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Physics in Canada
La Physique au Canada

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Canadian Association of Physicists / Association canadienne des physiciens et physiciennes

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Articles related to the 2022 Congress, Medals and Awards

Articles liés au Congrès, aux médailles et aux prix 2022

Physics in Canada
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Vol. 78, No. 1 (2022)

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Front cover: "Coefficient de Fresnel", by Richard Germain, Pointe-des-Cascades QC – First Place (Open Category), 2019 Art of Physics competition. / **Couverture** : « Coefficient de Fresnel », par Richard Germain, Pointe-des-Cascades QC - Première place (catégorie ouvert à tous), concours l'Art de la physique 2019.

Canadian Association of Physicists (CAP)
Association canadienne des physiciens et physiciennes (ACP)

The Canadian Association of Physicists was founded in 1945 as a non-profit association representing the interests of Canadian physicists. The CAP is a broadly-based national network of physicists working in Canadian educational, industrial, and research settings. We are a strong and effective advocacy group for support of, and excellence in, physics research and education. We represent the voice of Canadian physicists to government, granting agencies, and many international scientific societies. We are an enthusiastic sponsor of events and activities promoting Canadian physics and physicists, including the CAP's annual congress and national physics journal. We are proud to offer and continually enhance our web site as a key resource for individuals pursuing careers in physics and physics education. Details of the many activities of the Association can be found at http://www.cap.ca. Membership application forms are also available in the membership section of that website.

L'Association canadienne des physiciens et physiciennes a été fondée en 1946 comme une association à but non-lucratif représentant les intérêts des physicien(ne)s canadien(ne)s. L'ACP est un vaste regroupement de physiciens et de physiciennes oeuvrant dans les milieux canadiens de l'éducation, de l'industrie et de la recherche. Nous constituons un groupe de pression solide et efficace, ayant pour objectif le soutien de la recherche et de l'éducation en physique, et leur excellence. Nous sommes le porte-parole des physicien(ne)s canadien(ne)s auprès du gouvernement, des organismes subventionnaires et auprès de plusieurs sociétés scientifiques internationales. Nous nous faisons le promoteur enthousiaste d'événements et d'activités mettant à l'avant-scène la physique et les physicien(ne)s canadien(ne)s, en particulier le congrès annuel et la revue de l'Association. Nous sommes fiers d'offrir et de développer continuellement notre site Web pour en faire une ressource clé pour ceux qui poursuivent leur carrière en physique et dans l'enseignement de la physique. Vous pouvez trouver les renseignements concernant les nombreuses activités de l'ACP à http://www.cap.ca. Les formulaires d'adhésion sont aussi disponibles dans la rubrique « Adhésion » sur ce site.

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The Editorial Board welcomes articles from readers suitable for, and understandable to, any practising or student physicist. Review papers and contributions of general interest of up to four journal pages in length are particularly welcome. Suggestions for theme topics and guest editors are also welcome and should be sent to the Editor-in-Chief, Béla Joós, at bjoos@uottawa.ca.

Le comité de rédaction invite les lecteurs à soumettre des articles qui intéresseraient et seraient compris par tout physicien, ou physicienne, et étudiant ou étudiante en physique. Les articles de synthèse d'une longueur d'au plus quatre pages de revue sont en particular bienvenus. Des suggestions de sujets pour des revues à thème sont aussi bienvenues et peuvent être envoyées à la Redacteur-en-chef, Béla Joós, à bjoos@uottawa.ca.

REFLECTIONS ON THE CAP FELLOWS PROGRAM

Bruce D. Gaulin, Professor, McMaster University and Former CAP President 2018-2019

The CAP Fellows program has now launched with its inaugural class made up of Canadian Physics Nobel Laureates, Art MacDonald and Donna Strickland. On this occasion I was asked to reflect on how the CAP Fellows program came into being, and indeed, I think this is very timely as my memory has never been that great, and it isn't currently improving – so there is no time like the present to do so.

Many CAP councilors, members and staff had an important hand in bringing the Fellows program into being. But I remember it as my "baby", for proposing it when I came onto the CAP Presidential line, which I served on from 2016-2020. That was my fourth time serving on CAP council, as I had previously served as a regional councilor, Chair of the Division of Condensed Matter and Materials Physics, and Director of Academic Affairs. The idea of a CAP Fellows program had been brought up and debated on council at least twice before in my presence, but it had been dormant for at least a decade when I re-introduced it ~ 2017. At around the same time, CAP council took part in a strategic planning exercise leading to a 5-year plan for the CAP, with a mission statement that was very similar to the one which we have today: "To advocate, communicate and celebrate the role, value and contribution of Canadian Physics". The question came up as to what specific actions and initiatives could we take on to advance this mission, and my input to this was that we could finally form a CAP Fellows program that would celebrate more of our accomplishments and draw better attention to our membership.

I say "finally form" a Fellows program, as on my earlier incarnations on CAP Council I'd seen similar initiatives introduced and debated, and while there probably had been a preponderance of support for such a program, there was also opposition to it. On these two occasions, the pro-Fellows initiatives simply ran out of steam in the face of the opposition. It's hard (and perhaps unfair) for me to summarize the views opposing a CAP Fellows program at the time, but I would describe them as feeling that a Fellows program wasn't necessary, that we already had enough recognitions, and that there were better activities to put our energies into. It somehow seemed to not be something that Canadians did.

I felt that a Fellows program was in fact missing from our CAP community. It was not that we didn't have recognitions, we did (mostly) for high achievement in research. While these were and continue to be important celebrations, most of our membership won't qualify for these distinctions, in part because there simply aren't that many of them. I wanted a recognition that would celebrate achievement for more successful Canadian physicists, who were, in fact, serving our students, our research sponsors and Canadian society more broadly, extremely well.

I am a Fellow of two science societies, the American Physical Society and the Neutron Scattering Society of America. In both cases, I remember well the feeling of accomplishment and, well, joy, on receiving the message that I had been elected to Fellowship in these two societies. In both cases these pats-on-the-back came to me in mid-career and were a great source of encouragement. This was great – but it wasn't from my "home" society. Surely, our own CAP could also do this.

In any case, I was both pleased and a little bit surprised that my suggestion was enthusiastically embraced by the CAP board. I had not thought the proposal through all that carefully, and there were a lot of details to work out. Much thoughtful discussion then ensued, and it became clear that we weren't simply going to duplicate the APS Fellowship program. Fellowship in the APS is largely based on research achievement, primarily because it is the APS (mostly subject-based) Divisions that recommend new Fellows. We wanted it to be broader and to acknowledge success across the range of activities that Canadian physicists are involved in.

There was also good discussion on the appropriate French terminology for Fellow of the CAP. An ad-hoc group of francophone CAP members (Gary Slater, Béla Joós, Louis Marchildon, Cécile Fradin, Michel Gingras and André-Marie Tremblay) was consulted, and they considered several alternatives (such as Compagnon and Membre agréé) before settling on "Fellow de l'ACP". Interestingly, it was noted that the word "Fellow" is recognized by the Office Québecois de la Langue Française.

In due course, attention focused on how to launch the Fellows program, although this spilled over my tenure on the CAP Presidential line, and therefore my time on CAP council. Nonetheless, I really have to applaud how this was done, especially given the relative chaos of the Covid lockdown starting in 2020. The decision was taken to reach out to CAP's two very distinguished Nobel Laureates, Art MacDonald and Donna Strickland, with a proposal that they constitute the inaugural 2022 class of CAP Fellows. I thought this evoked the perfect combination of broad scientific excellence and diversity that we wanted to associate with our new CAP Fellows program. Luckily for us, Art and Donna, both longtime and strong CAP supporters, agreed to take part.

As the program goes forward, we are hoping that our CAP Fellowships will bring distinction to the Fellows themselves, and that the quality of our Fellowship selections will bring distinction to the CAP Fellows program. I'd say we are off to a good start! My message-in-a-bottle to our future Fellow cohorts is, first of all, congratulations! But also remember to pay it forward – make sure your hard working and accomplished friends and colleagues are nominated.

I'm very pleased to have been associated with the launch of the CAP Fellows program. A lot of good work was done by CAP council during my term on the Presidential Line, but, without doubt, this is what I remember best.

Bruce D. Gaulin, McMaster University, <gaulin@mcmaster.ca>

Bruce Gaulin is Distinguished University Professor and Brockhouse Chair in the Physics of Materials at McMaster University. He has served the CAP in many capacities over 35 years, including on the Presidential line from 2016-2020.

RÉFLEXIONS SUR LE PROGRAMME DES FELLOWS DE L'ACP

Bruce D. Gaulin, professeur à l'Université McMaster et président sortant de l'ACP 2018-2019

Le programme des Fellows de l'ACP est maintenant lancé avec sa classe inaugurale composée de lauréats canadiens du prix Nobel de physique, Art MacDonald et Donna Strickland. À cette occasion, on m'a demandé de réfléchir à la façon dont le programme des Fellows de l'ACP a vu le jour, et je pense que cela tombe à point nommé, car ma mémoire n'a jamais été très bonne, et elle ne s'améliore pas en ce moment - il n'y a donc pas de meilleur moment pour le faire.

De nombreux conseillers, membres et employés de l'ACP ont joué un rôle important dans la mise en place du programme des Fellows. Mais je m'en souviens comme de mon « bébé », car je l'ai proposé lorsque je me suis joins à la ligne présidentielle de l'ACP, où j'ai siégé de 2016 à 2020. C'était la quatrième fois que je siégeais au conseil de l'ACP, puisque j'avais auparavant été conseiller régional, président de la division de la physique de la matière condensée et des matériaux, et directeur des affaires académiques. L'idée d'un programme de Fellows de l'ACP avait été soulevée et débattue au conseil au moins deux fois auparavant en ma présence, mais elle était en dormance pendant au moins une décennie lorsque je l'ai réintroduite ~ 2017. À peu près à la même époque, le Conseil de l'ACP a pris part à un exercice de planification stratégique qui a débouché sur un plan quinquennal pour l'ACP, avec un énoncé de mission très semblable à celui que nous avons aujourd'hui : « Défendre, communiquer et célébrer le rôle, la valeur et la contribution de la physique canadienne ». La question s'est posée de savoir quelles actions et initiatives spécifiques nous pourrions entreprendre pour faire avancer cette mission, et ma réponse a été que nous pourrions enfin mettre en place un programme des Fellows de l'ACP qui célébrerait davantage nos réalisations et attirerait davantage l'attention sur nos membres.

Je dis « enfin » un programme de Fellows, car lors de mes précédentes incarnations au Conseil de l'ACP, j'avais vu des initiatives similaires introduites et débattues, et bien qu'il y ait probablement eu une prépondérance de soutien pour un tel programme, il y avait aussi de l'opposition à ce programme. À ces deux occasions, les initiatives pro-Fellows se sont tout simplement essoufflées face à l'opposition. Il m'est difficile (et peut-être injuste) de résumer les opinions qui s'opposaient à l'époque au programme des Fellows de l'ACP, mais je dirais qu'ils estimaient qu'un tel programme n'était pas nécessaire, que nous avions déjà suffisamment de reconnaissances et qu'il y avait de meilleures activités dans lesquelles nous pouvions consacrer nos énergies. D'une certaine manière, les Canadiens ne semblaient pas s'y intéresser.

J'ai eu le sentiment qu'un programme de Fellows manquait en fait à notre communauté de l'ACP. Ce n'est pas que nous n'ayons pas de reconnaissance, nous en avons (surtout) pour les grandes

réalisations dans le domaine de la recherche. Bien que ces reconnaissances aient été et continuent d'être importantes, la plupart de nos membres ne se qualifient pas pour ces distinctions, en partie parce qu'ils ne sont tout simplement pas si nombreux. Je voulais une reconnaissance qui célèbre les réalisations de physiciens canadiens plus performants, qui, en fait, servent extrêmement bien nos étudiants, nos commanditaires de recherche et la société canadienne dans son ensemble.

Je suis Fellow de deux sociétés scientifiques, l'American Physical Society et la Neutron Scattering Society of America. Dans les deux cas, je me souviens bien du sentiment d'accomplissement et de joie que j'ai ressenti en recevant le message m'annonçant que j'avais été élu Fellow de ces deux sociétés. Dans les deux cas, ces félicitations me sont parvenues en milieu de carrière et ont été une grande source d'encouragement. C'était formidable, mais cela ne venait pas de ma société « d'origine ». Notre propre ACP pourrait certainement faire de même.

Quoi qu'il en soit, j'ai été à la fois heureux et un peu surpris que ma suggestion soit accueillie avec enthousiasme par le conseil d'administration de l'ACP. Je n'avais pas réfléchi à la proposition avec beaucoup d'attention et il y avait beaucoup de détails à régler. Une discussion approfondie s'est ensuivie et il est apparu clairement que nous n'allions pas simplement reproduire le programme de Fellows de l'APS. La sélection des Fellows de l'APS est en grande partie basée sur la recherche, principalement parce que ce sont les divisions de l'APS (organisées par thème de recherche) qui recommandent les nouveaux Fellows. Nous voulions que le programme soit plus large et qu'il reconnaisse les succès des physiciens canadiens dans toute la gamme de leurs activités.

Il y a également eu une bonne discussion sur la terminologie française appropriée pour les Fellows de l'ACP. Un groupe ad hoc de membres francophones de l'ACP (Gary Slater, Béla Joós, Louis Marchildon, Cécile Fradin, Michel Gingras et André-Marie Tremblay) a été consulté et a envisagé plusieurs alternatives (telles que Compagnon et Membre agréé) avant d'opter pour « Fellow de l'ACP ». Il est intéressant de noter que le mot « Fellow » est reconnu par l'Office québécois de la langue française.

En temps voulu, l'attention s'est portée sur la manière de lancer le programme des Fellows, bien que cela ait empiété sur mon mandat à la ligne présidentielle de l'ACP, et donc sur mon mandat au Conseil de l'ACP. Néanmoins, je dois vraiment applaudir la façon dont cela a été fait, en particulier compte tenu du chaos relatif de la fermeture de Covid à partir de 2020. La décision a été prise de tendre la main aux deux très distingués lauréats du prix Nobel de l'ACP, Art MacDonald et Donna Strickland, en leur proposant de constituer la classe inaugurale de 2022 des Fellows de l'ACP. J'ai pensé que cela évoquait la combinaison parfaite d'excellence scientifique et de diversité que nous voulions associer à notre nouveau programme de Fellows de l'ACP. Heureusement pour nous, Art et Donna, tous deux fervents partisans de longue date de l'ACP, ont accepté de participer.

Au fur et à mesure que le programme progresse, nous espérons qu'il apportera de la distinction aux Fellows, et que la qualité de nos sélections de Fellows apportera une distinction au programme même des Fellows de l'ACP. Je dirais que nous sommes bien partis ! Le message que j'adresse à nos futures cohortes de Fellows est le suivant : tout d'abord, félicitations ! Mais n'oubliez pas non plus d'en faire profiter vos amis et collègues, qui travaillent dur et accomplissent de grandes choses, en veillant à ce qu'ils soient nommés.

Je suis très heureux d'avoir été associé au lancement du programme des Fellows de l'ACP. Le Conseil de l'ACP a fait beaucoup de bon travail pendant mon mandat sur la ligne présidentielle, mais c'est sans aucun doute le programme des Fellows dont je me souviens le mieux.

Bruce D. Gaulin, Université McMaster <gaulin@mcmaster.ca>

Bruce D. Gaulin est professeur distingué et titulaire de la chaire Brockhouse en physique des matériaux à l'Université McMaster. Il a occupé de nombreuses fonctions au sein de l'ACP au cours des 35 dernières années, notamment sur la ligne présidentielle de 2016 à 2020.

Les commentaires des lecteurs sur cet éditorial sont toujours les bienvenus.

NOTE: Le genre masculin n'a été utilisé que pour alléger le texte.

Werner Israel (1931-2022)

Werner Israel, an immense contributor to general relativity and the theory of black holes, died peacefully on May 18, 2022, at age 90. He was surrounded by his loving family, Werner telling stories until his final breath. He is survived by his daughter Pia, son-in-law Ralph, and grand-daughter Allison. Inge, the love of his life, passed away in 2019, and their beloved son Mark died from the consequences of a tragic traffic accident in 2010.

