulsed-laser deposition (PLD), require eventually to be micro–or even nanopatterned. This is a very challenging task because of their intrinsic physical and chemical properties as well as to the delicate nature of the substrate on which they are integrated. These properties, such as piezoelectricity, ferroelectricity, ferromagnetism or a combination thereof, are directly related to the structural quality and thus to the details of the fabrication processes of the films. We will firstly describe our efforts toward the growth and characterization of ferroelectric and multiferroic epitaxial thin films and then we discuss the challenges related with the fabrication and characterization of nanostructures of functional complex oxides. Piezoresponse Force Microscopy and Magnetic Force Microscopy enable the characterization of piezoelectric, ferroelectric and magnetic properties at the nanoscale. These techniques are used to characterize the functionality of our films and especially of our structures. An alternative method for patterning such complex oxide materials have investigated in detail, namely nanostenciling. We will report how features drawn in miniature microfabricated stencils are successfully transferred directly to the substrate surface, in the form of epitaxial nanostructures of functional complex oxides grown by PLD and will discuss the advantages of this resistless patterning technique.

* This work is being supported by INRS, NSERC, FQRNT

MO-POS-38

Solid and liquid potassium under extreme conditions: structures and electronic properties*. **Adam Chaffey** [1], Isaac Tamblyn [1], Jean-Yves Raty [2], Stanimir Bonev [1], [1] *Dalhousie University*, [2] University of Liege — While interesting high pressure liquid-phase behaviour has been reported for sodium and is expected for lithium, little is known about the behaviour of potassium at high pressure and elevated temperature. In this poster, we present recent results from first principles calculations of potassium, aimed at establishing its behaviour at various points in its phase diagram. Emphasis will be placed on the role of ion dynamics in the structural stability and electronic properties of high-pressure potassium, both solid and liquid. This work will be compared with our recent findings for the properties of compressed sodium and lithium.

* This work is being supported by NSERC

MO-POS-39

Diamond Coatings Synthesized by Microwave Plasma Enhanced Chemical Vapor Deposition on Cutting Tools*. **Yongji Tang**, Yuanshi Li, Songlan Yang, Wenwen Yi, Qiaoqin Yang, Akira Hirose, *University of Saskatchewan* — The unique properties of diamond, high hardness, low friction and high wear resistance, make it good candidate for cutting tool coatings. The most suitable substrate material for producing diamond coated tool is Co-cemented tungsten carbide (WC-Co). However, diamond coatings suffer from premature adhesion failure problems on carbide tools because of interfacial graphitization induced by the binder phase Co, and thermal expansion mismatch of diamond and WC-Co. In this work, H_2 plasma pre-treatment was used to modify the substrate surface morphology and reduce surface Co concentration to increase coating adhesion. Diamond coatings were deposited by microwave plasma enhanced chemical vapour deposition on the pre-treated WC-Co. Nano-indentation was employed to characterize the coating mechanical properties including hardness, elastic modulus, friction and wear. The results show that H_2 plasma pre-treatment is an effective way to enhance the diamond coating adhesion on WC-Co. The wear resistance of WC-Co cutting tool was greatly increased after the deposition of diamond coatings.

* This work is being supported by NSERC and CRC

MO-POS-40

Atomic Interactions in a BEC. **Abidin Kilic**, Cem Yuce, *Anadolu University* — One of the most interesting properties of Bose-Einstein condensates in dilute atomic gases is the existence of interactions between the constituent atoms. The mean-field interaction is mediated by the elastic collisions between atoms. The well-known Gross-Pitaevskii (GP) equation can be used to define a condensate in the limit of zero temperature and neglecting all correlations between the atoms. For controlling the BEC self-interaction, it would clearly be desirable to find some method to change the scattering length. It was proposed that the scattering length could be influenced using an external magnetic field. The magnetic field would allow one to shift the energy of a molecular bound state to near-degeneracy with the energy of a colliding pair of atoms, thereby altering the elastic scattering properties.

MO-POS-41

Ferromagnetic Interactions at Rotating Spin-1 Bosons. **Ertan Aydogdu**, Secil Oral, Abidin Kilic, *Anadolu University* — At low rotation rates, the typical boson occupation numbers $\langle n_{m\alpha} \rangle$ of the occupied ($n_{m\alpha} \neq 0$) single-particle states are large compared with 1. In this condition, a mean field (or classical) approach to the problem is generally expected to be quantitatively accurate. This typically involves breaking the orbital and spin symmetries, as well as particle number conservation. In the case of very low rotation, where $L \leq N$, we have seen that (neglecting the subtleties that arose for type II states) the states essentially involve only the m=0, 1, and 2 states, so that the basis set for the mean field calculation is particularly small. We present results for the LLL mean field ground state for $|\gamma| << 1$, in the anti-ferromagnetic regime, and we discuss the ground states at $l = 1$ for general values of γ.

MO-POS-42

Anti-Ferromagnetic Interactions at Rotating Spin-1 Bosons. **Secil Oral**, Ertan Aydogdu, Abidin Kilic, *Anadolu University* — Analysis of rotating spin-1 bosons, used mean field theory within the lowest Landau level, for slow rotation and general nonzero spin-dependent interactions. We define ground state spin textures at different interaction strengths, and discontinuous transitions between distinct spin textures as function of the angular momentum. Furthermore, the various skyrmion and vortex lattices which occur at higher angular velocities are described. At low rotation rates, the typical boson occupation numbers $\langle n_{m\alpha} \rangle$ of the occupied ($n_{m\alpha} \neq 0$) single-particle states are large compared with 1. In this circumstances, a mean field (or classical) approach to the problem is generally expected to be quantitatively accurate. In such an approach, the boson operators are replaced by expectation values, which are complex c-numbers: $b^{\dagger}_{m\alpha} \rightarrow b^{*}_{m\alpha}$, and the second-quantized Hamiltonian is then minimized with respect to both the magnitude and phase of these numbers to find the ground states. In essence the resulting state is a Bose condensate with the bosons condensed in one linear combination of the single-particle states. We present results for the LLL mean field ground state for $|\gamma| << 1$, in the ferromagnetic regime, and we discuss the ground states at $l = 1$ for general values of γ.

MO-POS-43

Structural Studies of Proton-Conducting Fluorous Block Copolymer Membranes*. **Barbara Frisken** [1], Olivier Diat [2], Steven Holdcroft [3], Laurent Rubatat [4], [1] *Dept. of Physics, Simon Fraser University*, [2] CEA, France, [3] Dept of Chemistry, Simon Fraser University, [4] Fribourg University, Switzerland — We use diblock copolymers as a model system to investigate the correlation between morphology and transport properties in ionomer materials. Diblock copolymers with a fluorinated block and a sulfonated polystyrene block allow control of the ionic exchange capacity by adjusting either the length of the sulfonated polystyrene chains or their degree of sulfonation. We have studied the structure of membranes made from various polymer configurations by small angle neutron scattering using contrast variation. Analysis shows that there is phase separation at length scales of the order of a few tens of nanometers due to the immiscibility of the two polymer blocks; and that there is substructure within the sulfonated polystyrene domains due to separation between the hydrated ionic groups and the hydrophobic polystyrene. We compare these results to transmission electron microscopy images and with proton conductivity and water content measurements.

* This work is being supported by NSERC

MO-POS-44

Structural characterization of a multiphase lipid system*. **Stefan Idziak** [1], Gianfranco Mazzanti [2], [1] *University of Waterloo*, [2] Dalhousie University — We examined the crystalline structure of mixtures of pure triglycerides as well as cocoa butter using the x-ray microbeam diffraction facility available at the PNC/XOR beamline at Argonne National Laboratory. This was done in an effort to directly correlate microstructure observed using optical microscopy with actual crystallographic properties such as phase and orientation. Mixtures of trilaurin, trimyristin, and cocoa butter were prepared and cooled confined between thin glass sheets before being characterized using optical microscopy. Wide angle diffraction studies were performed using a 7 micron spot size x-ray beam which permitted two dimensional diffractograms to be taken from different regions of the mixtures, allowing the crystallographic properties to be determined as a function of position within the material. Results from these studies will be presented.

