Physics
UNIVERSITY OF TORONTO

Spring 2024

INTERACTIONS

The Department of Physics Newsletter

McLennan Physical Labs
(credit: University of Toronto)

MESSAGE FROM THE CHAIR

Welcome to the Spring 2024 issue of Interactions, the Department of Physics newsletter!

Dear Physics community,

My term as Chair will be wrapping up at the end of June, making this my last Chair's Message. Although the last five years have been jam-packed, they also seem to have sped by very quickly. As you can see in this issue of the Newsletter, the Department continues to be a vibrant and active place thanks to the contributions of many people. I hope you enjoy reading all our latest news in this Spring 2024 issue of Interactions.

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We have several big events coming up in May. The first is the Story of Water Symposium on May 10, which will be a forum for Indigenous and Western science perspectives on the precious resource of water. The following week, on May 16 and 17, we will host the annual Welsh Lectures. Nobel prize-winner Alain Aspect from the Université Paris-Saclay will be talking about two quantum revolutions, while Steven Kivelson from Stanford University will tell us about new research on quasi-particles with fractional charge. At the end of the month, on May 31, we will co-host a Physics & Math Alumni Reunion, providing an opportunity for our alumni to reconnect and to hear about current research from several of our faculty – I hope to see some of you there! In addition, the Department will be participating in Science Rendezvous on Saturday, May 11, and Doors Open Toronto tours of some areas of the McLennan Physics building on Saturday, May 25 – all are welcome to visit!

In January, we welcomed two new faculty and one new staff to the Department. Morgan O'Neill joined us as Assistant Professor Tenure Stream in Earth, Atmospheric and Planetary Physics, Erica Rosenblum joined us as part-time Assistant Professor in ice-ocean interactions, and Jo-Anne Wurster is our new Receptionist/Departmental Assistant. We also said good-bye to Liz Glover, who retired in January after 20 years in the Department, working in the Physics Library, Graduate Office, and Reception; we will be celebrating Liz at our end-of-year party in June. We are running four faculty searches this year and hope to introduce more new colleagues in the Fall 2024 Newsletter.

This issue of the Newsletter includes profiles of Professor Morgan O'Neill, quantum optics Post-Doctoral Fellow Scott Smale, quantum condensed matter PhD Student Félix Desrochers, and Physics Specialist Allen Kasum. For our Alumni Profile, we interview Randall McArthur, whose PhD in Physics led to a lifelong career with Atomic Energy of Canada Limited.

The Research Spotlight features PhD Student Caleb Gemmell and Professor David Curtin and their work modelling the effects of atomic dark matter on the structure of galaxies. Keep an eye on Physics News for more research stories.

Sadly, our most recent News item is a farewell to Professor Anton Zilman, who passed away on April 23, 2024. Anton joined the Department in 2011 and was a valued member of our Biological Physics research cluster and had an active and productive research group. He also taught many undergraduate and graduate students over the past 13 years, and was fully engaged in the life of our Department, as well as serving as UTFA Council Member for Physics, Astronomy and Astrophysics since 2020. His sudden passing is a huge loss to our community and to his many friends and colleagues around the world. We extend our deepest sympathy to Anton's family. He will be greatly missed.

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On a happier note, we extend congratulations to our thirteen November 2023 PhD graduates and to Sophia Simon, who received the 2024 Xanadu Award for an Outstanding Publication by a PhD Student for the paper "Improved Precision Scaling for Simulating Coupled Quantum-Classical Dynamics", published in PRX Quantum.

Under faculty Awards and Announcements, we are pleased to report that Ania Harlick has been granted continuing status and will be promoted to Associate Professor Teaching Stream effective July 1, 2024. In breaking news, David Curtin, Andreas Hilfinger and Sarah Rauscher have just been granted tenure and will be promoted to Associate Professor on July 1. In addition, Miriam Diamond had a successful interim review, Institute of Particle Physics Principal Research Scientist Richard Teuscher had his position as Professor renewed for another five-year term, and Visiting Scholar Tahir Shaaran moved to a part-time Teaching Stream position. Honours continue to come in for our faculty, including election as an Optica Fellow for Kaley Walker, election as a Fellow of the Institute of Electrical and Electronics Engineers for Hoi-Kwong Lo, a Dean's Research Excellence Award for Young-June Kim, the Atmospheric Sciences Ascent Award from the American Geophysical Union for Debra Wunch, a Faculty of Arts & Science Outstanding Teaching Award – Early Career for Ania Harlick, recognition as an American Physical Society Outstanding Referee for Bob Holdom, and election as a Fellow of the Korean Academy of Science and Technology for Yong Baek Kim. Meanwhile, Lilian Leung was selected as the recipient of the 2024 Dean's Outstanding Technical Service Award from the Faculty of Arts & Science for her exceptional contributions as Senior Learning Services Specialist. Congratulations to everyone!

The Newsletter highlights the post-pandemic resumption of the Emeritus Faculty Lunch last fall, the 2023-24 Physics Career Accelerator Program, and various Outreach in Action activities. These include the Canadian premiere performance of "Patterns from Nature", the Pursue STEM program now in its fourth year, the School Visit Program, the CAP High School Exam Workshop, and the student-led "Not Quite a Lecture" initiative. We also include an update from the Physics Student Union (PhySU), which had a highly successful year, organizing many activities for the undergraduate community.

As I head into my last few months as Chair, I thank all members of the Department of Physics for your support over the past five years. We have accomplished much together, and while there are always projects to work on, the Department has seen many positive developments. We have had fifteen faculty searches and recruited four additional part-time faculty, a new librarian, and ten new staff. Six UTSG and two UTM faculty have had tenure/continuing status reviews, three faculty have been promoted to full professor, and another three faculty have had interim or part-time continuing appointment reviews. We have also increased the number of award nominations for our faculty and staff, resulting in many well-deserved recognitions.

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For our students, we launched a very successful appeal for donations to establish the Momentum Builders Scholarship to support Black and Indigenous undergraduate students in Physics. Thanks to the generosity of many of you, the endowment currently stands at more than $116,000, enabling us to fund several scholarships every year. We recently announced the second call for applications, and donations can still be made to the endowment (and to other Physics initiatives) via this link.

During the first half of my term, the review of our programs under the University's Quality Assurance Process was a major focus, involving extensive consultations, the preparation of a detailed self-study report, the (very positive) external review, and our response. This was followed by the preparation of the five-year Physics Unit-Level Academic Plan and the Tri-Campus Memorandum of Agreement for the Physics Graduate Program. All of these documents provide a solid foundation for the future of the Department.

In the area of equity, diversity, and inclusion, we are working to make the Department a positive and supportive environment for everyone. The Department's IDEA Committee has become more active, and we developed the Inclusivity Statement, hosted various EDI workshops, ensured that faculty search committees are informed about EDI issues, supported student attendance at several women in physics conferences, and implemented various other initiatives. Physics led the development of the Pursue STEM program for Black and Caribbean high school students, in collaboration with the Office of Student Recruitment, Leadership by Design, and other STEM departments in the Faculty of Arts & Science, and with additional support from the Provost's Access Programs University Fund (APUF). We are also in the process of redecorating an office on the third floor to serve as a multi-faith and well-being room and hope to make that available soon.