Werner Israel was born in Berlin, Germany on October 4, 1931. The family escaped the Nazi regime in 1936 and settled in Cape Town, South Africa, where they eventually owned a hardware store. Because of the parents' poor health, Werner and his younger brother Peter were placed in an orphanage for a few years. There Werner discovered the wondrous world of astronomy and expanded his education with frequent visits to the public library. Discovering that the mastery of astrophysics required some knowledge of mathematics, he proceeded to educate himself in that topic, mostly by studying textbooks at the beach.

Werner attended the University of Cape Town and earned BSc (1951) and MSc (1954) degrees. His studies were interrupted for a couple of years when his father sadly passed away, and his mother needed help with the hardware store. In 1956 he moved to Ireland with a scholarship, and joined the Dublin Institute for Advanced Studies, where he worked under the supervision of J.L. Synge. The Dublin years were to have a lasting effect on his career and life: Synge's style of research can be seen perpetuated in Werner's own, and in Dublin he met and married Inge Margulies (then named Inge Lee, because her father felt the new name would be more pleasing to the Irish ear), a woman of enormous talent and charm, a writer of plays, short stories and poetry. Inge's life had a remarkable parallel with Werner's: she also was born in Germany, and her family fled to France and then Ireland.

In 1958 Werner accepted a faculty position in the Department of Mathematics at the University of Alberta. The first years in Edmonton were very difficult for him; he was saddled with thirteen hours of lectures per week, six days a week. Somehow he managed to complete his thesis, obtain his PhD from Trinity College, Dublin (1960), and publish some papers during these early years. In 1972 he transferred to the Department of Physics, where he stayed until his retirement in 1996. After retiring, Werner and Inge settled in Victoria, British Columbia. He kept on with his research activities, taking an adjunct professorship at the University of Victoria, where he continued to supervise students and publish papers well into his eighties.

Werner's research world opened up considerably when he was invited (by Ivor Robinson) to attend the first Texas Symposium on Relativistic Astrophysics, held in Dallas in December, 1963. The meeting was prompted by the recent discovery of quasars and the realization that strong gravitational fields were required to explain such massively energetic phenomena. From this time on, Werner dedicated most of his scientific career to the theoretical exploration of what would, in a few years, be called black holes.

Werner made many seminal contributions to our understanding of black holes. In 1966 he formulated a thin-shell formalism [1] and exploited it to devise simple models of complete gravitational collapse to a black hole. This paper, like most of his work, develops an elegant mathematical formalism that is put to

the service of important physics. It has since been used by countless researchers in a multitude of applications.

In 1968 Werner formulated a uniqueness theorem for the Schwarzschild solution [2], the statement that among all static, asymptotically flat spacetimes that are solutions to the Einstein field equations in vacuum, the Schwarzschild spacetime is the only one that possesses a nonsingular event horizon. This powerful theorem, the proof that all nonrotating black holes are spherical and characterized by a single parameter (its mass), took the relativity community by surprise, and placed Werner firmly within its elite group.

In 1976 Werner provided his own derivation of the Hawking effect [3], that a black hole emits a thermal flux of quantum particles with a temperature proportional to the horizon's surface gravity; this effort generalized previous calculations and got to the true essence of the phenomenon. In 1986 he established a third law of black-hole dynamics [4], the statement that no continuous process can reduce the surface gravity of a black hole to zero within a finite time.

While Werner is best known for his varied contributions to black-hole physics, he has published important papers on virtually every subject in general relativity. Among a large number of examples are theories of nonequilibrium thermodynamics [5] and transport phenomena [6], a theory of polarizable media in electrodynamics [7], a theory of superfluidity [8], and a study of cosmic strings [9].

For his achievements Werner received many prestigious awards. In 1972 he was elected Fellow of the Royal Society of Canada, and in 1986 he was elected to the Royal Society of London. In 1981 he received the Medal of Achievement in Physics from the Canadian Association of Physicists. In 1994 he was made Officer of the Order of Canada, and in 1995 he was awarded the very first Medal for Outstanding Achievement in Theoretical and Mathematical Physics by the Canadian Association of Physicists and the Centre de Recherches Mathématiques. He was a founding member of the Cosmology program of the Canadian Institute for Advanced Research.

In spite of his superlative stature in the field of gravitational physics, Werner remained remarkably humble and unassuming throughout his life. In all the commentaries that were received from colleagues and friends following his death, a constant thread is how kind, caring, generous, warm and gentle Werner was in his interactions with others. His delicate sense of humour, often at his own expense, was another trademark. It was on full display when he went on stage wearing a flamboyant wig to embody Albert Einstein, in a moving play on Mileva Marić authored by Inge (who played Mileva). Werner was also known for his great erudition and love of music and movies. He was a fabulous mentor to his graduate students and postdocs, and an extremely effective educator in the classroom.

He is sorely missed.

Valeri Frolov, Department of Physics, University of Alberta
Eric Poisson, Department of Physics, University of Guelph
William G. Unruh, Department of Physics and Astronomy, University of British Columbia

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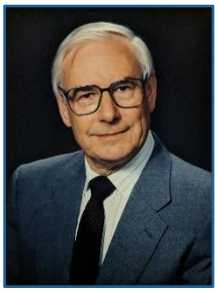
John Charles Douglas (Doug) Milton (1924-2022)



Doug Milton, BSc (Manitoba, Hons Physics), PhD (Princeton, Physics), only child of the late Frances (Craigie) and William (Bill) Milton. Doug was born in Regina in 1924 but grew up in Winnipeg during the depression and thus did not start school until 7. By all reports he was a good student (high school valedictorian) and very musical, soon joining every choir he could. He also became an accomplished pianist completing the full Royal Conservatory of Music program while in early high school and continued to study and perform through his undergrad years. In his final year of an honours degree at the University of Manitoba he specialized in physics, but when asked by a girl friend's father what a physicist did he had to admit he was not sure.

Based on a suggestion from a good friend he decided to go to Princeton, where he initially started working with Bob Hofstader developing gamma detectors, but Bob left for Stanford (and subsequently won a Noble prize), so Doug choose Harry Fulbright as a thesis advisor. Many years later, and to the amusement of one of his granddaughters, he said he thought that he chose to work with Harry "because he was so impressed that Harry could lead the cleanup after the Princeton Cyclotron fire, and still exit with a clean white shirt and tie". Together they were the first to measure the 2nd forbidden beta spectra of Be^{10} and Cl^{36}. Princeton was an exciting place to be at the time and Doug enjoyed attending regular seminars also attended by Albert Einstein and Robert Oppenheimer, the latter apparently regularly interrupting the speaker. He also took courses from J.A Wheeler in classical mechanics, from Eugene Wigner in Group Theory, and from David Bohm in the Foundations of Quantum Mechanics.

Doug arrived in Deep River in 1951 to begin working in Nuclear Physics at NRX. He was soon drafted into the Staff House Club where he met the Secretary of the Club, Gwen Shaw. In 1953 Gwen and Doug were married, beginning a wonderful partnership that lasted for more than 65 years, each supporting the other through many transitions and a number of adventures.

The NRX accident in 1952 stopped the physics experiments and since NRU was still under construction, Doug and John Fraser began a "table-top" experiment measuring the beta angular correlation, and thus measured the quadrupole moment of Er^{166} the first such measurement on a radioactive element. When NRU came online Doug and John began making fission measurements, making use of a new time-of-flight technique with much improved accuracy and were able to show the double hump nature of the fission barrier. Doug was a key proponent of the Intense Neuron Generator (ING) project that would have put Canada at the fore front of Neutron Physics even today but unfortunately it was not funded. Aside from two sabbatical years, all of Doug's professional career was at AECL, first as Scientist, then Nuclear Physics Branch Head, Director of the Physics Division, and as Vice-President, Physics and Health Sciences, becoming a charter member of the EMC (Executive Management Committee for all of AECL). Doug worked to create an environment where good high quality scientific research could be carried out and actively supported the careers of a number of very successful physicists. He was also active in the overall Canadian Physics community, as a Fellow of the Royal Society, and of the American Physics Society, President of the Canadian Association of Physicists (1992-1993) and member of several

Advisory Boards, most notably ABOT (the Advisory Board On TRIUMF) and the advisory board for the Tokamak de Varennes and CFFTP (Canadian Fuel and Fusion). Upon retirement Doug become one of CRNL's first researchers emeritus, actively participating in Accelerator Mass Spectroscopy Experiments (AMS). Gwen had become an expert at preparing the low background samples, and so they are able to attend several international AMS conferences together as professional collaborators.

As a branch head, Doug gave a presentation to senior management that included the suggestion that the future of nuclear physics lay in heavy ion physics and that they should consider developing a suitable facility. This kicked off an innovative project to build a super conducting cyclotron, however funding was tight and progress slow. Despite taking on ever more senior roles, Doug always tried to ensure any remaining research funds were directed to completing the project. Eventually the full project with the Tandem accelerator injecting into the Super Conducting Cyclotron came online and TASCC was born. It was an excellent example of low budget Canadian ingenuity, and a significant member of the small but very active heavy ion research facilities. When ACEL decided that nuclear physics was no longer part of their core mission and thus decided to close TASCC, Doug worked tirelessly to find alternative homes for TASCC. Management was unwilling to listen, and when it was clear AECL would not allow anything other than scrapping the facility, Doug severed all relations with the company.

One of Doug and Gwen's big projects was their house, a truly joint project. From Gwen acting as the general contractor, directing the work on site while pregnant, to Doug's state of the art electrical wiring it was a special project. Their kids have a fond memory of Gwen and Doug stopping work laying tiles in a bathroom to leave for a New Year's eve party, only to return a few hours later to finish the project. They were also avid gardeners and created a large garden with 2 waterfalls, 4 pools and a wandering stream connecting them as soon as they were able. They won several Trillium awards for the garden, and Doug served a term as president of the Deep River Horticultural Society.

Gwen and Doug were passionate about Deep River, feeling that it had provided a great home for them and their kids so in 2001 Gwen was one of the founders of the Deep River and District Community Foundation (DR&DCF), with strong support from Doug. In the early years Doug was Foundation treasurer and later acted a couple of terms as Chair. In many ways the foundation was the culmination of lives spent serving the community, starting with the Staff Hotel committee, through building the yacht club (Doug did much of the original wiring), and the Childs auditorium project.

Bruce Milton, Vancouver BC

Student Competitions 2022 Compétitions étudiantes

The CAP would like to thank and congratulate everyone that participated in this year's Best Student Presentation Competition, including 211 student competitors and the 32-member judging team, to everyone who attended the talks and visited the posters. Your support and participation was vital to the success of the event.

As always, this year was met with a series of fantastic poster and oral presentations and all presenters should be proud of their hard-work and accomplishments!

CAP Overall Student Poster Awards

PLACEMENT	NAME/AFFILIATION
First	Soud Al Kharusi, McGill University
Second	Logan Cooke, University of Alberta
Third	Helen Melino, Toronto Metropolitan University
Honourable Mentions	(in alphabetical order) Liam Farrell and Sakshi Kakkar

CAP Overall Student Oral Presentation Awards

PLACEMENT	NAME/AFFILIATION
First	Hannah Krivic, McMaster University
Second	Frank Wu, Simon Fraser University
Third	Daniel Dumford, University of Alberta
Honourable Mentions	(in alphabetical order) Karen Macias Cardenas, Antoine Hermann, Juliette Martin, Ashley Micuda, and Junjie Yin

CAP Division Student Poster Awards

DIVISIONS OF APPLIED PHYSICS AND INSTRUMENTATION, PHYSICS EDUCATION, AND PLASMA PHYSICS	
PLACEMENT	**NAME/AFFILIATION**
First	Logan Cooke, University of Alberta
Second	Stephane Vinet, University of Waterloo

DIVISION OF CONDENSED MATTER AND MATERIAL PHYSICS	
PLACEMENT	**NAME/AFFILIATION**
First	Cissy Suen, Queen's University

DIVISION OF GENDER EQUITY IN PHYSICS	
PLACEMENT	**NAME/AFFILIATION**
First	Sakshi Kakkar, University of Manitoba

DIVISION OF NUCLEAR PHYSICS	
PLACEMENT	**NAME/AFFILIATION**
First	Sakshi Kakkar, University of Manitoba

DIVISION OF PHYSICS IN MEDICINE AND BIOLOGY	
PLACEMENT	**NAME/AFFILIATION**
First	Helen Melino, Toronto Metropolitan University
Second	Elnaz Parniyany, Western University
Third	Brayden Kell, University of Toronto

DIVISION OF THEORETICAL PHYSICS	
PLACEMENT	**NAME/AFFILIATION**
First	Liam Farrell, McMaster University
Honourary Mention	Joshua Cadogan, University of Guelph

CAP DIVISION STUDENT ORAL PRESENTATION AWARDS

DIVISIONS OF APPLIED PHYSICS AND INSTRUMENTATION, PHYSICS EDUCATION, AND PLASMA PHYSICS	
PLACEMENT	**NAME/AFFILIATION**
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Second	Erin Flannigan, University of Ottawa

DIVISION OF ATOMIC, MOLECULAR AND OPTICAL PHYSICS, CANADA	
PLACEMENT	**NAME/AFFILIATION**
First	Edith Yeung, University of Ottawa
Second	Emma Blanchette, University of Windsor

DIVISION OF CONDENSED MATTER AND MATERIAL PHYSICS	
PLACEMENT	**NAME/AFFILIATION**
First	Junjie Yin, University of Waterloo
Second	Crmen Lee, McMaster University
Third	Griffin Howson, University of Windsor
DIVISION OF PHYSICS IN MEDICINE AND BIOLOGY	
PLACEMENT	**NAME/AFFILIATION**
First	Madeleine Bonsma-Fisher, University of Toronto
Second	Hannah Krivic, McMaster University
Third	Samuel Perron, Western University

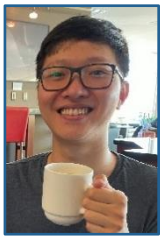
DIVISION OF NUCLEAR PHYSICS	
PLACEMENT	**NAME/AFFILIATION**
First	Frank Wu, Simon Fraser University
Second	Brynne Blaikie, University of Manitoba
Third	Coulter Walls, University of Manitoba

DIVISION OF THEORETICAL PHYSICS	
PLACEMENT	**NAME/AFFILIATION**
First	Karen Macias Cardenas, Queen's University
Second	Samantha Buck, University of Guelph
Third	Georgios Palkanoglou, University of Guelph

PARTICLE PHYSICS DIVISION	
PLACEMENT	**NAME/AFFILIATION**
First	Daniel Dumford, University of Alberta
Second	Alexandre Laurier, Carleton University
Third	Vincent Gousy-Leblanc, Université de Montréal

LIFETIME MEASUREMENT OF THE FIRST 2^+ AND 4^+ STATES IN ^{40}CA USING AN ALPHA-TRANSFER REACTION

SUMMARY: The first 2^+ (2_1^+) and 4^+ (4_1^+) states in the doubly magic ^{40}Ca were directly populated in a sub-barrier reaction to measure their lifetimes using the Doppler-Shift Attenuation Method (DSAM).



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Frank Wu received 2nd place in the 2022 CAP Best Overall Student Oral Presentation

Precise gamma-ray spectroscopy uses the well-understood electromagnetic interaction to explore the less-understood inter-nucleon strong interaction. In particular, lifetimes of nuclear states are determined by the matrix elements which can be calculated from electromagnetic transition operators and wavefunctions of the initial and final states. While the electromagnetic operators are well-understood, the nuclear wavefunctions, which nuclear structure theories attempt to construct, are less understood. Although some *ab-initio* theories have tried to model these wavefunctions with QCD, they still need to be experimentally validated. As a result, accurate and precise measurements of nuclear lifetimes are required to benchmark these theories. In the chart of nuclides, ^{40}Ca (N=Z=20) is among the few "doubly-magic" nuclides characterized by its full proton and neutron shells. Analogous to the closed electron shells in noble gasses, these closed nucleon shells give the system extra stability and make ^{40}Ca a popular testing ground for nuclear structure theories. The goal of this experiment was to reduce the 20% uncertainties in ^{40}Ca's 2_1^+ and 4_1^+ lifetimes in the literature.