* This work is being supported by NSERC/AFMNet

MO-POS-45

A Critical Evaluation of Theories of the Polymer Collapse Transition*. **James Munro Polson**, Sheldon B. Opps, Nicholas Abou Risk, Andrew Reddin, *University of Prince Edward Island* — The coil-globule transition of a polymer in a solvent has been studied using three different theoretical approaches: (1) Flory-Huggins (FH) theory, (2) the Polymer Reference Interaction Site Model (PRISM) theory and (3) Scaled Particle Theory (SPT). The theories have been used to calculate phase diagrams, which were then compared to the results obtained from explicit-solvent discontinuous molecular dynamics simulations. Consistent with our earlier observations, the FH theory was found to be surprisingly accurate in locating the transition point at high solvent density, though poor in predicting the size of the polymer as a function of degree of hydrophobicity. By contrast, the PRISM theory was found to give quantitatively poor predictions of the transition point, independent of the form of the solvent-induced effective pair potential employed in the calculations. This is probably mainly due to the assumption that solvent effects can be incorporated by the use of such monomer-monomer *pair* potentials. More quantitatively precise predictions of the transition point can probably be achieved by use of many-body solvation potentials such as one based on Scaled Particle Theory.

* This work is being supported by NSERC

MO-POS-46

Depth Profiling of Polymer Films with GISAXS*. **Marsha Singh**, Michael Groves, *Queen's University* — Grazing Incidence Small Angle X-ray Scattering (GISAXS) offers a non-destructive probe capable of in situ access to scattering information for surface and below-surface structures for length scales ranging from about 1 to 100 nm. The grazing incidence geometry relies on precision control of the angle of incidence of the collimated x-ray beam relative to the (flat) sample surface. When either or both of the sample incident or exit angles are below the critical angle at the air-sample interface, the evanescent wave is confined to the surface layer. In the case of polymer materials, this is typically a depth on the order of 10 nm. At higher angles, the scattering depth can extend many microns well into the bulk phase or film substrate. The resulting scattering information represents a cumulative average of the scattering seen over the full range of material encountered by the x-rays. We present here a model-independent method of obtaining true depth-specific scattering information using a numerical inversion algorithm with data obtained from a series of incident angles to reconstruct the scattering from specific depths below the surface. Results from simulated data generated for ideal multilayer systems and experimental data obtained with block copolymer films are used to test the proposed method. In both cases, in-plane structure is extracted as a function of depth below the air-film surface and the existence of well-defined layers with distinct nanoscale ordering is demonstrated.

* This work is being supported by NSERC

MO-POS-47

Shape and Scaling of Impact Craters in Granular Media*. **Simon J. de Vet**, John R. de Bruyn, *University of Western Ontario* — Impact craters are ubiquitous on rocky bodies in the solar system, but it is very difficult to directly study the process by which they are formed. We investigate craters formed by low energy vertical impacts of spherical projectiles into a non-cohesive granular material. As with large scale impacts, the strength of the material is negligible compared to the stresses applied, making this a good model system to study. We use a range of projectile densities and sizes and impact energies. The resultant crater surfaces are accurately digitized using a laser profilometer, allowing us to measure crater dimensions and study the crater shape. Crater dimensions (depth, radius, rim height) are shown to be dependent not just on just on impact energy, but also on the size and density of the projectile. The crater shape can be fitted to a hyperbola over the full range of experimental parameters, with a characteristic slope smaller than the granular angle of repose. Finally, we find that the energy required to excavate the crater is only a tiny fraction of the energy delivered by the projectile, and that this fraction is virtually independent of the impact parameters.

* This work is being supported by NSERC

MO-POS-48

Diffusion NMR spectroscopy in colloidal suspensions*. **Swomitra Palit**, Anand Yethiraj, *Memorial University of Newfoundland* — Dense, multiple-scattering colloidal suspensions are difficult to study by optical methods. We explore the use of pulsed-gradient diffusion NMR spectroscopy to study colloidal diffusion. We are sensitive to different regimes of diffusion in the colloidal suspension: restricted diffusion of the solvents as well as colloidal diffusion. We use both the spectroscopic aspect of NMR as well as the dynamical aspect of the pulsed-gradient technique to obtain distinct signals from binary mixtures of colloids.

* This work is being supported by NSERC

MO-POS-49

Ab initio Simulations in Liquid Lithium at High Pressures. **Jianjun Yang**, John S. Tse, *Department of Physics and Engineering Physics, University of Saskatchewan* — The effects of compression on the structural and electronic properties of liquid lithium are studied at 600 K using *ab initio* simulations. The structure undergoes changes at around 11 GPa and 45 GPa from simple liquid to high-coordination complex structures. This corresponds roughly to the changes occurred in the crystal structures, but it is not abrupt here. The liquid lithium is compressed almost uniformly at low pressures, while there are some deviations from the uniform compression above 45 GPa. The narrower half-height width of the first peak in pair distribution functions $g(r)$, showing more short range order, is found between 11 ~ 45 GPa. However, more investigations are required for the nature of the anomalous increasing self-diffusion coefficient D of the liquid lithium at the same pressure range. The structural change may be related to an electronic *s-p* transition in the liquid state. It is found the ratio of p to s contribution to density of states at the Fermi level is only 3.0 at zero pressure, while with increasing pressure the s component decreases gradually and the p component increases, and the ratio reaches 4.5 at 11 GPa and 6.3 at 45 GPa.

[MO-POS] INDUSTRIAL AND APPLIED PHYSICS / PHYSIQUE INDUSTRIELLE ET APPLIQUÉE — Monday / Lundi

MO-POS-50

Radiation Shielding Evaluation of Novel Nano-Particle Space Shielding Materials*. **Shaheen Dewji** [1], Nolan Hertel [1], Michael Shannon [1], Eric Burgett [1], Kimberly Burns [1], Dwayne Blaylock [1], Eric Grulke [2], Courtney Harrison [2], [1] *Georgia Institute of Technology* , [2] University of Kentucky — The properties of boron-injected, nano-particle novel shielding materials were evaluated for their radiation shielding effectiveness against galactic cosmic rays (GCR), simulated via high energy protons and neutrons. This material utilizes polyethylene, injected with up to 10% weight nanoparticle boron compounds. The radiation shielding effectiveness of polyethylene, in addition to polyethylene-based boron carbide, boron nitride, and nano-boron nitride was evaluated against aluminum, which is the conventionally employed shielding against GCR. This work further sought to address whether the shielding materials could improve polyethylene's performance. This material was tested for 600 MeV neutrons at the Los Alamos Neutron Science Center Weapons Neutron Research (WNR), and for 120 GeV protons at the Fermi National Accelerator Laboratory (Fermilab). Radiation shielding properties of each of the five shielding samples were evaluated using a depth-dose measurement for a 1.0 cc ion chamber immersed in a 1-cubic foot water chamber, and shielded for varying thicknesses at incremental distances from the particle source. At high neutron energies, the polyethylene-based materials had similar attenuation properties. Results from both the WNR and Fermilab concluded that aluminum exhibited the most effective shielding against high energy protons and the worst shielding properties for fast neutrons. Boron carbide was found to be the most effective shielding material for fast neutrons. Overall, boron carbide was the best overall shielding material for high energy protons and neutrons.

* This work is being supported by NASA

MO-POS-51

Experimental and Numerical Modeling Results for Optimization of Erosion Zone in a Planar Magnetron Cathode*. **Andranik Sarkissian**, Sergiy Navala, Pawel Jedrzejowski, Claude Côté, Carlos Robado, *Plasmionique Inc.* — The environmental concerns of current surface engineering practices require the use of substitute technologies with substantially reduced detrimental impact on the environment. Magnetron sputter deposition is already a well-established technology in a number of industries including microelectronics, optics, as well as surface coating industry, but for a very limited number of high added value products. There are a number of barriers that prevent the proliferation of the technology for application to a wider range of product. Target utilization efficiency is one such limiting factor. The efficiency of the target utilization is strongly affected by the magnetic field geometry, which is a fixed feature in any specific magnetron design. In this presentation we study the accuracy of an analytical model to predict the erosion zone for a given Magnetic configuration. Comparing the model predictions with experimental results highlights an excellent agreement at the early stages of the sputtering process. However, as the sputtering time increases the measured results tend to deviate from the model predictions. This deviation is attributed to the redeposition process, which was not taken into account in our analytical model, and highlights the importance of its inclusion in any model that needs to accurately predict the target utilization efficiency.