Although there is not much to show for it yet, there has been considerable effort over the past five years behind the scenes (building on the work of my predecessors in the decade before that!) to transform the Physics Library into a new Physics Collaborative Research and Learning Centre. Funding has been secured from the Provost's Student Spaces Enhancement University Fund and from the Faculty of Arts Science. After attending many dozens of meetings about the renovation since 2020, I'm disappointed that this will not be completed before the end of my term, but construction is currently scheduled to begin this summer and I look forward to the ribbon cutting when the new Centre opens!

While we all know the many problems with our aging building, there has recently been some progress towards the development of a McLennan Renewal Masterplan. Peter Hurley and I have been advocating for this for several years, and I'm pleased to report that the University has now developed the Terms of Reference for a Project Planning Committee to consider broad planning and infrastructure needs for the building. Also getting underway soon will be a badly needed upgrade of the washrooms on the first floor

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of the North Wing to address the issue of an insufficient number of washrooms for women and the lack of all-gender and accessible washrooms in that area.

It has been a great privilege and a highly rewarding experience to serve as the Chair of Canada's leading Department of Physics. Of course, one unanticipated challenge was the COVID-19 pandemic, which started in my first year and required all of us to adapt in our lectures, labs, research, work, and personal lives to cope with the continually changing circumstances. The success of the Department, both during COVID and beyond, is due to the tremendous efforts of many people. I'm grateful to everyone who has supported me and the Department of Physics during my term, including our faculty, staff, students, alumni, donors, and the Faculty of Arts & Science; it has been a very great pleasure working with everyone. I am especially grateful to the third-floor team of Assistant to the Chair Chris McGugan, former Finance Officer Ilda Cunha, Manager, Finance and HR Administration Michael Manley, CAO Peter Hurley, and Associate Chairs Young-June Kim, Joseph Thywissen, and Peter Krieger – I have been truly fortunate to have such outstanding colleagues. And finally, I would like to thank Research Officer Orfeo Colebatch and the wonderful students and postdocs in my research group for their patience and understanding when I've been diverted by Chair duties!

Looking ahead, I wish our incoming Chair great success – I know the Department will be in good hands!

As always, we welcome your feedback on Interactions – please contact our Editor, Supreet Randhawa, at newsletter@physics.utoronto.ca with your comments and news.

With very best wishes,

Kimberly Strong

Chair and Professor

Solar Eclipse Viewing at King's College Circle, April 8, 2024, Jo-Anne Wurster

Image Credits:
Artwork by Light, Water, and Origins of Life by Jackie Traverse
Photo by Silas Baisch on Unsplash

Story of Water Symposium

Friday May 10th, 2024

Venue at McLennan Physical Laboratories, Rm 103 (60 St George St, Toronto)
Lectures start at 1:30 pm | end at 5:30 pm | **First Workshop** at 10 am

Workshop | Registration Required
Capturing Nature through Indigenous Art - Inspiration and Technique
Jackie Traverse

Burning Questions: Exploring the Science and Sizzle of Biochar from Wood and Crustaceans
Dr. Marzieh Baneshi

NWMO's Journey in Learning from Water
Dr. Sarah Hirschorn, Dr. Jessica Perritt

Three-Eyed Seeing: How Can We Learn from Mino-Pimatisiiwin, Natural Law and Water
Prof. Myrle Ballard

Indigenous Worldviews on N'bi (Water): Responsibilities, Relationships, and Declarations
Prof. Sue Chiblow

Microfibers and Microplastics in Water: How Searching for Yooper Lights Got Me Looking At Water in Different Ways
Dr. Mark Jones

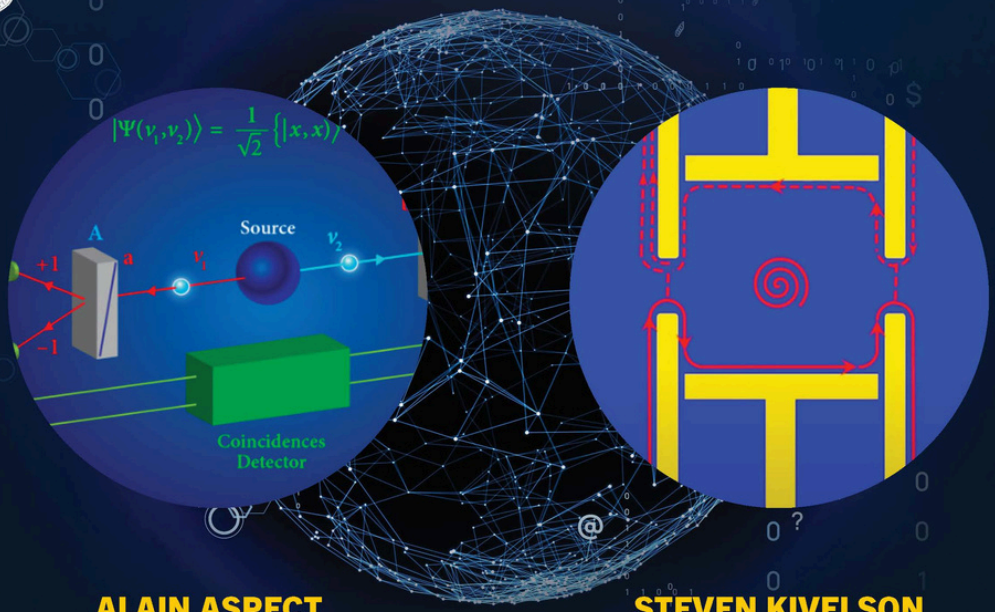
Lectures • Workshops • Hands-on Demonstrations

For more information our programs and schedule, please visit us at https://uoft.me/StoryofWater

UNIVERSITY OF TORONTO
water

In collaboration and funding provided by the Department of Chemistry, Physics, and Vice Dean Research, Faculty of Arts & Science.

THE WELSH LECTURES
IN PHYSICS 2024



ALAIN ASPECT
Institut d'Optique Graduate School
Université Paris-Saclay, France

STEVEN KIVELSON
Stanford University, USA

PUBLIC TALK
THURSDAY, MAY 16, 1:30 PM
From Einstein's insights to quantum technologies: two quantum revolutions
EARTH SCIENCES CENTRE
Auditorium ES1050, 5 Bancroft Ave.

PUBLIC TALK
THURSDAY, MAY 16, 3:30 PM
Observation of fractions of an electron in fractional quantum Hall devices
EARTH SCIENCES CENTRE
Auditorium ES1050, 5 Bancroft Ave.

COLLOQUIUM
FRIDAY, MAY 17, 2:00 PM
From Einstein and Bell to quantum technologies: quantum non-locality in action
KOFFLER HOUSE
Auditorium KP 108, 569 Spadina Cres.

COLLOQUIUM
FRIDAY, MAY 17, 11:00 AM
New physics from strong electron-phonon coupling including deconfined phases and emergent "photons"
KOFFLER HOUSE
Auditorium KP 108, 569 Spadina Cres.