EXPERIMENT

At TRIUMF, Canada's particle accelerator centre, nuclei can be accelerated by the super-conducting linear accelerator (SC-LINAC) in the ISAC-II facility to a few MeVs per nucleon [1]. Using the SC-LINAC, the low-lying 2_1^+ and 4_1^+ states in ^{40}Ca were directly populated by accelerating an ^{36}Ar beam onto a

gold-backed carbon target [2] of natural abundance. While the Coulomb barrier for the reaction is 17.9 MeV, the kinetic energy in the centre of mass frame was only 15.8 MeV. As a result, the reaction:

$$^{36}\mathrm{Ar} + {}^{12}\mathrm{C} \rightarrow 2\alpha + {}^{40}\mathrm{Ca}$$

was sub-barrier which allowed precise lifetime measurements in ^{40}Ca by suppressing the population of higher-lying excited states and limiting the decay to predominantly first order, which can be characterized by a simple exponential decay.

The TIGRESS Integrated Plunger (TIP) [3] and its 44-element PIN diode array were used to detect the alpha particles in coincidence with gamma rays for doppler-shift lifetime measurements using gamma-ray spectroscopy with the TIGRESS High-Purity Germanium (HPGe) array, shown in Figure 1.

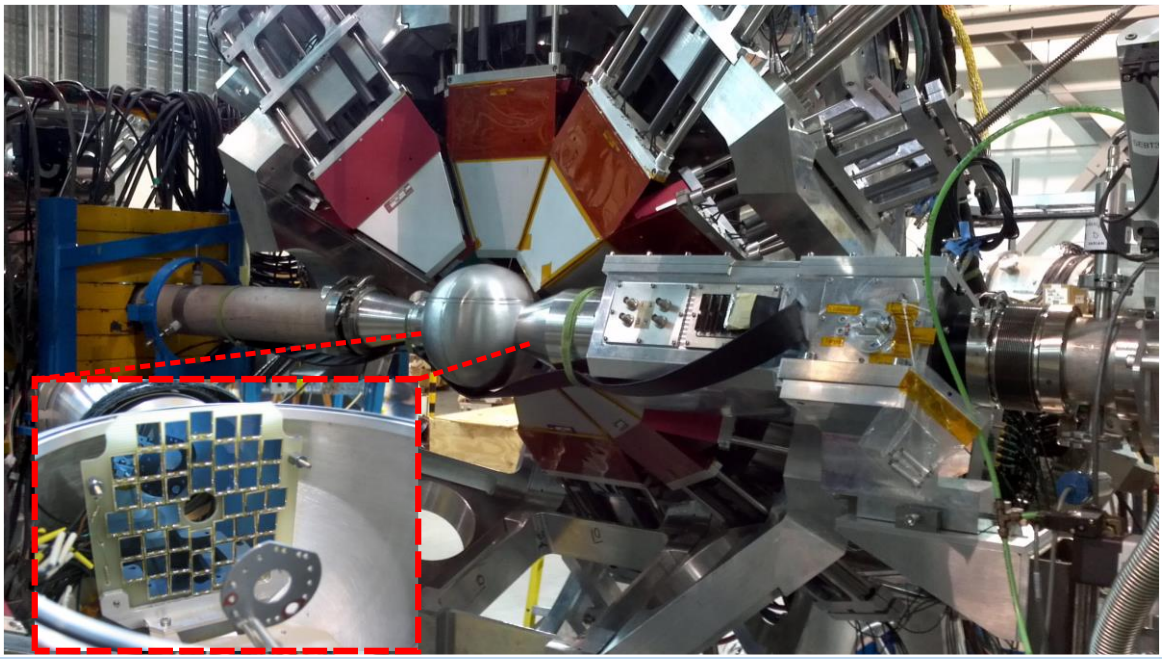


Figure 1. The TIGRESS HPGe array with the TIGRESS Integrated Plunger (TIP) chamber in the centre. The insert shows the inside of TIP, in its 44-element PIN diode array configuration.

ANALYSIS OF EXPERIMENTAL GAMMA-RAY SPECTRA

The ^{40}Ca reaction channel was isolated using the time-coincidence method and verified with the gamma-ray spectrum, shown in Figure 2. Alpha-gamma coincidence removed peaks from the Coulomb excitation of the gold backing, while additional alpha-alpha coincidence, chosen because the reaction which produced ^{40}Ca emitted two alphas, removed the peaks from competing reaction channels. The ratio of counts in the $2_1^+ \rightarrow 0_1^+$ and $4_1^+ \rightarrow 2_1^+$ peaks, shown in the bottom panel of Figure 2, was $6.9(\pm 0.7):1$. After accounting for the HPGe detectors having lower efficiencies for higher-energy gamma rays, this ratio became $21(\pm 2):1$. This ratio was further increased to $35(\pm 7):1$ by selecting

events with more energetic alpha particles, as more energy removed by the alpha particles meant less energy was available for the ^{40}Ca excitation. The lack of $4_1^+ \rightarrow 2_1^+$ feeding allowed for precise lifetime measurement of the 2_1^+ state. Similarly, no transitions were observed to feed into the 4_1^+ state.

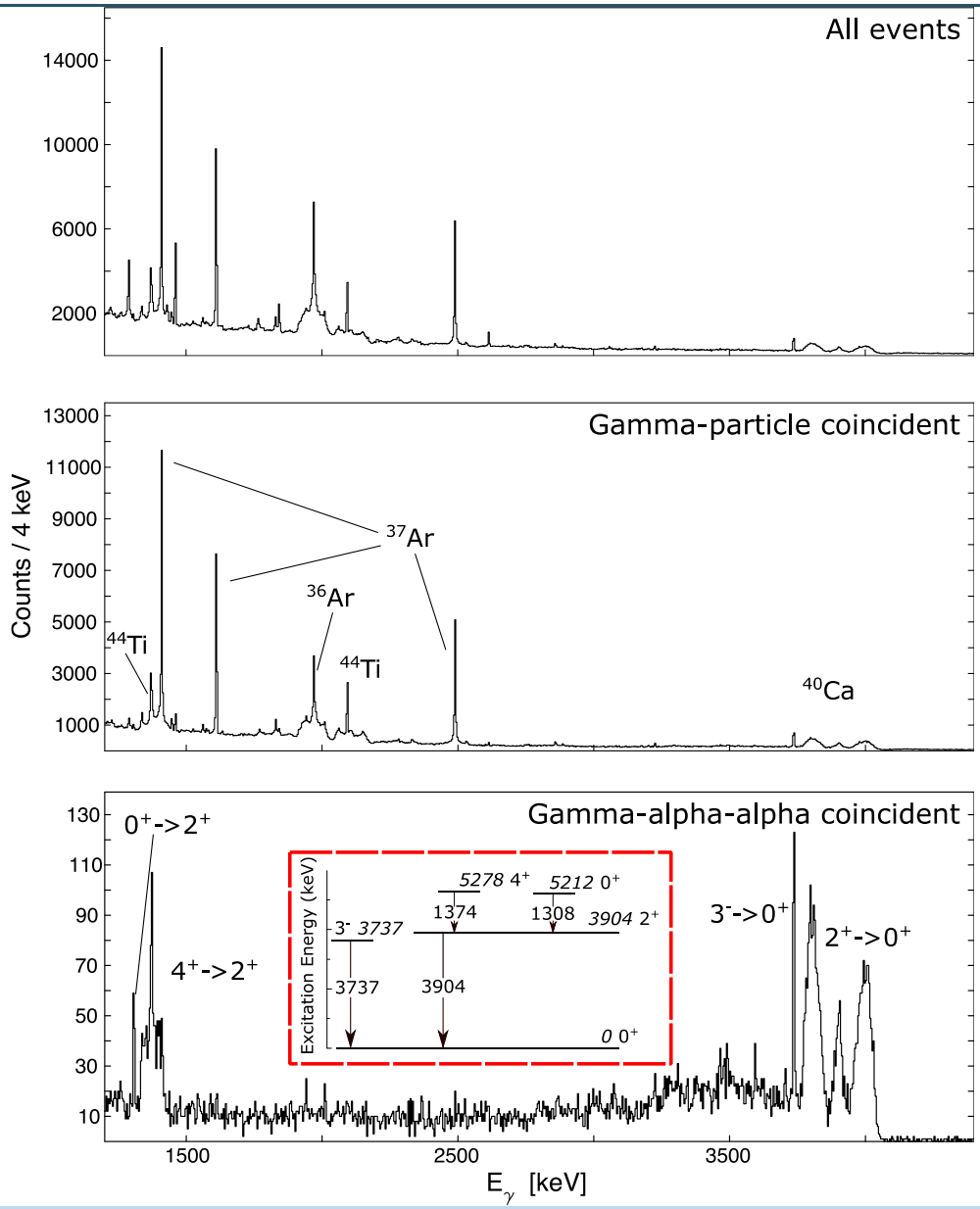


Figure 2. The Compton-suppressed gamma-ray spectra sorted before time coincidence (top), with gamma-particle (TIGRESS-PIN) coincidence (middle), and gamma-alpha-alpha (TIGRESS and 2 hits in separate PIN diodes) coincidence (bottom). Each bin is 4 keV wide. The insert in the bottom panel shows the relationship between the excited states in ^{40}Ca.

THE DOPPLER-SHIFT ATTENUATION METHOD (DSAM)

DSAM is a gamma-ray spectroscopy technique [3] to indirectly measure lifetimes on the order of femtoseconds to picoseconds by relating it to the stopping of the nucleus, illustrated in Figure 3. The DSAM target used for this experiment was made by depositing a gold layer onto a carbon film [2]. As the excited ^{40}Ca was formed in its 2_1^+ or 4_1^+ state within the carbon layer, it continued travelling in the beam direction and entered the gold backing. The longer the ^{40}Ca travelled in the gold, the slower it travelled, and eventually stopped. This means that the gamma rays emitted at different times experienced different amounts of Doppler shift, and the lifetimes of these excited states were encoded in the Doppler-shifted gamma ray spectrum. The lifetimes were extracted with Monte-Carlo simulations [4], described in the next section.

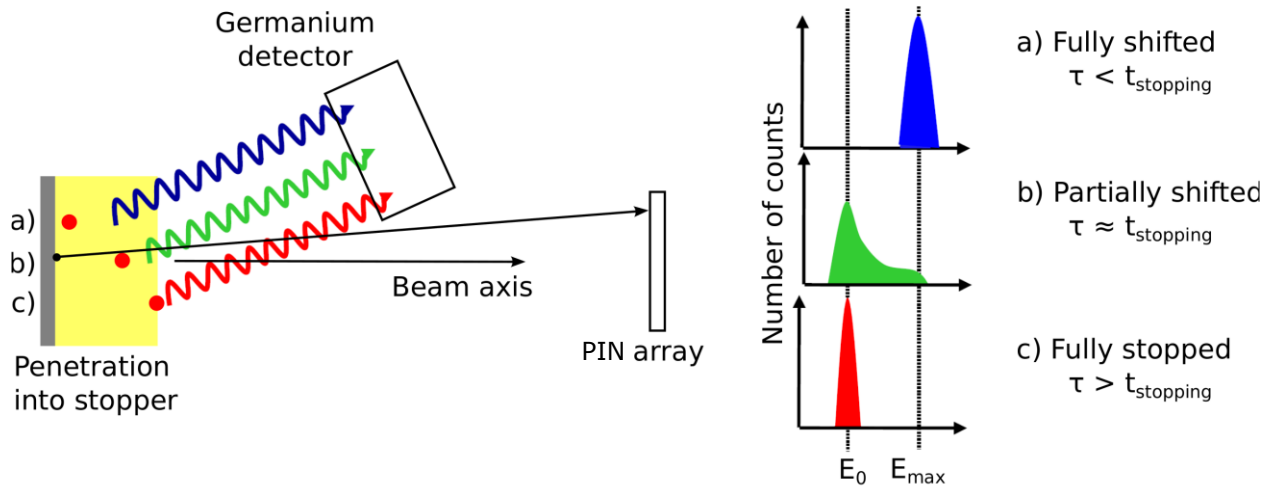
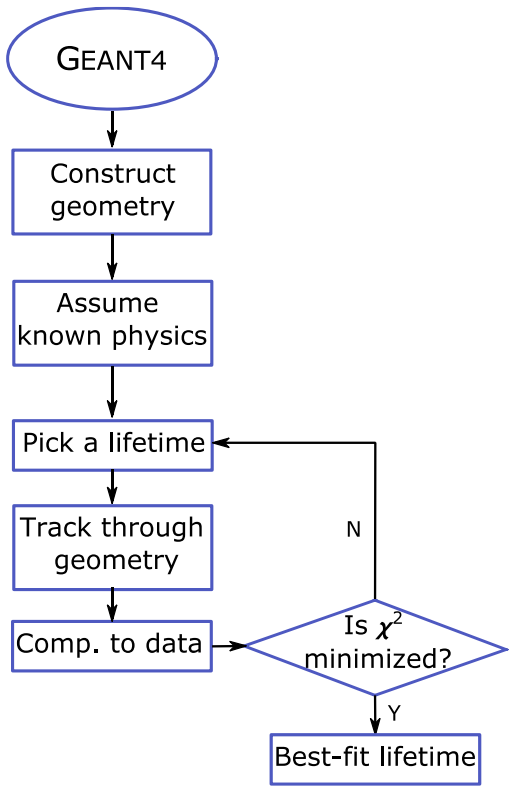


Figure 3. An illustration of the Doppler-Shift Attenuation Method (DSAM). As the ^{40}Ca (red circle) is produced in its excited state in the $^{nat.}$C target (grey), it continues to travel in the beam's direction and enters the gold backing (yellow) where it slows down and eventually stops. The longer the nucleus travels, the slower it gets. As a result, gamma rays that are emitted at different times experience different amounts of Doppler shift. This means that the lifetime information of the excited stated is encoded in the gamma-ray spectrum registered by the TIGRESS detectors, which can be extracted using Monte-Carlo simulations.

LIFETIME EXTRACTION USING GEANT4

Geant4 [5] is a Monte-Carlo framework which tracks the interaction of radiation with matter. It was used for lifetime determination by simulating gamma-ray spectra with various lifetimes, illustrated in Figure 4.



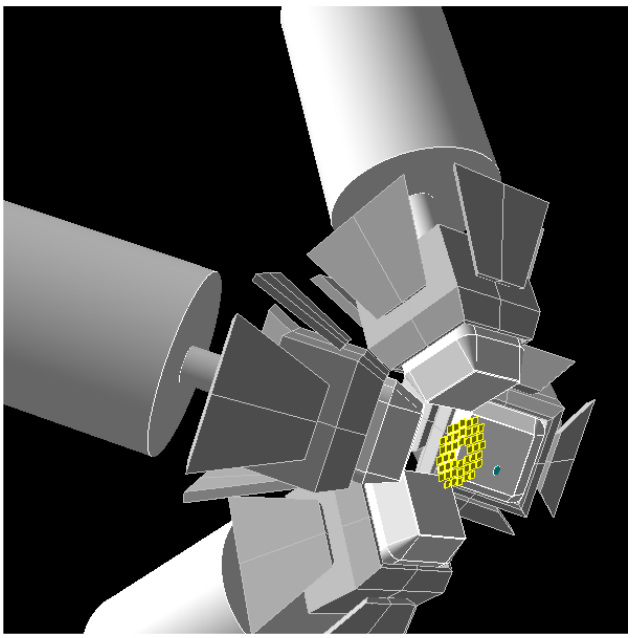


Figure 4. (Left) An illustration of the lifetime determination using Geant4. Geant4 takes user-defined reaction kinematics and lifetimes to track the simulated reaction products through the geometry and generates a set of simulated gamma-ray spectra for each lifetime. These simulated gamma-ray spectra can then be compared to the experimental spectra to find the best-fit lifetime.
(Right) Visualization of the experimental set-up in Geant4. Some TIGRESS detectors were removed to show the PIN Array.

The preliminary best-fit 2_1^+ lifetime was 42±5fs, and the 4_1^+ lifetime was 270±10 fs, as shown in Figure 5. Both uncertainties are statistical only. Systematic uncertainties are still under investigation.