* This work is being supported by Plasmionique

[MO-POS] MEDICAL AND BIOLOGICAL PHYSICS / PHYSIQUE MÉDICALE ET BIOLOGIQUE — Monday / Lundi

MO-POS-52

Effect of dimerization motif location on transmembrane polypeptide orientation*. **Mark McDonald**, Michael Morrow, *Memorial University of Newfoundland* — Deuterium nuclear magnetic resonance (^{2}H NMR) spectroscopy was used to study synthetic, single-pass transmembrane polypeptides in 1-palmitoyl-2-oleoyl-sn-glycero-3-phosphatidylcholine (POPC) multilamelar vesicles at 4 mol %. The polypeptides consisted of a Glycophorin A (GpA) dimerization motif incorporated into a poly-alanine-leucine helix terminated with lysine residues. Polypeptides were labelled on selected alanine residues. In earlier studies, similar polypeptides were found to be tilted with respect to the bilayer normal and to be undergoing fast, axially-symmetric reorientation about the bilayer normal while maintaining a preferred azimuthal orientation about the helix axis. In the current study, the orientation of the dimerization motif about the helix axis, relative to the lysine terminal residues, has been varied synthetically to investigate the effect of motif location on peptide orientation, dynamics, and aggregation. Quadrupole splittings and echo decay measurements indicate that the correlation time for polypeptide reorientation about the bilayer normal is ~10^{-7}s and that peptides with the dimerization motif also adopt a preferred average azimuthal orientation about the helix axis. Polypeptide orientation does appear to be sensitive to motif location within the polypeptide. This may be a result of motif-induced peptide-peptide interaction or a result of interaction between motif residues and surrounding lipids.

* This work is being supported by NSERC

MO-POS-53

The negative BOLD response due to visual stimuli in fMRI*. **Doug Wilson** [1], Gerhard Stroink [1], Matthias Schmidt [2], [1] *Dalhousie University*, [2] IWK Health Center — Functional magnetic resonance imaging (fMRI) is a powerful tool for non-invasively imaging neural activity. A majority of fMRI studies utilize the blood oxygenation level dependent (BOLD) response to measure activity within the brain. While the BOLD response measures hemodynamic activity and so is indirect, regions with BOLD responses correlated to stimulus presentation/task performance have nonetheless been shown to be closely linked to locations of electrophysiological activity. Most fMRI studies are interested in regions which show a large positive BOLD response; that is regions where blood oxygenation is strongly positively correlated with the stimulus/task. However, in many cases a strong negative correlation, the negative BOLD response, is also observed. While the positive BOLD response is very well studied, and recent work has been preformed to determine the origin of the negative BOLD response, little work has been done to investigate how changes in the stimulus/task affect the negative BOLD response. Both the positive and negative BOLD responses due to a variety of visual stimuli in several healthy subjects were recorded. From this the retinotopic mapping properties of the negative BOLD response, as well as its dependence on stimulus reversal rate and attentional modulation were determined. Our results show that the negative BOLD response is retinotopically mapped much like the positive BOLD response. However, unlike the positive BOLD response, this mapping seems to be linked to the unstimulated regions of the visual field which are adjacent to the stimulated regions. Our results also suggest an insensitivity to attentional modulation and reversal rate.

* This work is being supported by NSERC

[MO-POS] NUCLEAR PHYSICS / *PHYSIQUE NUCLÉAIRE* — Monday / *Lundi*

MO-POS-54

The determination of the masses of neutron rich isotopes produced in ^{252}Cf fission with the Canadian Penning Trap (CPT) mass spectrometer*. **K.S. Sharma** [1], H. Sharma [1], J. Fallis [1], J.A. Clark [2], G. Savard [3], F. Buchinger [4], J. Crawford [4], J.K.P. Lee [4], D. Lascar [5], A. Levand [3], N. Scielzo [3], S. Caldwell, [1] *University of Manitoba*, [2] Yale University, [3] Argonne National Laboratory, [4] McGill University, [5] Northwestern University — The masses of nuclides near the neutron drip line provide information on nuclear structure in regions of extreme neutron to proton ratios and are input to models that attempt to describe the astrophysical r-process. Recent upgrades to the CPT have allowed us to measure the masses of several neutron rich nuclides, produced in the fission of ^{252}Cf, that are further from stability than our previous measurements. A description of the instrumental upgrades and a summary of our new results will be presented.

* This work is being supported by NSERC

MO-POS-55

The Electron Beam Ion Trap of the TITAN Facility and Characterization of Extracted Highly Charged Ion Beam*. **Christian Champagne** [1], Alain Lapierre [2], Jens Dilling [2], Fritz Buchinger [3], [1] *McGill/TRIUMF*, [2] TRIUMF, [3] McGill — The TITAN (TRIUMF's Ion Trap for Atomic and Nuclear physics) facility at TRIUMF in Vancouver, consists of three ion traps: a linear radio-frequency quadrupole (RFQ) cooler and buncher trap, an electron beam ion trap (EBIT) and a Penning trap. The TITAN experiment is coupled to TRIUMF's ISAC (Isotope Separator and Accelerator) on-line facility producing singly charged isotopic ions. TITAN's main research objective is for high-precision atomic mass measurements of short-lived (~10 ms) radioactive isotopes to test nuclear structure models, help understand nucleo-synthesis production paths, as well as test the Standard Model. The mass determination in a Penning trap is done via a cyclotron-frequency measurement, and the precision of this measurement is proportional to the ion charge-state. The EBIT is a charge booster, which produces highly charged ions, and hence, it is used to increase the precision of measurements. Due to the low yield and short decay times of radioactive isotopes expected from the incoming ISAC beam, the breeding process has to be fast (~ms) and efficient, and the subsequent transfer from the EBIT to the Penning trap should be with minimal losses. Therefore, low beam emittances of the extracted beams from the EBIT are crucial in achieving mass measurements of high statistical significance. Design and status of the TITAN EBIT will be outlined and the method planned for measurements of the transverse emittances of highly charged ion beams will be presented. Once the emittance is measured the charge breeding process can be optimized to achieve all necessary objectives.

* This work is being supported by NSERC

MO-POS-56

Heavy residues produced in collisions of very heavy systems*. **René Roy** [1], Josiane Moisan [1], Abdelouahad Chbihi [2], John Frankland [2], [1] *Université Laval*, [2] GANIL, France — 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 fragment. 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.

* This work is being supported by CNRS

MO-POS-57

Analyse de la transition de phase dans la réaction Xn+Sn avec INDRA. **René Roy**[1], Francis Gagnon-Moisan [1], Marie-France Rivet [2], Bernard Borderie [2], Josiane Moisan [1], [1] *Université Laval*, [2] IPN, Orsay, France — La recherche d'une équation d'état pour la matière nucléaire passe par l'exploration du phénomène de la transition de phase. Pour parvenir à cette fin, des équipements complexes comme le multidétecteur INDRA [1] au GANIL (France) sont nécessaires. Il s'agit d'un ensemble de détecteurs 4π composé par plusieurs centaines de détecteurs multi genres (Si, CsI(Tl), chambres à ionisation). Un tel ensemble permet l'analyse de plusieurs signaux potentiels d'une transition de phase. L'étude des corrélations de charge dans le cadre de la 4^{ième} campagne d'expériences INDRA semble indiquer la présence d'un tel processus [2]. Cependant, en raison d'un manque de statistique, l'analyse doit être approfondie pour pouvoir tirer des conclusions. Les résultats obtenus à ce jour pour la 5^{ième} campagne avec les systèmes ^{124,136}Xe+^{112,124}Sn à 32 et 45 AMeV sont présentés. Références : [1] J. Pouthas *et al.*, *Nucl. Phys.* A369 (1995) 222; [2] Eric Bonnet, thèse de doctorat, IPNO-Université Paris-Sud XI, Décembre 2006.

MO-POS-58

Impacts of symmetry energy on dynamical clusterization. **René Roy**, Alexandre Vallée, *Université Laval* — 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. Within an "enlarged" Hartree-Fock framework (FTDDHF), we use nucleon distribution in phase-space to describe the whole system with local densities, temperatures and asymmetries N/Z. Based on the system thermodynamical properties, this clustering model will be a tool to investigate correlations between the creation of some fragments and local conditions. It will then be possible to use this model to study the asymmetric nuclear matter equation of state and its famous symmetry energy.

MO-POS-59

New analysis for low-energy neutron-deuteron elastic scattering using three-nucleon theory. **Juris P. Svenne** [1], L. Canton [2], K.S. Krozier [3], L.W. Townsend [4], [1] *University of Manitoba*, [2] Padova University, [3] AECL-CRL, [4] University of Tennessee — The theory of nuclear structure and reactions is now accurate enough in many regions of the periodic table that information derived from theory should likely be adopted, wherever possible, in the evaluated nuclear data libraries used in practical applications. One such region is the very light nuclei (A<6), where few-body theory applies. With accurate understanding of nucleon-nucleon interactions that fit well the NN scattering data, as well as advances in computer technology, it is possible to perform precise calculations of bound states and scattering of three-nucleon systems. Shortly after the release of ENDF/B-VI.8 in 2001, it was noticed at LANL that the calculated eigenvalues for a set of heavy-water solution benchmarks involving high-enriched uranium had decreased significantly relative to earlier versions of ENDF/B-VI. Such changes resulted from modifications to the angular probability distributions for elastic scattering at E < 3.2 MeV. Supporting experimental data in this energy region is rather old (>25 years), sparse and often inconsistent. We have carried out calculations with the AGS three-body theory and the Bonn NN potential at low energies, 50 keV to 3.0 MeV. We show the results of such calculations with comparison with available experimental data and to the ENDF/B-VI.8 and JENDL-3.3 evaluated angular distributions and their calculated reactivity impact for various critical systems involving heavy water.

