

# Physics in Canada La Physique au Canada

Volume 79, No. 1 2023

> Serving the Canadian physics community since 1945 / Au service de la communauté canadienne de physique depuis 1945

# **FEATURING / EN VEDETTE :**

2023 Recognitions, 2019-2023 Student Prizes, 2022 PhDs awarded, Conference Reports and IPhO

2023 Reconnaissances, 2019-2023 Prix des étudiant(e)s, 2022 Doctorats décernés, Rapports de conférence et IPhO (cap

Canadian Association of Physicists / Association canadienne des physiciens et physiciennes

# **Refracted Light**

This image was taken by shining a light through a plastic apple, which appears distorted behind a sheet of clear, textured resin. To create this texture, liquid resin was left to harden in a sheet of crumpled wax paper. The photograph demonstrates the refractive property of light. As light passes from one substance to another, the difference in density between the two mediums cai se the speed and wavelength of the lightwave to change. When light enters the second medium at an angle, the part of the wave that reaches the medium first is slowed down, causing the ray to bend and alter the direction of its path. In the photograph, the resin's texture causes light from the plastic ball to enter it at several different angles. Light which normally travels away from the viewers is refracted by the resin, causing it to bend towards the viewer's eye. This refraction creates the distorted appearance of the illuminated apple.

### by Maggie Wang

Cawthra Park Secondary School, Mississauga, ON 2019 Art of Physics Competition Honourable Mention - High School/CEGEP Individual Category

# Lumière réfractée

Cette image a été prise en projetant une lumière à travers une pomme en plastique, qui apparaît déformée derrière une feuille de résine transparente et texturée. Pour créer cette texture, on a laissé la résine liquide durcir sur une feuille de papier ciré froissé. La photographie illustre la propriété de réfraction de la lumière. Lorsque la lumière passe d'une substance à une autre, la différence de densité entre les deux milieux modifie la vitesse et la longueur d'onde de l'onde lumineuse. Lorsque la lumière pénètre dans le second milieu sous un angle, la partie de l'onde qui atteint le milieu en premier est ralentie, ce qui fait que le rayon se courbe et modifie la direction de sa trajectoire. Dans la photographie, la texture de la résine fait que la lumière provenant de la boule en plastique y pénètre sous plusieurs angles différents. La lumière qui s'éloigne normalement de l'observateur est réfractée par la résine, ce qui la fait se diriger vers l'œil de l'observateur. Cette réfraction crée l'apparence déformée de la pomme illuminée.

### par Maggie Wang

École secondaire Cawthra Park, Mississauga, ON Concours de l'Art de la physique 2019 Mention honorable - Catégorie individuelle des écoles secondaires et des cégeps



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**Front cover**: "Refracted Light", by Maggie Wang, Cawthra Park S.S, Mississauga, ON – Honourable Mention (High School/CEGEP Individual Category), 2019 <u>Art of Physics competition</u>. / **Couverture** : « Lumière réfractée », par Maggie Wang, Cawthra Park S.S, Mississauga, ON – mention honorable (catégorie individuelle des écoles secondaires et des cégeps), <u>concours l'Art de la physique</u> 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 https://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 picpac@cap.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 picpac@cap.ca.

# CANADIAN PHYSICS OLYMPIAD, CAP HIGH SCHOOL/CÉGEP PRIZE EXAM, AND PARTICIPATION IN THE INTERNATIONAL PHYSICS OLYMPIAD – SHOULD WE CONTINUE?

### Andrzej Kotlicki, Lecturer, University of British Columbia



Many years ago, long before even our postdocs or young faculty colleagues were born, brave individuals John Wylie, a teacher from the Toronto French School, and Michael Crooks, a professor from the University of British Columbia, started a Canada-wide competition in physics. The Canadian <u>CAP High School/Cégep Prize</u> <u>Exam</u> and Physics Olympiad were born. In 1993, the CAP's High School/Cégep prize exam was converted from a system of provincial exams to a system where a common national examination was administered across Canada. This facilitated the identification of the top students across Canada to be considered in the selection

process for the Canadian Physics Olympiad team. Until 2010, the Physics Olympiad was closely associated with the Canadian Chemistry Olympiad, and they were known jointly as the Canadian Chemistry and Physics Olympiad. The Canadian Chemistry and Physics Olympiad was first hosted by the Toronto French School and later was associated with the University of Toronto. In 2010 it was split into the Canadian Chemistry Olympiad and the Canadian Physics Olympiad, the latter finding a home at the University of British Columbia.

The goal of this program was to challenge interested physics students in the country and to find the best of the best to form a team that would represent Canada in the International Physics Olympiad. Amazingly enough, this program continues today, with only a 2-year break during COVID.

The results of the CAP High School/Cégep Prize Exam were always used to bring about 15 students to a National camp and to select, during the camp, 5 students to represent Canada in the International Physics Olympiad.

Canada started to participate in the International Physics Olympiad in 1994 and in 1997 we organized the 28<sup>th</sup> International Physics Olympiad in Sudbury. John Wylie headed the organizing committee, Chris Waltham (UBC) chaired the academic committee for theoretical problems and Andrzej Kotlicki (UBC) chaired the academic committee for experiments. We had great help from a large number of faculty members from universities across Canada, who were members of academic committees and marked the problems. The local organizing committee did a fantastic job with wonderful help from the local population. The International Physics Olympiad in Sudbury was funded from donations, mainly from

The contents of this journal, including the views expressed above, do not necessarily represent the views or policies of the Canadian Association of Physicists.

#### Comments of readers on this Editorial are more than welcome.

Inco. Every country participating in the IPhO has to take a turn organizing it; considering that there are about 80 countries participating almost every year we can participate for a long time before it is our turn again.

Funding of the CAP High School/Cégep Prize Exam comes entirely from donations to the CAP Foundation, while funding for the National Camp and participation in the IPhO comes from the contribution of the hosting organization and, only if essential, from the participating students themselves. At the moment, the UBC Physics and Astronomy Department provides four TA units and faculty time, use of classrooms and labs, and technical help for the National Camp. The Faculty of Science Dean's office provides the time of our very successful fundraiser Fiona Beaty.

For a long time we could not get any funding from the funding agencies. Getting funding for a competition is not easy. Before Fiona kindly took over we had very lean years when we could not organize the National Camp and just took the 5 best students from the CAP exam as the team members. We even had to ask the students to cover their cost of travel to IPhO. For years now I have covered my own travel costs when I go to the IPhO as a leader. Fortunately, nowadays Fiona has managed to reach out to the Canadian Physics Olympiad alumni and some generous foundations and we are financially safe for a few years.

Throughout the period of trying to stabilize financial support for this program, I was both surprised and disappointed to discover that, judging from the comments we received with the refusals of our requests for funding support, and the decreasing number of schools participating in the CAP High School/Cégep Prize Exam, competitions seem to be out of favor in our educational system. According to the critics, competitions make only a few winners happy and depress every other participant. It is interesting that this philosophy is never applied to sports...

It seems that this goal of making every student happy rather than reaching excellence in their field of study is overwhelming our whole educational system. As an educator and researcher with over 55 years experience I find this very worrisome. Our high school education is fully funded by taxpayers, the university education partly. I do not know about other taxpayers, but I definitely like to see my physician, pharmacist or engineer creating some new stuff for me happy, but given the two other bad choices I would rather have them highly competent and unhappy than happy and incompetent.

How can we hope for the greatest progress for our country if we don't challenge our students to reach the highest goals they can achieve in the subject?

One of our team members Vincent Millington allowed me to share with you a quotation from his email:

"I want to express my gratitude to the IPhO and physics camp programs. Beyond being just a physics competition, this experience has instilled in me a sense of humility and a lasting work ethic. It has also given me the chance to meet incredible people while learning and enjoying myself. We are very lucky to have people who dedicate their time and effort to make these opportunities possible, and I am truly thankful for that!"

### EDITORIAL / ÉDITORIAL

In view of this feedback and a lot of other positive ones we plan to continue with these activities!

There are a lot of people involved in the work I am writing about. Thank you all very much. It is a pleasure and an honor to collaborate with you all.

Andrzej Kotlicki, University of British Columbia, < kotlicki@phas.ubc.ca>

Andrzej Kotlicki is a Lecturer at the University of British Columbia. He is the Team Leader of the Canadian Physics Olympiad Team.

# OLYMPIADE CANADIENNE DE PHYSIQUE, EXAMEN DU PRIX DE L'ACP ÉCOLE SECONDAIRE/CÉGEP, ET PARTICIPATION AUX OLYMPIADES INTERNATIONALES DE PHYSIQUE – FAUT-IL CONTINUER ?

#### Andrzej Kotlicki, maître de conférences, Université de la Colombie-Britannique



Il y a de nombreuses années, bien avant la naissance de nos postdocs ou de nos jeunes collègues de la faculté, des individus courageux, John Wylie, un enseignant de la Toronto French School, et Michael Crooks, un professeur de l'Université de la Colombie-Britannique, ont lancé un concours de physique à l'échelle du Canada. C'est ainsi que sont nées les Olympiades de physique et l'examen du prix de l'ACP pour les écoles secondaires et les cégeps canadiens. En 1993, l'examen du prix de l'ACP pour les écoles secondaires et les cégeps est passé d'un système d'examens

provinciaux à un système où un examen national commun est administré dans tout le Canada. Cela a facilité l'identification des meilleurs élèves du Canada, considérés dans la sélection de l'équipe canadienne des Olympiades de physique. Jusqu'en 2010, les Olympiades de physique étaient étroitement associées aux Olympiades canadiennes de chimie, et elles étaient connues conjointement sous le nom d'Olympiades canadiennes de chimie et de physique. Les Olympiades canadiennes de chimie et de physique ont d'abord été organisées par la Toronto French School, avant d'être associées à l'Université de Toronto. En 2010, elles ont été scindées en deux : les Olympiades canadiennes de chimie et les Olympiades canadiennes de physique, ces dernières étant hébergées par l'Université de la Colombie-Britannique.

L'objectif de ce programme était de mettre au défi les étudiants en physique intéressés du pays et de trouver les meilleurs d'entre eux pour former une équipe qui représenterait le Canada aux Olympiades internationales de physique. Aussi étonnant que cela puisse paraître, ce programme se poursuit encore aujourd'hui, avec seulement une pause de deux ans pendant la COVID.

Les résultats de l'examen du prix de l'ACP École secondaire/Cégep ont toujours été utilisés pour amener une quinzaine d'élèves à un camp national et pour sélectionner, pendant le camp, cinq élèves qui représenteront le Canada aux Olympiades internationales de physique.

Le Canada a commencé à participer aux Olympiades internationales de physique en 1994 et, en 1997, nous avons organisé les 28e Olympiades internationales de physique à Sudbury. John Wylie a dirigé le

Le contenu de cette revue, ainsi que les opinions exprimées, ne représentent pas nécessairement les opinions ou les politiques de l'Association canadienne des physiciens et physiciennes.

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

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

### EDITORIAL / ÉDITORIAL

comité organisateur, Chris Waltham (UBC) a présidé le comité académique pour les problèmes théoriques et Andrzej Kotlicki (UBC) a présidé le comité académique pour les expériences. Nous avons bénéficié de l'aide précieuse d'un grand nombre de professeurs d'universités de tout le Canada, qui étaient membres des comités académiques et ont noté les problèmes. Le comité d'organisation local a fait un travail fantastique avec l'aide précieuse de la population locale. Les Olympiades internationales de physique de Sudbury ont été financées par des dons, principalement d'Inco. Chaque pays participant à l'IPhO doit l'organiser à tour de rôle ; étant donné qu'il y a environ 80 pays participants presque chaque année, nous pourrons participer pendant longtemps avant que ce ne soit à nouveau notre tour.

Le financement de l'examen du prix de l'ACP pour les écoles secondaires et les cégeps provient entièrement de dons à la Fondation de l'ACP, tandis que le financement du camp national et de la participation à l'IPhO provient de la contribution de l'organisation hôte et, seulement si c'est essentiel, des étudiants participants eux-mêmes. Actuellement, le département de physique et d'astronomie de l'UBC fournit quatre unités d'assistance technique et du temps de travail, l'utilisation des salles de classe et des laboratoires, ainsi qu'une aide technique pour le camp national. Le bureau du Doyen de la Faculté des sciences met à disposition le temps de Fiona Beaty, notre collectrice de fonds très efficace.

Pendant longtemps, nous n'avons pu obtenir aucun financement des agences de financement. Il n'est pas facile d'obtenir des fonds pour un concours. Avant que Fiona ne prenne gentiment le relais, nous avons connu des années de vaches maigres, au cours desquelles nous n'avons pas pu organiser le camp national et nous nous sommes contentés de prendre les cinq meilleurs élèves de l'examen de l'ACP comme membres de l'équipe. Nous avons même dû demander aux étudiants de couvrir leurs frais de voyage à l'IPhO. Depuis des années, je couvre mes propres frais de voyage lorsque je me rends à l'IPhO en tant que responsable. Heureusement, aujourd'hui, Fiona a réussi à contacter les anciens participants aux Olympiades canadiennes de physique et quelques fondations généreuses, et nous sommes financièrement à l'abri pour quelques années.

Pendant toute la période où j'ai essayé de stabiliser le soutien financier pour ce programme, j'ai été à la fois surpris et déçu de découvrir que, à en juger par les commentaires que nous avons reçus avec les refus de nos demandes de soutien financier, et la baisse du nombre d'écoles participant à l'examen du prix École secondaire/Cégep de l'ACP, les concours semblent ne plus être valorisés dans notre système éducatif. Selon les critiques, les concours ne rendent heureux que quelques gagnants et dépriment tous les autres participants. Il est intéressant de noter que cette philosophie n'est jamais appliquée aux sports...