Sponsored by the Department of Physics. For further information, call (416) 978-7135, visit https://welsh.physics.utoronto.ca/ or email: iyer@physics.utoronto.ca

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PHYSICS & MATH ALUMNI REUNION

May 31st @ 6PM
MP125, 60 St. George St.
Toronto

Featuring a panel on

Current Research in Physics & Mathematics

Welcoming remarks by Department Chairs: Robert Jerrard (Mathematics) and Kimberly Strong (Physics)

Speakers:

TRISTAN COLLINS
ASSOCIATE PROFESSOR,
MATHEMATICS

MARY PUGH
PROFESSOR,
MATHEMATICS

HUNTER SPINK
ASSISTANT PROFESSOR,
MATHEMATICS

MORGAN O'NEILL
ASSISTANT PROFESSOR,
PHYSICS

YOUNG-JUNE KIM
PROFESSOR,
PHYSICS

Live musical performance

Physics
UNIVERSITY OF TORONTO

Mathematics
UNIVERSITY OF TORONTO

Faculty Profile

Morgan O'Neill

Assistant Professor, Earth, Atmospheric and Planetary Physics

Dr. Morgan O'Neill joined the Department on January 1, 2024.

Welcome to U of T Physics Dr. O'Neill!

Can you provide a brief introduction to yourself, including your academic background and area of research?

I study atmospheric dynamics, with a focus on how moist thermodynamics influences the structure and strength of storms. I am interested in how different climates serve as boundary conditions on severe storms of all types, and how these storms can feed back on climate change. I tend to work on smaller, storm-scale aspects of these questions, because I am particularly interested in highly nonlinear, unbalanced flows. My group uses a combination of theory and numerical modeling to probe storm evolution and impact on the larger environment.

I have a B.S. in Physics from the University of New Hampshire, and a Ph.D. in Atmospheric Science from the Massachusetts Institute of Technology. I was a Koshland Prize postdoctoral fellow at the Weizmann Institute of Science and then a T. C. Chamberlin postdoctoral fellow at the University of Chicago, before joining the Stanford faculty in the Department of Earth System Science in 2018.

Could you share some details about your current research interests and any specific projects you are working on?

My group has had some smaller-scale field campaign involvement in the past, with research planes that fly through hurricanes. This summer, I will be part of a North American team led by Dr. Allison Wing at Florida State University that will participate in a large multinational field campaign. The ORCESTRA campaign, delightfully, has components such as MAESTRO, CELLO and PERCUSSION. We North Americans are part of PICCOLO, a small but mighty contribution of Colorado State University's dual-polarized SEA-POL radar dish. SEA-POL will be installed on a German research vessel to probe the structure of precipitation in the North Atlantic InterTropical Convergence Zone, and what that means for convective self-organization, structure and efficiency.

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I am also looking forward to continuing recent research into the hydraulic jump that forms above certain supercell thunderstorms in regions like the Great Plains. The possibility of hydraulic control occurring within a fluid (the atmosphere) due to itself is very cool, and has the potential to be at least locally relevant to climate feedbacks. I hope to extend study of this extreme feature to wildfire storms (pyrocumulonimbus) and hurricanes. Finally, some summer students will help me go back to some of my doctoral research into polar vortices on giant planets. We hope to help community efforts to understand why Jupiter has "vortex crystals", packed polygonal structures of cyclonic storms, fixed rigidly at each pole. It's wacky and we'll throw some supercomputing time at it.

Are there any lessons from your own academic journey that you would like to share?

I recommend that students be their whole selves and live a full life alongside pursuing academia or private or public sector goals. It's not worth putting other parts of your brain and heart on hold while you sprint toward some professional goal single-mindedly. Your life is already happening to you! Wear several hats; stay close with circles that can't parse your abstract; volunteer; exercise; have a family if you want. It's all great. The passage of time permits no do-overs, so if you want several lives you need to live them all simultaneously. I chose to stay in academia because it's the best possible fit for me in a lot of dimensions. I opt-in every day. Find your fit, and demand that it has the balance you need to be happy.

What drew you to join our department, and what aspects do you find most appealing or unique?

I am so, so thrilled to be here. I'm excited to be back in a physics department, which is such a natural, though unusual, home for climate science. When I was an undergraduate studying physics and astronomy, I remember walking by myself around campus, surveying all the other students headed to class, and thinking, "*those students are probably studying something reasonably interesting, but I am studying the secrets of the universe*". The idea that I could be permitted to learn the secrets of the universe was just so compelling to me as a driver for education. And it still is a ridiculous privilege. I look forward to learning these secrets from you all.

I think the cohort model of admitting graduate students and letting them arrive and figure out what they really want to do, is equitable and good for science. And the range of summer research programs is great - it looks like I'll have three research students this summer! I also have enjoyed getting to know my EAPP colleagues and see a ton of possibilities for collaboration on some exciting questions in the future. So far, I have experienced a very warm and supportive welcome as I move my family from the States to Toronto. It has been a wonderful and affirming couple of months already and I am very grateful for the opportunity to be here.

Post Doctoral Fellow Profile

Scott Smale

Quantum Optics

Dr. Scott Smale has been working as a postdoctoral fellow in Professor Amar Vutha's group since 2021 focusing on precision measurement, and for the past two years has been designing and building a next-generation cryogenic atomic clock in collaboration with the National Research Council Canada (NRC).

The NRC currently operates a room temperature Strontium (Sr+) ion atomic clock in Ottawa. In this clock, an ion is trapped in an ion trap that resides inside a vacuum chamber. The dominant systematic effect that affects this clock, as well as any room temperature state-of-the-art optical atomic clock, is the frequency shift of the optical clock transition due to blackbody radiation. The blackbody radiation shift scales with the temperature of the ion's surroundings to the fourth power: by cooling the ion's environment to near 4 Kelvin, the blackbody radiation shift is reduced by nearly 8 orders of magnitude compared to room temperature. Room temperature atomic clocks are only able to reach state-of-the-art accuracy by measuring the temperature of the environment that surrounds the ion very precisely and then subtracting the inferred blackbody radiation shift from the measured frequency. The uncertainty on this inferred shift is the dominant systematic uncertainty. In contrast the goal of the cryogenic approach is to reduce the blackbody shift itself to a level that is negligible.

Conveniently, cooling the chamber that surrounds the ion also suppresses the next leading systematic effect: the ion experiences a collisional frequency shift of the clock transition due to collisions with background gas particles in the vacuum chamber. At cryogenic temperatures, gas particles will freeze onto the cold cryogenic components inside the vacuum chamber. This reduces the pressure and therefore the collisional shift.

One of the major challenges of this project is choosing the right materials in the design of the clock. For example, there are a limited number of materials that remain strong and ductile at cryogenic temperatures, including an even smaller subset of these materials that are non-magnetic at cryogenic temperatures. The design itself must take care not to create a set of requirements for a given part such that no material in the world can possibly satisfy them.

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Solving the challenges of the clock design has been very rewarding: the clock is now being built, providing cherished "hands on" time.

Dr. Smale says that collaboration with the NRC has been invaluable for this project. Dr. Pierre Dubé and Dr. Kosuke Kato, who operate the room temperature Sr+ clock at the NRC, have been incredibly helpful sharing their knowledge about Sr+ ion clocks, as well as Professor Vutha, who is the ideal supervisor for this project with his immense knowledge of cryogenics, clocks, and precision measurement.