[MO-POS] OPTICS AND PHOTONICS / *OPTIQUE ET PHOTONIQUE* — Monday / *Lundi*

MO-POS-60

Spatially graded structured thin films fabricated through glancing angle deposition*. **Kathleen Krause**, Matthew Hawkeye, Michael Brett, *University of Alberta* — Glancing Angle Deposition (GLAD) has become a common technique for producing thin porous films with interesting nanometer-scale structural features [1]. A recent development has been to further modify the GLAD process in order to create porous nanostructures that have spatially graded profiles, suitable for application in fluidic and sensor devices. During the single-step GLAD process, macroscopic shadowing was used to produce a thin film with thickness variation across its length. Conventional GLAD substrate motion was used, but at the centre of the substrate holder a shadowing block was placed. During deposition, a shadow was cast on the substrate. The area and duty cycle of this shadow depend on the deposition parameters and shadowing block geometry. To explore the use of this spatially graded film for sensing applications, graded optical interference filters were grown under different conditions. Conventional GLAD-deposited optical filters have been demonstrated in the past, but all have had a uniform thickness across the substrate [2,3]. Graded thickness thin film optical filters have also been demonstrated, but these have required complex multi-step methods to produce [4,5]. In this poster we demonstrate the sensing applications and investigate the optical characteristics of the GLAD spatially graded optical filter. References: [1] K. Robbie, M.J. Brett, and A. Lakhtakia, "Chrial sculptured thin films," *Nature*, **384**, 616, 1996; [2] A.C. van Popta *et. al.*, "Gradient-index narrow-bandpass filter fabricated with glancing angle deposition," *Optics Letters*, **29**, 2545-2547, 2004; [3] M.M. Hawkeye, M.J. Brett, "Narrow bandpass optical filters fabricated with one-dimensionally periodic inhomogeneous thin films," *Journal of Applied Physics*, **100**, 044322-1 - 044322-7, 2006; [4] A. Piegari, "Variable narrowband transmission filters with a wide rejection band for spectrometry," *Applied Optics*, **45**, 3768-3773, 2006; [5] D.W. Dodds, I. Gershkovich, and B.T. Cunningham "Fabrication of a graded-wavelength guided-mode resonance filter photonic crystal," *Applied Physics Letters*, **89**, 123113-1 – 123113-3, 2006.

* This work is being supported by NSERC, NRC, iCore, Micralyne

MO-POS-61

Classical chaos in a novel inhomogeneous photonic billiard*. **Julien Poirier** [1], Samir Saïdi [2], Guillaume Painchaud-April [1], Pierre-Yves St-Louis [1], Josette Lépine [1], Louis J. Dubé [3], [1] *Université Laval*, [2] Université Pierre et Marie Curie, [3] Université Laval et Université Pierre et Marie Curie — Dielectric microcavities / microlasers are becoming key components for novel optoelectronic devices. They represent a realization of a wave chaotic system (see companion contribution: *Wave chaos in a new class of optical microcavity*) where for instance the lack of symmetry in the resonator shape leads to non-integrable ray dynamics in the short-wavelength limit (*photonic billiard*). Contrary to usual procedure where a transition from a regular to a chaotic regime is induced by a geometric deformation of a circular cavity, we propose a scenario inducing rotational symmetry breaking by choosing an inhomogeneous dielectric material inside a circular cavity, i.e. *chaos in an integrable billiard geometry*. We study the consequences of this choice, isolate the conditions for integrability in such systems, describe the transition to chaos and classify the effects of the symmetry of the inhomogeneous dielectric on the trajectories.

* This work is being supported by NSERC

MO-POS-62

Many-particle effects in the propagation of slow light through dense atomic gases*. **Iyad Mahmoud**, Karl-Peter Marzlin, Barry Sanders, *University of Calgary* — Quantum interference effects in atoms, such as electromagnetically induced transparency in three-level atoms in Lambda-configuration, can be used to control light and can be utilized for quantum information processing and communication. We present a novel theoretical treatment of the interaction of light with an ensemble of Lambda-atoms that includes many-body effects in atomic gases of high density. In this regime atom-atom correlations are generated by resonant dipole-dipole interactions (DDI), which lead to modifications of the linear and nonlinear optical properties of the medium. We use many-body Green's functions to analyze the impact of DDI on electromagnetically induced transparency and derive the susceptibility of the atomic gas. Our method combines the dressed-state approach to coherent population trapping with Keldysh diagram technique of non-equilibrium many-body theory. The developed method provides an intuitive picture of the evolution process of light passing through this system and may help to optimize quantum control of light in atomic gases.

* This work is being supported by NSERC and iCORE

MO-POS-63

Enhanced electrochromic properties of nanostructured tungsten trioxide thin films*. **Gisia Beydaghyan**, Jean-Luc M. Renaud, P.V. Ashrit, *Université de Moncton* — Nanostructured tungsten trioxide films were fabricated with the technique of glancing angle deposition (GLAD) in a thermal evaporation chamber with a base pressure of $2x10^{-6}$ Torr. Films were deposited at vapor incidence angles of 0, 20, 40, 50, and 60 degrees with thickness of 160 – 220 nm, as determined by spectroscopic ellipsometry. Subsequent to deposition, films were heated for 1 hour under air at 400 °C. To investigate their electrochromic properties, samples were intercalated with small amounts (5 – 15 nm) of lithium by dry-lithiation, a technique developed in our laboratory. Transmission and reflection spectra of samples were collected with the diffuse reflectance accessory of a CARY 5000 spectrophotometer. Compared with our earlier studies of similar, but unheated, nanostructured films, these samples showed significantly enhanced coloration in the infra-red region. It was found that the coloration arises from absorption as well as the increased reflection in the infra-red region. Morphological investigation by atomic force microscopy (AFM) indicated the appearance of grain clusters upon heating. Our studies indicate that these clusters significantly contribute to the superior coloration properties of the films. The implication of these results with regard to the performance of electrochromic devices and fabrication of tunable photonic crystals will be discussed.

* This work is being supported by AIF-FIA

MO-POS-64

Full range complex ultrahigh resolution Fourier domain optical coherence tomography system for 3D imaging of biological tissue*. **Prabakar Puvanathasan**, Kostadinka Bizheva, *University of Waterloo, Department of Physics and Astronomy* — A compact, fiber-based, ultrahigh resolution Fourier domain optical coherence tomography (UHR FDOCT) system with an extended measurement range is presented. Wavelength independent reconstruction of the complex OCT signal over the full scanning depth range is achieved by use of a pair of broad bandwidth, fiber-based acousto-optic frequency shifters (AOFS) operated at a slight frequency difference with respect to each other and subsequent quadrature detection of the spectral fringe pattern at the beat frequency. The UHR FDOCT system is interfaced with a broad bandwidth Ti:Al_2O_3 laser (Femtolasers Inc., lc = 780 nm, Dl = 156 nm and P_{out} = 60 mW ex-fiber) is interfaced to the FDOCT system. A high efficiency (>80%) custom designed spectrometer that utilizes a 4096 pixels linear array CCD camera with 20 kHz readout rate is used at the detection end of the system. Due to the reduced transmission bandwidth of the two AOFS, the effective spectral bandwidth detected by the spectrometer is Dl = 115 nm, which results in 2.3 µm x 3 µm (axial x lateral) image resolution in air corresponding to 1.7 µm x 2.2 µm in biological tissue. The FDOCT system provides time resolution of 62 µs and sensitivity of 117 dB for 1.5 mW incident power.

* This work is being supported by NSERC, OPC, ORDCF

[MO-POS] PHYSICS EDUCATION / *ENSEIGNEMENT DE LA PHYSIQUE* — Monday / *Lundi*

MO-POS-65

Lines of Magnetic Flux: The External Field of a Long Time-Dependent Solenoid*. **William E. Baylis**, *University of Windsor* — Magnetic fields are often best envisioned in terms of lines of flux, a concept introduced by Faraday and reinforced in modern times by flux quantization in low-temperature conductors. The magnetic field outside a long solenoid carrying a constant current is vanishingly small, and this is usually also assumed valid when the current changes slowly. However, since lines of magnetic flux can exist only as closed loops, a changing flux inside the solenoid must be accompanied by a magnetic flux outside. An exact solution of the electromagnetic field of a solenoid with a steadily growing current turned on at $t = 0$ is presented, and it shows that the external flux lines expand at superluminal speeds. An analysis in terms of the vector potential confirms the result when retardation is included. Causality thus shows that magnetic lines of flux are at best a nonlocal concept and it is the total electromagnetic field **F** or the spacetime vector potential A that is physically significant.