Il semble que cet objectif de rendre tous les étudiants heureux plutôt que d'atteindre l'excellence dans leur domaine d'étude submerge l'ensemble de notre système éducatif. En tant qu'éducateur et chercheur avec plus de 55 ans d'expérience, je trouve cela très inquiétant. Notre enseignement secondaire est entièrement financé par les contribuables, l'enseignement universitaire en partie. Je ne sais pas ce qu'il en est des autres contribuables, mais j'aime bien voir mon médecin, mon pharmacien ou mon ingénieur créer quelque chose de nouveau pour moi, heureux. Cependant, face à deux mauvais choix, je préférerais qu'il/elle soit très compétent(e) et malheureux(se) plutôt qu'heureux(se) et incompétent(e). Comment pouvons-nous espérer le plus grand progrès pour notre pays si nous ne mettons pas nos étudiants au défi d'atteindre les objectifs les plus élevés qu'ils peuvent atteindre dans leur matière ?

L'un des membres de notre équipe, Vincent Millington, m'a permis de partager avec vous un extrait de son courriel :

« Je tiens à exprimer ma gratitude aux programmes de l'IPhO et du camp de physique. Au-delà d'une simple compétition de physique, cette expérience m'a inculqué un sens de l'humilité et une éthique de travail durable. Elle m'a également donné la chance de rencontrer des gens incroyables tout en apprenant et en m'amusant. Nous avons beaucoup de chance d'avoir des personnes qui consacrent leur temps et leurs efforts à rendre ces opportunités possibles, et j'en suis vraiment reconnaissant ! »

Au vu de ces réactions et de nombreux autres commentaires positifs, nous prévoyons de poursuivre ces activités !

De nombreuses personnes sont impliquées dans le travail dont je vous parle. Merci beaucoup à tous. C'est un plaisir et un honneur de collaborer avec vous tous.

Andrzej Kotlicki, Université de la Colombie-Britannique, < kotlicki@phas.ubc.ca>

Andrzej Kotlicki est maître de conférences à l'Université de la Colombie-Britannique. Il est le chef de l'équipe canadienne des Olympique de physique.

# BIBIANA CUJEC (1926-2022)



B ibiana Cujec (née Dobovisek), was born on December 25, 1926 in Ljubljana, Slovenia, then part of the Kingdom of Yugoslavia. She grew up as a single child (an older sister had died in infancy) and she was educated by Ursuline nuns in elementary school and gymnasium. In 1945, she began studies at the University of Ljubljana, with the aim of becoming a high-school teacher. Influenced by the post-war political climate, she concentrated on physics and mathematics since, as hard, fact-based, sciences, she believed they would be less vulnerable to interference from the authorities.

Politics did influence her fate, however. When she graduated in 1950, at the time of the Tito-Stalin split, she was recruited to stay on for graduate work. A new research centre, the Josef Stefan Institute, was being established at the university as part of the Yugoslav program to obtain nuclear-weapons capability, to counter the nascent Soviet threat. With Anton Peterlin as her adviser, she began research using nuclear emulsions, first studying comic-ray interactions, with plates exposed on balloon flights by researchers at Lund University in Sweden. She later focussed on photonuclear processes, using plates exposed at Frank Goward's pioneering electron synchrotron in the UK. In 1954 the institute purchased a 31 MeV betatron and Cujec carried out her thesis research with it, earning her doctorate in 1959.

By this time, the political situation at the institute had evolved unfavourably, so in 1961 Cujec left Ljubljana. She had arranged a postdoctoral position at the University of Pittsburgh cyclotron laboratory, working in Bernard Cohen's group on experiments with 15 MeV deuterons. Since hard currency was a scarce commodity in Yugoslavia, and the prestige of nuclear physicists was still at its post-war height, Cohen was able to arrange for her travel to the US on a military transport plane flying from Frankfurt to Philadelphia. The excitement of the experience was tempered by having to leave her two young daughters, aged two and four, with their grandmother. After a lonely year, the family was reunited in 1962, when the girls flew to the US with their grandmother, and their father, who had been working in Munich, arrived by ship.

At the end of the postdoc appointment, the family moved to Edmonton and Cujec worked as a postdoc in Jack Sample's group at the University of Alberta. She used 5.5 MeV deuterons, from the van de Graaff accelerator, and a neutron time-of-flight spectrometer to study proton stripping reactions, paying close attention to the radiation-safety protocols, as she was carrying her third child at that time.

The Edmonton appointment was fixed-term, so Cujec kept an eye out for something more permanent. Lloyd Elliot, then head of the nuclear physics branch at Chalk River, offered her a position but the offer was rescinded by someone higher up in the lab administration - one can only speculate why. Elliot persisted, recommending her to Larkin Kerwin, head of the physics department at Laval University, who offered her a place as assistant professor. The timing of these events was fortunate for two reasons: Claude Geoffrion, then dean of sciences at Laval, had recently spent a sabbatical year at Columbia

### IN MEMORIAM

University where he had become acquainted with Chien-Shiung Wu. She had recently demonstrated the non-conservation of parity in nuclear beta decay, providing the evidence that led to the Nobel Prize for Tsung-Dao Lee and Chen-Ning Yang. Geoffrion needed no convincing that women could make excellent nuclear physicists and approved Kerwin's decision immediately. The second piece of luck was that Laval was building a nuclear-physics group to make use of their new van de Graaff accelerator, a twin of the Alberta machine. The university had been delayed in acquiring the facility by the government of Maurice Duplessis, which had steadfastly refused to allow Laval to accept federal funding for research infrastructure. Nuclear physics there could only begin after the Duplessis era had ended and the 'Quiet Revolution' of the 1960s got underway.

Cujec stayed at Laval for her entire career and retired as full professor in 1993 after almost 30 years of academic activity. She carried out most of her research at the van de Graaff laboratory but supplemented this with three sabbatical leave experiences. The first, during the 1971-72 academic year, was spent at Caltech, where she worked at the Kellogg Laboratory in Charlie Barnes' group and developed an abiding interest in nuclear astrophysics. She returned for another sabbatical visit seven years later, a highlight of which was coauthoring a paper with Willy Fowler, the director of Kellogg and future (1983) Nobelist.

Her last sabbatical leave (1985-86) was spent at CERN using a beam from the low-energy anti-proton ring (LEAR) to measure scattering cross-sections. That she was able to maintain a high level of teaching, research, and travel to conferences, while raising four children, is largely due to the support she enjoyed from her husband Anton. After retiring from the university she moved with him to Victoria and cared for him until his death in 2001. She remained in Victoria until 2013 when she moved to Edmonton to live with one of her daughters. She died there on September 8, 2022.

Bibiana Cujec met many challenges during her remarkable life and was deeply grateful for the opportunities she found at Laval. Her legacy not only includes her children and grandchildren but also the students there who were mentored by her at all levels, from undergraduates to postdocs. To honour her memory, two prizes, to be awarded annually, have been established at Laval. One is for a student studying physics and the other is for a student from the engineering-physics program. Both are to award graduating students who have shown exceptional aptitude for experimental work.

David Hanna, McGill University

# WILLIAM (BILL) ROSS FRISKEN (1933-2023)



B ill Frisken, experimental particle physicist and Professor Emeritus at York University, died August 8, 2023. Born in Hamilton, Ontario in May, 1933, the second son of Orval James Frisken, engineer, and Chalmers Melissa (Barrowman) Frisken, Bill grew up in a lakeside home near the village of Bridgenorth, and attended high school at the Peterborough Collegiate and Vocational Institute. He remembered his early years mainly for summer holidays spent fishing, swimming, and sailing, but during that part of his life he and his brother John each built their

own sailing dinghy, using salvaged cedar planks for the hull and discarded flour bags for sails. He and John also spent many hours tending to the needs of a vintage Model A Ford, which their father gave them on condition they earn enough money to keep it supplied with gas, oil, and tires, and that they repair it themselves. Bill and John rebuilt every part of that machine, learning a lot of auto-mechanics in the process.

Bill took the Model A with him to Queen's University, where he enrolled in Engineering Physics in Fall 1951. It was a fateful decision, for car ownership brought an introduction to Frances Code, English major and newly-appointed editor of the *Queen's Journal*. They were married on the evening of May 19, 1956, the day that Bill graduated in Engineering Physics in the morning and Frances in English Literature in the afternoon. (They celebrated their 67<sup>th</sup> anniversary this past May.)

In Fall 1956 Bill began graduate studies at Queen's for his MSc degree, for which he built an apparatus to study the angular correlation of nuclear gamma rays using two scintillation counters. And so began what he would later describe as his "long and exciting career in experimental particle physics." In the fall of 1957, a graduate scholarship took him and Frances to the University of Birmingham, which was operating a small 1 GeV proton synchrotron. He joined a group investigating mesons created in protonproton collisions using a bubble chamber (first reported by Don Glasser four years earlier) and a more sophisticated version of his scintillation counter apparatus. After receiving his Ph.D in the summer of 1960 he returned to Canada to join McGill University as an assistant professor. This was followed by a move to Long Island, New York, in 1964 where Bill began work as an associate scientist at Brookhaven National Laboratory where he designed detector systems for particles produced in proton-proton and meson-proton collisions, around the time when particle physicists were just beginning to realize that "elementary" particles like protons and neutrons were not elementary at all, but dynamic assemblies of smaller particles (later termed quarks and gluons). The next move was to Cleveland, Ohio, where Bill had secured an appointment as Associate Professor at Case Western Reserve University (CWRU). During his time at CWRU, he collaborated on experiments at Argonne, scattering charged pions from protons, producing neutral pions and neutrons, again challenging the elementary nature of these particles.

Bill took a break from particle physics starting in the summer of 1971 when he contracted with Resources for the Future (RFF), a U.S. think tank, to produce a report summarizing scientific research

being done on climate change. This work eventually resulted in two lengthy review articles, "Extended Industrial Revolution and Climate Change" (1971) and "The Atmospheric Environment of Cities" published by RFF in a single volume, *The Atmospheric Environment*, in 1973. It also led to his return to Canada in 1971 as a professor of environmental physics at York University. He spent several years working in environmental physics in the early days when scientists began to think seriously about climate change.

But the solar neutrino crisis of the early 1970's brought him back to particle physics and he began working on experiments at Fermilab developing tracking calorimeters for neutrino-proton scattering experiments. It was around this time that the Institute of Particle Physics (IPP) of Canada was formed to promote collaboration in particle physics research among Canadian universities. Bill soon became heavily involved in an IPP proposal to build a circular accelerator in which to collide high energy electrons and protons. While the IPP first planned to develop this collider at Fermilab in Chicago as the Canadian High Energy Electron Ring (CHEER), the proposal eventually came to fruition as the Hadron-Electron Ring Accelerator (HERA) at the Deutsches Electronen Synchrotron laboratory (DESY) in Hamburg, Germany. Bill was a key player in Canada becoming the first country to support and contribute to HERA. During this period, Bill also helped design and build a sophisticated cylindrical vertex drift chamber for the  $e^+ - e^-$  collider experiment ARGUS at DESY, which opened a window into understanding bottom quark physics and made the important discovery of  $B^0 - \overline{B^0}$  mixing in 1987.

The IPP was a major collaborator in the ZEUS experiment carried out in the HERA collider, which began operation in 1991 and collected data until 2007. For ZEUS he spearheaded the development of a huge laboratory in Markham, Ontario where he and colleagues from McGill and the University of Toronto designed and built several tonnes of specialized calorimeters to measure the energies of particles scattered from HERA electron-proton collisions. ZEUS and other HERA experiments contributed enormously to the understanding of the internal quark and gluon structure of the proton.

Bill continued to pursue more physics after he retired in 1996, investigating superconducting radio frequency accelerator cavities, giving his last scientific presentation in 2005. Many undergraduates, graduate students, and post-doctoral fellows benefitted from his well-known imaginative expertise in designing and constructing unique particle detectors. All his colleagues greatly enjoyed the infectious wit with which he communicated his ideas.

Barbara Frisken, Simon Fraser University John Martin, University of Toronto

For more about Bill Frisken's career in Physics, please check out his memoir entitled <u>WRF – My Life in</u> <u>Physics</u>, accessible from the History section of the webpage of <u>York U's Department of Physics and</u> <u>Astronomy</u>.

## REPORT ON CANADA'S PARTICIPATION IN THE 53RD INTERNATIONAL PHYSICS OLYMPIAD IN TOKYO, JAPAN



By ANDRZEJ KOTLICKI (<<u>kotlicki@phas.ubc.ca</u>>, University of British Columbia)

he 53rd International Physics Olympiad (IPhO) took place from July 9 to July 17, 2023 in Tokyo, Japan. It was great to see the IPhO running in-person after a 3-year COVID break.

### ACADEMIC PROGRAM

Japanese organizers did a fantastic job creating, analyzing and marking Olympiad problems. The Academic Committee worked perfectly with two Nobel prize winners and a large number of distinguished professors from various branches of physics who participated. The problems were very well designed not only to challenge the best high school physics students in the world but also to interest them in subjects of physics usually not taught in schools and to teach them some new skills. The International Board discussion resulted in very few significant changes to the problems.

It was amazing to realize how much support this high school competition had from leading Japanese physicists, universities and their educational authorities, as well as leading industrial companies that sponsored the event. Companies like Toshiba, Hitachi, Casio, Honda, Hamamatsu, Nikon and Toyota, just to name a few, were on the sponsor list.

The first experimental problem was loosely based on the Kibbel balance. It asked students to measure the mass of a cylindrical oscillator and the mass of additional weights by measuring the static and dynamic characteristics of the oscillating system.

The second experimental problem asked students to measure the thickness of a birefringent quartz crystal by measuring the light from the white (phosphor-based) LED propagating through the crystal at certain polarizations. The light from the LED was passed through a transmission diffraction grating, which could be rotated allowing the different wavelengths of the LED to pass through the crystal placed between 2 polarizers.

Both problems required a careful assembly of the experimental setup, making precise measurements, graphing them, calculating the results and analyzing the experimental errors. It was an excellent test of the students' experimental skills.