Prior to working as a postdoctoral fellow, Dr. Scott Smale earned his PhD in Professor Joseph Thywissen's group working with ultracold atoms, where much of the work involved dynamical measurements of a degenerate Fermi gas: specific subjects ranged from studying spin transport in strongly-interacting unitary Fermi gasses to studying transitions between dynamical phases. His favourite analogy for those measurements is a ball rolling down a hill: if the shape of the hill is known well, the dynamical measurement of following the path that the ball takes reveals information about the ball that might not be accessible with static measurements.

When not in the lab, he enjoys playing video games, hosting board game nights, and spending time feeding his insatiable curiosity. He has spent many weekends learning how to do something new just for the sake of curiosity.

MP Building, Summer (2022), Sheela Manek

Graduate Student Profile

Félix Desrochers

PhD Candidate

Quantum Condensed Matter Physics

From an early age, Félix has always been curious about science. As a child, he was captivated by documentaries discussing space-time, black holes, particle physics, and all sorts of fascinating things that didn't (and to a large extent, he admits, still don't) make sense to him. His enthusiasm for physics was further reinforced in high school and CEGEP, where he was lucky enough to have great Physics and Mathematics professors. By presenting the subject in an engaging and enjoyable manner, they sparked his curiosity to study in this field.

These experiences led Félix to pursue a Bachelor's degree in Engineering Physics at Polytechnique Montreal, where he was awarded the prestigious Schulich Leader Scholarship. After completing his undergraduate studies, he was certain that there was still much more he wanted to learn about the subject. Pursuing a graduate degree in Physics thus felt like the most natural path. However, he was unsure of the field for his graduate studies and whether to study experimental or theoretical physics. Although theoretical physics felt daunting at the time, considering his absence of research experience in the field, he ultimately decided to delve into it and discovered a deep fascination with the subject.

Félix is currently doing research in condensed matter physics under the supervision of Prof. Yong-Baek Kim. Much of his research has focused on novel phases of matter called Quantum Spin Liquids. These novel states of matter have attracted much interest in recent years because they can host fractionalized quasiparticles. Namely, the excitations in these systems are fundamentally different from the electrons, protons, and neutrons that constitute all materials. For instance, these particles can carry spin but no charge and have unusual exchange statistics, which are neither fermionic nor bosonic.

In particular, much of Félix's recent work has focused on a class of materials called quantum spin ice – which, despite the confusing name, is just a specific example of a Quantum Spin Liquid on the pyrochlore lattice in the figure below. Quantum spin ice is a

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spectacular phase of matter that realizes the lattice equivalent of quantum electrodynamics, meaning that the material hosts emergent photon-like modes (i.e., excitations similar to light particles). This “emergent light” in quantum spin ice differs significantly from the light we are all used to. For instance, its speed should be approximately 1 m/s (in contrast to 3×10^8 m/s for conventional light in a vacuum), implying that one could easily outpace it in a race. Despite the apparent abstract nature of all of this, he has collaborated directly with experimentalists to test some of his predictions. As a result of some of this work, Félix received a Vanier Graduate Scholarship last year– one of the most prestigious awards for Ph.D. students in Canada.

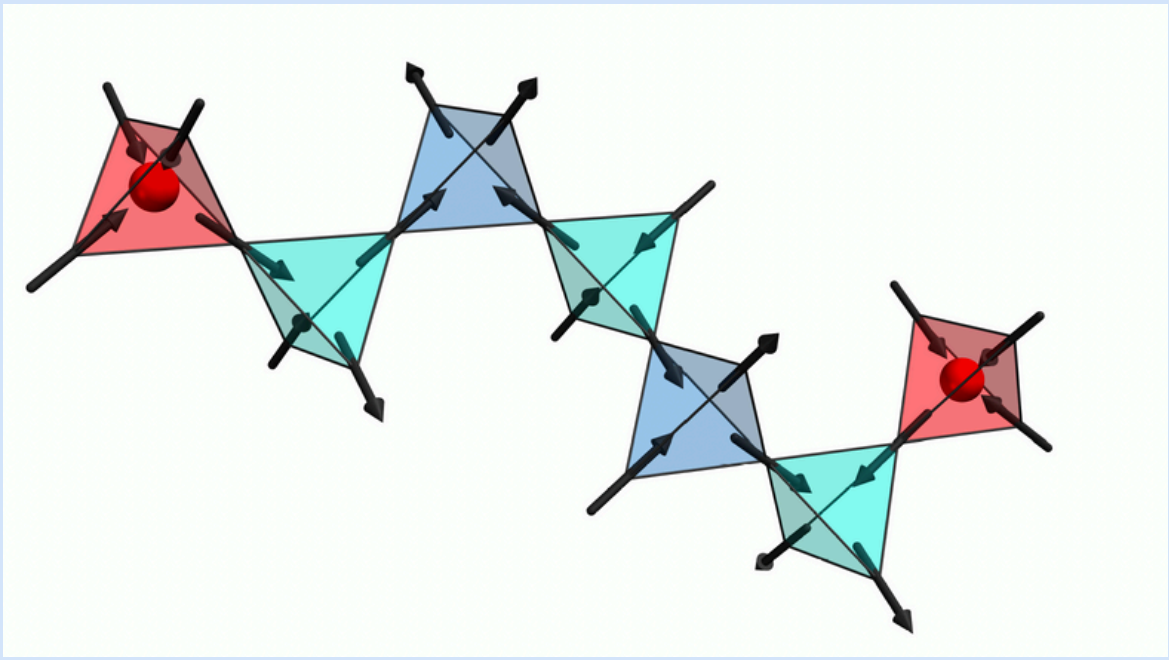

Figure: Spin ice compounds have a pyrochlore lattice formed by a network of corner-sharing tetrahedra. Local magnetic moments live at the sites of this pyrochlore lattice. Two moments are forced to point towards the center of the tetrahedron and two outwards. If this "2-in-2-out" rule is broken, a defect tetrahedron that acts as a source of the emergent field is created.

Félix is uncertain what the future holds and whether his work will be related to his current research interests. He only hopes to continue solving exciting and intellectually stimulating problems. When not at the office or trying to find new ways to explain to his family and partner what he is working on, Félix enjoys playing soccer and rock climbing.

Undergraduate Student Profile

Allen Kasum

Physics Specialist Program

Year of Study: 4

Why did you decide to major in Physics? What was your inspiration?

In high school I originally planned on pursuing engineering, either electrical or engineering physics. This changed since I was always very interested in the theory behind the topics, which we were taught in my high school physics classes, such as some special relativity and diffraction. I really wanted to learn more and get a rigorous understanding of these subjects, and this is what pulled me to physics.

What do you enjoy most about the physics program?

My favourite aspect of the physics program is the practical lab courses. I have currently completed all the practical courses (PHY224/324/424) and computational physics, as well as working towards completing the time series analysis and electronics lab. I have found that these courses have helped me immensely in my research and I can see how the two courses I am currently in are going to be of great benefit. I also enjoy all the opportunities undergraduate students have for research, including the NSERC USRA, SURF award, and senior level thesis/ supervised reading courses. There are many avenues for students to get involved.

What other extra-curricular activities are you involved in during your degree?