* This work is being supported by NSERC

MO-POS-66

Low Cost Introductory Physics Lab Experiments with Good Accuracy*. **Farook Al-Shamali**, Sardarli Arzu, Connors Martin, *Athabasca University* — The lab component is an important part of an introductory physics course. Its goal is to help the students understand the important connection between theory and experiment in physics. However, a perception exists among students, and also many instructors, that highly quantitative experiments can only be done in supervised physics laboratories and using special and costly equipment. This poses an obstacle that becomes more apparent when designing distance education lab courses. Due to the nature of distance education, the need arises for low-cost lab experiments that can be done by the student at home with very limited (or even no) supervision. It is also important to achieve this goal without compromising lab quality. This is exactly what we have been doing at Athabasca University during the past few years. Two recently developed experiments are introduced. The first experiment involves measuring the coefficients of volume expansion for air and for water, while the second experiment presents a simple procedure for performing two-dimensional elastic collisions. Both experiments are conducted using common household items and can be easily and safely performed by most students as home labs or as a homework experiments. Complete quantitative analysis can be done for both experiments with good accuracy, comparable to what is normally achieved in traditional physics laboratories.

* This work is being supported by Athabasca University

MO-POS-67

Clickers in the College Classroom*. **Nathaniel Lasry**, *John Abbott College* — Peer Instruction (PI) is a student centered teaching method developed at Harvard by Eric Mazur. In PI, students provide instructors with real-time feedback by using either flashcards or wireless remotes (aka 'clickers'). Instructors are then able to gauge the class' comprehension level and adapt the pace and content of the course as a function of the feedback provided by students. This talk will address 2 questions. First, does the use of clickers enable more conceptual learning than flashcards? Second, since methods developed at Harvard may not be suited to all student populations, is PI effective in a public community college setting? Results of a classroom study assessing the differences in learning between clickers and flashcards will be presented. Also presented are results on the dependence of the effectiveness of PI on student proficiency levels.

* This work is being supported by PAREA

MO-POS-68

Reaching out to the Wider Community: Faraday Science Show at the University of British Columbia. **Marina Milner-Bolotin**, *University of British Columbia* — Faraday Science Shows for Children from 5 to 105 years old have become a tradition at the University of British Columbia. More than 250 families requested to register on the Science Outreach List of the Department of Physics and Astronomy and there is no lack of participants in the science outreach events offered at UBC. This presentation will share some tips on how to reach out to the community and how to build effective and efficient science outreach network. We will also discuss the involvement of the undergraduate and graduate students in these events.

MO-POS-69

Designing Environmentally Oriented Conceptual Questions for Introductory Physics and Chemistry Courses*. **Marina Milner-Bolotin**, Michael Eastwood, Joss Ives, Jackie Stewart, *University of British Columbia* — Is it possible to incorporate environmentally oriented questions into traditional introductory physics and chemistry courses? We believe that every introductory science student will benefit from seeing the connections between the concepts under study and their applications to "hot button" environmental and sustainability issues. Modern clicker technology allows instructors to incorporate these questions easily and effectively in both small and large science classes and make science students aware of their role in solving current environmental problems.

* This work is being supported by Shell Canada Environment Grant

[MO-POS] PLASMA PHYSICS / PHYSIQUE DES PLASMAS — Monday / Lundi

MO-POS-70

Digital Plasma Position Measurement System for the STOR-M Tokamak*. **Carlos Paz-Soldan**, Jordan Morelli, *Queen's University* — A digital plasma position measurement system for the Saskatchewan Torus-Modified (STOR-M) tokamak that would operate in real-time was developed using LabView. This system implements the position measurement equations developed by Ninomiya et al. which are based on DC voltage signals from Rogowski coils located outside the vacuum vessel. Using sampled uncompensated STOR-M shot data, an analysis was performed to identify sources of noise and possible avenues for digital signal compensation. A large source of noise was found to be centered on 120 kHz, and small DC offsets were found to be present on all of the coils. LabView modules with added functionality were created in LabView that were able to compute the plasma position in and out of real-time. In addition, added functionality modules were created that actively compensated the input coil signal, triggered from a digital port rising edge, and integrated using variable time constants. Variable gains were also employed in the system to provide added tunability for optimization once deployed on-site. A hardware system was designed and implemented using an FPGA module to further test the viability of this data acquisition system. Output position signals were calculated out of real-time and found to be in agreement with the existing position signal. A calculation time study determined that the FPGA module was able to compute the plasma position at over 10 kHz, allowing future real-time use. Ongoing development will enable this system to replace the existing analog plasma position measurement system currently deployed on STOR-M.

* This work is being supported by Queen's University

MO-POS-71

Simulation of Fusion Plasma Evolution in a Fillippov type Plasma focus device by laser interferometry*. **Ahmad Talaei**[3], M. Sadat Kiai [2], Raza Amrollahi [3], [1] *Technical University of Amirkabir, P.O.Box 15875-4413 Tehran - Iran*, [2] Nuclear Science & Technology Research Institute (NSTR), Nuclear Science Res, [3] Technical University of Amirkabir , P.O.Box 15875-4413 Tehran - Iran — Many studies have examined the roles played by different neutron production mechanisms in plasma focus devices. The result of this investigation indicates that, there is a correlation between thermonuclear and non-thermonuclear (beam-target) mechanisms for the neutron production. To study the plasma behavior in different moment of pinch time, we have developed a simulation code based on electron distribution functions related to isotropic thermonuclear and anisotropic non-thermonuclear mechanisms using laser interferometry method. The device under our consideration is a Fillippov type plasma focus (25 kV, 288 μF, 90 kJ) and when D-D plasma is used, the device produces a typical short pulsed neutron emission spectra of about 180 ns. The method allows the determination of the fringe density maps generated by different distribution functions. The device performance characteristics is first described, followed by detail presentation of the simulated method and, also the interoperation of results obtained for the fringe density maps of different mechanisms. References: [1] "Plasma diagnostics of discharge channels for neutralized ion-beam transport", Christoph Niemann *et.al.* 2002; [2] "Correlation between Neutron and X-ray Emission from Megajoule Plasma Focus", M. Scholz, H. Schmidt, *et.al.*; [3]"Main Issues of High-Current Plasma-Focus Experiments". J. Sadowski, *et.al.* 2002; [4] "Study D-D Neutrons in the Experiments on S-300 Pulsed Power Machine", J. Kravarik. *et.al.* 2006; [5] "Studies of Plasma Discharges by Means of Spectroscopy at Free Propagation Pulsed Plasma Streams and their Interactions with Different Targets", E. Skladnik, *et.al.* 2005.

* This work is being supported by Amirkabir university

MO-POS-72

Plasma Processing for Optoelectronics at the University of Saskatchewan*. **Michael Bradley**, Marcel Risch, *University of Saskatchewan* — This poster will present an overview of the work of the research group of Prof. Michael Bradley at the University of Saskatchewan. My group is currently engaged in the development of plasma processing technologies for applications in the areas of optoelectronics and photonics. The ever-increasing technological importance of photonics devices and hybrid CMOS/photonic chips is presenting new challenges for materials fabrication and device architectures. Plasma processing methods will be one of the key enablers for device fabrication in this growing field. My research group has aggressively pursued the development and acquisition of new plasma tools to enable device fabrication in this area. We currently operate one ICP plasma chamber as a plasma ion implantation (PII) device, using a custom-designed high-voltage modulator, and we have recently (January 2007) acquired a new plasma chamber for advanced plasma processing work (this plasma tool was funded by the CFI and designed and built by Plasmionique, Inc. of Varennes, QC). This poster will present an overview of the plasma processing technologies we use and the plasma tool suite we are currently operating. It will also present our recent results in the area of silicon-compatible photonics as well as a new research effort in the area of direct-bandgap semiconductors such as GaAs and GaN.

* This work is being supported by NSERC, CFI

MO-POS-73

Plasma Ion Engine Development at the University of Saskatchewan*. **Darren Hunter**, Michael Bradley, *University of Saskatchewan* — This poster will present design studies on new ion engine concepts currently being pursued in the research group of Prof. Michael P. Bradley of the University of Saskatchewan Plasma Physics Laboratory (PPL). The goal of this new research program is to take advantage of the substantial advances in plasma ion source technology which have occurred over the past decade (in the area of ion source geometry as well as new materials). These advances should make possible new and significantly improved plasma-based ion engines. Such ion engines have relatively low thrust, but extremely high"specific impulse" (essentially thrust per unit of fuel consumed). This makes them particularly well suited for satellite orbital transfer applications as well as deep space missions, where long acceleration times are available. The recent efforts at the U of S in this direction will be summarized, and new ion engine concepts and analysis will be presented.