The first theoretical problem was related to analyzing the Brownian motion of colloidal particles, electrophoresis and coagulation of colloidal particles for the purification of water.

In the second theoretical problem students had to analyze the giant nucleus stability related to neutron stars and then to calculate the period of the pulsar (a neutron star in a binary system) including relativistic effects. They also had to analyze the gravitational waves produced by a binary system of neutron stars.

The third theoretical problem was related to phenomena arising from the interaction between water and objects due to surface tension. The merging of two droplets of water on a hydrophobic surface amazingly leads to a jump of the resulting bigger droplet. Students had to calculate the height of the jump and then analyze the general case of forces acting between the floating objects.

The problems were difficult, with a best overall score of 90.4%.

### OUR TEAM

Olympiad participants representing Canada are drawn from the highest scoring students in the Canadian Association of Physicists (CAP) High School Prize Exam competition, held annually in spring across participating high schools in Canada. This national exam allows students to compete on physics problems reflecting the High School IB curriculum. This year, the CAP exam was written by 568 students from 100 schools. This number of participants was almost double the number who wrote the CAP exam last year, but we are still not up to pre-Covid numbers.



Figure 1. National Olympiad Training Camp participants. Back row from left to right: Team leader Andrzej Kotlicki, Dongli Tian, Parth Sheth, Tristan Yan-Klassen, Zander Li, Wenhe Zhang, staff Sajjan Grewal; middle row: Ryan Marshall, Vincent Millington, Qi Xuan Ding, Anthony Lu, Connor Wong, Yushan Wang; front row: Eric Shao, Tian Pu; front kneeling: Daniel Chane, Zichong Wang. Students who have the top score nationally in this exam are personally invited to train at the National Olympiad Training camp, held on the UBC campus in Vancouver, as preparation for the selection of our national team who will compete in the IPhO World Physics finals. It is through the generosity of our sponsors that we are able to organize this 8-day Olympiad National Training Camp for the 15 top student placements from the CAP High School Exam. Over the week, participants worked, studied and tested with graduate students and faculty trainers, meeting UBC physics scientists and touring physics facilities.

It is worth mentioning that our National Training camp focused on desperately trying to fill the enormous gap between the IPhO syllabus and the scope of physics taught in Canadian schools. The lectures (covering in one hour the material usually presented in a few weeks of normal teaching) and labs introduced students to new concepts and skills. The camp tests were related to new subjects so we were not testing students' memorized knowledge but their ability to use new materials and skills to solve problems.



Figure 2: The members of the Canadian team. From left to right: Wenhe Zhang (Marianopolis College QC, student of Baharak Fatholahzadeh), Connor Wong (St. George's School BC, student of Nathan Moens), Team leader Dr. Andrzej Kotlicki (UBC, Director for the Canadian Physics Olympiad Program), Team leader Dr. Lior Silberman Professor of Mathematics at UBC and past IPhO contestant for the 1994 Israeli team), Vincent Millington (Cégep de Sainte-Foy QC, student of Maxime Verreault), Eric Shao (Semiahmoo Secondary School BC, student of Louay El Halabi). In front: Zander Li (Laurel Heights Secondary School ON, student of Nathan Zehr).

Over the week, our campers worked well together both in physics work and study to physics social time. We were impressed with their curiosity and determination to succeed.

At the end of the week, the top five scorers were selected as our IPhO National team.

### ORGANIZATION AND RESULTS

The opening and closing ceremonies, as well as the exams, were held in the National Olympics Memorial Youth Center. At the opening ceremony, the formal speeches presented by the Japanese Minister of Education, the IPhO President, and the head of the organizing committee were welcoming and concise. The Japanize drum show and Karate demonstration were amazing.

During the time between and after the exams the participants had the pleasure of hearing two lectures by two Nobel prize winners: professors Kajita Takaaki on neutrinos and Amano Hiroshi on the discovery of blue diode. There were many excursions offered: around Tokyo, to Asakusa and Ueno, Odaiba, Hakone, Tsukuba, Nikko and Kamakura. The participants had a chance to visit some amazing temples, palaces and museums. The closing ceremony had again some short speeches and was illustrated by Koto music and a great juggling show.

86 teams participated in this year's Olympiad. There were 3 guest teams (first time participants) and one team of individual participants from Russia.



Figure 3. Our team with medals after the opening ceremony. From left: Japanese guide who took care of our team, Wenhe Zhang, Zender Li, Eric Shao, Connor Wong, Vincent Millington, and Team leader Andrzej Kotlicki.

Our students did fairly well, considering the limitations of a short training period (one intensive week as compared to countries holding multiple gold medalists, who train their teams for 1 to 2 years).

Connor Wong, Wenhe Zhang, Eric Shao and Zander Li received bronze medals and Vincent Millington honorary mention. Connor was very close to silver (received a top score amongst the bronze medalists) and Vincent was very close to bronze.

At the end of the closing ceremony the Iranian leader (in charge of the Iranian team since 1989), Professor Ahmad Shirzad, invited all participating countries to participate in the 54th International Physics Olympiad in 2024 to be held in Isfahan, Iran.

Participating in the Canadian Olympiad final camp and IPhO is a tremendous opportunity for high school students to meet others with similar skills and interests, and to build long-lasting friendships and connections with the brightest physics talents around the world.

### ACKNOWLEDGEMENTS

Many thanks to our sponsors, whose support made Canadian student participation in this prestigious competition possible:

- The Department of Physics and Astronomy, UBC
- The Trottier Family Foundation
- Sonny Chan, IPhO alumnus (1998,1999) and medalist
- TRIUMF, Canada's Particle Accelerator
- The University of Toronto Schools

# UNVEILING THE MARVELS OF PARTICLE PHYSICS: OUR JOURNEY TO CERN



By EDWARD CSUKA (<u>ECsuka@sd43.bc.ca</u>, Coquitlam School District), APRIL BUTLER (<u>abutler@gnspes.ca</u>, West Kings District High School), ADAM MILLS (<u>adam\_mills@wecdsb.on.ca</u>, Assumption College Catholic High School), and ERIC SIMONSON (<u>esimonson@sd61.bc.ca</u>, Oak Bay High School)

**SUMMARY**: This article chronicles the extraordinary journey of four Canadian high school physics teachers to CERN, the European Organization for Nuclear Research, in Geneva, Switzerland. Sponsored by the Canadian Association of Physicists, The Perimeter Institute for Theoretical Physics, and the Institute for Particle Physics, our expedition was a testament to the unity of global scientific pursuit. Through this immersive experience, we delved into the heart of particle physics, witnessed groundbreaking research, exchanged pedagogical practices, and forged international connections. This article serves to illuminate the transformative power of CERN and its impact on science education.

### A SHINING BEACON OF UNITY

ERN, the European Organization for Nuclear Research, is a symbol of human achievement that transcends borders, politics, and conflicts. Nestled on the Franco-Swiss border near Geneva, Switzerland, CERN is a sprawling scientific campus that has become synonymous with groundbreaking research in particle physics. Established in 1954, it has since evolved into one of the world's most iconic and influential scientific institutions.

At its core, CERN is driven by a singular mission: to unravel the mysteries of the universe by studying the fundamental particles that make up everything around us. This mission is realized through colossal scientific experiments conducted with a spirit of cooperation that knows no boundaries. CERN's scientists, researchers, and engineers come from diverse cultural backgrounds and corners of the globe, even scientists from nations currently engaged in armed conflict can unite at this international hub of scientific inquiry.

#### UNVEILING THE MARVELS OF PARTICLE PHYSICS ... CSUKA (ET AL.)

CERN operates on a truly global scale, with 23 member states and countless partner institutions from around the world. Its collaborative nature is encapsulated in the organization's motto: "Science for Peace." This ethos reflects the belief that scientific knowledge is a common heritage of humanity, and that by pooling resources and knowledge, we can achieve profound discoveries that benefit all.

One of CERN's most iconic achievements is the Large Hadron Collider (LHC), a colossal scientific instrument that spans a circumference of 17 miles (27 kilometers) beneath the Earth's surface (Figure 1). The physicists who operate the LHC are conducting the world's largest ever scientific experiment. It propels subatomic particles to nearly the speed of light before smashing them into one another, allowing scientists to observe the resulting subatomic debris and gain insights into the fundamental building blocks of matter.



Figure 1. April Butler is posing beside a poster of the tunnel housing the collider. The poster shows one of the Large Hadron Collider's 1,232 dipole magnets, which are designed to bend the particles' paths as they travel around the beamline.

CERN's impact extends far beyond the boundaries of particle physics. It is a beacon of unity, bringing together scientists, educators, and students from all walks of life to engage in collaborative research and exchange of knowledge. It inspires awe and curiosity not only among those within its gates but also among people worldwide, igniting a passion for science and exploration.

CERN's commitment to education and outreach is exemplified through programs like their two International High School Teacher programmes, which bring together educators from across the globe, including the four of us from Canada. CERN's Science Gateway, an outreach project currently under development, further underscores its dedication to making science accessible to the public and fostering the next generation of scientists.

During our time at CERN, we had the privilege of witnessing the incredible scientific instruments and experiments used in particle physics research. One of the most striking moments came when we learned about the humble beginnings of particle detectors. In the early days of research, scientists used simple objects like pots – yes, ordinary cooking pots – as makeshift particle detectors when they couldn't find more suitable equipment. This revelation was a poignant reminder of the resourcefulness of scientists and the determination to explore the unknown, even with limited means. The sight of a simple pot transformed into a scientific tool spoke volumes about human curiosity and the relentless pursuit of deeper knowledge.

### GLOBAL GATHERING OF EDUCATORS AT CERN

The High School Teacher Programme at CERN is a profound immersion in the power of international collaboration. For the last 25 years CERN has been bringing together educators from around the world. In the summer of 2023, 78 physics teachers from 32 different countries were united in two groups stewarded by Educational Outreach leader, Jeff Wiener. Our shared passion for science education had united us in a unique global gathering of educators, each bringing a distinctive background, perspective, and teaching style to the table.

The diversity within our group emphasized the universal language of science. Whether from North America, South America, Asia, Europe, or Africa, we had convened at CERN driven by a common objective: to deepen our grasp of particle physics and ignite inspiration in our students. Conversations in the cafeteria ranged from particle detectors' intricacies to innovative methods for conveying complex scientific concepts to young learners. We were engaged in a truly global exchange of ideas and knowledge.

This diverse convergence underscored the critical role of international collaboration in scientific research. Science recognizes no borders, a principle epitomized by CERN. The institution's existence hinges on contributions from member states and partner institutions worldwide. For instance, the Large Hadron Collider is the largest scientific experiment ever conducted by humankind and its creation was a monumental cooperative endeavor, with scientists and engineers from diverse countries working seamlessly to push the boundaries of human knowledge.

Our interactions with educators from various nations enriched our insights into diverse approaches to science education. We swapped teaching techniques, discussed educational system challenges in our respective countries, and explored innovative ways to engage students in scientific exploration. This dynamic exchange broadened our horizons as educators and fostered enduring friendships.

Our time at CERN extended beyond classrooms and lecture halls, allowing us to forge strong bonds. Shared experiences, such as bowling and pizza nights, movie screenings, international gift exchanges, and even impromptu ceilidh dancing lessons, created connections that will endure long after our Geneva visit. These cultural exchanges were as profound as our scientific discoveries, emphasizing the significance of nurturing connections between individuals from various corners of the globe.

### LEARNING FROM THE FOREFRONT AT CERN

Our CERN experience was a rare opportunity to glean insights from some of the world's brightest minds in the field of particle physics. During our visit, we had the privilege of engaging in discussions and lectures with these luminaries. Interactions with leading physicists and researchers at CERN granted us firsthand exposure to groundbreaking work and profound understandings of their achievements. Each encounter was an immeasurable educational experience, expanding our comprehension of the universe and the enigmas of particle physics.

Numerous tours of active experiments were expertly intertwined with our lectures and discussions. There is something about taking an elevator down 100 meters underground to visit the LHC's Compact Muon Solenoid (CMS) that brings a sense of awe and wonder (Figure 2). The CMS is one of four giant particle detectors that acts like a camera, taking snapshots of the aftermath of high-speed proton collisions. The magnetism of this device is so strong that a string of paper clips defies gravity and strikingly turns sideways toward the detector.



Figure 2. Edward Csuka standing in front of a life-size poster showing CERN's 15 meter tall Compact Muon Solenoid (CMS) particle detector.

Another remarkable experience was delving into antimatter research alongside Dr. Sameed, who provided insights into the Alpha G experiment. Antimatter, the enigmatic counterpart to the matter composing the visible universe, remains one of the most puzzling aspects of particle physics. Dr. Sameed's passion for his work was palpable, and his explanations offered glimpses into the intricacies of antimatter research.

Our journey also led us into the realm of Higgs boson exploration, a particle discovery that sent seismic ripples through the physics community. We had the privilege of engaging with physicists like Luis Roberto Flores Castillo, who stand at the vanguard of this groundbreaking research. Their explanations illuminated the significance of the Higgs boson and its role in shaping our comprehension of the fundamental forces governing the cosmos.

Beyond particle physics, we ventured into medical research at CERN, where scientists like Manjit Dosanjh are pioneering innovative techniques and technologies. These applications of particle physics in the medical field broadened our horizons and underscored the far-reaching impacts of fundamental research. Our encounters with these luminaries left enduring imprints on our grasp of physics and the potential that lies ahead.

### IGNITING TOMORROW'S SCIENTISTS

The High School Teacher Programme allowed us to amass a treasury of ideas and strategies to kindle the flames of curiosity and passion for science among our students. CERN's dedication to education and outreach inspired us, equipping us with the inspiration needed to shape the future of budding scientists.

One of the most profound lessons from our time at CERN was the realization and confirmation that science education transcends textbooks and classrooms. The real world of science is dynamic, engaging, and filled with opportunities for hands-on exploration. We discovered that students thrive when they can connect their learning to the real world, and CERN furnished us with tangible examples to bring into our classrooms.