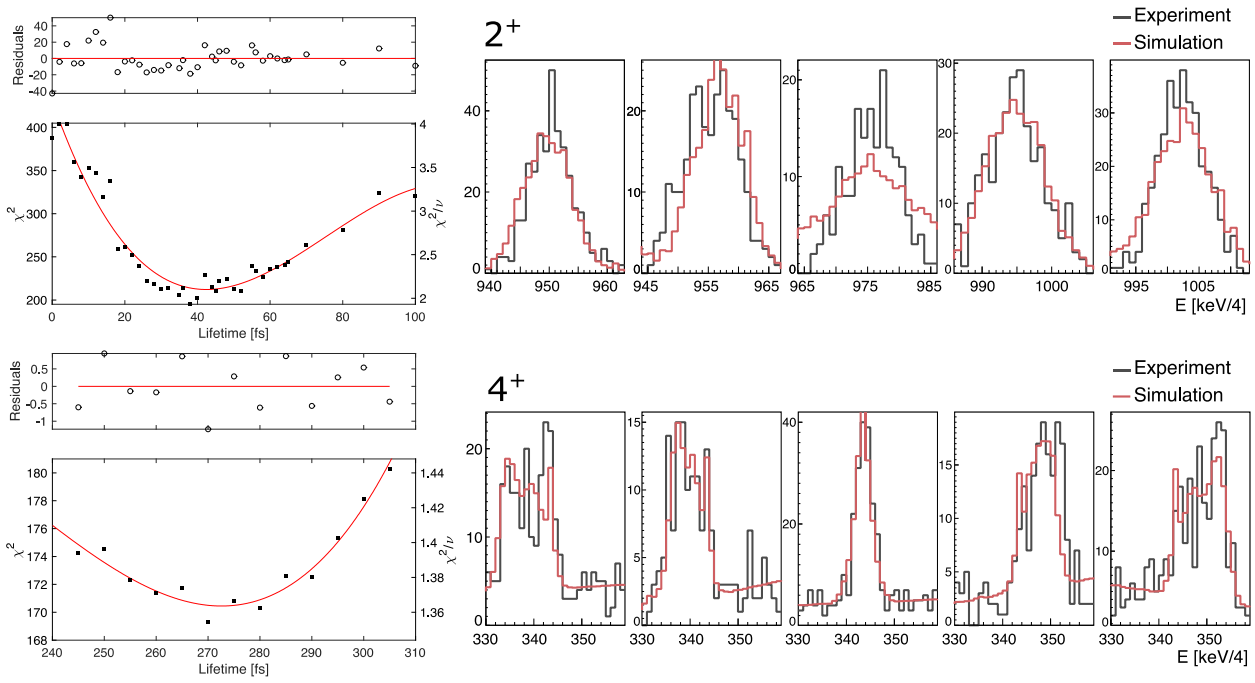


Figure 5. The determination of lifetimes for the 2^+ (top) and 4^+ (bottom) excited states in ^{40}Ca. The best-fit lifetime was defined to be the lifetime which generates the simulated gamma-ray spectra with the lowest chi-square when compared to the experimental spectra. The simulated spectra (red) with the best-fit lifetimes are shown with the experimental spectra (black). The spectra in horizontal panels correspond to Doppler groups at forward and backward angles with respect to the ^{40}Ca's direction, which was calculated from kinematic reconstruction.

Although the simulated gamma-ray spectra for the 4^+ peak agreed with the experiment, the simulated 2^+ peak was too wide in the centre panel where the gamma rays were emitted near $90°$ with respect to the momentum of ^{40}Ca. This indicates that the simulated initial angular distribution of ^{40}Ca, from the simplified reaction used to date, was inconsistent with that in the experiment. Current work is being done to constrain the reaction mechanism further using the charged-particle information.

SUMMARY AND OUTLOOK

The 2_1^+ state in ^{40}Ca was directly populated with a direct-population-to-feeding ratio of $35(\pm 7):1$, while the 4_1^+ was directly populated with no observed feeding. The lifetimes with statistical uncertainties for the 2_1^+ and 4_1^+ states were measured to be 42±5fs and 270±10fs, respectively, providing factors of 2 and 5 reduction from current literature values. The systematic uncertainties, which depend on the initial angular distribution of ^{40}Ca and the stopping powers used in the simulation, are currently under investigation.

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USING GPUS TO DESIGN A WATER CHERENKOV DETECTOR FOR A NEUTRINOLESS DOUBLE BETA DECAY SEARCH IN NEXO

SUMMARY: This article summarizes how nEXO uses GPUs to simulate and design a next-generation neutrinoless double beta decay experiment.

by SOUD AL KHARUSI[1,2] <soudk@standord.edu> (for the nEXO Collaboration)

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Soud Al Kharusi received 1st place in the 2022 CAP Best Overall Student Poster Presentation

WHAT IS nEXO?

nEXO is a proposed next-generation non-collider particle physics experiment. The experiment will search for a hypothesized nuclear decay mode in the isotope Xe-136 known as neutrinoless double beta decay ($0\nu\beta\beta$) [1]. In $0\nu\beta\beta$ decays, two electrons are ejected from the nucleus without the emission of corresponding electron antineutrinos. An observation of this decay mode, which is only possible in a handful of isotopes across the nuclear chart, will be evidence of physics beyond the standard model addressing several open and possibly connected questions: why is there more matter than antimatter in the Universe, and why are the neutrino masses so incredibly small relative to the other particles in the standard model?

An observation of this decay mode would prove that lepton number can be violated in nature. It would also show that neutrinos and antineutrinos are the same particle, i.e. a neutrino would be deemed a Majorana fermion (with spin ½), a property physicists have been investigating since the discovery of neutrino masses. A measurement of the $0\nu\beta\beta$ decay half-life would also inform on the absolute mass of neutrinos, a presently unknown quantity.

nEXO consists of three detector volumes: a liquid xenon time projection chamber (TPC) at its heart, enriched in the isotope Xe-136, a vacuum insulated cryostat filled with a hydrofluoroether cryogenic fluid, and a water-Cherenkov Outer Detector (OD) on the exterior (Fig. 1). The $0\nu\beta\beta$ signals are searched for in the TPC, which is kept at 165K and shielded from environmental radiation by the cryogenic fluid surrounding it, while the OD keeps track of the nearby ambient radiation that may otherwise create $0\nu\beta\beta$-like signals in the TPC.

Energy released in the TPC by ionizing radiation, i.e. particles that lose their energy by ionizing xenon atoms (these include x-ray and gamma-ray photons, alphas, betas, and muons), produces two measurable signals: localized "clouds" of ionization charge and a flash of 175 nm scintillation light. Ionization is drifted under an applied electric field to an instrumented anode where its distribution and total charge are recorded. Scintillation light pulses are detected with a large array of silicon photomultipliers (SiPMs). Together, charge and light readings provide a measurement of total energy, and a 3D reconstruction of the location and topology of the individual energy depositions. This information is used to distinguish the type of particle that interacted in the TPC [2].

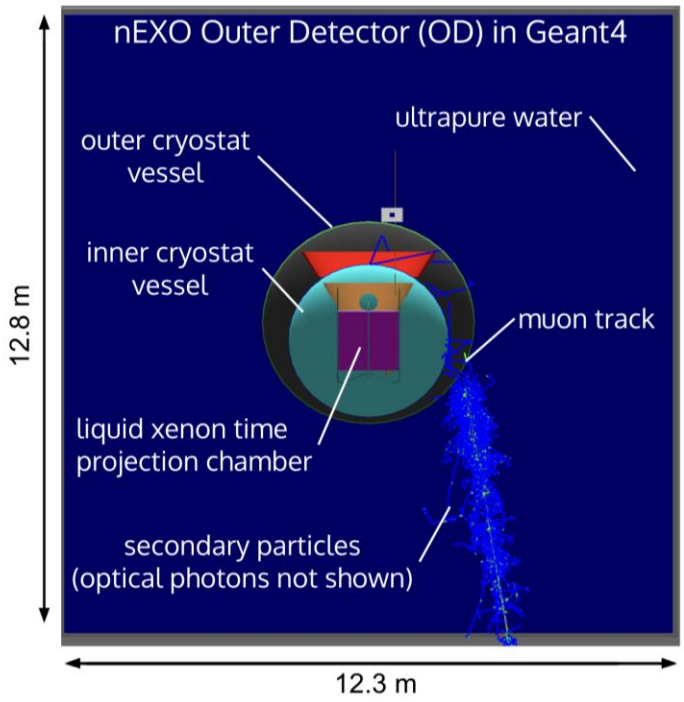

Figure 1. Geant4 rendering of the nEXO experiment. A cosmogenic muon track is displayed going through the Outer Detector and producing secondary particles of concern.

THE OUTER DETECTOR

In the Outer Detector, we use ultrapure water to serve as a passive shield from ambient gamma and neutron radiation from the surrounding rock and concrete. The Outer Detector also plays an active role as a water-Cherenkov detector [3]. The Cherenkov effect occurs whenever high energy charged particles pass through a dielectric medium (such as water) at velocities greater than the local speed of light, i.e. materials with a real index of refraction greater than 1 that are transparent to the ultraviolet-to-optical wavelength range. In the case of nEXO, which aims to be situated 2 km beneath the surface at SNOLAB, the only high energy particles making it so deep underground are cosmogenically produced

muons from the Earth's upper atmosphere. These cosmogenic muons have energies extending into the TeV range, well above the Cherenkov threshold of a muon passing through water (160 MeV), and so their passage through the Outer Detector emits a burst of light in a forward-facing cone with a broad wavelength spectrum that peaks in the ultraviolet and extends into the visible. nEXO uses photomultiplier tubes (PMTs) which are installed all over the interior of the OD walls to detect this light, and veto any subsequent backgrounds produced in the TPC that could mimic the $0\nu\beta\beta$ signal.

DESIGNING A NEXT-GENERATION PARTICLE PHYSICS EXPERIMENT

All modern particle physics experiments begin with a detector concept in the minds of scientists. This concept then needs to be validated and fleshed-out by testing it in Monte Carlo simulations. By measuring the proposed detector's response to expected signals and backgrounds, we can make more confident statements on which particular designs perform best after examining an ensemble of many Monte Carlo particle interactions in each said design.

nEXO is no outlier to this design framework. Although nEXO is based on the successes of the EXO-200 experiment [4], many changes were introduced due to the better technology available to us today, compared to two decades ago. In particular, we highlight two of these changes here: the use of SiPMs, the photodetectors inside the TPC [5], and the move to a water-Cherenkov veto system (the OD) due to tighter background constraints. Both photon-detection systems must be studied by propagating and ray-tracing the photons resulting from either the scintillation of the xenon (in the TPC), or the Cherenkov photons resulting from high energy charged particles traversing the water in the OD.

Ray tracing is notoriously a computationally expensive task. Conventional techniques for particle physics experiments employ an industry standard Monte Carlo software called Geant4 [6]. Although extremely powerful and well validated, Geant4 is a CPU-based program that, until recently, did not support multi-threaded photon propagation [7, 8]. It is also notoriously difficult to manipulate and build complex geometries within Geant4, and so the iterative process of trying out new detector geometries is a time consuming task. nEXO gets around this by building the detector using standard CAD files, and opting to use Chroma [9, 10], an open source ray tracing software, for photon propagation studies.

CHROMA: A GPU-BASED RAY-TRACING SOFTWARE

Chroma is a program optimized to run on Graphical Processing Units (GPUs), devices that have recently become infamous due to their unstable prices and usage in cryptocurrency mining. Originally developed to perform graphical calculations for visual renderings, including those for video games, GPUs are now a staple element in any modern computational toolset. GPUs are purpose-built to handle many parallelizable computations on shared memory. I.e. tasks which require performing similar calculations on independent subsets of a large dataset. This ability makes GPUs particularly good at training neural networks, mining cryptocurrencies and, of course, ray tracing many photons in parallel.

nEXO uses Chroma for optical simulations in both of the experiment's major detector components. In the TPC we use Chroma to map-out the photon detection efficiency of the SiPM array for energy

deposits anywhere in the liquid xenon [1]. This allows for a better estimate of the scintillation energy that will be measured for a given energy deposit, while bypassing the need to slowly track all photons that are produced in the Geant4 simulation as was done in [3]. The second place that nEXO employs Chroma is to simulate cosmogenic muons' Cherenkov emission in the OD; muons with a mean energy of 350 GeV produce hundreds of thousands of photons as they traverse the OD, which is a lot of particles to track and parse through sequentially for a single event. Chroma is being used here to optimize the muon detection efficiency of the OD by deciding on the placement of the PMTs on Outer Detector surfaces, and examining the effect of different optical properties on the surfaces of OD components (e.g. whether to use a reflective liners or bare stainless steel components).

nEXO collaborators encoded the expected underground muons' angular, and energy spectra in Python scripts which then call Chroma to set the photon starting positions, wavelengths, and angles relative to the muon track before passing all the photons to the GPU for propagation. In this way, many photons are propagated simultaneously for each step of the muon's track all the way to their detection on the photocathode of a PMT. This allows for rapid studies evaluating various PMT configurations, reflectivity variation of components, and a speedup of ~100x compared to equivalent Geant4 simulations. An example Cherenkov cone propagated in Chroma is displayed in Fig. 2.

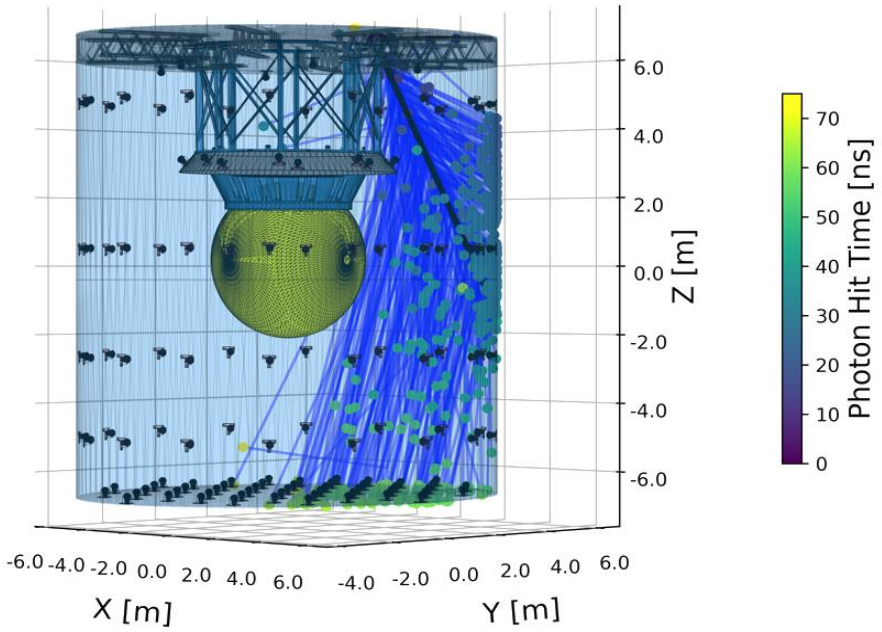

Figure 2. The nEXO Outer Detector simulated in Chroma with an example array of 127 photo-multiplier tubes. A nominal muon track entering from above and exiting the right hand side of the tank emits Cherenkov photons in a characteristic cone shape.

Although this GPU-accelerated analysis of muon tracks is still missing a lot of the microphysics (muons of such high energy produce secondary particles that can cause even more Cherenkov light) one can imagine a future where the amplification of the total light yield from secondary particles is parameterized so well that the default go-to programs used to simulate any high-energy Cherenkov detector would make use of the wonderful technology that is the GPU.

ACKNOWLEDGEMENTS

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USING ULTRASOUND IMAGING FOR QUANTIFYING KIDNEY FIBROSIS

SUMMARY: A signal analysis technique using raw ultrasound radiofrequency (RF) data is proposed as a non-invasive method for the detection of kidney fibrosis for kidney transplants.

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Helen Melino received 3rd place in the 2022 CAP Best Overall Student Poster Presentation

Chronic Kidney Disease (CKD) affects ~10% of the world population and currently has no cure [1]. Kidney transplantation remains the only option for treatment, however, the donor pool is very small compared to the number of patients on the waiting list [2]. This small donor pool consequentially leads to patients receiving older, less healthy kidneys with pre-existing fibrosis. Fibrosis is characterized by the accumulation of extracellular matrix proteins, which impairs kidney function [3]. Biopsies are considered the gold standard of assessment but have limitations as they are invasive and are not representative of the total fibrotic burden on the kidney.

In this project, we are working towards exploring whether ultrasound (US) imaging can detect and quantify kidney fibrosis. US imaging is a non-invasive alternative to a renal biopsy, can assess the full kidney, and it is also widely accessible. Using signal analysis techniques on B-mode US images of murine kidneys, this work aims to find differences in US imaging for varying degrees of kidney fibrosis verified by histological results.