* This work is being supported by USTEP

MO-POS-74

Nonlinear kinetic effects in inductively coupled plasmas via particle-in-cell simulations*. **Aaron Froese**, Dmytro Sydorenko, Andrei Smolyakov, *Dept of Physics and Engineering Physics, University of Saskatchewan* — The kinetic effects in an inductively coupled plasma due to thermal motion of particles modified by self-consistent magnetic fields are studied by using a particle-in-cell code. In the low pressure, low frequency regime, electron mean free paths are large relative to device size and the trajectories are strongly curved by the induced rf magnetic field. This causes problems for classical, local theories, which are unable to recover effects accumulated along each nonlinear path, especially considering the initial thermal distribution of the particles. If the nonlinearities are ignored, the plasma heating and ponderomotive force are in agreement with analytic linear theories. With full dynamics, a nonlinear regime appears in which the anomalous skin effect is supressed due to local nonlinear trapping at large amplitude. This in turn partially restores the plasma heating and ponderomotive force to local values. The transition between linear and nonlinear regimes is investigated as a function of temperature.

* This work is being supported by NSERC

MO-POS-75

Relativistic self-focusing, electron acceleration and ultra-short laser pulse propagation in underdense plasmas*. **Neda Naseri** [1], Paul-Edouard Masson-Laborde [1], Valery Bychenkov [2], Wojciech Rozmus [1], [1] *University of Alberta*, [2] Lebedev Physics Institute — This paper discusses theoretical studies and particle-in-cell (PIC) simulations of nonlinear processes related to short pulse laser propagation in underdense plasmas. For the laser power above critical power for relativistic self-focusing in two spatial dimensions PIC simulation results converge to stationary laser filaments. Conditions for the formation of multifilament structures are discussed and demonstrated in simulations for relatively long pulses. For short laser pulses nonlinear propagation at relativistic intensities involves pulse erosion, frequency shift and characteristic steepening at the front of the pulse. Different mechanisms of particle acceleration are described including particle trapping at the front of the pulse, acceleration by the plasma wake fields and by the electromagnetic wave. These processes are simulated and discussed in the context of recent experiments with gas jet targets on the ALLS facility.

* This work is being supported by NSERC

MO-POS-76

Electron Acceleration by a Tightly Focused Laser Pulse*. **Konstantin Popov** [1], Valery Bychenkov[2], Wojciech Rozmus[1], [1]*University of Alberta*, [2]Lebedev Physics Institute, RAS — Advances in laser technology have made possible compact multi-terawatt laser systems with high intensities up to 10^{22} W/cm^2, when a laser beam is focused to the focal spot on the order of one wavelength. We have used an exact solution to the Maxwell equations to describe electric and magnetic fields in the focal region of such tightly focused pulse. Electron acceleration by these pulses is dominated by the presence of high longitudinal fields at the laser focus and strong inhomogeneities across the laser propagation direction. By using the test particle approach we have found the energy change for an electron ejected in the given direction. The correlations between electron energies and the emission angles were studied. We also obtained the dependence of the maximum electron energy on the focal spot size.

* This work is being supported by NSERC

[MO-POS] SURFACE SCIENCE / SCIENCE DES SURFACES — Monday / Lundi

MO-POS-77

Solution Studies of Cyclodextrins and Gemini Surface Active Compounds. **Lee D. Wilson**, Ronald E. Verrall, *Department of Chemistry, University of Saskatchewan* — The apparent molar volumes ($V_{\phi,S}$) of a homologous series of bisquaternary ammonium cationic (gemini) [C_nH_{2n}-$N(CH_3)_2Br$-$(CH_2)_3$-$C_nH_{2n}N(CH_3)_2Br$ n=6,8,10,12] salts (S) have been determined in water (w) and in aqueous cyclodextrin (CD) solutions at 25 °C. The magnitude of $V_{\phi,S}$ in ternary (w+CD+S) solutions containing β–CD, DM-β–CD (2,6-di-O-methyl β–cyclodextrin), HP-β–CD (6-O-(2-hydroxypropyl) β–cyclodextrin) are greater than in the binary (w+S) aqueous systems. As the length of the pendant N-alkyl group increases, the magnitude of the apparent molar volume (AMV) at infinite dilution ($V_{\phi,S}°$) in ternary solution increases. The transfer volume of the gemini surfactant in ternary aqueous solutions can be related to the formation of inclusion complexes between the pendant N-alkyl chains and the interior of the CD macrocycle. The changes in transfer volume are well described by a simple molecular additivity scheme which accounts for the number of alkyl groups included and the number of water molecules that are displaced from the lipophilic CD interior. Measurement of the ^{1}H NMR chemical shifts of the gemini surfactant in the presence of cyclodextrin are consistent with the AMV results described above. The pendant N-alkyl groups display the greatest change in complexation induced shift (CIS) values as the concentration of CD increases in the ternary (D_2O+CD+S) solution. Alkyl groups adjacent to the quaternary ammonium group display the greatest CIS values and these results are consistent with observed correlations observed nOe effects for these host-guest systems. The spectroscopic and thermodynamic data have been quantitatively described in terms of two-and three-site models that account for the formation of bound and unbound species. Equilibrium binding constants obtained from each independent method are in good general agreement and increase as the pendant N-alkyl groups of the gemini surface active material increases.

[MO-POS] THEORETICAL PHYSICS / PHYSIQUE THÉORIQUE — Monday / Lundi

MO-POS-78

Quasi-linear Elliptic Partial Differential Equations and Physics Application. **Guner Ilican** — In this study, the existence of a solution for the boundary-value problems of quasi-linear elliptic partial differential equations for convex regions on plane is studied. Then, these equations are applied on a physics problem.

MO-POS-79

Gauge fixing the gravitational path-integral. **Arundhati Dasgupta**, *University of New Brunswick* — I shall describe a unique method of gauge fixing the gravitational path-integral which solves the conformal mode divergence problem associated with the Euclidean gravitational action.

MO-POS-80

Where are the Black Hole Entropy Degrees of Freedom?*. **Saurya Das** [1], S. Shankaranarayanan [2], Sourav Sur [1], [1] *University of Lethbridge*, [2] Max-Planck-Institut fur Gravitationphysik, Albert-Einstein-Institut — Understanding the area-proportionality of black hole entropy (the `Area Law') from an underlying fundamental theory has been one of the key goals of all theories of quantum gravity. A key question that one asks is: where are the degrees of freedom, giving rise to black hole entropy, located? Taking the point of view that entanglement between field theory degrees of freedom inside and outside the horizon can be a source of this entropy, we show that when the field is in its ground state (or related classes of states), the degrees of freedom near the horizon contribute most to the entropy, and the area law is obeyed. When the field is excited however, degrees of freedom far from the horizon contribute more significantly, and deviations from the area law are observed. In other words, we identify the location of those degrees of freedom which are responsible for the area law.

* This work is being supported by NSERC

MO-POS-81

Some further analytical results on the solid angle subtended at a point by a circular disk using elliptic integrals. **Eduardo Galiano-Riveros** [1], D. Timus [2], M.J. Prata [3], S.L. Kalla [4], M.I. Abbas [5], F. Oner [6], [1] *Laurentian University*, [2] Laser & Plasma Institute - Romania, [3] Univ. Losofona - Portugal, [4] Kuwait University, [5] Alexandria University - Egypt, [6] Amaysa University - Turkey — A series formulation involving complete elliptic integrals of the first and second kind for the solid angle subtended at a point by a circular disk is presented. Results from the present model were tested against data sets obtained with previous treatments for the solid angle in order to determine the degree of simplicity and speed of our calculations. Animated 3-D graphs are presented.

MO-POS-82

Tunnelling From a Black Hole*. **Ryan Kerner**, Robert Mann, *University of Waterloo* — It has been thirty years since it was discovered that black holes could radiate particles. From this astounding discovery came the important implication that black holes radiate heat, with a temperature like any other thermodynamic object. In recent years a semi-classical method was developed that actually models this black hole radiation as a quantum tunnelling effect, allowing one to determine its temperature. I will investigate this tunnelling method for calculating black hole temperature. I will provide a comparison of the tunnelling approach to other methods of calculating the temperature and outline some pros and cons of each. I will demonstrate the tunnelling method by describing the calculation for the standard Schwarzschild black hole. Finally I will present the results of my calculations that extend the tunnelling method to a broad class of spacetimes such as: Charged-Kerr black holes, Taub-NUT black holes, Rindler space (the Unruh temperature is recovered), and higher dimensional Kerr-Godel black holes (that are of interest to string theory). My results indicate that black hole radiation really can be understood as a quantum tunnelling phenomenon, providing further theoretical evidence for black hole radiation.