For instance, we were introduced to educational programs that employ LEGO, the beloved building blocks, to impart complex particle physics concepts in an accessible way. This innovative approach illustrates how abstract ideas can be made tangible and relatable to young minds, motivating us to incorporate similar hands-on methods to make scientific principles come alive for our students.

The Cloud Chamber demonstration was another eye-opening experience. It allowed us to visualize subatomic particle paths as they interacted with matter, offering the opportunity to "see" the invisible world of particle physics. This hands-on experiment proved a powerful tool for demystifying complex concepts and igniting curiosity among students, inspiring us to provide similar experiences in our own classrooms.

Furthermore, our comprehensive tour of the Large Hadron Collider (LHC) and its operational insights were invaluable resources to bring back to our students. These insights allowed us to explain the intricate science behind the LHC in an accessible and relatable manner. We realized that sharing the

immense scale of the LHC and the global collaboration it embodies could inspire students to appreciate the beauty of teamwork and the grandeur of scientific exploration.

Our time at CERN underscored the importance of nurturing curiosity and critical thinking in our students. The concept maps shared by Milena Vujanovic, a CERN expert in education outreach, provided practical tools to encourage students to connect ideas and visualize the interplay of scientific concepts. These strategies are essential for cultivating a deep and enduring passion for science.

Strategies to ignite curiosity and passion for science:

- Inquiry-Based Learning: We embraced the idea that curiosity is the driving force behind scientific discovery. Encouraging students to ask questions, investigate, and find answers fosters a love for learning. We adopted inquiry-based learning methods to empower students to take ownership of their scientific explorations.
- 2. Storytelling: We realized the power of storytelling in making science relatable and engaging. Sharing the stories of scientific discoveries, struggles, and the human element behind research can captivate students' imaginations and inspire them to pursue scientific careers.
- 3. Interdisciplinary Connections: CERN's multidisciplinary approach highlighted how science transcends traditional boundaries. We encouraged students to explore connections between physics, mathematics, engineering, and other disciplines, emphasizing the holistic nature of scientific inquiry.

### BROADER PERSPECTIVE GAINED FROM CERN'S RESEARCH

CERN's research extends far beyond the confines of particle physics. It delves into the very essence of our universe, seeking answers to questions that have puzzled humanity for centuries. By studying the fundamental building blocks of matter and the forces that govern them, CERN's scientists are unraveling the secrets of the cosmos.

Our visit allowed us to grasp the interconnectedness of all things. We saw how the tiniest particles, invisible to the naked eye, play a crucial role in the grand tapestry of the universe. CERN's research reminds us that even the smallest components of our world are intertwined with the most significant cosmic phenomena, creating a holistic understanding of reality.

CERN's pursuit of knowledge is, at its core, a quest to explore the origins of the universe. It seeks to answer questions about the Big Bang, the formation of galaxies, and the nature of dark matter and dark energy. This endeavor reminds us of humanity's insatiable desire to understand its place in the cosmos and to trace its origins back to the very beginning.

The research at CERN ignites our imagination and reminds us that we are the descendants of stardust, born from the fusion of atoms in the hearts of ancient stars. It invites us to contemplate the surprisingly deep connections between the smallest particles and the vast expanses of the universe, fostering a sense of wonder and humility.

In conclusion, our journey to CERN provided us with a new perspective on everyday objects and the broader implications of scientific research. It revealed the resourcefulness of scientists, the

interconnectedness of all things, and the potential of humanity to explore its origins. It reinforced our belief that science is not confined to the laboratory but is a journey of discovery that unites us all in the quest to unlock the mysteries of the cosmos. As Ralph Waldo Emerson once wrote: "The mind, once stretched by a new idea, never returns to its original dimensions." Our minds have been stretched, and we are forever changed by the awe-inspiring journey through the world of particle physics at CERN.

### ACKNOWLEDGEMENTS

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# CONGRATULATIONS / FÉLICITATIONS! 2019 STUDENT PRIZE WINNERS / GAGNANTS DES PRIX POUR LES ÉTUDIANT(E)S 2019

# 2019 UNIVERSITY PRIZE EXAM RESULTS / RÉSULTATS DE L'EXAMEN DU PRIX UNIVERSITAIRE 2019

The 2019 examination was coordinated by the University Prize Exam Committee, chaired by Christine Kraus, Laurentian University. The exam was written by 66 students from 15 universities/colleges.

Cette année, 66 étudiants de 15 universités ont participé au concours universitaire et qui était administré par le commité d'examen du prix universitaire, présidé par Christine Kraus, Université Laurentienne.

First prize/Premier prix	Jonathan Zhang	University of British Columbia
Second prize/Deuxième prix	Matthew Gerry	University of Toronto
Third prize/Troisième prix	Jonathan Corbett	Queen's University

- 4. Pedram Amani, University of British Columbia
- 5. Pierre-Antoine Bernard, Université de Montréal
- 7. Jonathan Boretsky McGill University
- 8. Twesh Upadhyaya, University of Toronto
- 9. Mathew Schneider, Simon Fraser University
- 10. Benjamin Lamoureux, University of Alberta
- 6. Emilie Hertig, University of British Columbia

## 2019 CAP HIGH SCHOOL-CÉGEP PRIZE EXAM NATIONAL WINNERS / L'EXAMEN DU SECONDAIRE OU COLLÉGIAL DE L'ACP – GAGNANTS À L'ÉCHELLE NATIONALE 2019

First prize/Premier prix	Li Zhening	Sir John A. Macdonald Secondary, ON
Second prize/Deuxième prix	Xu Yuheng (Jack)	Unionville High School, ON
Third prize/Troisième prix	David Tang	University of Toronto Schools, ON

### 2019 CANADA-WIDE SCIENCE FAIR PRIZES / PRIX DE L'EXPO-SCIENCES PANCANADIENNE 2019

The 2019 Canada-wide Science Fair was held from May 15-17 in Fredericton, NB. This year the CAP sponsored prizes at each of the "senior", "intermediate" and "junior" categories:



Figure 1. 2019 CWSF prize winners (from left to right): Cyril Mani (senior), Jarek Osika (intermediate), and Krish Modi (junior) with Ben Newling (UNB), the CAP's Director of Student Affairs.

### SENIOR CAP PHYSICS PRIZE - CYRIL MAINI, QC

Project: Democratizing Aerospace Technologies: A Novel Approach to Space R&D

**Biography:** Animé par la philosophie qu'il y a quelque chose à apprendre de toute situation, expérience et personne, je m'applique sans relâche et avec détermination à rencontrer, explorer et développer des opportunités pour me dépasser et devenir. Pour ce faire, je participe à une panoplie d'activités tel que le débat oratoire en tant que capitaine de l'équipe de mon école. J'ai aussi fondé ma propre startup sociale, au nom de Micreau, qui s'occupe de stimuler l'ingéniosité des jeunes par l'entremise de projets innovants dans les écoles du Québec. Mon chemin pour l'instant me dirige vers le génie aérospatial puis un possible MBA pour poursuivre dans l'administration scientifique, car je ne pourrais vivre dans un quotidien qui ne côtoie pas l'innovation. Je suis lauréat de la bourse avenir de l'Ordre des Ingénieurs du Québec et du prix de l'Ordre des Géologues du Québec. Souvent perdu dans la lune, mon rêve a toujours été et reste de travailler à l'agence spatiale canadienne comme astronaute pour une ventuelle colonisation de Mars et si je ne peux être la personne a y mettre le pied, je veux être part du projet. Jechante du Elvis Presley en cuisinant avec mon père pour relaxer.

**Abstract:** Mon projet cherche à démocratiser la recherche et développement des technologies aérospatiales en offrant un exemple de comment tous et chacun peuvent s'y intéresser et y apporter leurs innovations. Avec un budget et des ressources limitées, j'ai intégralement conçu, prototypé et produit une fusée multi-étage autonome dans mon garage (carburant, moteur, système aéronautique, fuselage, bouclier thermique, etc) avec des matériaux et procédés accessibles à tous.

### INTERMEDIATE CAP PHYSICS PRIZE - JAREK OSIKA, FLIN FLON, MB

#### Project: Radio Eyes? Blackhole Hunter

**Biography:** Hello! My name is Jarek Osika, I am a grade 9 student at Hapnot Collegiate School in Flin Flon Manitoba and I am 15 years old. I like science, computers and anything outdoors. I have a whole YouTube channel focused on science and projects. It is called Itz Jarek! My science fair project is on radio telescope interferometer tuned to 2.4 GHz to detect a black hole object called Cygnus A. My radio telescope is made for sensing radio waves from outer space and graphing them on a computer using a Lime Software defined radio processor board along with some other components. I have been very interested and astounded by astronomy ever since I was little so I thought this project would be the right choice for me as I have been taking it farther each year. I am planning to keep going with this project as the years go by, I have been improving it every year to make it better and make it be able to detect more things farther away. If you are entering the science fair, I encourage you to research and make a project on a topic you are interested in.

**Abstract:** My project is building a software defined radio telescope interferometer to detect the blackhole object Cygnus A in the Swan constellation 600,000,000 light years away from Earth from my backyard. I am using two 33 inch microwave dishes tuned to 2.4 GHz with homemade bi-quad feeds made from copper wire, brass plating and coax cable.

### JUNIOR CAP PHYSICS PRIZE - KRISH MODI, SARNIA, ON

### Project: 'No to Photo'? My Photo Consent

**Biography:** My name is Krish Modi and I am in eighth grade and attend Rosedale Public School in Sarnia, Ontario. I enjoy participating in a variety of extracurricular activities from academics to sports. I have been an Air-Cadet for two years. In Air-Cadets, we learn leadership, marketing, teamwork, and survival skills, all of which have helped me a lot. I aspire to participate in STEM-related activities and competitions. Some of which include: Mathletics, Math Kangaroo, Caribou Math, and of course the Science Fair. I have also been the lead programmer on my FLL Robotics team. Playing soccer, swimming, and coding are some of my hobbies. This thirst for STEM-related knowledge has driven me to participate in the Lambton County Science Fair for the sixth time. This year, I have explored the negative effects that photos taken without consent, have on an individual. I have devised a wearable device which when worn will distort any photo or video taken by any camera. A multitude of mathematical, physical, and hypothetical experiments were conducted which suggest that this is a plausible solution. I have been fortunate enough that my regional science fair selected me to participate in my first Canada-Wide Science Fair.

**Abstract:** Photos taken without consent and used for cyber-shaming have damaging effects on individuals. A wearable device is developed which emits a powerful, invisible, pulsing light in a wide angle using an efficient optics arrangement to distort an image taken by any camera. No such device or mechanism is available till date. A working prototype created using information gathered from various experiments is a plausible solution.

# CONGRATULATIONS / FÉLICITATIONS! 2020 STUDENT PRIZE WINNERS / GAGNANTS DES PRIX POUR ÉTUDIANT(E)S 2020

# 2020 UNIVERSITY PRIZE EXAM RESULTS / RÉSULTATS DE L'EXAMEN DU PRIX UNIVERSITAIRE 2020

The 2020 examination was held virtually on February 4 and was coordinated by the University Prize Exam Committee, chaired by Christine Kraus, Laurentian University. The exam was written by 51 students from 11 universities/colleges.

Cette année, 51 étudiants de 11 universités ont participé au concours universitaire. IL'examen s'est déroulé virtuellement le 4 février et qui était administré par le commité d'examen du prix universitaire, présidé par Christine Kraus, Université Laurentienne.

First prize/Premier prix	Samuel Li
Second prize/Deuxième prix	Hanzhen Lin
Third prize/Troisième prix	An Zihe

- 4. Kehui Li, University of Toronto
- 5. Eric Culf, University of Ottawa
- 6. Pierre-Antoine Bernard, Université de Montréal

University of Toronto University of Toronto University of Toronto

- 7. Pedram Amani, University of British Columbia
- 8. Wucheng Zhang, University of British Columbia (tie)
- 8. Zhi Han, University of Alberta (tie)
- 9. Leo Goutte, McGill University

### OTHER 2020 STUDENT PRIZES / AUTRES PRIX 2020 POUR ÉTUDIANTS

The High School/Cégep Prize Exam and the Canada Wide Science Fair were not held in 2020 due to Covid-19.

L'Examen du prix du secondaire ou collégial de l'ACP et l'Expo-sciences pancanadienne n'ont pas eu lieu en 2020 en raison de la COVID-19.

# CONGRATULATIONS / FÉLICITATIONS! 2021 STUDENT PRIZE WINNERS / GAGNANTS DES PRIX POUR LES ÉTUDIANT(E)S 2021

# 2021 UNIVERSITY PRIZE EXAM RESULTS / RÉSULTATS DE L'EXAMEN DU PRIX UNIVERSITAIRE 2021

The 2021 examination was held virtually on March 9 and was coordinated by the University Prize Exam Committee, chaired by Christine Kraus, Laurentian University. The exam was written by 61 students from 14 universities/colleges.

Cette année, 61 étudiants de 14 universités ont participé au concours universitaire. L'examen s'est déroulé virtuellement le 4 février et qui était administré par le commité d'examen du prix universitaire, présidé par Christine Kraus, Université Laurentienne.

First prize/Premier prix	Samuel Li	University of Toronto
Second prize/Deuxième prix	Qiu Shi Wang	McGill University
Third prize/Troisième prix	Pedram Amani	University of British Columbia
4. Tony An, University of Toronto 5. William Francis, Queen's University 6. Qi Lin Xue, University of Toronto		8. Jay Epstein, University of Toronto (tie) 9. Ryan Ripsman, University of Toronto (tie) 10. Ryohei Weil, University of British

Columbia

The High School/Cégep Prize Exam was not held in 2021 due to Covid-19.