In third year, I was part of an intramural volleyball team that my friends had created. I never played volleyball competitively before, so this was a much-needed break with all the problems set and labs that were due at the time.

What are your research interests?

My research interests are split among fields, and I have experience in a few. Currently I am working with Professor Robert Orr in Experimental High Energy Physics, specifically in the ATLAS Inner Tracker Upgrade (ITk) group. The focus of the project is in relation to the upgrade being done on the inner tracker at the LHC at CERN. The group is responsible for

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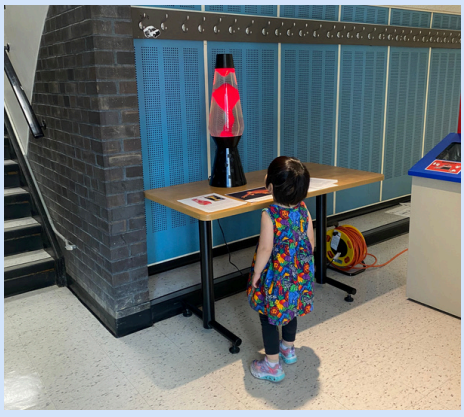
quality control and quality assurance of modules and sensors from various batches that are being produced for the upgrade. One thing we are studying is the effects of annealing over time against charge collection in these sensors. This will need to be heavily understood, since over its decade long lifespan the sensors will suffer radiation damage from the constant collisions being tested, and the efficiency of charge collected will want to be maximized. I am also working with Dr. Sergio de la Barrera for my fourth-year thesis project. The project is in the field of quantum condensed matter and consists of building layered structures of two-dimensional materials to form microscopic electronic devices for cryogenic measurements. I am learning about “moiré” materials such as twisted bi-layer graphene and how to engineer it and similar stacked structures.

What is your favorite course and why?
My favourite course is PHY385, Introductory Optics. Professor Amar Vutha is a very knowledgeable and passionate instructor and always had me excited and curious to learn more. The course also had a lab component where we worked with optical instruments and tested some of the theory that we had learned in the previous week of class which allowed me to better understand experimental optics.

What are your future plans?
I plan to pursue a MSc and a PhD in experimental physics. I am currently deciding between experimental particle physics or quantum optics. I hope that in the future I have finally decided and what I plan to do after this I have not thought of, so we will see!

Where do you see yourself in 10 years?
I hope to be doing something that I am passionate about and is fulfilling. Whether that be continuing in research or finding a job in industry, I’m open to either.

Tell me something interesting about yourself.
I love to cook. I am constantly looking for new and intricate recipes and try and set aside a night or two a week to cook for myself.



Curious child at Science Rendezvous (2023), Supreet Randhawa

Alumni Profile

Randall McArthur

BSc 1982 - Mathematics (University of Waterloo)
MSc 1986 - Physics (University of Toronto)
PhD 1991 - Physics (University of Toronto)

Randall focused on Applied Mathematics during his undergraduate studies at the University of Waterloo, establishing a strong foundation needed for theoretical research in Physics. Randall's research during his time in graduate school at U of T looked at theories of gravitation and high-energy particle physics, with a particular interest in superstrings since he was fascinated by the idea that particles are not points.

In 1990, Randall started working with Atomic Energy of Canada Limited (AECL) and was trained to work with CANDU nuclear reactor physics. (The division he had joined is now part of AtkinsRéalis.) He later expanded that to include engineering quality assurance and eventually became a lead nuclear engineering auditor.

How did your time at the university shape your career aspirations?
The technical topics that I studied in university provided excellent background to understand nuclear reactor core physics. More generally, I was eager to learn, and the university had helped me develop logical, organized, and systematic thinking, which became critical for my professional success. Originally, I had intended to stay in academia. However, toward the end of the PhD program I reassessed my goals and decided to change to industrial work. I started to look for a job that would fit well with my academic background, would provide opportunities to learn new and interesting things, and would accommodate my analysis interest and approach.

What career path did you pursue after graduating from U of T?
I found commercial work in the CANDU nuclear engineering industry. Over a period of 32 years, I successfully contributed to reactor physics analysis and engineering quality assurance before I retired in 2022 to revisit academic interests.

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What are some of your fondest memories from your time at the university?

My best memories from the University of Toronto relate to colleagues who became friends. For example, one of my undergrad roommates also became a peer at the University of Toronto. A brilliant colleague, he seemed to always challenge and inspire me academically while being there as a friend during the ups and downs of grad school. I recall getting excited in the 1980s as I sent my very first network message (we didn't call it e-mail at the time), watching it bounce from server to server around the globe, dreaming of a day when we could interactively share graphics online. I practically lived in my office on the 11th floor of the McLennan building. From there I could see the Harbourfront fireworks, hear the CNE airshows (while trying to study) and even see across to the other side of Lake Ontario on a clear day. I would hob-nob with the other graduate students and even watch them play Dungeons and Dragons (apparently there are similarities with particle interactions in that game). The post-docs and faculty seemed always more than happy to help me where they could, and I also contributed where possible. My favourite faculty antic was when Professor John Moffat showed up on Halloween to teach his post-graduate class – wearing an Einstein mask! In a real sense, I felt that like I was part of a family in the physics building, even beyond the confines of the 11th floor of the McLennan building.

Are there any specific professors or courses that had a significant impact on your career choice?

Regarding my career change from academia, I am thankful for the input of Professor John Moffatt and his former students Dr. Robert Mann and Dr. Martin Green (who was also doing some work for Ontario Hydro at the time), as well as Professor David Rowe from nuclear physics. Also, Professor David Bailey's experimental physics course showed me that non-theoretical work is interesting and exciting, and this provided me with some confidence in moving out of a theoretical career. I was thankful to find industrial work reasonably close to my area of study. However, my career-change decision was relatively sudden and triggered by other factors.

What challenges did you face as you transitioned from university to the professional world? How did you overcome those challenges, and what did you learn from them?

My transition to industry required significant job-hunt effort. To meet my needs, I found work in collections while waiting to hear back from prospective employers. Once I obtained a job with AECL, my main challenge was to "get up to speed" with the rest of the reactor physics team while finishing my PhD and getting married. This involved reading, training, testing, and asking too many questions! I learned that both persistence and humility pay off in a professional environment (and in finding a spouse).

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What advice would you give to current students who are studying in your field? Are there specific skills or experiences you recommend they focus on to enhance their future prospects?

If you are a student who dreams of uncovering something new and exciting, my advice is to take advantage of the time that you have now to do the digging. Like me, you may come to a point in your research where you feel pulled away from academia. For those who may consider a transition into commercial work, I advise developing a work ethic of humility and cooperation in combination with confidence and assertiveness.

I have found that a good commercial reputation is built on great internal teamwork. A physics graduate who takes an industrial job such as doing nuclear reactor physics analysis, will find the physics to be deeply entrenched within an engineering framework. The pure physics of the current generation of operating nuclear reactors was established decades ago, so a starting applied-physics worker must learn not only the strict controls of engineering but also how to thrive within them. Coming from pure physics, I developed an overarching desire for safety that helped me with this. If you are a physics student considering such a transition, I recommend that you take a few engineering courses and take every opportunity to build software engineering experience.

Have you been involved with the university since graduation, such as through alumni associations or mentorship programs?