* This work is being supported by NSERC

MO-POS-83

Numerical Simulation of the Orbital Decay of a Compact Object in Orbit About a Massive Kerr Black Hole. **Peter Komorowski**, François Ouegnin, Martin Houde, Sreeram Valluri, *University of Western Ontario* — The evolution of a compact object's (CO) orbit about a massive black hole (MBH) that is assumed to have various scaled spin angular momenta ($-1 \leq S/M^2 \leq 1$) was modelled. The Parameterized Post-Newtonian equations were analysed numerically by two methods: the SUNDIAL Package (developed by the Lawrence Livermore Laboratory) which uses an ordinary differential equation (ODE) solver with sensitivity analysis capabilities and by the Method of Lines with a prediction/correction capability. The results obtained by these two methods were found to be in reasonable agreement with one another and to be consistent with the results obtained by Barack and Cutler (*Phys. Rev. D* **69**, 082005 (2004)). For a static MBH the orbital evolution was modelled from a starting eccentricity of $e \sim 0.5$ with radial frequency $\nu \sim 0.41$ mHz; and found to approach the last stable orbit (LSO) along a time parameterised curve of decreasing eccentricity and increasing radial frequency. Similar behaviour was observed in the presence of spin. Prograde spins prolonged the time the CO stayed aloft while directing the frequency-eccentricity curve towards both higher radial frequencies and eccentricities. Retrograde spins caused the CO to reach the LSO more quickly while exhibiting smaller radial frequencies and eccentricities.

MO-POS-84

Initial data of distorted black holes*. **Aaryn Tonita** — Within the 3+1 formalism of general relativity, axially symmetric initial data is generated for distorted black holes. This is accomplished by specifying a surface of revolution, which need not be smooth but must have the topology of a sphere. The physical motivations of the problem are discussed as well as the mass bounds of the resultant black holes.

* This work is being supported by NSERC

MO-POS-85

Fermi-Frenet coordinates for space-like curves*. **Michael Underwood**, Karl-Peter Marzlin, *Institute for Quantum Information Science at the University of Calgary* — We generalize Fermi coordinates, which correspond to an adapted set of coordinates describing the vicinity of an observer's world line, to a coordinate system in a neighbourhood of the worldsheet of an arbitrary spatial curve in a static spacetime. The spatial coordinate axes are fixed using a covariant Frenet triad, analogous to that of classical differential geometry, so that the metric can be expressed in terms of the curvature and torsion of the spatial curve. This construction is used to analyze the covariant definition of inertial forces felt by an observer constrained to motion upon the worldsheet. We also consider the application of these coordinates to examining photon propagation in arbitrarily-curved optical fibres.

* This work is being supported by iCORE and NSERC

MO-POS-86

Towards an accurate force distribution for Globular Clusters*. **John Hawkin** [1], John Lewis [2], [1] *University of Alberta*, [2] Memorial University of Newfoundland — The Holtsmark distribution has been accepted to be a close approximation of the force distribution on stars in a globular cluster ever since its derivation by Holtsmark in 1917. The Holtsmark distribution is also used to describe the distribution of electrostatic force on charged particles in a plasma. It was re-derived by Chandrasekhar in 1943 [1], and this is still the standard derivation in the literature today [2]. Chandrasekhar believed that he had proven that the dominant contribution to the force on any star is almost exclusively due to the nearest neighbour to that star, and this was used to justify the assumption that the force distribution of an infinite cluster would be the same as that of a real cluster with a finite radius. We find evidence that this assertion is flawed, and we use numerical experiments to show that the dominant force on stars far from the centre of a cluster is in fact given by the far field. Then we give the beginnings of a more generalized derivation of the force distribution in a star cluster. We show that both the radius and mass distribution of the cluster must be taken in to account in order to obtain an accurate estimate of the overall distribution of forces.
References: [1] Chandrasekhar. Stochastic problems in physics and astronomy. *Reviews of Modern Physics*, **15**, 1943; [2] L. Pietronero and R. Mohayaee, A cellular automaton model of gravitational clustering. *Physica A*, **323**, 2003.

* This work is being supported by NSERC

MO-POS-87

A Fermion Basis for Clifford Algebras*. **Renan Cabrera**, William E. Baylis, *University of Windsor* — It has been shown that the Lie algebras of the special orthogonal groups can be written in terms of the biproducts of the creation and annihilation operators of a set of different fermions. This also allows us to construct Clifford algebras from a null basis of second-quantized fermion operators. The consequences are potentially important because they combine the geometric insight of Clifford algebras with the physical foundation of the fermion algebra.

* This work is being supported by NSERC

MO-POS-88

M-theory in the Sky*. **Amjad Ashoorioon** [1], Axel Krause [2], [1] *University of Waterloo*, [2] Arnold Sommerfeld Center for Theoretical Physics — I will demonstrate how one can realize Cascade inflation in M-theory. Cascade inflation is a realization of assisted inflation which is driven by non-perturbative interactions of N M5-branes. Its power spectrum possesses three distinctive signatures: a decisive power suppression at small scales, oscillations around the scales that cross the horizon when the inflaton potential jumps and stepwise decrease in the scalar spectral index. All three properties result from features in the inflaton potential. The features in the inflaton potential are generated whenever two M5-branes collide with the boundaries. The derived small-scale power suppression serves as a possible explanation for the dearth of observed dwarf galaxies in the Milky Way halo. The oscillations, furthermore, allow to directly probe M-theory by measurements of the spectral index and to distinguish cascade inflation observationally from other string inflation models.

* This work is being supported by NSERC & NSF

MO-POS-89

Bubble Spacetimes and AdS/CFT Correspondence. **Masoud Ghezelbash**, Robert Mann, *University of Waterloo* — We provide good supporting evidence in favor of AdS/CFT correspondence in asymptotically AdS time-dependent backgrounds. In this regard we study the bubble spacetimes in five and seven dimensions and find the correct relationship between the field-theoretic trace anomaly and the asymptotic boundary stree-energy.

MO-POS-90

A relativistic hybrid model. **Peter J.S. Watson**, *Carleton University* — A number of authors have considered potential models for hybrid mesons. These frequently involve approximating the vibrating flux-tube by a set of beads, and making an adiabatic approximation. Since the beads are massless, the correct approximation requires the solution of a Klein-Gordon-like equation treating the beads and the quarks on the same footing. We show how to solve the N-bead case exactly for massless quarks, and how the energy can be renormalized to obtain a plausible spectrum.

MO-POS-91

Realist View of Quantum Mechanics and Relativistic Invariance*. **Simon Levesque**, Louis Marchildon, *Université du Québec à Trois-Rivières* — The quantum-mechanical description of a microscopic system and of the apparatus used to measure a property of that system seems to predict the superposition of macroscopically distinct states, which is never observed in practice. Von Neumann proposed to solve this measurement problem through state vector collapse. Such mechanism is not easy to reconcile with the principle of relativity. We investigate the solution of the measurement problem proposed by Bohm, in the framework of a realist approach to quantum mechanics (based on the Schrödinger equation or the Dirac equation) wherein particles follow deterministic trajectories. Although statistical predictions of Bohmian mechanics appear compatible with the principle of relativity, it seems that the trajectories themselves are not. In this context, we examine Bohm and Hiley's proposal of a preferred reference frame, Hardy's argument about the impossibility of a realist and relativistic theory, and Dewdney and Horton's proposal for invariant trajectories.

* This work is being supported by NSERC

MO-POS-92

Quantum Information in Non-inertial Frames*. **Robert Bruce Mann** [1], Ivette Fuentes-Schuller [2], Paul Alsing [3], Trace Tessier [3], [1] *University of Waterloo*, [2] UNAM, Mexico, [3] University of New Mexico — Entanglement is at the heart of quantum information and quantum computational processes. Yet it is an observer-dependent phenomenon, and I summarize recent research that leads to this result. In general two observers determine the entanglement between particle modes by each detecting one of the modes and observing the correlations between their measurements. However, as a consequence of the Unruh effect, a state that is maximally entangled in an inertial frame becomes less entangled if the observers are relatively accelerated. In the infinite acceleration limit the entanglement goes to zero for bosons, but for fermions it asymptotically reaches a non-vanishing minimum value. In this high acceleration limit, our results can be applied to a non-accelerated observer falling into a black hole while the accelerated one barely escapes.