7. Adrien Yeung, Simon Fraser University

## 2021 CANADA-WIDE SCIENCE FAIR PRIZES / PRIX DE L'EXPO-SCIENCES PANCANADIENNE 2021

The 2021 Canada-Wide Science Fair was held virtually from May 17-21. The CAP sponsored prizes at each of the "senior", "intermediate" and "junior" categories.

### SENIOR CAP PHYSICS PRIZE - ADAM PATTON, KAMLOOPS, BC



**Project:** The Shapes of the Future - Increasing Electrode Efficiency in Electrolysis for Hydrogen Production

**Abstract:** Hydrogen is a promising alternative fuel because it can be made using the world's most common resource, water, through the process of electrolysis. Currently, this process uses expensive platinum electrodes for hydrogen production; for this reason, the cost-effective method of steam reforming is utilized to produce hydrogen which has a carbon footprint. The goal of this project was to increase the efficiency of alternative alloys in the process of electrodes. It was discovered that developing readily available alloy electrode shape combinations could increase hydrogen production by 22% and reduce deterioration by 61%. From these results, two electrode shapes were

created; one design, a dimple hexagonal bar, increased hydrogen production by 26% and decreased deterioration by 63%. This project successfully demonstrates that alternative electrode materials can be used for hydrogen fuel production, allowing clean hydrogen fuel to be economically produced utilizing electrolysis.

### INTERMEDIATE CAP PHYSICS PRIZE – MITCHELL CLAPPERTON, BAY AREA, ON



**Project:** The Creation & Optimization of a Wake Mitigation Device Using Computational Fluid Dynamics

**Abstract:** Recreational boat wakes can have significant negative impacts on the natural and built environment, and this project set out to seek a technical solution to that problem. Using 3D computer aided design modelling software and computational fluid dynamics, I created a Wake Simulation Model to simulate a boat moving through water at a variety of fixed speeds in order to quantify the wakes produced. I investigated options and determined that the incorporation of a wake mitigation device positioned on the bow of a boat could achieve significant wake reductions. Tests were conducted to find the optimal mitigation device design, size and location for various modes of boat operation. I was able to demonstrate a

reduction of 42% in wake energy through my preferred design.

# JUNIOR CAP PHYSICS PRIZE – TÉO L'ITALIEN, DISTRICTS FRANCOPHONES DU NOUVEAU-BRUNSWICK – NEW BRUNSWICK



Project: Le réjuvénateur de marqueurs

**Abstract:** Je m'appelle Téo et je suis un garçon très curieux. C'est pour ça que je me suis demandé s'il y avait un moyen de donner une deuxième vie aux marqueurs qui ne fonctionnent plus. Et j'ai trouvé ! J'ai inventé une machine dans laquelle on peut mettre des marqueurs qui semblent ne plus fonctionner afin de leur permettre d'être encore utilisables. Cette machine fonctionne en utilisant la force centrifuge et elle fait tourner les marqueurs très rapidement ce qui fait en sorte que l'encre restante dans le marqueur est repoussée vers le bout avec lequel on écrit. Ma machine s'appelle le Réjuvénateur de marqueurs. À mon avis, il est très important de pouvoir réutiliser les marqueurs qui ne fonctionnent plus afin de réduire le gaspillage, protéger l'environnement et économiser de l'argent.

# CONGRATULATIONS / FÉLICITATIONS! 2022 STUDENT PRIZE WINNERS / GAGNANTS DES PRIX POUR LES ÉTUDIANT(E)S 2022

# 2022 UNIVERSITY PRIZE EXAM RESULTS / RÉSULTATS DE L'EXAMEN DU PRIX UNIVERSITAIRE 2022

The 2022 examination was held virtually on March 22 and was coordinated by the University Prize Exam Committee, chaired by Christine Kraus, SNOLAB. The exam was written by 57 students from 18 universities/colleges.

Cette année, 57 étudiants de 18 universités ont participé au concours universitaire. IL'examen s'est déroulé virtuellement le 22 mars et qui était administré par le commité d'examen du prix universitaire, présidé par Christine Krause, SNOLAB.

First prize/Premier prix	Ryohei Weil
Second prize/Deuxième prix	Samuel Li
Third prize/Troisième prix (tie)	Amirali Atrli
Third prize/Troisième prix (tie)	Qiu Shi Wang

- 5. Frédéric Duong, McGill University
- 6. (tie) Adam Prus-Czarnecki, University of Alberta
- 6. (tie) Benjamin Lamoureux, University of Alberta

University of British Columbia University of Toronto University of Toronto McGill University

- 6. (tie) Tony An, University of Toronto
- 9. Kevin Lin, University of British Columbia
- 10. (tie) Emily Mellors, University of British Columbia Okanagan
- 10. (tie) Sean Lan, University of British Columbia

## 2022 CAP HIGH SCHOOL-CÉGEP PRIZE EXAM NATIONAL WINNERS / L'EXAMEN DU SECONDAIRE OU COLLÉGIAL DE L'ACP – GAGNANTS À L'ÉCHELLE NATIONALE 2022

First prize/Premier prix	Victor Gao	Bayview Secondary School, ON
Second prize/Deuxième prix	Connor Wong	St. George's School, BC
Third prize/Troisième prix	Yuehan Hu	Bayview Secondary School, ON

## 2022 CANADA-WIDE SCIENCE FAIR PRIZES / PRIX DE L'EXPO-SCIENCES PANCANADIENNE 2022

The 2022 Canada-Wide Science Fair was held virtually from May 16-20. This year the CAP sponsored one prize in the Senior category.



Figure 1. 2022 CWSF prize winner Zachary Ireland, Winnipeg MB.

## SENIOR CAP PHYSICS PRIZE – ZACHARY IRELAND, WINNIPEG MB QUANTIFYING THE LIKELIHOOD OF NEUTRON ABSORPTION UTILIZING RADIATIVE CAPTURE CROSS-SECTIONS

Included in this study is the testing of nuclides and compounds for purposes of discovering alternate materials for reactor control rods and nuclear containment. Fast incident neutrons—released as fission products with mean energies of ~2 MeV—are perpendicularly incident upon the surface of a rectangular prism composed of the nuclide or compound being tested. Prism length required to absorb 99% of the incident neutrons, nuclear reaction rate, and prism durability are quantified. Nuclides and compounds with shorter prism lengths, higher nuclear reaction rates, and greater prism durability are best fitted for absorbing neutrons as products of fission reactions. Denoted as nuclear poisons, these substances can stop the spread of neutron radiation, potentially mitigating the biological or environmental effects of a hypothetical nuclear accident. This study is to function as a contribution to the advancement of nuclear power and the eventual passing of the climate crisis.

# CONGRATULATIONS / FÉLICITATIONS! 2023 STUDENT PRIZE WINNERS / GAGNANTS DES PRIX POUR LES ÉTUDIANT(E)S 2023

## 2023 CAP HIGH SCHOOL-CÉGEP PRIZE EXAM NATIONAL WINNERS / L'EXAMEN DU SECONDAIRE OU COLLÉGIAL DE L'ACP – GAGNANTS À L'ÉCHELLE NATIONALE 2023

First prize/Premier prix	Zander Li	Laurel Heights Secondary School, ON
Second prize/Deuxième prix	Tian Pu	Bayview Secondary School, ON
Third prize/Troisième prix	Yunshan Wang	Victoria Park Collegiate Institute, ON

## 2023 CANADA-WIDE SCIENCE FAIR PRIZES / 2023 PRIX EXPO-SCIENCES PAN CANADIENNES

The 2023 Canada-Wide Science Fair was held in Edmonton AB from May 14-19. This year the CAP sponsored one prize in the Senior category.

### SENIOR CAP PHYSICS PRIZE - AFAQ VIRK, CORNWALL, ON



Project: elECHOlocation: An Innovation to Mitigate Visual Impairment

**Abstract:** Many species in nature - humans included - rely on their sense of sight to get around in their environment. An impairment of this sense can thus pose a variety of issues with regards to quality of life. The purpose of this project was to develop a research-backed method to facilitate the process of man-made echolocation electronically through the construction of a device that can be worn/held to alleviate the challenges of navigation that exist for visually impaired individuals. Then, its efficacy was measured experimentally to determine possible use cases and benefits in practical applications, providing overall promising results.

# STUDENT COMPETITIONS 2023 COMPÉTITIONS ÉTUDIANTS

The CAP would like to thank and congratulate everyone who participated in this year's Best Student Presentation Competition, including 143 student competitors and the 35-member judging team, and to thank 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 Awardees who place 1<sup>st</sup>, 2<sup>nd</sup>, or 3<sup>rd</sup> are typically invited to submit an extended abstract for publication in PiC. This practice was paused in 2023 but this invitation has now been extended to the 2023 winners, and any contributions received will be published in a future issue.

# CAP OVERALL STUDENT POSTER AWARDS

PLACEMENT	NAME/AFFILIATION
First	Janani Balasubramanian, University of Ontario Institute of Technology
Second	Lisa Rudolph, McGill University
Third	Brennan Cornell, Trent University
Honourable	(in alphabetical order) Dean Eaton (University of Waterloo), Mustafa Saeed
Mention	(University of New Brunswick), Yasaman Yousefi Sigari (University of
	Saskatchewan)

# CAP OVERALL STUDENT ORAL PRESENTATION AWARDS

PLACEMENT	NAME/AFFILIATION
First	Timothy Blackmore, University of New Brunswick
Second	Defne Tanyer, University of Waterloo
Third	Sean Vanbergen, University of British Columbia
Honourable	(in alphabetical order) Jean-Marie Coquillat (Queen's University), Amaia Driollet
Mention	(Université de Montréal), Yasaman Heshmatzadeh (McMaster University), Rohith
	Kaiyum (York University), Everett Patterson (University of Waterloo)

### CAP DIVISION STUDENT POSTER AWARDS

DIVISION OF APPLIED PHYSICS AND INSTRUMENTATION	
PLACEMENT	NAME/AFFILIATION
First	Yasaman Yousefi Sigari, University of Saskatchewan

DIVISION OF ATOMIC, MOLECULAR AND OPTICAL PHYSICS CANADA	
PLACEMENT	NAME/AFFILIATION
First	Dean Eaton, University of Waterloo
First	Jocelyn Van der Veen, University of Toronto
Third	K Shalaby, University of New Brunswick

DIVISION OF CONDENSED MATTER AND MATERIAL PHYSICS	
PLACEMENT	NAME/AFFILIATION
First	Brennan Cornell, Trent University

DIVISION OF GENDER EQUITY IN PHYSICS	
PLACEMENT	NAME/AFFILIATION
First	Janani Balasubramanian, University of Ontario Institute of Technology

DIVISION OF NUCLEAR PHYSICS	
PLACEMENT	NAME/AFFILIATION
First	Louis Croquette, McGill University
Second	Jayani Dissanayake, University of Guelph

DIVISION OF PHYSICS IN MEDICINE AND BIOLOGY	
PLACEMENT	NAME/AFFILIATION
First	Janani Balasubramanian, University of Ontario Institute of Technology
Second	Nishel Alexander, University of Prince Edward Island

DIVISION OF PLASMA PHYSICS	
PLACEMENT	NAME/AFFILIATION
First	Jeremy Talbot-Pacquet, Queen's University

DIVISION OF THEORETICAL PHYSICS	
PLACEMENT	NAME/AFFILIATION
First	Mustafa Saeed, University of New Brunswick

PARTICLE PHYSICS DIVISION	
PLACEMENT	NAME/AFFILIATION
First	Lisa Rudolph, McGill University

# CAP DIVISION STUDENT ORAL PRESENTATION AWARDS

DIVISION OF APPLIED PHYSICS AND INSTRUMENTATION	
PLACEMENT	NAME/AFFILIATION
First	Defne Tanyer, University of Waterloo
Second	Bryce Norman, Carleton University

DIVISION OF ATMOSPHERIC AND SPACE PHYSICS	
PLACEMENT	NAME/AFFILIATION
First	Sneha Susan Babu, University of Alberta
Second	Vadym Bidula, McGill University
Thrid	Pouya Pourkarim, University of Calgary

DIVISION OF ATOMIC, MOLECULAR AND OPTICAL PHYSICS, CANADA	
PLACEMENT	NAME/AFFILIATION
First	Timothy Blackmore, University of New Brunswick
Second	Nicholas Caron, University of New Brunswick
Thrid	Varsha Varsha, Lakehead University

DIVISION OF CONDENSED MATTER AND MATERIAL PHYSICS	
PLACEMENT	NAME/AFFILIATION
First	Yasaman Heshmatzadeh, McMaster University
Second	Leo Goutte, McGill University

DIVISION OF PHYSICS EDUCATION	
PLACEMENT	NAME/AFFILIATION
First	Eamonn Corrigan, University of Guelph
Second	Victoria Arbour, University of Guelph

DIVISION OF PHYSICS IN MEDICINE AND BIOLOGY	
PLACEMENT	NAME/AFFILIATION
First	Rohith Kaiyum, York University
Second	Coral Hillel, York University
Third	Jerit Mitchell, University of Regina

### CAP STUDENT COMPETITION PRIZES 2023 PRIX DES COMPÉTITIONS ÉTUDIANTES DE L'ACP

DIVISION OF NUCLEAR PHYSICS		
PLACEMENT	NAME/AFFILIATION	
First	Lilianna Hariasz, Queen's University	
Second	Sean Vanbergen, University of British Columbia	
Third	Brynne Blaikie, University of Manitoba	

DIVISION OF PLASMA PHYSICS		
PLACEMENT	NAME/AFFILIATION	
First	Amaia Driollet, Université de Montréal	
Second	Jean-Baptiste Billeau, Ecole Polytechnique de Montréal	

DIVISION OF THEORETICAL PHYSICS		
PLACEMENT	NAME/AFFILIATION	
First	Everett Patterson, University of Waterloo	
Second	Xiyuan Li, Western University	
Third	Sarah Muth, Memorial University of Newfoundland	

PARTICLE PHYSICS DIVISION		
PLACEMENT	NAME/AFFILIATION	
First	Jean-Marie Coquillat, Queen's University	
Second	Mark Anderson, Queen's University	
Third	Braeden Veenstra, University of Alberta	

# 2023 CAP MEDAL RECIPIENTS / LAURÉATS DES MÉDAILLES DE L'ACP DE 2023

The CAP is very pleased to recognize its 2023 medal recipients. Please visit the <u>CAP website</u> 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 2023. Veuillez consulter <u>le site</u> <u>web de l'ACP</u> 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

**Robert Myers, Perimeter Institute for Theoretical Physics**, in recognition of his groundbreaking research in quantum field theory and quantum gravity, and his central role in the founding of the Perimeter Institute.