Over the last several years I have had the privilege to be involved with the University of Toronto Physics Mentorship Program, using my industry experience to encourage undergraduate physics students in their career decisions. I also supported the U of T Computer Science department in the Level Up Showcase event last year. I saw that the students involved were excited and inspired to excellence through these activities. I encourage greater public investment in U of T activities like these!

Can you share your perspective on current trends or developments in your industry?

Outside normal life-cycle activities for operating CANDU designs, the Canadian nuclear reactor industry seems to be moving in at least three exciting directions: refurbishment of operating CANDU reactors, initial construction of Small Modular Reactors (SMRs), and design of next-generation reactors such as the AtkinsRéalis CANDU MONARK design. Engineering and physics for this industry strongly depends on well-established and reliable software, however, there is some movement toward introducing AI techniques. I would be comfortable with AI methods for nuclear reactor design and operations if they are as reliable as corresponding non-AI methods (e.g., learning never decreases accuracy) and if they met the same reliability standards. Scientific and engineering software is very tightly controlled in the nuclear industry!

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Looking back, what do you consider to be the most valuable aspect of your university experience?

Being able to carry out my post-graduate studies at the University of Toronto was a dream come true for me. I learned how to understand our highly mechanistic physical universe, and this was invaluable to my later activities in an engineering work environment. However, I also learned there was more to life than physics. For example, my personal Christian tradition and belief in God was solidified and over the years that helped me to not just do my work, but to thrive in it.

I am grateful to have had access to the university's resources – but even more than that I am privileged to have had the opportunity to work under people whom I consider great physicists, including Professors John Moffatt and Robert Mann, as well as the late Professor David Rowe. They helped me reach a degree of research satisfaction beyond my expectations. If you have opportunity to work with a masterful 'out-of-the-box' physicist, that is something you can treasure for the rest of your life!

Back Campus Field, on Hoskin Avenue (2005), A. W. Peet

Research Spotlight

Caleb Gemmell and Prof. David Curtin – High Energy Theory

"Dissipative Dark Substructure: The Consequences of Atomic Dark Matter on Milky Way Analog Subhalos" Submitted to arXivLabs in November 2023.

Authors: Caleb Gemmell, Sandip Roy, Xuejian Shen, David Curtin, Mariangela Lisanti, Norman Murray, Philip F. Hopkins

The research analyses simulations of galaxies that contain a subcomponent of atomic dark matter. The aim of this study is to compare the behaviour of galaxies containing only cold dark matter (the standard cosmological assumption) and galaxies with both cold dark matter and a small amount of atomic dark matter. Atomic dark matter differs from cold dark matter because it can lose energy and cool like the hydrogen gas found in our galaxy, compared to cold dark matter that only interacts gravitationally. We look at how atomic dark matter may change the properties of the nearby satellite galaxies, as well as the distribution and orbits of the dark matter only subhalos.

Interview with Caleb Gemmell, first author of this research:

Could you describe the primary focus of your research project? What specific objectives or questions are you aiming to address through your research?
While the existence of dark matter is supported by a range of cosmological and astrophysical observations, its behaviour on small scales, less than roughly the size of our Milky Way galaxy, is mostly untested. At the same time, there have been potential discrepancies between computational simulations of galaxies and data at these same scales when assuming the standard cold dark matter model. The specific objective of this article was to try to understand how atomic dark matter behaves astrophysically on these small scales, and address whether it could resolve some of these discrepancies, as well as possibly identify new signals to look for in observational data that could point to atomic dark matter being present in our galaxy.

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What methodologies or approaches are you employing in your research? Are there any innovative or unique aspects to your research methods?

This research revolves around massive computational simulations that have been standard in the field of computational astrophysics. However, there has been an increasing interest in alternative models of dark matter that are only beginning to be studied using these simulations, with this work being the second study of atomic dark matter hydrodynamical simulations.

Can you share details about any ongoing projects or recent findings in your research? Have there been any unexpected discoveries or outcomes that stood out to you? Images with caption?

Our central takeaway from the project is that even at 6% of dark matter being atomic, this can have catastrophic effects on the simulated galaxies. In a previous paper by the collaboration, it was shown to diminish the size of the galactic disk. In this work we found it led to the formation of satellite galaxies much smaller than we observe in the Milky Way, as well as increasing the number of dark matter subhalos orbiting close to the disk. We want to follow up on this result by looking at how these subhalos could perhaps affect the stellar stream population around galaxies. Stellar streams are thin arrangements of stars that could be sensitive to disruptions by these subhalos, making them promising probes of dark matter properties.

Have you collaborated with other researchers or departments on your projects? How does your research contribute to interdisciplinary efforts within the department or beyond?

This work started on a semester exchange to Princeton University, working with Prof. Mariangela Lisanti and her graduate student, Sandip Roy, which was possible due to the support of the McDonald Institute and Canada First Research Excellence Fund. As a primarily particle physicist, it was essential to also involve astrophysicists on the project, both in helping run the simulations and interpreting our results, for which we thank our collaborators Jacob Shen (MIT), Norman Murray (CITA, UofT) and Phil Hopkins (CalTech). As you can see this was a large collaboration between universities, but also an interdisciplinary effort between particle theorists and astrophysicists. At the end of the day we're all interested in trying to understand what the fundamental nature of dark matter could be.

How do you approach disseminating your research to the broader academic community?

Giving talks at workshops and conferences is the main method of trying to share the work we've done outside the publication of the paper. I've presented the results of this research at the Perimeter Institute, the Centre of Computational Astrophysics, and the University of

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Pittsburgh, hoping to show other researchers how atomic dark matter is an exciting model to consider for future studies. Being involved with hackathons is also another avenue to get more people involved with these studies, helping people build experience with the simulation tools themselves.

What are your plans for the future of your research? Are there specific goals you hope to achieve in the next few years?

One project we are in the stages of starting is using these atomic dark matter simulations to study what effects this model could have on Lyman Alpha observations. These observations probe the structure of the universe at much earlier times than the galactic simulations we carried out for this work and could provide additional constraints on what types of atomic dark matter is allowed in our universe. This work will also involve using machine learning techniques to maximally understand our model from a minimal set of simulations thanks to the involvement of Keir Rogers, a postdoc at the Dunlap Institute here in Toronto.

What advice would you give to other researchers in the department, especially those in related fields? Are there lessons learned from your research journey that you'd like to share?

I think the biggest takeaway from this project I had was the strength of interdisciplinary research. Cosmologists, astrophysicists, and particle theorists are all interested in understanding dark matter, and here at the University of Toronto we have groups or institutes in all three areas. Strengthening ties and communication channels between the fields opens up exciting new projects for everyone involved.

More information here: https://arxiv.org/abs/2311.02148

More on Prof. David Curtin's research group: https://curtin.physics.utoronto.ca/

Spring at UofT campus (2022), Miriam Diamond

November 2023 PhD Graduates

Congratulations to our November 2023 graduates!