* This work is being supported by NSERC

MO-POS-93

The Spekkens Toy Model Revisited*. **Michael Skotiniotis**, Aidan P. Roy, Barry C. Sanders — The Spekkens toy model is an interesting example of how to augment classical physics in order to perform several quantum informational tasks using limited resources. We revisit the Spekkens toy model and look at the different representations for the group of operations on a single toy bit. We show that in the representation of the operators as Euler rotations, there exist rotations that obey the knowledge balance principle, yet are not present in Spekkens' original group. We demonstrate that this expanded group of single toy bit operations, which includes Spekkens' original operations as a subgroup, is isomorphic to the extended Clifford group for one qubit (modulo scalar multiples of the identity). We also investigate the case for two toy bits again expanding the group of toy operations to include some, but not all, of the extended operations.

* This work is being supported by ICORE

MO-POS-94

The observer in Everett-inspired interpretations of quantum mechanics*. **Ghislain St. Yves**, Louis Marchildon, *Université du Québec à Trois-Rivières* — The standard Copenhagen interpretation of quantum mechanics assumes the existence of macroscopic objects with purely classical behavior. Fifty years ago, H. Everett proposed to extend the theory's formalism to a universal description, confronting the consequence that all measurement results are actual. This paradoxical way to view reality could be explained, according to Everett, in terms of relative states of the observer. This interpretation was made more explicit later by different investigators, who construed it as describing the coexistence of many classical worlds or of many states of consciousness of a given individual. Several attempts to refute Everett's general idea are in fact objections to these specific reinterpretations. The notion of observer is essential in a universal theory, since experimentation and observation, ultimately, must be described in classical terms. We intend to analyze the status of the observer in various Everett-inspired interpretations. We will investigate, in particular, what resources are available in the quantum-mechanical formalism to introduce the observer, and what eventually needs to be added.

* This work is being supported by NSERC

MO-POS-95

Quantum Simulation Circuits for Sparse Hamiltonians*. **Nathan Wiebe**, Barry Sanders, *Institute for Quantum Information Science* — In 1982, Feynman suggested a quantum computer would efficiently simulate quantum systems and illustrated this concept with Heisenberg chains (Int. J. Theor. Phys, 21, 467), which are difficult to solve on a classical computer. Recently, building upon the work of Aharonov and TaShma (Proc. 35th Annual ACM Symp. On Theory of Computing, 20-29), Berry, Ahokas, Cleve, and Sanders (arxiv:quant-ph/0508139) developed an algorithm that simulates state evolution for generic sparse time-independent Hamiltonians, which accounts for all resources and has a cost that is nearly linear in time. We present a quantum circuit protocol to implement this algorithm. Furthermore we discuss the adaptation of this scheme for a broad class of time-dependent Hamiltonians.

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

MO-POS-96

Excited States in Lattice Gauge Theories*. **Ahmad Hosseinizadeh** , Helmut Kröger, *Université Laval* — A new method based upon the Hamiltonian formulation of lattice gauge theories is developed to compute the energy eigenvalues and wave functions of the ground state and excited states from transition amplitudes between physical states. These states are taken from a stochastic basis with guidance of a physical probability density function. This is in close analogy to the numerical simulation of lattice gauge theories by computing path integrals via Monte Carlo importance sampling method and use of the action weight factor exp(-S). The transition amplitudes are computed by a hybrid approach using standard path integrals and group theoretical methods. The physical information of a system can be obtained from these amplitudes for the models

based on U(1), SU(2) and SU(3) lattice gauge theories. We present the results obtained by applying the Monte Carlo Hamiltonian technique for the case of U(1) gauge theory. We compute energy spectra, wave functions as well as thermodynamical functions such as average energy and specific heat for a (2+1) dimensional lattice. Our results appear to be consistent with computations by the direct Hamiltonian. We believe that this method can be applied also to lattice QCD to extract exited states energies and wave functions and to study hadron structure functions and hadron scattering reactions.

* This work is being supported by NSERC

MO-POS-97

Networks of Recurrent Events, a Theory of Records, and an Application to Finding Causal Signatures in Seismicity. **Joern Davidsen**, Peter Grassberger, Maya Paczuski, *University of Calgary* — We propose a method to search for signs of causal structure in spatiotemporal data making minimal a priori assumptions about the underlying dynamics. To this end, we generalize the elementary concept of recurrence for a point process in time to recurrent events in space and time. An event is defined to be a recurrence of any previous event if it is closer to it in space than all the intervening events. As such, each sequence of recurrences for a given event is a record-breaking process. Defining events to be nodes, and links of each event to its recurrences, we create time-ordered networks of recurrent events. Significant deviations in properties of that network compared to networks arising from random processes allow one to infer attributes of the causality which [illegible] We derive analytically a number of properties for the network of recurrent events composed by a random process in space and time. We extend the theory of records to treat not only the variable where records happen, but also time as continuous. In this way, we construct a fully symmetric theory of records leading to a number of new results. Those analytic results are compared in detail to the properties of a network for earthquakes in Southern California. Significant disparities from the ensemble of random networks that can be plausibly attributed to the causal structure of seismicity include the appearance of a fundamental length scale for recurrences, independent of the time span of the catalog, which is consistent with observations of the "rupture length".

MO-POS-98

Universality in Dynamical Systems*. **Jean-Francois Laprise**, *Université Laval* — We suggest that random matrix theory applied to a classical action matrix can be used in classical physics to distinguish chaotic from non-chaotic behavior. We consider the 2-D stadium billiard system. By unfolding of the spectrum of such matrix we compute the level spacing distribution, the spectral auto-correlation and spectral rigidity. We observe Poissonian behavior in the integrable case and Wignerian behavior in the chaotic case. We present numerical evidence that the action matrix of the stadium billiard displays GOE behavior and give an explanation for it. 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

MO-POS-99

Fourth-order algorithm for solving stiff Langevin equations for nonlinear oscillators*. **Ilya Vadeiko**, François Drolet, *McGill University* — One dimensional nonlinear oscillators are described by a second order ordinary differential equation. The Langevin force is represented by a zero-mean Gaussian noise. The stiffness in the equation usually arises in the over-damped regime of the oscillator. Several fourth-order algorithms have been proposed to treat this problem in each particular limit [1-5]. These algorithms are unsuitable for applying either in deeply asymptotic but still important regions of parameters or in three dimensional multi-body cases. We are proposing a unified method for solving the Langevin equations in a wide range of physically relevant parameters. The method is based on combining standard explicit and implicit fourth-order algorithms with an appropriate expansion for the stochastic force. In the over-damped limit, the implicit form of the method reduces the computational effort by considering only the important, slowly-varying component of oscillator trajectories. The unified form and numerical advantage (in computer time) of our approach make it easily applicable to other complex stochastic problems such as: Particle diffusion in fluids moving through porous media, Stochastically driven oscillators in dimensions higher than one, Mean first-passage time and Brownian movement in molecular and cell biology. References: [1] R.L. Honeycutt, *Phys. Rev. A* **45**, 604 (1992); [2] E. Hershkovitz, *J. Chem. Phys.* **108**, 9253 (1998); [3] A.N. Drozdov and J.J. Brey, *Phys. Rev. E* **57**, 1284 (1998); [4] H.A. Forbert and S.A. Chin, *Phys. Rev. E* **63**, 016703 (2000); [5] J.-D. Bao, R.-W. Li, W. Wu, *J. Comp. Phys.* **197**, 241 (2004).

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MO-POS-100

A Shock Analysis in a Static, Self-Gravitating, Spherically Symmetric Star, with a Focus on Asymmetric Neutrino Heating*. **Gregory Mohammed**, *University of Northern British Columbia* — Supernova simulations produced by numerical modeling of different stellar configurations are not found to be as energetic as found in nature. In general, numerical simulations "fizzle-out" resulting in a failed explosion with a bounce effect. Relatively recent work has shown that neutrino interaction with the shock systems being formed within the star leading up to a supernova may power the outgoing shock waves to the extent whereby a more powerful explosion occurs. This "neutrino heating" is still being explored, with recent studies focusing on asymmetric neutrino effects. The purpose of the work presented here is to go back to basics; begin with a static, self-gravitating, spherically symmetric star, and employ a neutrino beam which occurs in a very well defined space within the star, so that it is asymmetrical. The numerical technique employed is the finite volume approach on Godunov's method. The system is initially one dimensional with relativistic hydrodynamics and no forcing terms. There is no rotation or charge; thus, the experiment is as simple as one can begin with. The focus here is to observe what occurs in the simplest test case.

* This work is being supported by OSAP

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