### CAP Herzberg Medal / Médaille Herzberg de l'ACP

**Joseph Maciejko, University of Alberta**, in recognition of his leadership role and groundbreaking research on topological phases of matter.



### CAP-COMP Peter Kirkby Memorial Medal for Outstanding Service to Canadian Physics / La Médaille commémorative Peter Kirkby de l'ACP-OCPM pour services significatifs à la physique au Canada

**Laura Pankratz, Government of Alberta**, in recognition of her service to both the CAP and to Canadian society through her exemplary work in education and outreach.



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

**Yanqin Wu, University of Toronto,** in recognition of her outstanding and impactful contributions to our understanding of the evolution of planets and planetary systems.



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

Hae-Young Kee, University of Toronto, in recognition of her theoretical work in a variety of strongly correlated electron systems, particularly those in which spin-orbit coupling is important. Her work has emphasized identifying appropriate model Hamiltonians that have led to new insights and predictions. Her work on  $\alpha$ -RuCl3 and novel phases arising from spin-orbit coupling in iridates has been particularly impactful.



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

**Paul Garrett, University of Guelph**, in recognition of his recent demonstration that the collective excitations of nuclei in the cadmium region, previously understood to be text book examples of vibrations about a spherical shape, are better described as rotations of coexisting deformed shapes, and hence that spherical vibrational nuclei are either very rare or do not exist.



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

**Jason Harlow, University of Toronto**, in recognition of his influence on undergraduate education in his department and involvement in Physics Education Research. Prof. Harlow is known as an inspiring instructor who encourages students to think independently, critically, and analytically.



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

**Michel L. Trudeau, Hydro-Quebec**, in recognition of his innovative work in new materials development and detailed materials characterization which has resulted in advances in materials synthesis and analytical techniques. His creative and important contributions to industrial and applied physics will benefit the entire community, through the application of this knowledge to the development and understanding of industrial materials.

# 2023 CAP Fellows / Les Fellows de L'ACP de 2023

The CAP is very pleased to announce the 2023 CAP Fellows (FCAP). 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.

L'ACP est très heureuse d'annoncer les Fellows de l'ACP (FCAP) de 2023. Le programme de fellows 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.



**Richard Bond**, **University of Toronto**, in recognition of his broad, stellar research contributions in the field of cosmology and astrophysics. Dr. Bond also has contributed extensively to the Canadian physics community through roles he has played in major Canadian and international experimental and theoretical consortia, for example, the Planck satellite, the Atacama Cosmology Telescope, Director of CITA, and Director of CIFAR cosmology and gravity program. He has been awarded the CAP Medal of Lifetime Achievement and the CAP-CRM Prize in Theoretical and Mathematical Physics, the Killam Prize, and the Herzberg Gold Medal, amongst other prizes.



**Gordon Drake, University of Windsor,** in recognition of his development of new measurement tools through the combined application of both high-precision theory and experiment to atoms. He has been awarded the CAP Medal for Lifetime Achievement in Physics and the CAP Peter Kirby Medal. He is also recognized for his dedicated and legendary contributions in service to the Canadian physics community which are simply too numerous to mention. He was the president of the CAP in 2000-2001.



**Charles Gale, McGill University,** in recognition of his research contributions to the field of high-density nuclear physics, specifically the behaviour of quark matter at high density and pressure as is obtained in heavy ion collisions. Dr. Gale was awarded the 2022 CAP Medal for Lifetime Achievement in Physics and he has also received both the 2015 CAP-CRM Prize for Theoretical and Mathematical Physics and the 2017 CAP-TRIUMF Vogt Medal. His contributions to the Canadian physics community are manifest and include being a founding member of the Canadian Institute of Nuclear Physics and serving on many board positions concerning nuclear theory in Canada and internationally.

### 2023 CAP Fellows /Les Fellows de l'ACP de 2023



**Giovanni Fanchini, Western University**, in recognition of his internationally recognized work in organic and carbon-based nanomaterials and scanning probe microscopy. His contributions to the Canadian physics community are also invaluable; he has been the Chair of DCMMP, regional councillor for the CAP, and chair of the NSERC RTI Selection Committee, among others. He has also contributed extensively to the professional practice of physics through the development of graphene-based materials and their applications in conjunction with the private sector. The committee also underscores his commitment and contribution to physics outreach, educational activities and the promotion of EDI-based principles in the discipline of physics.



**Graeme Luke, McMaster University,** in recognition of his outstanding research accomplishments in experimental condensed matter physics; being a world-renowned expert in muon spin rotation techniques. He was awarded several recognitions for his research work including, significantly, the 2019 CAP Brockhouse Medal. Dr. Luke has also made important contributions to the Canadian physics community as Chair of DCMMP, as Chair of the Department of Physics and Astronomy at McMaster, and as Chair of the TRIUMF Users Committee, among several other positions.



**Richard MacKenzie, Université de Montréal**, in recognition of his dedication and commitment to the Canadian physics community through his tireless contributions to the CAP: he was President of the CAP in 2016-2017; he was a regional councillor; he was on the Editorial Board of Physics in Canada and the Canadian Journal of Physics; he was Chair of the Division of Theoretical Physics; and he was a co-chair of the 2013 CAP Congress Local Organizing Committee, among other contributions. His contributions to research in theoretical physics are largely in soliton physics, important and applicable across many fields: particle physics, condensed matter physics, cosmology and quantum information theory.



**Kenneth Ragan, McGill University**, in recognition of his outstanding service to the Canadian physics community and for the invaluable contributions and commitment to physics education that he has portrayed. He was the President of the CAP in 2013-2014. He has served as a member of the NSERC grant selection committee for subatomic physics and he was the Chair of the Long-range planning committee for subatomic physics, among several other similar posts. He is an invaluable educator winning several recognitions including the 2020 CAP Medal for Excellence in Undergraduate Teaching.

### 2023 CAP Fellows /Les Fellows de l'ACP de 2023



Mark Sutton, McGill University, in recognition of the research that he has undertaken in experimental condensed matter physics which merited his award of the 2001 CAP Brockhouse Medal and the 2017 CAP Medal for Lifetime Achievement in Physics. His research has been focused on using synchrotron radiation to analyze non-equilibrium materials. He has contributed to the Canadian physics community through his leadership from being Chair or member of various Canadian and International Committees concerning Synchrotron Light sources.



**Michael Thewalt, Simon Fraser University,** in recognition of his research contributions leading to his being awarded the 2004 CAP Medal for Lifetime Achievement in Physics and the 2004 CAP Brockhouse Medal. The committee also notes his contributions to the Canadian physics community, being President of the CAP in 2001-2002, a member of the NSERC Women's Faculty Awards Selection Committee, and a member of the Editorial Board of the Canadian Journal of Physics, among others.

# 2023 HIGH SCHOOL-CÉGEP PHYSICS TEACHING AWARDS / PRIX DE L'ACP EN ENSEIGNEMENT DE LA PHYSIQUE AU SECONDAIRE ET AU COLLÉGIAL 2023

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



**Ian Doktor, Jasper Place High School**, in recognition of his passion and dedication in teaching physics, particularly for his involvement of students in the design and implementation of astronomy projects and for the care and enthusiasm in his teaching that inspires students to continue in physics.

#### Ontario



**Saara Naudts, Peel District School Board - Mayfield Secondary School**, in recognition of her passion and dedication in teaching physics, particularly her use of physics education research and culturally responsive and relevant pedagogies that inform her classroom and inspire her students to pursue physics.

#### Atlantic / Atlantique



**Amanda Craig, Gonzaga High School**, in recognition of her significant positive impact on students through cultivating supportive class communities and providing opportunities for student enrichment. Amanda has built collaborations with Memorial University of Newfoundland, worked to improve provincial curricula, and currently teaches the only AP Physics course in the province.

The HS-Cégep Teaching Awards were not awarded in 2023 for either the British Columbia and Yukon (Colombie-Britannique et Yukon) or the Quebec and Nunavut (Québec et Nunavut) regions.

# 2023 CAP-CAPF Scholarships / Bénéficiaires de Bourses d'études de l'ACP-FACP 2023

The CAP is pleased to announce the recipients of the 2023 CAP-CAPF student scholarships, made possible through the generous donations to the CAP Foundation. <u>Please visit the CAP website</u> 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. <u>Veuillez consulter le site web de</u> <u>l'ACP</u> 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 2023 Allan Carswell Physics Educator Scholarships / Les Bourses Allan Carswell d'enseignant(e) en physique de 2023



**Kara Deane, University of British Columbia**, in recognition of her excellent academic record and demonstrated ability in designing and delivering physics teaching activities. Additionally, she has made substantial contributions to the promotion and education of STEM subjects through her outreach and volunteer work with youth. Kara's curiosity is what draws her to physics, and she hopes to share this with students by "[counteracting] narratives that place physics on a pedestal of impossible difficulty and [grounding] abstract concepts in the daily lives of students".



**Elijah Adams, University of Calgary**, in recognition of his excellent academic record and strong skills in communicating physics. He adopts a student-centered approach and has utilized this to explore inquiry-based learning and create high-quality physics course materials for hybrid learning. Elijah believes that "a compelling introduction to physics is crucial for students' continued interest in higher education" and that physics education can "cultivate unique problem-solving skills and enhance learning capabilities across all fields".

# The 2023 Eric C. Svensson Memorial Graduate Scholarship / La Bourse commémorative pour étudiants de cycles supérieurs Eric C. Svensson de 2023



Janani Balasubramanian, Ontario Tech University, in recognition of her highly original community service and her groundbreaking research supporting the development of technology to automatically diagnose blood disorders in real-time using a surface-enhanced Raman scattering-based nano-sensor. She is carrying out this research under the supervision of Dr. Nisha Agarwal at Faculty of Science, Ontario Tech University and is a recipient of Ontario Graduate Scholarship 2023-2024 and Mitacs Globalink Graduate Fellowship 2023. Recently arriving in Canada, Ms. Balasubramanian participated at the 2023 CAP Congress and won the "Overall

Best Poster" title and the first prize in both Division of Gender Equality in Physics and Division of Physics in Medicine and Biology at the Congress. In addition, she triumphed at the Catalyst Challenge 2023 themed 'Accelerating Climate Action' securing First Prize for her project focused on repurposing fallen leaves into eco-friendly paper materials. This initiative, conducted for post-secondary institutions across Canada by Brilliant Catalyst, Ontario Tech University, highlights her dedication to sustainable practices and environmental innovation. Previously, she participated in a number of interdisciplinary projects in India including winning first prize for "Fem Kit", a polycystic ovarian syndrome diagnostic strip kit and first prize in National level Smart India Hackathon conducted by government of India. She has been and continues to be active as a mentor and teacher. Janani, who is completing her Masters Degree at Ontario Technical University, is an active researcher, having published more than 31 papers, on many of which she is one of the lead authors. Her work clearly demonstrates the application of advanced techniques based on physics to important real-world health problems. She is already a leader and ambassador for the field.

# MEET YOUR 2023-24 EXECUTIVE



### PRESIDENT / 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 / VICE-PRÉSIDENT

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.

### VICE-PRESIDENT / VICE-PRÉSIDENT ÉLU



Pierre Bénard's educational background includes a Ph.D. and undergraduate studies completed at the Université de Sherbrooke, as well as a Master's degree from the University of Toronto. He has focused his research and scholarly endeavors primarily on condensed matter theory, particularly in the area of high-temperature superconductivity. However, Pierre's interests have expanded to encompass applied physics, specifically working on materials and technologies relevant to the energy transition. From 2017 to 2023, Pierre served as the Director of the Hydrogen

Research Institute at the Université du Québec à Trois-Rivières, where he made significant contributions to the field. During his tenure, he successfully established a collaborative research unit with colleagues at INRS EMT in Varennes, concentrating on materials for the new energy transition. Furthermore, he played a key role in the creation of an innovation zone focused on technologies essential to the energy transition. Pierre's dedication extends beyond his research and academic pursuits. He aims to address the future and role of physics in Canadian society while considering the regional context and the challenges faced by smaller universities. With his comprehensive understanding of the discipline, Pierre seeks to bring valuable perspectives to the development of the Canadian Association of Physicists and advocate for the interests of physics within the broader scientific community.



### PAST PRESIDENT / PRÉSIDENTE SORTANTE

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.

### 2023-2024 CAP EXECUTIVE / ÉXÉCUTIF DE L'ACP 2023-2024



### SECRETARY-TREASURER / SECRÉTAIRE-TRÉSORIÈRE

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.



### **EXECUTIVE DIRECTOR / DIRECTRICE EXÉCUTIVE**

Francine Ford, Canadian Association of Physicists

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# PHD PHYSICS DEGREES AWARDED IN CANADIAN UNIVERSITIES DOCTORATS EN PHYSIQUE DÉCERNÉS PAR LES UNIVERSITÉS CANADIENNES

### JANUARY 1 TO DECEMBER 31 2022 / 1ER JANVIER AU 31 DÉCEMBRE 2022

### **CARLETON UNIVERSITY**

ALDOSARY, G., "Advancing Treatment Accuracy of Accelerated Partial Breast Irradiation", E. Vandervoort, February 2022, now a Medical Physics Fellow at The Ottawa Hospital, Ottawa, Ontario, Canada.