Audette, A. - Physical Mechanisms Behind the Midlatitude Atmospheric Energy Transport Response to Imposed Arctic Sea Ice Loss. (Supervisor P. J. Kushner)

Barron, J. P. O. - New Probes of Hidden Sectors: From Colliders to Cosmology. (Supervisor D. Curtin)

Bartram, F. M. - Optical studies of topological magnetic materials. (Supervisor L. Yang)

Cabaj, A. - Synthesizing Observations and Models to Improve Estimates of Snow on Arctic Sea Ice. (Supervisor P. J. Kushner)

Kisliuk, D. P. - Searches for Lepton Flavour Violating Higgs Boson Decays with the ATLAS Detector. (Supervisor R. S. Orr)

Li, K. - Quantifying the impacts of resolution-dependent model errors on tropospheric ozone simulation. (Supervisor D. B. A. Jones)

Lindquist, A. W. - Unconventional Superconductivity in Spin-Orbit Coupled Systems. (Supervisor H.-Y. Kee)

Mackay, V. - Instrument Design and Analysis Techniques for Low-Redshift 21 cm Cosmology and Transient Detection with CHORD and CHIME. (Supervisor K. Vanderlinde)

McGibbon-Gardner, S. M. - Models of Elite and Equipotent Dynamics in Cellular Reprogramming and Cancer Growth. (Supervisor S. Goyal)

Meng, H. Y. - Searching for beyond the Standard Model phenomena in dijet events with at least one lepton with the ATLAS detector. (Supervisor W. Trischuk)

Roy, J. - Aspects of Resummation in Effective and Finite Temperature Field Theory. (Supervisor M. E. Luke)

Voleti, S. - Hidden order and Spin liquids in Correlated d-orbital oxides. (Supervisor A. Paramekanti)

Yip, L. S. K. - Control of Acoustic Waves by Locally Resonant Phononic Crystals. (Supervisor S. John)

Xanadu Award

PhD candidate Sophia Simon receives the 2024 Xanadu Award for an Outstanding Publication

Through generous support from Xanadu, the Xanadu Award for an Outstanding Publication was established in the Department of Physics to acknowledge PhD students who have published a peer-reviewed article in an academic journal on a topic related to **quantum information and quantum optics.** We are delighted to announce this year's recipient – Sophia Simon – who received the award in recognition of her paper "Improved Precision Scaling for Simulating Coupled Quantum-Classical Dynamics", which was published in PRX Quantum in 2024.

This award is the result of a donation from Xanadu, a Toronto-based start-up company with close ties to the Department of Physics. A number of former post-doctoral fellows, PhD students and undergraduate students are affiliated with Xanadu.

Xanadu founder and CEO Christian Weedbrook says *"we wanted to encourage students in the field of quantum information and quantum optics and to let them know that Xanadu, and many other quantum startups in Canada, exist when they graduate."*

Sophia Simon shared her thoughts on her award-winning research:

What inspired you to pursue research in this field?

The inspiration to pursue research in quantum computing derives largely from the potential of quantum computers to vastly outperform classical computers for certain tasks. Understanding how much of a quantum speedup is possible for a given problem is one of the key motivators for my research.

How does your research impact the society we live in today?

My research focuses on developing and analyzing quantum algorithms for fault-tolerant quantum computers.

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While these algorithms will likely not be implemented in the near future, they provide a strong motivation for continuing the efforts to build a fault-tolerant quantum computer as they promise significant speedups over classical algorithms for problems such as simulating physical systems.

What impacts do you hope to make through your achievement?

High-precision simulations of coupled quantum-classical dynamics are of great interest in physics, chemistry, biology and pharmacology. For example, molecular dynamics is often formulated in this way wherein the nuclei are treated as classical particles while the electrons are treated quantum-mechanically. This allows numerical investigations of chemical reactions, protein-folding and many other physical processes. However, existing algorithms suffer from unfavorable scaling with precision, making high-precision simulations infeasible for most systems of interest. In this work, we present a novel quantum algorithm that provides a super-polynomial improvement in the precision scaling for simulating coupled quantum-classical dynamics, thus enabling high-precision molecular dynamics simulations. Given the significant speedup of our algorithm and the importance of molecular dynamics simulations across the natural sciences, I hope that this work will inspire further research on simulating quantum-classical systems on quantum computers.

Read the award-winning paper here:
https://journals.aps.org/prxquantum/abstract/10.1103/PRXQuantum.5.010343

More on Xanadu: https://www.xanadu.ai/

University of Toronto at Spadina Ave (2022), Deepayan Banik

Awards & Announcements

Announcements

Miriam Diamond

Assistant Professor Miriam Diamond had a successful interim review in November 2023.

Tahir Shaaran

Dr. Tahir Shaaran moved from a Visiting Scholar position to a part-time (75%) Assistant Professor Teaching Stream position from January 1 to June 30, 2024.

Richard Teuscher

Professor Richard Teuscher's position as a Principal Research Scientist at the Institute of Particle Physics was renewed for another five-year term, effective January 1, 2024.

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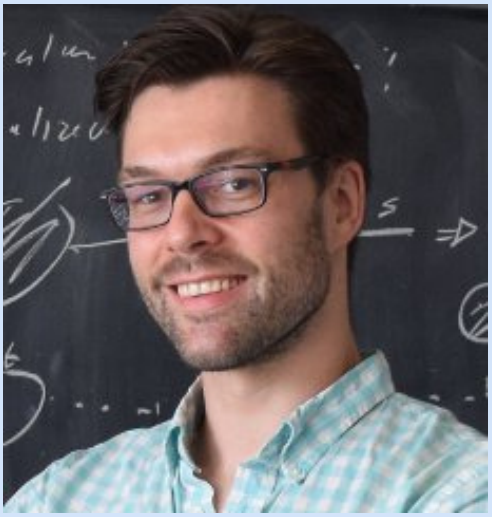
Ania Harlick

Assistant Professor Ania Harlick had a successful continuing status review and will be promoted to Associate Professor Teaching Stream, effective July 1, 2024.



David Curtin

Assistant Professor David Curtin had a successful tenure review and will be promoted to Associate Professor, effective July 1, 2024.

Andreas Hilfinger

Assistant Professor Andreas Hilfinger (of the Department of Chemical and Physical Sciences at UTM and the Department of Physics) had a successful tenure review and will be promoted to Associate Professor, effective July 1, 2024.

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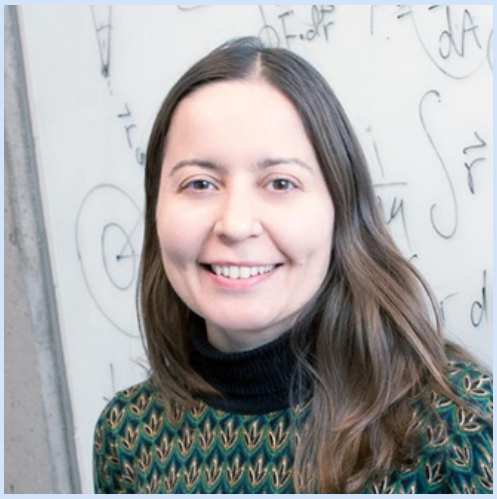

Sarah Rauscher

Assistant Professor Sarah Rauscher (of the Department of Chemical and Physical Sciences at UTM and the Department of Physics) had a successful tenure review and will be promoted to Associate Professor, effective July 1, 2024.