METHODS

EXPERIMENT

Fibrosis was induced in the left kidneys of 15 mice by obstructing the left ureters via Unilateral Ureteral Obstruction (UUO) surgery. The right kidneys were left unobstructed as controls. On days 0, 7, and 14, five mice were sacrificed, and their kidneys were imaged *ex vivo* using B-mode US in a saline bath at 4°C to mimic the conditions of a transplanted kidney. After imaging, histology slices were taken from the top, middle and bottom regions of the kidneys for histological analysis.

SIGNAL ANALYSIS

The signal analysis technique employed compares the signal amplitude (SA) values for each pixel in the kidney ROI for a series of B-mode images. The comparisons were made by taking the absolute differences in individual pixel SAs for each imaging frame relative to the first acquired frame. These changes are shown in Fig. 1 using coloured parametric maps of B-mode images to localize the areas of significant changes, and histograms to show the distribution of pixels experiencing a change in SA. All figures were generated using MATLAB.

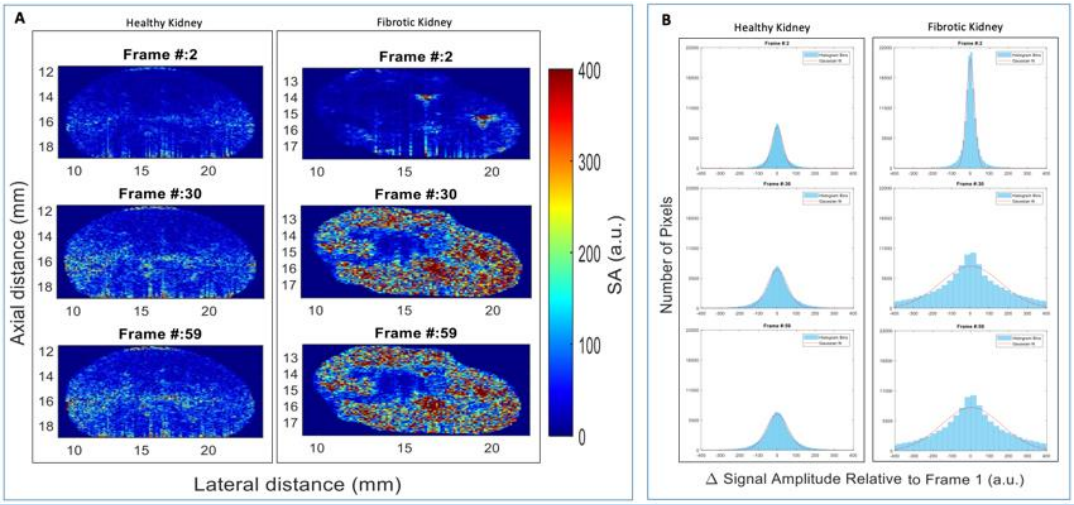

Figure 1. Changes in SA during a single 59-frame acquisition are shown for healthy and fibrotic kidneys as coloured parametric maps (A) and histogram distributions (B). 59 frames of B-mode images were taken using a frame rate of 5 frames per second, therefore frames 2, 30 and 59 correspond to imaging time-points of 0.4 s, 6.0 s, and 11.8 s, respectively.

In addition, a Gaussian fit was applied to each histogram, and the full width at half maximum (FWHM) for each Gaussian fit was plotted as a function of imaging time, where every 0.2 seconds corresponds to the next US frame (Fig. 2).

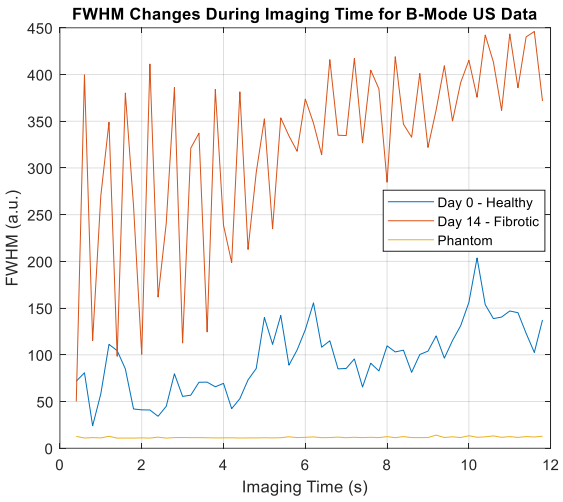

Figure 2. FWHM as a function of imaging time for histograms of healthy and fibrotic kidneys and a phantom.

DISCUSSION

From Fig. 1A, it is noted that SA values from *ex vivo* murine kidneys change over time in various locations, with the greatest changes corresponding to red pixels. Healthy kidneys show small changes in SA at an axial distance of ~16 mm and near the edges of the kidney, whereas fibrotic kidneys exhibit large changes in SA throughout the kidney. These observations can also be explained using Fig. 1B, where healthy kidneys give similar distributions throughout imaging time, while fibrotic kidneys have narrow histogram distributions at the beginning of imaging, which become broader as imaging time progresses.

When comparing the FWHM for the kidneys and the phantom in Fig. 2, the FWHM increases over imaging time for both kidney conditions but has very minimal changes over imaging time for the phantom. Fibrotic kidneys show the largest increase in FWHM over time.

CONCLUSIONS

These temporal changes in pixel signal amplitudes during US image acquisition suggest that this method, with further development, could be the new standard for the non-invasive quantification of kidney fibrosis. Larger changes in FWHM for kidneys compared to phantoms may indicate biologically induced motion in the kidneys during imaging. Furthermore, the larger increase in FWHM over time for fibrotic kidneys compared to healthy kidneys suggests that the FWHM to a fit of the distribution of SA changes could possibly be used as an indicator of kidney fibrosis.

ACKNOWLEDGEMENTS

The authors acknowledge the funding support of the Collaborative Health Research Project grant co-funded by NSERC and CIHR.

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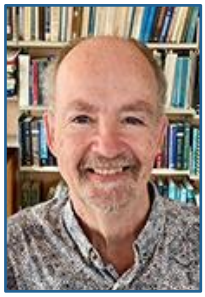
2. K. De Vusser, *et al.,* "The Predictive Value of Kidney Allograft Baseline Biopsies for Long-Term Graft Survival," JASN **24**, 1913-1923 (2013).
3. J. Duffield, "Cellular and molecular mechanisms in kidney fibrosis," J Clin Invest **124**, 2299-2306 (2014).

2022 CAP Medal Recipients / Lauréats des médailles de l'ACP de 2022

The CAP is very pleased to recognize its 2022 medal recipients. Please visit the CAP website for the list of medal recipients with a link to the detailed citations and any remarks submitted by the recipient following the receipt of the award.

L'ACP est très heureuse de reconnaître ses récipiendaires de médailles 2022. Veuillez consulter le site web de l'ACP pour obtenir la liste des récipiendaires de médailles, ainsi qu'un lien vers les citations détaillées et les remarques à la suite de la réception de la récompense.

CAP Medal for Lifetime Achievement in Physics / Médaille de l'ACP pour contributions exceptionnelles à la physique



CHARLES GALE, McGill University

Awarded in recognition of his profound contributions as a world leader in high-energy nuclear science, and in the physics of strongly interacting matter under extreme conditions of high temperature and density.

CAP Herzberg Medal / Médaille Herzberg de l'ACP

DARYL HAGGARD, McGill University

Awarded in recognition of her leadership role in the development of multimessenger astronomy, and the ground-breaking discovery of the electromagnetic signal accompanying gravitational waves from colliding neutron stars.

CAP-INO Medal for Outstanding Achievement in Applied Photonics / La Médaille de l'ACP-INO pour contributions exceptionnelles en photonique appliquée

HOI-KWONG LO, University of Toronto

Awarded in recognition of his outstanding impact on the field of Quantum communication in terms of practical implementations, laying the groundwork for commercial products for the Quantum internet. Dr Lo is a researcher of truly international caliber, with large impact at the forefront of quantum cryptography and quantum key distribution (QKD) physics.

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

DAVID LONDON, Université de Montréal

Awarded in recognition of his outstanding contributions to the theory of elementary particles, including trailblazing contributions to the analysis of B meson decays and CP violation in the Standard Model of particle physics.

CAP-TRIUMF Vogt Medal for Contributions to Subatomic Physics / Médaille Vogt de l'ACP-TRIUMF pour contributions en physique subatomique

ASIMINA ARVANITAKI, Perimeter Institute for Theoretical Physics

Awarded in recognition of her innovative contributions to a number of areas of fundamental physics and in particular for identifying experiments that could test the underlying physics.

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

JAMES CHARBONNEAU, University of British Columbia

Awarded in recognition of his teaching excellence and educational leadership at the University of British Columbia, including contributions to the Scholarship of Teaching and Learning and development of open-source educational software.

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

FEDERICO ROSEI, INRS-EMT

Awarded in recognition of his experimental work on tailoring the properties of a wide array of nanomaterials to find applications in photovoltaics, biocompatibility and self-assembling systems.

2022 CAP Fellows / Les Fellows de l'ACP de 2022

The CAP Fellowship Program recognizes CAP members who have made important contributions in physics research, in physics teaching, in the advancement of technology, or in service to physics in Canada. The CAP is very pleased to announce its inaugural class of CAP Fellows (FCAP) consisting of Canadian Physics Nobel Laureates, Art MacDonald and Donna Strickland, who are receiving this honour for their outstanding contributions to physics research and education, to leadership within the Canadian physics community and for inspiring the next generation of physics graduates.

Le programme de bourses Fellowship de l'ACP reconnaît les membres de l'ACP qui ont apporté une contribution importante à la recherche en physique, à l'enseignement de la physique, à l'avancement de la technologie ou au service de la physique au Canada. La CAP est très heureuse d'annoncer sa première classe de Fellows de la CAP (FCAP), composée des lauréats canadiens du prix Nobel de physique, Art MacDonald et Donna Strickland, qui reçoivent cet honneur pour leur contribution exceptionnelle à la recherche et à l'enseignement de la physique, pour leur leadership au sein de la communauté canadienne des physiciens et pour avoir inspiré la prochaine génération de diplômés en physique.

Dr. Arthur B. McDonald, FCAP

Arthur MacDonald is the Gray Chair Emeritus at Queen's University and is a co-recipient of the 2015 Nobel Prize in Physics, with Takaaki Kajita, "for the discovery of neutrino oscillations, which shows that neutrinos have mass".

Photo: Dr. MacDonald receiving his Fellows certificate from CAP President Manu Paranjape at the 2022 Congress held at McMaster University.

Dr. Donna Strickland, FCAP

Donna Strickland is a Professor in the Department of Physics and Astronomy at the University of Waterloo and is a co-recipient of the 2018 Nobel Prize in Physics, with Gérard Mourou, "for developing chirped pulse amplification".

Photo: Dr. Strickland receiving her Fellows certificate from CAP President Manu Paranjape at the 2022 Congress held at McMaster University.

2022 HIGH SCHOOL-CÉGEP PHYSICS TEACHING AWARDS / PRIX DE L'ACP EN ENSEIGNEMENT DE LA PHYSIQUE AU SECONDAIRE ET AU COLLÉGIAL 2022

British Columbia and Yukon / Colombie-Britannique et Yukon

EDWARD CSUKA, Coquitlam School District

Awarded in recognition of his passionate teaching of physics, in addition to his leadership of the Power of Ideas Exhibit and his dedication in seeking funding to launch and support a new STEAM program. Edward also provides extra-curricular opportunities for learners to develop their ideas and passions in the sciences through a robotics club, science fairs, and an innovation society, where students develop their ideas into designs and 3D-printed objects.

Edward Csuka has always had a great passion for science and in particular, physics. Deeply inspired as a teenager by Stephen Hawking's, "A Brief History of Time", Edward enjoys asking the big questions and revels in the pursuit of the elegant solutions that the Universe reluctantly reveals. His passion is contagious and ignites curiosity in students' brilliant minds seeking answers. Edward is recognized for his unique style of empowering others. Rather than giving students labs with predetermined procedures, he presents open-ended real world physics challenges. Students design their own experiments and report their results. Edward is invigorated when students find new and exciting ways to tackle difficult challenges.

Edward runs the Terry Fox Robotics Club and the Terry Fox Innovation Society for inventive, innovative, and entrepreneurial students. In 2014, he was one of only 40 physics teachers globally to be invited to the Einstein Plus Workshop at the Perimeter Institute for Theoretical Physics (PI). In collaboration with PI, Edward hosted the Power of Ideas Tour in 2017 as part of the Canada 150 Project. In addition to the Tour, Edward orchestrated 20 extra side attractions involving 75 professional presenters from top science institutions in the Greater Vancouver area. Many of Edward's students were highly involved and given prominent leadership roles. The Tour was well publicized in the media and over 1000 visitors came in from the community. The Tour also sparked the Fox Science Fair, which grew to involve hundreds of students. Following the Power of Ideas, Edward was awarded a Certificate of Recognition plaque from the SD43 School Board, and he continued to organize Power of Ideas events in 2018 and 2019. Edward is honoured and grateful to have enormous support from numerous exceptional leaders, colleagues and students who continue to motivate, lift, and inspire him.

Prairies and Northwest Territories / Prairies et Territoires du Nord-Ouest

CHRISTOPHER SARKONAK, Brandon School Division

Awarded in recognition of his passion and dedication in teaching physics, particularly his ungrading policies, inclusive classroom, and commitment to sharing strategies to assist other physics teachers. Christopher's student-centered, equity-based approaches in the classroom have led naturally into his support and celebration of women through an annual STEM for Girls event. Notably, he has also twice received the Ceremonial Star Blanket, awarded annually within his school to a teacher who has supported Indigenous learners' successes as selected by a committee of graduating Indigenous students.

In 4 years of teaching Physics at Crocus Plains Regional Secondary School, Christopher has worked to create an exciting and engaging program that has seen the enrollment double during that time. Part of this accomplishment also comes through collaboration with the Electronics, Design Drafting, Welding, Music, and Photography departments to show the importance that physics has in a variety of fields.

It is through a number of professional development opportunities across the world, courtesy of CERN (becoming the first Canadian high school teacher selected by CERN through direct entry for their International High School Teacher Programme in 2019), the Perimeter Institute (of he is now the Regional Coordinator for Manitoba), the IQC, the CLS, the AAPT, and PASCO, that Christopher has brought unique experiences back to the classroom to engage and invigorate students. He has worked to start initiatives in the school to give students access to the CLS Students on the Beamline program, the Moon Camp Challenge from ESA, working with K-8 schools to promote STEM in the community, and encouraging participation in the local science fair. Last year saw Christopher mentor a group of students in advocating for the first hadron therapy facility in Canada for curing cancer. One of the most impactful initiatives that Christopher has spearheaded at Crocus Plains has been the development of a STEM for Girls program to get more female students interested in STEM fields. This has seen female enrollment in STEM increase significantly since its introduction four years ago. Christopher has worked to create an inspiring classroom where students are encouraged to take risks and explore the things that make them come alive.

Ontario / Ontario

ADAM MILLS, Assumption College Catholic High School

Awarded in recognition of his dedication to the development of physics pedagogy and a classroom practice guided by physics education research. Adam's passion for active learning and student collaboration have had a positive impact on student learning and his students' interest and achievement in physics. He is also a mentor to other physics teachers through his work with the OAPT and as an Associate Teacher with the University of Windsor, mentoring trainee teachers.

Adam Mills (BSc Honours Physics and High Technology, 2005) has served as an incredibly respected, admired, dedicated, and innovative science, math, and physics teacher for the Windsor Essex Catholic District School Board since 2012. Adam currently teaches (among many other subjects) International Baccalaureate Physics at Assumption College Catholic High School in Windsor, Ontario. His passion for

teaching has previously earned him recognition as a recipient of a University of Chicago Outstanding Educator Award in 2016. He has devoted tireless service to his profession, serving as both vice-president and president of the Ontario Association of Physics Teachers, an organization with over 400 members. Adam has facilitated numerous teaching workshops for this association and for local teachers, presenting to colleagues and peers his experiences with the implementation of innovative teaching pedagogies like the use of inquiry-based classrooms, the design of novel assessment and evaluation methods, and the use of cognitive therapy and neuroscience to develop a more "scientific model for learning." Along with this service to his profession, Adam has remained dedicated to his students, advising a Canadian Young Physics Tournament team, coaching senior boys soccer, and advising his school's Math Club and Science Olympiad Team. Adam has inspired and motivated numerous young students to pursue careers in STEM fields and through his work with the University of Windsor Faculty of Education he strives to help prepare the next generation of teachers by improving the experiences and education of Teacher Candidates and by providing subject-specific feedback to the university students training for International Baccalaureate qualifications.