### **CONCORDIA UNIVERSITY**

SALAHI, HAMID REZA, "Simulation of Multi Pulse EPR Signals for Distance Measurement in Biological Systems by Exploitation of COSY, DQ, DQM, DQC, and DEER Signals; Relaxation Due to Fluctuation of Spin-Hamiltonian Parameters of Echo ELDOR Signal; and Effect of Instantaneous Diffusion and Many Body Interaction in a Frozen Malonic Acid Crystal on a SECSY Signal", (S. Misra), October 2022.

ZUBAIR, MUHAMMAD, "Quantum Transport in Dirac Materials and Their Heterostructures", (P. Vasilopoulos), May 2022, Postdoctoral fellowship at the University of Alabama, Tuscaloosa, AL, USA.

### DALHOUSIE UNIVERSITY

BOYS, B., "Global Trends in Satellite-Derived Fine Particulate Matter & Developments To Reactive Nitrogen In A Global Chemical Transport Model", (R. Chang), May 2023.

BRADY, B., "Exploring Transient Neural Events In Healthy Populations Using Non-Invasive Neuroimaging", (T. Baroudouille), October 2022, Postodoctoral Researcher, NovaResp Technologies Inc., Halifax, NS, Canada.

CHURCH, C., "Techniques to Minimize the Dosimetric Impact of Intrafractional Motion with Improved Treatment Accuracy and Efficiency on a C-arm Medical Linear Accelerator", (A. Syme, D. Parsons), October 2022, Physics Resident, Ottawa Hospital, Ottawa, ON, Canada.

CLEGG, C., "Characterizing Degradation in Organic Redox Flow Batteries", (I. Hill), May 2023, Defending her Thesis on December 12 2022.

CORMIER, M., "Li-ion Battery Materials Theory and Computation to Guide and Interpret Experiments", (J. Dahn), May 2023, Sr. Cell Research Scientist, Novonix, Bedford, Nova Scotia, Canada.

FARRELL, S., "Developing Computational Models To Understand Aging", (A. Rutenberg), May 2022, Post Doctoral Fellowship, University of Toronto, Dept of Physics, Toronto, ON, Canada.

LOGAN, E., "Understanding and Mitigating Degradation In Li-Ion Batteries", (J. Dahn), October 2022.

### ÉCOLE POLYTECHNIQUE MONTRÉAL

AGIOTIS, L., "Nonlinear Propagation of Femtosecond Laser Pulses in Plasmonic Nano-Colloids", (M. Meunier), April 2022, Postdoctoral Fellow at Polytechnique Montréal, Montréal, Quebec, Canada.

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.

ATTENDU, X., "Advancements in Multimodal Endoscopic Optical Coherence Tomography: Novel Hardware, Software, and Optical Strategies", (C. Boudoux, T. v. Leeuwen), Septembre 2022, Postdoctoral Fellow at Polytechnique Montréal/Amsterdam University Medical Centers, Montréal, Quebec/Amsterdam, Hollande du Nord, Canada/Pays Bas.

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

CASTONGUAY, S., "Capillary Modelling for Flow Control and Accurate Mass Transport in Microfluidics", (T. Gervais, E. Delamarche), April 2022, Research Engineer (Explosion & Fluid Dynamics) at Lloyd's Register- Applied Technology Group, Darmouth, Nova Scotia, Canada.

NICOLAS, J., « Ingénierie de contrainte et stabilité des hétérostructures épitaxiales de  $Ge_{1-x} Sn_x \gg$ , (O. Moutanabbir), June 2022, searching for employment.

PHANEUF-L'HEUREUS, A.-L., "Field-Induced Modulation of Single-Exciton Emission in ZnSe:Te2 under Resonant and Non Resonant Excitation", (S. Francoeur), April 2022, searching for employment.

REALI, M., "Eumelanin for Organic Electronics: Film Formation and Transport Physics", (C. Santato, F. Cicoira), December 2021, Postdoctoral Fellow at Polytechnique Montréal, Montréal, Quebec, Canada.

#### McGILL UNIVERSITY

AHMED, W., "Search for a bosonic decay of a charged Higgs at the LHC with the ATLAS detector", (R. Steele), May 2023.

AL KHARUSI, S., "Development of a water Cherenkov muon veto for the nEXO neutrinoless double beta decay experiment", (T. Brunner, D. Haggard), February 2024.

BHARDWAJ, M., "Deciphering the Origins of FRBs Using Local Universe CHIME/FRB Discoveries", (V. Kaspi), May 2023.

BOYCE, H., "Observational probes of supermassive black hole environments: from the event horizon to the sphere of influence", (D. Haggard), February 2023.

BURNS, D., "Timescale coupling phenomena with hydrodynamics phase field crystal models: The atomic scale shuffle", (N. Provatas, M. Grant), February 2024.

CHURCHILL, "Electromagnetic radiation from various stages of relativistic heavy-ion collisions", (C. Gale), February 2023.

COWIE, M., "Charge re-organization timescales and loss tangents at semiconductor surfaces measured by nc-AFM", (P. Grutter), October 2023.

ENGSTRÖM, L., "Combining spin-orbit coupling and multi-orbital interactions: a recipe for novel magnetism and superconductivity", (T. Pereg-Barnea, W. Witczak-Krempa), October 2023.

FRICK, M., "Improvements to the thermodynamic and kinetic consistency of the Phase Field Crystal model", (N. Provatas), May 2023.

FUENTES, R. "Hydrodynamics of convection with composition gradients: Salty water and Jupiter", (A. Cumming), February 2023.

GAMBINI, G., "A dark matter candidate in the context of physics beyond the standard model", (J. Cline), February 2023.

HEFFERNAN, M., "Quantification of the Quark-Gluon Plasma with Statistical Learning", (C. Gale), February 2023.

JREIDINI, P., "Novel developments in phase-field crystal modeling for the solidification of complex materials", (N. Provatas), February 2023.

JUTRAS-DUBÉ, L., "Geometric models of embryonic pattern formation and of genetic oscillator synchronization", (P. Francois), February 2023.

LI, Y., "Holographic conformal field theories and their flat-space structures", (Caron-Huot), October 2023.

LI, Z., "Search for a fermiophobic charged Higgs boson in proton-proton collisions with the ATLAS detector", (F. Corriveau, A. Warburton), February 2024.

LIU, Z., "Spatial organization and dynamics of multiple DNA molecules confined in a nanofluidic cavity", (W. Reisner), May 2023.

MATTE, D., "Ultrafast electron cold field emission from a tungsten nanotip by single cycle THz pulse", (D. Cooke), February 2023.

### 2022 PhD Degrees Awarded / Doctorats décernés 2022

McGOWAN, J., "Measurement of the electroweak production of a photon and a W boson in association with two jets using the ATLAS detector", (B. Vachon), February 2024.

MENDES SILVA, M., "Nuclear equations of state, superfluidity models and cold neutron star observations", (C. Gale, A. Cumming), October 2023.

MODARRESI-YAZDI, R., "Comparative studies of jet quenching in relativistic heavy ion collisions", (C. Gale), October 2023.

MURRAY, K., "Design and commissioning of a multi-reflection time-of-flight mass-spectrometer for Barium tagging with nEXO", (T. Brunner), May 2023.

NASERI, H., "The use of radiomics and natural language processing to detect pain in the simulation-CT images of patients undergoing radiotherapy for bone metastasis", (J. Kildea), May 2023.

PAGANO, M., "From mitigating systematics to theoretical interpretation of the 21cm signal during the epoch of reionization", (A. Liu), May 2023.

PROULX-GIRALDEAU, F., "Guided by evolution: biophysical mechanisms of homeostasis, control and adaptation in cells", (P. Francois), May 2023.

PUEL, M., "Topics beyond the standard cosmological model", (J. Cline), February 2024.

SAHA, S., "Search for a new light particle produced in association with a top quark pair with the ATLAS Detector", (S. Robertson), February 2023.

SOLYOM, A., "Spin-orbit torque control of nanomagnetic devices probed by nitrogen-vacancy centres in diamond", (L. Childress, J. Childress), October 2023.

WAKELING, H., "A measurement of the denominators of R(D(\*)) with 189 inverse femtobarns of Belle II data", (S. Robertson), May 2023.

ZAHRAEE, Z., "Analytical Bootstrap of Conformal Field Theory", (S. Caron-Huot), February 2024.

ZENG, L., "Organization, Mixing, and Demixing of Semiflexible Polymer Chains in Nanochannels Under Nonequilibrium Compression", (W. Reisner), February 2024.

#### SIMON FRASER UNIVERSITY

GHEIDI, S., "Muon Spin Relaxation Studies of Cuprates in the Normal State", (J. Sonier), June 2022, now an Associate Data Scientist at Euromonitor International, Chicago, Illinois, USA.

LATHOUWERS, E., "Energy and information flows in strongly coupled rotary machines", (D. Sivak), June 2022, now a Data Scientist at AbCellera, Vancouver, BC, Canada.

LEHMANN, K., "Estimating Deceiving Signatures and their Role in the Observation of the VBF Production Mode in the Higgs-Boson Decay into two W Bosons", (B. Stelzer), June 2022, now a Quantum Engineer at Orange Quantum Systems, Delft, South Holland, Netherlands.

OZDEMIR, U., "Phenomenology of Unconventional Superconductors", (D. Broun), October 2022, searching for employment.

SAHA, T., "Information-Powered Engines", (J. Bechhoefer), October 2022, now an Associate Test Engineer at MKS Instruments, Richmond, BC, Canada.

#### TORONTO METROPOLITAN UNIVERSITY

MANKOVSKII, G., "Gold Nanoparticle Quantification with Total Reflection X-Ray Fluorescence", (A. Pejovic-Milic), June 2022, currently unemployed.

MOSLEMI, A., "Quantitative Computed Tomography Imaging and Machine Learning for Evaluating Chronic Obstructive Pulmonary Disease", (M. Kirby), October 2022, pursuing a Postdoctoral Fellowship at Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada.

ZHAO, N., "Decorrelated Compounding in Ultrasound Images", (Y. Xu), October 2022, pursuing a Postdoctoral Fellowship at Toronto Metropolitan University, Toronto, Ontario, Canada.

### UNIVERSITY OF BRITISH COLUMBIA OKANAGAN

DENG, XINCHEN, "Machine Learning Assisted Raman Spectroscopy for Monitoring Radiation Treatment Response in Cancer Cells and Tissues", (A. Jirasek), Summer 2022, searching for employment.

#### **UNIVERSITY OF GUELPH**

ANNETT, S., "Commissioning a Novel Quad Near Field Detector for High Energy X-Ray Diffraction Microscopy with Preliminary Applications to an Aluminum Alloy ", (S. Kycia), June 2022, Postdoctoral Fellowship, University of Guelph, Guelph, ON, Canada.

LEE, D., "Development of Dynamical Self-Consistent Field-Theory for Active Rods and its Application to Finger-Like Pattern Formation in Bacteria Colonies at a Glass-Agar Interface", (R. Wickham), June 2022, Quantitative Analyst, Deloitte, Toronto, ON, Canada.

LYU, Z., "Topics in Compact Object Astrophysics and Fundamental Physics with Current and Future Gravitational Wave Observations", (H. Yang), October 2022, Postdoctoral Fellowship, Peking University, Beijing, P.R. China.

PARG, R., "Micropipette Deflection and Constrained Blister Measurements of Agar-Glass Adhesion", (J. Dutcher), October 2022, searching for employment.

#### **UNIVERSITY OF MANITOBA**

RAHMAN, S., "Using Parity-Violating Weak Interaction to Measure Neutron Matter Density and Search for New Physics", (J. Mammei), February 2022, pursuing Postdoctoral Fellow, University of Manitoba, Department of Physics and Astronomy, Winnipeg, Manitoba, Canada.

SICIARZ, P., "Investigation of Adaptive Radiation Therapy Including Deformable Image Registration, Treatment Planning Modification Strategies, Machine Learning & Deep Learning", (B. McCurdy), February 2022, pursuing Postdoctoral Fellow, CancerCare Manitoba, Winnipeg, Manitoba, Canada.

#### **UNIVERSITY OF NEW BRUNSWICK**

ADAIR, A., "Advancing Pure Phase Encoded MRI Measurement of Flow", (B. Newling), May 25, 2022.

GAUTHIER, A., "Characterizing and Quantifying Turbulent Flow using Magnetic Resonance", (B. Newling), May 25, 2022.

ZARRINGHALAM, H., "High-Resolution Laser and Far-Infrared Fourier Transform Synchrotron-Based Spectroscopy of Selected Molecules", (D. Tokaryk, A. Adam), Oct 13, 2022.

#### **UNIVERSITY OF OTTAWA / UNIVERSITÉ D'OTTAWA**

ALSAIARI, F., "Manipulation of Phase and Polarization with Liquid Crystal Technology and its Application in Advanced Optics", (Ebrahim Karimi), January 2022, Assistant Professor at the University of Hafr Al Batin, Kingdom of Saudi Arabia.

BODDISON-CHOUINARD, J., "Gated Quantum Structures in Two-Dimensional Semiconductors", (A. Lucian-Mayer), November 2022, Postdoctoral Fellow at the University of Ottawa.

BROWN, G. G., "Attosecond *In Situ* Measurement and Recombination", (Paul Corkum), January 2022, Postdoctoral fellow in the Max Born Institute in Berlin, Germany.

FLOREZ GUTIERREZ, J., "Optical parametric amplifications: from nonlinear interferometry to black holes", (Jeff Lundeen), March 2022, R&D scientist at Quantinuum, a quantum computing company in London UK.

HE, L., "DNA Nanostructures for Nanopore-based Digital Assays", (Vincent Tabard-Cossa), August 2022, Postdoctoral Fellowship at Harvard U, Boston USA (Wyss Institute with Prof. Peng Yun).