Quebec and Nunavut / Québec et Nunavut

HÉLÈNE NADEAU, Dawson College

Awarded in recognition of her dedication to teaching physics and the development of students' experimental and research skills. Hélène has developed unique cégep courses combining neuroscience and the physics of brain imaging techniques. In addition to supervising and encouraging students in a variety of research projects, she also supports them in extra-curricular competitions, such as "Science, on tourne!", PontPop, and Concours Génie Civilisé. Teaching interdisciplinary content with a collaborative, problem-solving approach, Hélène sets students up for success in pursuing careers in the sciences.

Dr. Hélène Nadeau has taught a wide variety of physics courses for over 25 years. Her courses are all designed to be interactive and student-centred, with many group activities and problem-solving sessions, so that the students participate actively in their own learning. She has also extensively mentored students in designing and building objects to perform specific tasks, so that they could experience physics in the real world.

Over the years, Dr. Nadeau identified a significant weakness in the science program. CEGEP students dream of becoming tomorrow's innovators but have very little opportunity to get acquainted with how science is really done. There is a crying need for a strategy for introducing a large number of students to the ins and outs of authentic research projects. As today's students are attracted by multidisciplinary research, Dr. Nadeau has designed a combination of programs in which students work on projects combining several disciplines under the umbrella of neuroscience:

1. In the summer internship program in research in neuroscience, students work on projects with partners in various labs in the Montreal area. This began in 2015 and has been pursued every summer since, growing enormously in popularity.
2. In the Fall of 2017, an extra-curricular activity was started, in which a large group of Dawson students is led through a year-long research project. This too has become an annual event.

3. In 2019 a new science option course was created, entitled Topics in Physics: Introduction to Brain Imaging. And in 2021 a complementary course, open to students of any program, was given: Contemporary issues: Introduction to research in Neuroscience.

Atlantic / Atlantique

APRIL BUTLER, West Kings District High School

Awarded in recognition of her passion and dedication in teaching physics, evidenced through her students-first approach and wide-ranging involvement in school life and professional development. April's enthusiasm for physics permeates her classroom practice. Beyond the classroom, she has supported students' engagement in events such as the brain wars, theme park physics, Lego robotics, science fairs, and physics olympics. Additionally, she shares her professional expertise by mentoring trainee teachers and has been involved in the development of provincial curricula and examinations.

Described as a "master teacher" by her colleagues, April Butler is a physics teacher who has devoted herself to inspiring young people to learn valuable life lessons through their study of physics. In addition to the countless students she has inspired in her classes, she has mentored many student teachers over the span of her 28-year career at West Kings District High School in Nova Scotia. A self-described life-long learner she has participated in and lead numerous professional development opportunities for herself, her students and her colleagues. Her impact extends far beyond the walls of her classroom as she played a key role in the development and implementation of the Nova Scotia high school physics curriculum. A common theme among the comments of those who have studied with, been mentored by, and worked with April is the lifelong impact she has had on them all. April is a highly trained, energetic, passionate and creative educator who is highly sought after, and the students, staff and community of West Kings District High counts themselves as extremely fortunate to have her amongst them.

2022 CAP-CAPF SCHOLARSHIP RECIPIENTS / BÉNÉFICIAIRES DES BOURSES D'ÉTUDES DE L'ACP-FACP 2022

The CAP is pleased to announce the recipients of the 2022 CAP-CAPF student scholarships, made possible through the generous donations to the CAP Foundation. Please visit the CAP website for the list of scholarship recipients with a link to the detailed citations and any remarks submitted by the recipient following the receipt of the award.

L'ACP est heureuse d'annoncer les récipiendaires des bourses étudiantes de l'ACP-FACP pour 2022, rendues possibles grâce aux généreux dons à la Fondation de l'ACP. Veuillez consulter le site web d'ACP pour obtenir la liste des récipiendaires des bourses d'études, ainsi qu'un lien vers les citations détaillées et les remarques à la suite de la réception de la récompense.

The 2022 Boris P. Stoicheff Memorial Graduate Scholarship

KATE FENWICK, University of Ottawa/NRC

Awarded in recognition of high academic standing, success in research publications, and leadership and commitment to STEM gender diversity.

The 2022 Allan Carswell Physics Educator Scholarship

ÉLOÏSE FAEHNDRICH, University of British Columbia

Awarded in recognition of her excellent academic record as well as her proven passion for and skill at physics and physics pedagogy. She has done outstanding work over the years with young people, providing her with invaluable experience that will serve her well in her future career in education. Éloïse cites the love of mystery as one of the things that drew her to physics. As a teacher, she hopes to "engage students in that aspect of learning where mystery meets wonder".

The 2022 Allan Carswell Physics Educator Scholarship

ELI SOLLID, University of Calgary

Awarded in recognition of his excellent academic record and strong physics knowledge as well as his great communication and pedagogical skills. These were evidenced in part by his completion of an original physics education research project that used interdisciplinary applications to create and implement a physics course designed to improve student attitudes towards physics. Eli believes that with the proper support students' way of thinking about physics can undergo a significant transformation. The desire to provide this support is what "...continually impassions [him] to teach".

MEET YOUR 2022-23 EXECUTIVE

PRESIDENT / PRÉSIDENTE

Barbara Frisken is a Professor of Physics at Simon Fraser University. She completed her Ph.D. in physics at the University of British Columbia in 1989 and was a postdoctoral fellow at the University of California, Santa Barbara, before joining the faculty at SFU in 1992. Her research interests include structural studies of soft matter systems aimed at understanding relationships between microstructure and bulk properties; current projects focus on anion-conducting polymer membranes for fuel cells. She served as Chair of her department from 2006-2011, during which time she led a team of 30 faculty members and also chaired search committees for staff and faculty and the department's salary and tenure review committee. She currently serves as Chair of her department's Undergraduate Curriculum Committee. She has chaired two university-wide committees: The University Curriculum Implementation Task Force (2004-2006) and the Teaching Assessment Working Group (2017-2019). Barbara's involvement in the CAP includes a term as Chair of the Division of Condensed Matter and Materials Physics (1997-1998), Chair of the Publications Committee (1999-2001), Chair of the Committee to Encourage Women in Physics (2002-2005), Director of Academic Affairs (2012-2015), and Co-Chair of the 2019 CAP Congress Local Organizing Committee.

VICE-PRESIDENT / VICE-PRÉSIDENT

William (Bill) Whelan is a Professor of Physics at the University of Prince Edward Island. He completed a PhD in Medical Physics at McMaster University in 1996 and joined the faculty at the Toronto Metropolitan University that same year. After 12 years on faculty at TMU, he joined the University of Prince Edward Island in 2008 as a Tier 2 Canada Research Chair in Biomedical Optics. His research is focused on the design and development of biomedical sensors, based on Raman, optoacoustic, and near-infrared spectroscopy. He was Chair of the Department of Physics (2015-2021) and Chair of the Faculty of Science Research Committee. Bill has served on grant review panels for NSERC (Physics EG1505), the Canadian Cancer Society Research Institute (Innovation/I2I Programs) and CIHR (Medical Physics and Imaging). Bill's participation in the CAP includes serving as Chair of the Division of Medical and Biological Physics (2001-03), Director of Communications (2006-09) and Chair of the CAP- NSERC Physics Liaison Committee (2014-17). He was also a member of the National Board of Directors of the Canadian Cancer Society (2010-12). Bill is actively involved in science outreach, including chairing the PEI Science Fair for 10 years and co-chairing the Canada-Wide Science Fair in 2012.

Vice-President Elect / Vice-président élu

Martin Williams is a tenured faculty member in the department of physics at the University of Guelph and serves as the university's director of Teaching and Learning. Martin's teaching has been recognized through several awards including the CAP Medal for Excellence in Teaching Undergraduate Physics and the University of Guelph's Distinguished Professor Award for Excellence in Teaching. Martin obtained his Ph.D. degree in Experimental Condensed Matter Physics from Imperial College, University of London, UK. Martin has an active research programme with current interests in the Scholarship of Teaching and Learning. Before arriving at Guelph, he worked as a postdoctoral fellow at Imperial College and University College London. He is a chartered Physicist and member of the Institute of Physics UK and a past Chair of the Division of Physics Education of the Canadian Association of Physicists.

Past President / Président sortant

Manu Paranjape was born in Liverpool, UK, he did not live there too long, and grew up in Edmonton, Alberta. As a high school student, he won the Alberta wide high school exam in mathematics. He received his BSc (Honours) and MSc from the University of Alberta. His MSc supervisor was Yasushi Takahashi, of the Ward-Takahashi identities. His thesis was on the field theory of hydrodynamics. He then went to MIT, in Cambridge, Massachusetts to pursue his PhD, which he did under the supervision of Jeffrey Goldstone, well known of course for the discovery of the Goldstone boson. After his PhD, he spent 9 months at UBC as a postdoc under the guidance of Gordon Semenoff followed by two years as a postdoc at the ETH (Eidgenössiche Technische Hochschule) in Zürich, under the guidance of Christoph Schmid. After this, in October of 1986, he came to the Université de Montréal, as a chercheur adjoint (a position equivalent to assistant professor), officially an Attaché de Recherche du CRSNG. He obtained tenure and eventually promotion to full professor by 2002. He is currently a Professor with the Department of Physics at the Université of Montréal.

He has been active in many CAP related activities, serving as co-chair and then chair of the Division of Theoretical Physics for four years. During this time, he founded of the series of meetings, Theory CANADA, which are now in their 14th session. Since then, he was co-chair of the local organizing committee of the Annual Congress of the Canadian Association of Physicists that was held in Montreal in 2013, and he has been a member of the IUPAP committee for mathematical physics, and a member of the CNILC (Canadian National IUPAP Liaison Committee) for the past two years. Most recently, he has been involved with the accession of Canada into the Asia Pacific Center for Theoretical Physics, and he is the council member for Canada.

SECRETARY-TREASURER / SÉCRETAIRE-TRÉSORIER

Christine Kraus is a SNOLAB research scientist, with adjunct positions at Laurentian University and Queen's University. Her research field is particle astrophysics. In 2004 she received her Ph.D. from the Johannes Gutenberg University in Mainz, Germany for the final analysis of the Mainz Neutrino Mass experiment. From there she moved to Canada to pursue a postdoctoral fellowship on the famous SNO experiment at Queen's University. Since 2010, when she moved to Sudbury as a Canada Research Chair, her main focus is the SNO+ experiment, which is now taking data. Prof. Kraus is a past advisory council member as well as a past PPD chair.

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PhD Physics Degrees Awarded in Canadian Universities

Doctorats en physique décernés par les universités canadiennes

December 2020 to December 2021 / Décembre 2020 à Décembre 2021

CARLETON UNIVERSITY

DELGOBBO, P., "Attenuated Alpha Backgrounds in the DEAP-3600 Dark Matter Search Experiment", (S. Viel), October 2021, searching for employment.

DYDULA, C., "Development of X-ray Coherent Scatter Projection Imaging Systems", (P. Johns), February 2021, Medical Physics Resident at Odette Cancer Centre, Toronto, Ontario, Canada.

EFSEAFF, M., "Validation of a Novel General Cavity Theory Formalism", (M. MacPherson), October 2021, Radiation Safety Officer at Best Theratronics, Ottawa, Ontario Canada.

GALLACHER, D., "Commissioning and Calibration of a Small-Scale Modular Liquid Argon Detector, Argon-1, for Novel Studies in Background Rejection Techniques Towards Next-Generation Dark Matter Detectors", (M. Boulay), October 2021, PhD Candidate at McGill University, Montreal, Quebec, Canada.

KEESHAN, B., "Investigating Custodial Symmetry Violation in the Georgi-Machacek", (H. Logan), October 2021, Postdoctoral Fellow at bioMECHATRONICS Lab, Ottawa Ontario, Canada.

LIU, M., "Patient-Specific Planning Target Volume Margins for Liver Stereotactic Robotic Radiosurgery", (J. Cygler, E. Vandervoort), February 2021, Medical Physics Resident at the Ottawa Hospital, Ottawa, Ontario, Canada.

MAYOROV, K., "Postmastectomy radiation therapy for patients with tissue expanders", (E. Ali), February 2021, Data Analyst at Beaconsure, Toronto, Ontario, Canada.

MURTHA, N., "Reconstruction of a Radioactive Source Distribution using a Tomographic Spatial-unfolding Method with Compton Gamma Imager Measurements", (L. Sinclair), October 2021, Medical Physics Resident at Tom Baker Cancer Centre, Calgary, Alberta, Canada.

RETHMEIER, C., "Characterization of Alpha Decays and Detector Response and Search for 5.5 MeV Solar Axions in DEAP-3600", (K. Graham), October 2021, Postdoctoral Fellow at University of Alberta, Calgary, Alberta, Canada.

SMITH, P., "Beauty from Senselessness: Searching for Signals of Beyond the Standard Model Physics in a Complex World", (D. Stolarski), October 2021, searching for employment.

STAATS, E., "Electrical Characterization of Silicon Strip Sensors for the ATLAS ITk at the HL-LHC with Extended Investigations of Sensor Properties", (T. Koffas), February 2021, PhD candidate at Carleton University, Ottawa, Ontario, Canada.

DALHOUSIE UNIVERSITY

BUTEAU, S., "Applying Machine Learning Techniques to Lithium-ion Cell Research", (J. Dahn), May 2021, Research Scientist, Quantumscape.

FARRELL, S., "Developing computational models to understand aging", (A. Rutenberg), May 2022.

GAUTHIER, R., "Understanding and Preventing Lifetime Failure in Lithium-ion Batteries", (J. Dahn), October 2021, Postdoctoral Fellow, Dalhousie University, Halifax, NS, Canada.

HENRY, C., "The Development of a CT-based Framework for Radiation Dosimetry in Yttrium-90 Transarterial Radioembolization", (A. Syme, G. Mawko), May 2022, Postdoctoral Fellow, University of Texas, Houston, Texas, USA.

HUPMAN, A., "Development of a Novel Radiation Dosimeter: The Stemless Plastic Scintillation Detector", (A. Syme, I. Hill), October 2021, Medical Physics Resident, Sunnybrook Hospital, Toronto, ON, Canada.

LOULI, A., "Developing Anode-Free Lithium Metal Cells with Liquid Electrolytes", (J. Dahn), October 2021, Research Engineer, Volkswagen, San Jose, California, USA.

SADEGHI, P., "Development and evaluation of a novel technology for monitoring patient motion during stereotactic radiotherapy", (J. Robar), October 2021, Medical Physics Resident, Princess Margaret Hospital, Toronto, ON, Canada.

POLYTECHNIQUE MONTRÉAL

ALLARD, C., « Étude sur la synthèse et les propriétés optique de nanohybrides composés de nanotubes et de colorants organiques encapsulés », (P. Desjardins, R. Martel), December 2021, searching for employment.

CAO, Yang, “Additive Manufacturing of Terahertz Waveguide Components for THz Sensing and Communication”, (M. Skorobogatiy), December 2021, searching for a Postdoctoral Fellowship in North American or Japan.

DAOUST, P., « Étude des propriétés physiques d'alliages de nitrure d'aluminium et de nitrure de terre rares », (P. Desjardins, R. Masut), August 2021, searching for employment.

GOUDA, A., “Biosourced Quinone-Based Molecular Materials for Electrochemical Energy Storage”, (C. Santato), July 2021, Postdoctoral Fellow at University of Toronto, Toronto, Ontario, Canada.

HERRERA JIMENEZ, E., “Effect of growth conditions and surface treatment on the performance of protective coatings on aircraft engine components”, (J.-E. Japieha, L. Martinu), February 2021, Postdoctoral Fellow at École de technologie supérieure (ETS), Montréal, Québec, Canada.

MORIN, A., « Fort couplage photon-magnon d'échantillons ferromagnétiques dans des cavités hyperfréquences : application aux réseaux de nanofils ferromagnétiques », (D. Ménard), December 2020, searching for employment.