HIRBODVASH, Z., "Long Range Surface Plasmon Waveguides for Electrochemical Detection", (Pierre Berini), October 2022, Currently employed in the artificial intelligence and machine learning industry.

MOBINI, E., "Mechanisms of Enhancement of Nonlinear Optical Interactions in Nonlinear Photonic Devices based on III-V Semiconductors", (Ksenia Dolgaleva), August 2022, software engineer at Optiwave Inc. PARKS, A., "Role of U(1) Gauge Symmetry in the Semiconductor Bloch Equations", (Thomas Brabec), October 2022, Postdoctoral Research Associate, Wyant College of Optical Sciences, University of Arizona.

ROBICHAUD, L-E., "k.p. theory for wurtzite InGaN quantum dot arrays with applications to ratchet band solar cells", (Jacob Krich), January 2022, Quantum Researcher at Quantum Bridge Technologies, Toronto.

ROSE, P. A., "Algorithms for efficient calculation of nonlinear optical spectra: Ultrafast Spectroscopy Suite and its applications", (Jacob Krich), March 2022, Postdoctoral Fellow at University of Ottawa, Ottawa.

RYCZKO, K., "Accelerating the Computation and Design of Nanoscale Materials with Deep Learning", (Isaac Tamblyn), December 2021, Machine Learning Scientist at Sandbox.

TIESSEN, C. J., "Optimization of a Cesium-Sputter Ion Source for use in Accelerator Mass Spectrometry", (William Kieser), March 2022, Researcher at IONPLUS AG, Dietikon (near Zurich), Switzerland.

### **UNIVERSITY OF TORONTO**

ADAMEK, L., "A Search for the H  $\rightarrow \mu\mu$  Decay and a Measurement of the Mass of the Higgs Boson Using H  $\rightarrow$  4l Events With 139 fb-1 of Proton-Proton Collision Data Collected by the ATLAS Experiment", (P. Savard), March 2022, now a Data Analyst, Ceridian, Toronto, ON, Canada.

BONSMA-FISHER, M.J., "Population Dynamics of CRISPR Adaptive Immunity in Communities of Bacteria and Phages", (S. Goyal), November 2022, now pursuing a Postdoctoral Fellowship, Data Sciences Institute, University of Toronto, Toronto, ON, Canada.

CARTER, J.W.S., "Luminosity Studies and a Search For Heavy Resonances Decaying into a Pair of Z Bosons with the ATLAS Detector", (P. Krieger), November 2022, now a Software Engineer, Intel Corporation, Toronto, ON, Canada.

CIUNGU, B.M., "Studies of the Higgs Boson Properties in  $\sqrt{s} = 13$  TeV pp Collisions.", (R.S. Orr), June 2022, searching for employment.

DAOUD, H., "Theoretical and Experimental Advances in Studying the Ultrafast Dynamics of Atoms and Molecules", (R.J.D. Miller), June 2022, pursuing a Postdoctoral Fellowship, University of Toronto, Toronto, ON, Canada.

FERRETTI, H., "Quantum Parameter Estimation in the Laboratory", (A.M. Steinberg), March 2022, now an Analyst - Rotation Program in Sales and Trading, National Bank of Canada, Montréal, QC, Canada.

GRYBA, S.K., "From Dark Matter to Leptoquarks: Phenomenology of Physics beyond the Standard Model", (D. Curtin), November 2022, searching for employment.

HE, T., "Mitigating Model Errors in Chemical Data Assimilation: Application of New Data Assimilation and Machine Learning Approaches", (D.B.A. Jones), November 2022, now pursuing a Postdoctoral Fellowship, University of Washington, Seattle, WA, U.S.A.

HIRASAWA, H., "Atmosphere and Ocean Components of the Sahel Climate Response to Aerosol Forcing", (P.J. Kushner), November 2022, now pursuing a Postdoctoral Fellowship, University of Victoria, Victoria, BC, Canada.

HUO, Y., "High Resolution Climatological Simulations for South and Southeast Asia and the Tibetan Plateau", (W.R. Peltier), November 2022, now pursuing a Postdoctoral Fellowship, University of Toronto, Toronto, ON, Canada.

INGLIS-WHALEN, M., "Power Corrections and Rapidity Logarithms in Soft-Collinear Effective Theory", (M.E. Luke), June 2022, self-employed and searching for employment.

JEFFERY, P.S., "Water Vapour and Ozone: Measuring Key Trace Gases in Challenging Regions", (K.A. Walker), June 2022, now Research Associate, MOPITT, University of Toronto, ON, Canada.

MIRSANAYE, K., "Digital Histopathology with Second-Harmonic Generation Microscopy", (V. Barzda), November 2022, searching for employment.

NUNN, C.J., "Mitochondrial Genome Dynamics in Yeast: How Mutation and Selection Inform the Fate of a Dispensable Genome", (S. Goyal), November 2022, searching for employment.

PEN, U.-Y., "An Automated Tabletop Continuous Culturing System with Multicolor Fluorescence Monitoring for Microbial Gene Expression and Long-Term Population Dynamics", (S. Goyal), June 2022, searching for employment.

SARRACINI, A., "Time-Resolved Electron and Serial X-Ray Crystallography of PbS Quantum Dots and Biomolecules", (R.J.D. Miller), November 2022, now a Postdoctoral Researcher, Paul Scherrer Institute, Villigen, Aargau, Switzerland.

SMART, M.R., "Collective Dynamics of Interacting Cell Types", (A. Zilman), November 2022, now pursuing a Postdoctoral Fellowship ("Flatiron Research Fellow") at the Flatiron Institute in New York, NY., U.S.A.

SPIERINGS VAN DER WOLK, D., "Precise Larmor Time Measurements of a Tunneling Bose-Einstein Condensate", (A.M. Steinberg), March 2022, pursuing a Mitacs Industrial Postdoctoral Fellowship at the University of Toronto and Entangled Networks, Toronto, ON, Canada.

TOWSTEGO, T., "Study of Neutrino Oscillations with Enhanced Selection of Electron Neutrino Interactions", (H.A. Tanaka), November 2022, now Patent Engineer, Xanadu, Toronto, ON, Canada.

TRETYAKOV, I., "Signal Processing and Instrument Characterization on a Large-N Radio Interferometer", (K. Vanderlinde), November 2022, now an AI/ML researcher, Lockheed Martin, Orlando, FL, U.S.A.

VENU, V., "Strongly Interacting Fermions in a Multi-Orbital Optical Lattice", (J.H. Thywissen), November 2022, now pursuing a Postdoctoral Fellowship, Quantum Valley Ideas Lab, Waterloo, ON, Canada.

WILSON, M.J., "A New Search for Low-Mass Dark Matter and an Examination and Reduction of the Uncertainty due to the Photoelectric Absorption Cross Section Using a Cryogenic Silicon Detector with Single-Charge Sensitivity", (M. Diamond), June 2022, pursuing a Postdoctoral Fellowship at Karlsruhe Institute für Technologie in Karlsruhe, Germany.

YANG, B., "Physical Processes in Ice-covered Lakes", (M.G. Wells), June 2022, now pursuing a Postdoctoral Fellowship, University of Victoria, Victoria, BC, Canada.

ZHANG, C., "Interacting Electronic Orders in Cuprate Heterostructures and Praseodymium-doped Cuprate Thin Films" (J.Y.T. Wei), November 2022, searching for employment.

ZHONG, X., "Experimental Quantum Communication Based on Sagnac Interferometers", (H.K. Lo), June 2022, now a senior consultant at Ernest & Young, Toronto, ON, Canada.

#### **UNIVERSITY OF VICTORIA**

AYDIN, D., "Sensing and Emission in Optical Cavities", (P. Loock), November 2021.

HIGGS, C., "Dwarfs Among Giants: Exploring Environmental Impacts on Dwarf Galaxies with the Solo Survey", (A. McConnahie, K. Venn), November 2021, now an Astronomy Outreach Specialist for the Education & Public Outreach Team, Rubin Observatory, Tuscon, Arizona, USA.

MACDONELL, D., "Search for Dark Matter Produced in pp Collisions with the ATLAS Detector", (R. Sobie, R. Kowaleski), May 2022, now a postdoc impact fellow at MIT Climate & Sustainability Consortium, Cambridge, MA, USA.

MALDONADO, M., "Comprehensive Ionization Model Development for the FEBIAD Ion Source and Its Application for TRIUMF's Radioactive Ion Beam Program", (A. Gottberg, D. Karlen), July 2022, searching for employment.

PECK, R., "Nanoplasmonics with Dispersive and Lossy Media", (R. Gordon, A. Brolo), May 2022, searching for employment.

RENNEHAN, D., "Simulating the Universe: The Evolution of the Most Massive Galaxies", (A. Babul), April 2022, now a Flatiron Research Fellow at the Center for Computational Astrophysics, Flatiron Institute, New York, NY, USA.

### 2022 PhD Degrees Awarded / Doctorats décernés 2022

TAHERI NIEH, M., "Advanced Wavefront Sensing and Astrometric Techniques for the Next Generation of Extremely Large Telescopes", (D. Andersen, K. Venn), April 2022, now with Laboratoire d'Astrophysique de Marseille and Keck Observatory, Waimea, HI, USA.

THORP, M., "A Multifaceted Investigation of the Resolved Properties of Galaxy Mergers", (S. Ellison), November 2022, now a postdoctoral associate at the University of Bonn, Bonn, Germany.

TRUDEAU, A., "Galaxy Populations in Distant, X-ray Selected Clusters of Galaxies", (J. Willis), August 2022, now a postdoctoral associate at the University of Florida, Gainsville, Florida, USA.

### **UNIVERSITY OF WATERLOO**

BÉJANIN, J., "Advances in Superconducting Circuit Quantum Electrodynamics", (M. Mariantoni, J. Martin), June 2022.

CAYUSO, J., "Studying the Largest Scales in the Universe with the Kinetic Sunyaev-Zel'dovich Effect", (M. Johnson, N. Afshordi), June 2022.

CHUNG, K., "Hodge Theory for Geometrically Frustrated Magnetism", (M. Gingras), June 2023 (degree complete in 2022).

DELMASTRO, D., "Non-Perturbative Aspects of Gauge Theories", (J. Gomis), October 2022.

GIRI, U., "Reconstructing Cosmic Velocities with the Kinetic Sunyaev-Zeldovich Effect", (K. Smith), June 2022 (degree complete in 2021).

GONDA, T., "Resource Theories as Quantale Modules", (F. Girelli), June 2022.

GRAY, F., "Symmetries in Black Hole Spacetimes", (D. Kubizňák, R. Mann), June 2023 (degree complete in 2022).

GUNDERMAN, L., "Collective Spin-Cavity Ensembles and the Protection of Higher-dimensional Quantum Information", (D. Cory), June 2023 (degree complete in 2022).

HAN, L., "Line-Scan Spectral-Domain Optical Coherence Tomography for Cellular Resolution Structural and Vascular Imaging of Biological Tissues", (K. Bizheva), October 2022.

JAI-AKSON, P., "Edge Modes and Carrollian Hydrodynamics on Stretched Horizons", (L. Freidel, R. Myers), June 2023 (degree complete in 2022).

KAN, A., "Quantum Computational Particle Physics: Algorithms, Resource Estimation, and Model-Building", (C. Muschik), June 2022.

LEE, Y. S., "Devices for Satellite-Assisted Quantum Networks", (T. Jennewein), June 2022 (degree complete in 2021).

LIN, J., "Security Analysis of Quantum Key Distribution: Methods and Applications", (N. Lütkenhaus), June 2022 (degree complete in 2021).

MELEK, M., "Mitigating Fiber Nonlinearity with Machine Learning", (D. Yevick), June 2022.

MUKHERJEE, S., "Selected topics in Computational Relativity", (E. Schnetter, A. Broderick), October 2022.

SACHS, A. M., "The Unruh-DeWitt Detector Model: Modified Dispersion and Nonlinear Couplings", (R. Mann, A. Kempf), June 2022 (degree complete in 2021).

SAKHARWADE, N., "An Operational Road towards Understanding Causal Indefiniteness within Post-Quantum Theories", (L. Hardy, A. Kempf), June 2022.

SHI, Y., "Molecular Beam Epitaxial Growth of InSb Quantum Well Heterostructures for Applications in Topological Quantum Computing", (Z. Wasilewski), June 2022 (degree complete in 2021).

SPITZER, I., "Topics in Weak Gravitational Lensing", (M. Hudson), June 2022.

TANSUWANNONT, T., "Flags and Error Weight Parities: A Development of Fault-tolerant Quantum Computation with Few Ancillas", (D. Leung), June 2022 (degree complete in 2021).

XI, C., "Advancing Techniques for Detecting Dwarf Satellite Populations Beyond the Local Group", (J. Taylor), October 2022.

YANG, B., "Tunneling Transport and Spectroscopy of Two-Dimensional Magnetic Materials", (A. Tsen), October 2022.

ZHOU, Y., "Twisted Holography: The Examples of 4d and 5d Chern-Simons Theories", (K. Costello, J. Gomis), June 2023 (degree complete in 2022).

### WESTERN UNIVERSITY

DAS, I., "The Role of Nonideal Magnetohydrodynamic Effects, Gravitational Instability, and Episodic Accretion in Star-Formation", (S. Basu), October 2022, pursuing Postdoctoral Fellowship at Academia Sinica Institute of Astronomy and Astrophysics at Taipei, Taipei City, Taiwan, Republic of China.

GETANGAMA, N., "Electrical and Mechanical Properties of Polymer Nanocomposites", (J. Hutter, J. de Bruyn), October 2022, Laboratory Technician at Western University, London ON Canada.

WYENBERG, C., "Wideband and Relativistic Superradiance in Astrophysics", (M. Houde), October 2022, pursuing Postdoctoral Fellowship at Institute for Quantum Computing, Waterloo, ON 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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# The Canadian Association of Physicists: A Physics Community

# l'Association canadienne des physiciens et physiciennes : La Physique, une communauté



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