REALI, Manuel, “Eumelanin for Organic Electronics: Film Formation and Transport Physics”, (C. Santato, F. Cicoira), December 2021, Postdoctoral Fellow at Polytechnique Montreal, Montreal, Quebec, Canada.

SRIDHARAN, A., “A Study of In-Plane Charge Carrier Diffusion and Photon Recycling in Hybrid Organic-Inorganic Perovskites”, (S. Kéna-Cohen), July 2021, Ingénieur de test en Antennes (RF) at MDA, Montréal, Québec, Canada.

QUEEN'S UNIVERSITY

BHOONAH, A., “On the origin, dynamics and detection of superheavy, ultralight, and composite dark matter", (J.A. Bramante), November 2021, Postdoctoral Researcher at Colorado State University, Fort Collins, CO, United States.

CARLSON, C., “Theory and Simulation Techniques of Broadband Light-Matter Interactions in Nanophotonics", (S. Hughes), November 2021, Bachelor of Education student at Lakehead University, Thunder Bay, ON, Canada.

GHAITH, M., "Development of Low-Energy Calibration Techniques for SuperCDMS using LEDs Operated Cryogenic Temperatures", (W. Rau), June 2021, Senior Instructor of Physics at Abu Dhabi University, Abu Dhabi, United Arab Emirates.

GROOME, R., "Experimental speed distribution measurements and NHC self-assembly on Au(111)", (A.B. McLean), June 2021, Canadian Bank Note, Ottawa, ON, Canada.

KARUNAKARAN, A., "Characterizing Dwarf and Diffuse Galaxy Populations in the Local Universe", (K. Spekkens), November 2021, Postdoctoral Researcher at the Instituto de Astrofísica de Andalucía (IAA-CSIC), Granada, Spain.

LAM, I., "Search for Invisible Nucleon Decay in SNO+ with Improved Sensitivity", (A.J. Wright), June 2021, Postdoctoral Researcher at Carleton University, Ottawa, ON, Canada.

VIDAL, M., "Quenching factor measurement of neon nuclei in neon gas and study of the feasibiity of detecting coherent elastic neutrino-nucleus scattering at a nuclear reactor using a spherical proportional counter", (R.D. Martin, G. Gerbier), November 2021, Posdoctoral Researcher at Stanford University, Stanford, CA, United States.

ROYAL MILITARY COLLEGE OF CANADA

LEIBOLD, J., "Advanced Nanofabrication and Sensing Using Interference Lithography", (G. Sabat), May 2021, Military Faculty, Department of Physics and Space Science, RMC.

SAINT MARY'S UNIVERSITY

GONZALEZ, A., "Probing high-velocity outflows in active galactic nuclei and their relationship to the inner disc environment with X-ray observations", (L. Gallo), September 2021, Postdoctoral Fellow at Saint Mary's University, Halifax, Nova Scotia, Canada.

SIMON FRASER UNIVERSITY

DREYER, E., "The search for new high-mass resonances in the dilepton final state using the full Run-2 ATLAS dataset of 13 TeV proton-proton collisions", (B. Stelzer), October 2021, searching for employment.

JINDAL, L., "Mechanisms for directed transport and organization at subcellular scales", (E. Emberly), June 2021, Data Scientist at Tripstack, Toronto, ON, Canada.

KOROSEC, C., "Modelling and engineering artificial burnt-bridge ratchet molecular motors", (N. Forde), June 2021, NSERC Postdoctoral Fellow at York University, Dept. of Math and Stats, Toronto, ON, Canada.

KUMAR, A., "Anomalous relaxation in colloidal systems", (J. Bechhoefer), June 2021, Postdoctoral Associate in the Cell Biology Department at Yale School of Medicine, New Haven, Connecticut, USA.

LARGE, S., "Dissipation and control in microscopic nonequilibrium systems", (D. Sivak), June 2021, Data Scientist at Viewpoint Investment Partners, Calgary, Alberta, Canada.

LEE-HONE, N., "Spectroscopy and phenomenology of unconventional superconductors", (D. Broun), June 2021, searching for employment.

MCKINNON, T., "Study of Magnetic Interlayer Coupling in Synthetic Antiferromagnets for use in MRAM Devices", (E. Girt), June 2021, Software engineer at Flow Labs, Oakland, California, USA.

OMELCHENKO, P., "Spin Current Propagation in Metallic Heterostructure: Pt, Pt/Au and Ta", (E. Girt, B. Heinrich), June 2021, searching for employment.

SCHIBLI, E., "Nanostructure and ion dynamics of novel ionenes via scattering and simulation", (B. Frisken), June 2021, Data Scientist at Canfor, Vancouver, BC, Canada.

WANG, Y., "Correlated Percolation in the Fracture Dynamics on a Network of Ionomer Bundles", (M. Kennett), June 2021, searching for employment.

YANG, A., "Investigation of core-shell nanowires via electron-beam-induced current", (K. Kavanagh), June 2021, searching for employment.

TORONTO METROPOLITAN UNIVERSITY

SHAAER, A., "Improving Accuracy of Interstitial HDR Brachytherapy Through MRI-based Targeted Innovations", (A. Ravi, C. Kumaradas), June 2021, Medical Physics Resident at Grand River Hospital, Kitchener, ON, Canada.

VAN DELINDER, K., "Particle Neutron Gamma-X Detection (PNGXD)", (J. Grafe), June 2021, Medical Physics Resident, Juravinski Cancer Centre, Hamilton, ON, Canada.

WANG, Y., "The Development of Theranostic Agents for Photoacoustic Detection and Laser-Activated Anti-HER Breast Cancer Therapy", (M. Kolios), October 2021, searching for employment.

ZALEV, J., "3D Opto-Acoustic Image Reconstruction and Motion Tracking Using Convex Optimization Algorithms", (M. Kolios), June 2021, Computational Imaging Physicist/Consultant at OA Signal Technologies Inc., Toronto, ON, Canada.

TRENT UNIVERSITY

COLE, R., "Frequency-time and Polarization Considerations in Spectral-focusing-based CARS Microscopy", (A. Slepkov), September 2021, Instructor at Trent University, Peterborough, Ontario, Canada.

UNIVERSITÉ DE MONTRÉAL

BERGERON, G., « Applications des structures algébriques associées aux systèmes intégrables », (L. Vinet), octobre 2021, Research and Development Scientist at NXTSENS, Montreal, Quebec, Canada.

FINES-NEUSCHILD, M., « La dualité ethnographe-physicienne : Étude réflexive sur les négociations identitaires en physique », (L. Heaton, D. London), octobre 2021, postdoctorante en EDI (équité, diversité et inclusion) en STIM (Sciences, technologie, ingénierie et mathématiques), Université Concordia, Montréal, Québec, Canada.

MYRONOVA, M., "Applications of finite reflection groups in Fourier analysis and symmetry breaking of polytopes", (J. Patera), July 2021, Postdoctorante en vision par ordinateur (infographie) au département d'informatique, Université de Montréal, Montréal, Québec, Canada.

NAJAFI, F., « Étude de la violation CP dans des processus au LHC qui brisent la conservation du nombre leptonique », (R. MacKenzie, D. London), juillet 2021, searching for employment.

ROBERT BIGRAS, G., « Modification de films de graphène dans la post-décharge en flux de plasmas micro-ondes d'azote à pression réduite », (L. Stafford), mars 2021, Computer Vision Specialist at General Electric Aviation, Bromont, Québec, Canada.

SIMARD, M., « Étude de la tomodensitométrie spectrale quantitative et ses applications en radiothérapie », (H. Bouchard), mars 2021, Posdoctoral Fellow at University College London, London, United Kingdom.

VINCHON, P., « Étude fondamentale des interactions plasma-graphène dans les plasmas Argon/B2H6 », (L. Stafford), mars 2021, Conseiller à la recherche, Université de Montréal, Laboratoire René-J.-A.-Lévesque, Montréal, Québec, Canada.

UNIVERSITÉ DE SHERBOOKE

BERTRAND, S., « Génération et détection de la polarisation de vallée optique dans les semimétaux de Weyl », (I. Garate, R. Côté), août 2020, Expert en mégadonnées, CGI, Sherbrooke, QC, Canada.

BOURGEOIS-HOPE, P., « La conductivité thermique comme sonde pour les états exotiques des matériaux quantiques », (L. Taillefer), mai 2021, Professionnel, Teledyne Dalsa, Bromont, QC, Canada.

BUREAU-OXTON, C., « Contrôle et caractérisation d'un qubit singulet-triplet entraîné par l'interaction spin-orbitre dans le silicium / Control and characterization of a spin-orbit-driven singlet-triplet qubit in silicon », (M. Pioro-Ladrière), juin 2021, Postdoctorante, École polytechnique fédérale de Zurich, Zurich, Suisse.

DI PAOLO, A., « Qubits supraconducteurs protégés basés sur des modes à haute impédance / Noise-protected superconducting qubits based on high-impedance modes », (A. Blais), juin/June 2020, Postdoctoral Fellow, MIT, Cambridge, MA, US.

GIROD, C., « Chaleur spécifique à basse température dans l'état normal des cuprates supraconducteurs », (L. Taillefer, T. Klein), janviér 2021, Postdoctorant, Laboratoire National de Los Alamos, Los Alamos, NM, États-Unis.

HARDY, G., « Etudes des effets de proximité dans les hétérostructures de Pr2-x Cex CuO4 et le LaFeO3 », (P. Fournier), septembre 2020, Postdoctorant, Institut quantique (UdeS), Sherbrooke, QC, Canada.

JUBGANG FANDIO, D.J., « Etude des propriétés électroniques et de la dynamique des charges dans diverses nanostructures semi-conductrices par la spectroscopie térahertz », (D. Morris), août 2021, Postdoctorant, Université d'Ottawa, Ottawa, ON, Canada.

KRISHNA, A., « Portes tolérantes aux fautes pour les codes produits d'hypergraphes / Fault-tolerant gates on hypergraph product codes », Postdoctoral Fellow, Stanford University, Stanford, CA, US.

PRÉMONT-FOLEY, A., « Réseaux de tenseurs et solutionneurs d'impureté pour la théorie du champ moyen dynamique », (D. Sénéchal), juillet 2020, Stagiaire postdoctoral, Université de Sherbrooke, Sherbrooke, QC, Canada.

ROCHETTE, S., « Accélérer la mise à l'échelle des processeurs quantiques avec les boîtes quantiques à grilles », (M. Pioro-Ladrière), septembre 2020, Coordonnatrice, Institut quantique (UdeS), Sherbrooke, QC, Canada.

SIMONEAU, J.O., « Mesures temporelles large bande résolues en phase du bruit de grenaille photoexcité et statistique de photons d'un amplificateur paramétrique Josephson », (B. Reulet), janvier 2021, Physicien, Nord Quantique, Sherbrooke, QC, Canada.

THIBAULT, K., « Effets de rétroaction du bruit dans un circuit électrique », (B. Reulet), janvier 2020, Coordonnateur, Institut quantique (UdeS), Sherbrooke, QC, Canada.

UNIVERSITY OF BRITISH COLUMBIA

ABOUEI, Elham, "Optimization of multimodal OCT for early cancer detection and diagnosis", (C. MacAulay), searching for employment.

ASHTON, Edward, "The Search for Jovian and Saturnian Irregular Moons and a Study of Their Luminosity Functions", (B. Gladman), November 2021, Postdoctoral Fellow at the Academica Sinica Institute of Astronomy and Astrophysics in Taipei, Taiwan.

DEHN, Martin, "Charge-neutral muon centers in magnetic and non-magnetic materials: implications and applications", (R.F. Keifl), November 2021, searching for employment.

DENG, Meiling, "Antenna Array Design, Beam Calibration of the CHIME to Measure the Late-time Cosmic Acceleration and Mapping of the North Celestial Cap", (M. Halpern), May 2021, Postdoctoral Fellow at the Dominion Astrophysical Observatory, DRAO.

EVETTS, Nathan, "Solid-state nuclear magnetic resonance magnetometry at low temperature with application to antimatter gravity experiments by ALPHA", (C. Michal), May 2021, Postdoctoral Fellow at ABQMR, Albuquerque, New Mexico, USA.

FUJIMOTO, Derek, "The Interfacial Dynamics of Amorphous Materials as Revealed by Beta-NMR Measurements and Molecular Simulations", (R. Keifl), Postdoctoral Fellow at TUCAN (TRIUMF Ultra Cold Advanced Neutron source), Vancouver, B.C.

GALLINA, Giacomo, "Development of a single vacuum ultra-violet photon-sensing solution for nEXO", (R. Kruecken, F. Retiere), May 2021, Postdoctoral Researcher, Princeton University, Princeton, USA.

GE, Shuailiang, "Axion Quark Nugget Dark Matter Model: Developments in Model Building and Observations", (A. Zhitnitsky), November 2021, Postdoctoral Researcher at Peking University, Beijing, China.

GOOD, Deborah, "Timing Pulsars and Detecting Radio Transients with CHIME", (I. Stairs), November 2021, Postdoctoral Fellow and Research Associate at University of Connecticut, Storrs, Connecticut, USA and Flatiron Institute Center for Computational Astrophysics, New York, New York, USA.

HUGHES, Anna, "The Space Weather of Ultracool Dwarfs", (A. Boley), November 2021, Quantum Software Engineer at Agnostiq.

KABERNIK, Oleg, "Reductions in finite-dimensional quantum mechanics: from symmetries to operator algebras and beyond", (R. Raussendorf), May 2021, Algorithm Developer, Rafael Advanced Defense Systems, Haifa, Israel.

KHODA, Elham, "Searches for new high-mass resonances in top-antitop and di-electron final states using the ATLAS detector", (A. Lister), May 2021, Postdoctoral Scholar Department of Physics, University of Washington, Seattle, WA, USA.

LANTAGNE-HURTUBISE, Etienne, "Holographic quantum matter: toy models and physical platforms", (M. Franz), November 2021, Postdoctoral Fellow at the California Institute of Technology (Caltech), Pasadena, California, USA.

LI, Chengshu, “Low-dimensional quantum systems from novel constituents”, (M. Franz), November 2021, Postdoctoral Fellow at Tsinghua University, Beijing, China.

MASSEY-ALLARD, Jonathan, “Learning physics with interactive simulations: inductive inquiry learning activities for an introductory electromagnetism course”, (D. Bonn), November 2021, searching for employment.

MAY, Alex, “Quantum tasks in holography”, (M. Van Raamsdonk), November 2021, Postdoctoral Fellow at Stanford University, Palo Alto, California, USA.

QU, Chen Ge, “Atomic modification of graphene on silicon carbide: adsorption and intercalation”, (A. Damascelli, S. Burke), November 2021, Test Engineer at Scienta Omicron, Taunusstein, Hesse, Germany.

ROBERTSON, Andrew, “Nuclide Production and Imaging Applications of ^{225}Ac for Targeted Alpha Therapy", (V. Sossi, P. Schaffer), May 2021, Medical Physics Resident at BC Cancer, Vancouver, BC, Canada.

SHIRMOHAMMAD, Maryam, “New Raman scattering enhancement methods with potential for improving the detection of breath VOCs”, (H. Zeng), May 2021, Medical Physics Resident at the University of Michigan, Ann Arbor, MI, United States of America.

SONIER, Marcus, “Adaptive Radiotherapy Treatment Corrections to Account for Patient-Specific Systematic Soft Tissue Deformations: Prostate, Lung, and Head & Neck Cancer”, (R. Ramaseshan, S. Reinsberg), May 2021, Medical Physicist at BC Cancer - Abbotsford, Abbotsford, BC, Canada.

STUART, B., "Scanning tunnelling microscopy of topological materials", (S. Burke, D. Bonn), June 2021, Cardiac Mapping Engineer at Kardium, Burnaby, BC, Canada.

WAMER, Kyle, "Generalization of the Haldane conjecture to SU(n) chains", (I. Affleck), June 2021, Quantitative Researcher at NumerixS Quant in Vancouver, BC, Canada.

WILSON-GEROW, J., "A Study of the Quantum-to-Classical Transition in Gravity, and a Study of the Consequences of Constraints in Gauge Theory Path-Integrals", (P. Stamp), searching for employment.

WONG, V., "New physics hunt at the Large Hadron Collider with the ATLAS detector: search for heavy exotic resonances and upgrade of the Transition Radiation Tracker DAQ system", (C. Gay), November 2021, Postdoctoral Researcher at TRIUMF, Vancouver, BC, Canada.

YAN, Z., "Probing the universe with multiple large-scale structure tracers", (G. Hinshaw, L. van Waerbeke), November 2021, Postdoctoral Fellow at Ruhr-University Bochum, Bochum, North Rhine-Westphalia, Germany.

YANG, F., "Topological quantum phase transitions and topological quantum criticality in superfluids and superconductors", (F. Zhou), November 2021, Postdoctoral Fellow at the Institute of Advanced Studies, Tsinghua University, Beijing China.

UNIVERSITY OF CALGARY

EVANS, A., "Laser cooling of Antihydrogen", (R. Thompson), May 2022, searching for employment.

GHAFFARI, R., "Characterizing Energetic Electron Precipitation and Whistler-mode Waves during Electron Injection Events", (C. Cully), May 2022, Postdoctoral Fellow at University of Calgary, Calgary, AB, Canada.

GOSWAMI, S., "Photonic quantum technologies: non-destructive photon detection and quantum simulation in solid-state systems", (C. Simon), May 2022, searching for employment.

KUZNETSOVA, S., "Exploring the Role of GD-EOB-DTPA (PRIMOVIST®) MRI in Liver Stereotactic Body Radiation Therapy Accuracy", (N. Ploquin), November 2021, Medical Physics Resident at the University of California San Diego, San Diego, CA, USA.

LEFEBVRE, P., "From bipartite to multipartite entanglement", (D. Oblak), May 2022, Postdoctoral Fellow at Paris Center for Quantum Computing, Sorbonne University, Paris, France.

WEIN, S., "Modelling Markovian light-matter interactions for quantum optical devices in the solid state", (C. Simon), November 2021, Postdoctoral Fellow at Institut Neel, Grenoble, France.

ZARKESHIAN, P., "Photonic approaches to multi-party entanglement in solids and learning in the brain", (C. Simon), May 2022, Mitacs Postdoctoral Fellow at 1Qbit, Vancouver, Canada.

UNIVERSITY OF GUELPH

BAYLIS, B., "Morphology and Mechanical Stiffness of Soft Phytoglycogen Nanoparticles Revealed by AFM Force Spectroscopy", (J. Dutcher), October 2021, Postdoctoral Fellow, University of Guelph, Guelph, ON, Canada.

MACLEAN, A., "Spectroscopy of ^{188}Hg Following the β^+/EC Decay of ^{188,188m}Tl", (C. Svensson), October 2021, Analytical Analyst I, The Co-operators, Guelph, ON, Canada.

MUNRO, R., "Biosynthetic isotopic labelling strategies for the production of membrane proteins for solid-state Nuclear Magnetic Resonance", (L. Brown), February 2021, Customer Success Scientist, Nicoya, Kitchener, ON, Canada.

NELSON, M., "Hybrid Quantum Systems: Complementarity of Quantum Privacy and Error-Correction, and Higher Rank Matricial", (D. Kribs, B. Zeng), June 2021, Postdoctoral Fellow, University of Illinois at Urbana-Champaign, Champaign, IL, USA.

SIMMONS, J., "Small Angle Neutron Scattering Studies of Native and Chemically Modified Phytoglycogen Nanoparticles", (J. Dutcher), June 2021, BI R&I Analyst I, The Co-operators, Guelph, ON, Canada.

UNIVERSITY OF MANITOBA

GOICOECHEA, A., "Anderson Localization of Ultrasound in Disordered Anisotropic Media", (J.H. Page), February 2021, searching for employment.

UNIVERSITY OF OTTAWA / UNIVERSITÉ D'OTTAWA

ABDOLGHADER, P., "Coherent Nonlinear Raman microscopy and the applications of deep learning & pattern recognition methods to the extraction of quantitative information", (A. Stolow), November 2021, Research and Development Scientist at few-cycle Inc., Varennes, Québec.

BEATTIE, M., "Semiconductor Materials and Devices for High Efficiency Broadband and Monochromatic Photovoltaic Energy Conversion", (K. Hinzer), October 2021, Postdoctoral Fellow at University of Ottawa, Ottawa, ON, Canada.

BRITTON, M., "Isolating the gain in the nitrogen molecular cation", (P. Corkum), December 2020, Postdoctoral Fellow at Stanford University.

HAJEBIFARD, A., "PLASMONIC Nano-Resonators and Fano Resonances for Sensing Applications", (P. Berini), March 2021, on maternity leave.

MOHAMMED, A., "Experimental and theoretical investigations of magnetic, electronic structure, and hyperfine interaction properties of new Fe-based superconductors and $EuFeAs_2$", (Z. Stadnik), March 2021, Assistant Professor, National University of Defense Technology, Xian campus, China.

POWANWE, Sadrak Arthur, "Brain Rhythm Fluctuations: Envelope-Phase Modeling and Phase Synchronization", (A. Longtin), June 2021, Postdoctoral Fellow with Dr. Adam Sachs (Ottawa Health RI) and A. Longtin.

QIAO, L., "Theoretical Study of Voltage-driven Capture and Translocation Through a Nanopore: From Particles to Long Flexible Polymers", (G. Slater), June 2021, Postdoctoral Fellow at Johannes Guttenberg University, Mainz, Germany.

RAHIMIANGOLKANDANI, M., "Interaction of Structured Femtosecond Light Pulses with Matter", (R. Bhardwaj), October 2021, Postdoctoral Fellow at University of Ottawa, Ottawa, ON, Canada.

VANUS, Benoit Yvon E., "All-optical signal processing using the Kerr effect for fiber-based sensors", (X. Bao), January 2021, Engineer at Optiwave, Ottawa, Canada.

ZHOU, Z., "Characteristic Study of Noise Reduction of Brillouin Random Fiber Lasers", (X. Bao), October 2021, Assistant Professor, National University of Defense Technology, Xian campus, China.

UNIVERSITY OF REGINA

COMTE, M., "An Investigation into Seeding the Solar System via Terrestrial Meteorites", (M. Beech), June 2021, searching for employment.

FODA, A., "Photoproduction of the b1(1235) Meson off the Proton at Egamma = 6-12 GeV", (Z. Papandreou), June 2021, Postdoctoral Fellow at GSI, Germany.

UNIVERSITY OF SASKATCHEWAN

ADELEKE, A., "Structures, Structural Transformations and Properties of Selected Elemental and Extended Solids", (Y. Yao), May 2021, searching for employment.

ADENIYI, A., "First Principles Investigations of Novel Condensed Matter Materials", (Y. Yao), September 2021, Community Panel Analyst at Federated Cooperative Limited, Saskatoon, SK, Canada.

DeBOER, T., "Advancing the Characterization of Semi-conductors with Synchrotron Radiation", (A. Moewes), December 2020, Postdoctoral Fellow at University of Saskatchewan, Saskatoon, SK, Canada.

QAMAR, A., "Core-level Soft X-Ray Spectroscopy of PbO-based Photoconductors and Nano-Sheets of MoO_3", (A. Moewes), August 2021, instructor at Okanagan College, Okanagan, BC, Canada.

ZIELINSKI, J., "Temperature Gradient Driven Instabilities, Structure, and Transport in Magnetized Plasmas", (A. Smolyakov), September 2021, Postdoctoral Fellow at University of Alberta, Edmonton, AB, Canada.

UNIVERSITY OF TORONTO

ANDERSON, R.M.A., "Conductivity of ultracold fermions in an optical lattice", (J.H. Thywissen), June 2021, Waveguide Metrology Researcher, Google, Kitchener, ON, Canada.

BOGNAR, K., "Studies of stratospheric and tropospheric ozone, NO_2, and BrO using UV-visible spectroscopy in the arctic and at mid-latitudes", (K. Strong), June 2021, Postdoctoral Fellow at University of Saskatchewan, Saskatoon, SK, Canada.

BOUDJADA, N., "Symmetry-broken phases and transport in multiband systems", (A. Paramekanti), November 2021, Morgan Stanley, Montreal, QC, Canada.

BOURASSA, J., "Strategies for noisy photonic quantum technologies: quantum computation to quantum key distribution", (H.K. Lo), November 2021, Quantum Computing Researcher at Xanadu, Toronto, ON, Canada.

CASHA, A., "Higgs boson measurements in leptonic final states with the ATLAS detector at the Large Hadron Collider", (R.S. Orr), November 2021, Postdoctoral Fellow at the European Organization for Nuclear Research (CERN), Toronto, ON, Canada.

CHERN, L.E., "Magnetic field induced phases in Kitaev magnets: A semiclassical analysis", (Y.B. Kim), November 2021, Postdoctoral Fellow at the Department of Physics, University of Cambridge, UK.

CHOI, W., "Quantum dynamics and topology of the Kitaev materials", (Y.B. Kim), November 2021, Postdoctoral Fellow at the Technical University of Munich, Germany.

CONKLIN, R., "Gravitational wave echoes: theory and application", (B. Holdom), November 2021, Research Scientist at Amazon, Toronto, ON, Canada.

DE BENEDETTI, M.R., "The decorrelation length and time scale diagnostic tools to visualize spatial and temporal variability in geophysical fields", (G.W.K. Moore), June 2021, Manager, Biostatistics, Bristol Myers Squibb (BMS), Berkeley Heights, NJ, USA.

FERNANDES, D., "Mapping the conformational landscape & spatial organization of G protein-coupled receptors using single-molecule fluorescence", (C.C. Gradinaru), June 2021, pursuing a Master of Biotechnology, University of Toronto, Toronto, ON, Canada.

GOLDBERG, A.Z., "Disquisitions on quantum-enhanced polarimetry", (D.F.V. James), June 2021, Research Associate at National Research Council Canada, Canada.

LANGEMEYER, S.M., "The feedback between core heat flux, compositional heterogeneity, and the dynamics of a rheologically obtained plate-like surface in numerical mantle convection models", (J.P. Lowman), June 2021, Lecturer, University of Toronto, Scarborough, ON, Canada.

LI, D., "Radio propagation effects and coherent sources", (U.-L. Pen), June 2021, Sherman Fairchild Postdoctoral Scholar Research Associate in Astronomy at California Institute of Technology, California, USA.

MAHON, P.T., "Theory of electronic response to electromagnetic fields in crystalline solids", (J.E. Sipe), November 2021, Postdoctoral Fellow at the University of Texas at Austin, Texas, USA.

OJEDA, M.L., "Measurement of Higgs couplings to top quarks and τ leptons with the ATLAS detector", (P. Savard), November 2021, Postdoctoral Fellow at DESY laboratory, Hamburg, Germany.

PATRI, A.S., "Exotic phenomena emerging from localized multipolar degrees of freedom", (Y.B. Kim), November 2021, Postdoctoral Fellow at Massachusetts Institute of Technology, Cambridge, MA, USA.

ROCHE, S., "Measurements of greenhouse gases from near-infrared solar absorption spectra", (K. Strong), November 2021, Postdoctoral Fellow at Harvard University, Cambridge, MA, USA.

SINCLAIR, J., "Weakly measuring the time an unscattered photon causes atoms to spend in the excited state", (A.M. Steinberg), March 2021, Postdoctoral Fellow at Massachusetts Institute of Technology, Cambridge, MA, USA.

SMALE, S.D., "Observation of a transition between dynamical phases in a harmonically trapped degenerate Fermi gas", (J.H. Thywissen), November 2021, Postdoctoral Fellow at Department of Physics, University of Toronto, Toronto, ON, Canada.

SORN, S., "Topology and magnetism in quantum materials", (A. Paramekanti), November 2021, Postdoctoral Fellow at the Karlsruhe Institute of Technology, Germany.

STAVROPOULOS, P.P., "Emergent phenomena in correlated materials with strong spin-orbit coupling", (H.-Y. Kee), November 2021, Postdoctoral Fellow at University of Minnesota, MN, USA.

YAMANOUCHI, S., "Long-term analysis of Toronto-area atmospheric composition", (K. Strong), June 2021, Postdoctoral Fellow at University of Toronto, Department of Civil and Mineral Engineering, Toronto, ON, Canada.

YUAN, B., "Neutron scattering study of magnetic excitations in quantum magnets Bi_2CuO_4 and $CoTiO_3$", (Y.J. Kim), November 2021, Postdoctoral Fellow at Max Planck Institute, Hamburg, Germany.

UNIVERSITY OF VICTORIA

CHEN, M., "Mass Assembly in Star Formation via Interstellar Filaments", (J. Di Francesco, J. Willis), May 2021, Postdoctoral Fellow at Queen's University, Kingston, Ontario, Canada.

CLARKSON, O., "The First Stars and the Convective-Reactive Regime", (F. Herwig), May 2021, searching for employment.

GHASEMI BOSTANABAD, M., "Search for supersymmetry in final states with multiple bottom quarks with the ATLAS detector", (J. Albert), October 2021, Postdoctoral Fellow at the Institute for Research in Fundamental Sciences, at Tehran, Iran.

KIELTY, C., "Chemo-dynamics of Newly Discovered Metal-Poor Stars and Improved Spectroscopic Tools", (K. Venn), May 2021, Research Assistant for Substance, UVic/community-based drug testing program, Victoria, BC, Canada.

LINDSAY, C., "Simulation of the TRIUMF Proton Therapy Facility for Applications to 3D Printing in Radiotherapy", (C. Hoehr, A. Jirasek), May 2021, Postdoctoral Researcher at the British Columbia Cancer Agency, Vancouver, BC, Canada.

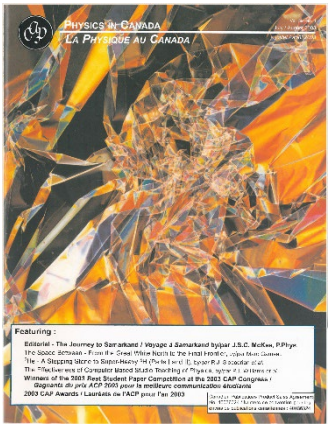
MCLEAN, K., "Search for dark matter produced in association with a Z boson in the ATLAS detector at the LHC", (M. Lefebvre), May 2021, now working for BC provincial government, Victoria, BC, Canada.

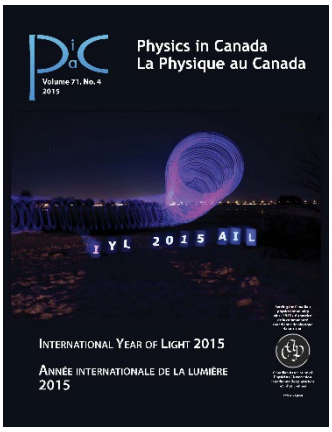
WESTERN UNIVERSITY

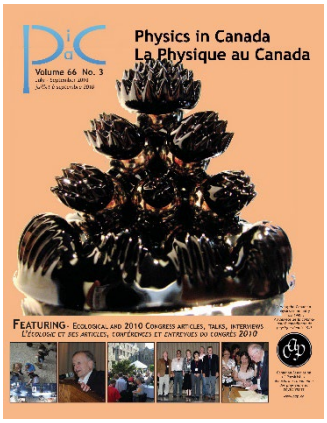
BAKER, M, "Field theories from physical requirements: Noether's first theorem, energy-momentum tensors and the question of uniqueness", (D.G.C. McKeon, S. Kuzmin), October 2021, Assistant Professor in the Department of Physics at St. Francis Xavier University, NS, Canada.

CALL FOR COVER ART FOR PHYSICS IN CANADA

You are invited to submit photographs of beautiful or unusual physics phenomena that may be selected to appear on the cover of Physics in Canada. Please send an electronic copy of the photograph, with a short (200 words or less) description explaining the phenomena in terms suitable for, and understandable to, any practising or student physicist, to the Editor of Physics in Canada at pic-pac@cap.ca. Please note that all entries must be original artwork produced by the participant.







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Vous êtes invités à soumettre des photographies de phénomènes physiques magnifiques ou inhabituels qui pourraient être sélectionnées pour figurer sur la couverture de La Physique au Canada. Veuillez envoyer une copie électronique de la photographie, accompagnée d'une brève description (200 mots ou moins) expliquant le phénomène en des termes adaptés et compréhensibles pour tout physicien(ne) en exercice ou étudiant(e), au rédacteur en chef de La Physique au Canada à l'adresse suivante : pic-pac@cap.ca. Veuillez noter que toutes les contributions doivent être des œuvres d'art originales produites par le participant.

The Canadian Association of Physicists:
A Physics Community

l'Association canadienne des physiciens et physiciennes :
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