Awards

Professor Kaley Walker honoured as a 2024 Optica Fellow

Professor Kaley Walker was elected as a 2024 Optica Fellow in recognition of her research excellence and scientific leadership in atmospheric remote sensing using applied spectroscopy, as well as extensive contributions to professional service and public outreach.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/professor-kaley-walker-honoured-as-a-2024-optica-fellow/

Professor Hoi-Kwong Lo named 2024 IEEE Fellow

This distinction is awarded to select IEEE members whose extraordinary accomplishments in any of the IEEE fields of interest are deemed fitting of this prestigious grade elevation.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/professor-hoi-kwong-lo-named-2024-ieee-fellow/

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Professor Debra Wunch honoured by the American Geophysical Union

Professor Debra Wunch received the Ascent Award from the American Geophysical Union (AGU) for her outstanding contributions to Earth and space sciences. Wunch's leadership and scholarship have played a central role in enabling large space-based remote sensing efforts of greenhouse gases.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/prof-debra-wunch-honoured-by-the-american-geophysical-union/

Professor Young-June Kim receives the 2023 Dean's Research Excellence Award

Professor Young-June Kim received the 2023 Dean's Research Excellence Award recognizing faculty members whose contribution in research has had a sustained influence in their chosen disciplines. Prof. Kim is a leading experimental physicist in the field of quantum condensed matter physics and quantum materials.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/professor-young-june-kim-receives-the-2023-deans-research-excellence-award/

Professor Ania Harlick is the recipient of a 2023-2024 Faculty of Arts & Science Outstanding Teaching Award – Early Career

Professor Ania Harlick, Assistant Professor, Teaching Stream in the Department of Physics, has been named as the recipient of a 2023-2024 Faculty of Arts & Science Outstanding Teaching Award – Early Career. This award recognizes teaching excellence in undergraduate and graduate education, with a focus on classroom instruction and course design and/or curriculum development, for early career faculty, particularly over the past two years.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/professor-ania-harlick-is-the-recipient-of-a-2023-2024-faculty-of-arts-science-outstanding-teaching-award-early-career/

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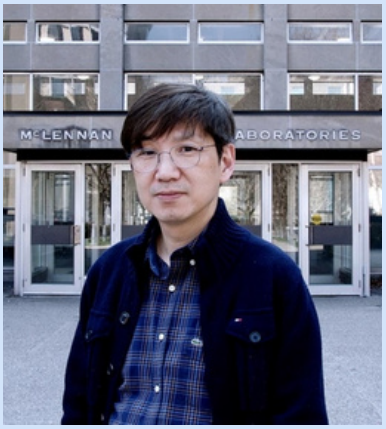
Professor Bob Holdom recognized as an APS Outstanding Referee

Professor Bob Holdom, Emeritus Professor in the Department of Physics, has been selected as one of 156 Outstanding Referees for 2024 by the editors of the American Physical Society's (APS) Physical Review journals. The Outstanding Referee Program recognizes the essential work that anonymous peer reviewers do to hold the high standards of our esteemed physics journals.

More:
https://journals.aps.org/OutstandingReferees

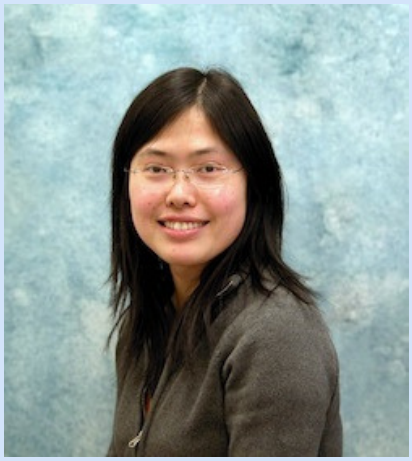
Professor Yong Baek Kim honoured by the Korean Academy of Science and Technology



Professor Yong Baek Kim has been elected as a 2024 Fellow of the Korean Academy of Science and Technology, which is the highest scholarly institution in the science and technology field in Korea. Fellows are recognized for having produced original research results and significantly contributing to the development of their field.

More:
https://kast.or.kr/kr/notice/news.php

Lilian Leung selected for a Dean's Outstanding Technical Service Award



Senior Learning Services Specialist Lilian Leung has been selected as the recipient of the 2024 Dean's Outstanding Technical Service Award from the Faculty of Arts & Science. This award recognizes her exceptional contributions and technical skills, and the vital support that she provides to meet the many and varied teaching needs of the Department of Physics. Lilian is a wonderful colleague who also brightens the Department with her readiness to help and her positive attitude.

Emeritus Faculty Lunch 2023

After a gap of several years due to the pandemic, we resumed the annual Emeritus Reunion Lunch last fall. The lunch took place on October 26, 2023 at the Faculty Club. Our emeritus faculty met our three newest faculty and heard about what is the new in the Department, and caught up over lunch!

Left to Right; Front row: Henry van Driel, David Dunlop, Kim Strong, John Pitre, David Bailey
Back row: Ron Farquhar, Nigel Edwards, Boris Braverman, Anthony Key, Gordon West, Sergio de la Barrera, Xiang Li, Dick Bailey

Emeritus Faculty Lunch, 2023, Boris Braverman

Arrivals & Departures

We welcome three new members to the Department of Physics and bid one staff member good-bye.

Arrivals

Jo-Anne Wurster
Receptionist/Departmental Assistant

Jo-Anne joined the Department in January 2024, coming from UofT's University Family Housing residence. Although working in a variety of reception, front-line and administration roles, in her other life she is a composer, whose music has been performed around the world, a rehearsal pianist, and accompanist; not only does she sit on the Board of Alexander Showcase Theatre but was also put on the Marketing Committe after uttering four fateful words, "*I have an idea!*". Jo-Anne is an avid hat-collector and has not yet met a chocolate she has not liked.

Erica Rosenblum

- Assistant Professor (part-time term appointment) in ice-ocean interactions
- Joined on January 1, 2024

Dr. Erica Rosenblum considers herself an Arctic oceanographer, a climate scientist, or a physicist, depending on who's asking. Her research is focused on Arctic ice-ocean interactions using a range of tools including climate models, hydrographic and satellite observations, idealized models, and lab experiments. Before starting at UofT, she held an NSERC Postdoctoral Fellowship at the University of Manitoba following the completion of her PhD at Scripps Institution of Oceanography in California. When she's not doing science, she is most likely playing a weird racquet sport like beach tennis - and yes you should definitely try it.

Continued on next page.

Arrivals

Morgan O'Neill

- Assistant Professor in Theory, Modelling, and Dynamics of the Atmosphere
- Joined on January 1, 2024

Departures

Elizabeth Glover

Liz joined the Physics Library in 2004 as a Library Technician. For 14 years she was a friendly, helpful presence in the library, assisting students, faculty, and staff with a variety of services including finding information sources, troubleshooting issues, resource sharing, digitization, reference assistance, and more. Liz's time at the Physics Library was defined by her extensive expertise, professionalism, and genuine empathy in understanding and assisting others. Her quick wit and remarkable capacity to connect with people by remembering their names, faces, and details of their lives transformed the library into a warm and inviting space for everyone. From 2014 to 2018 she took on other jobs in the Department, including helping in the Graduate Office with student admissions and scholarships. In 2018, Liz moved to a 100% position in room 301 as the Departmental Assistant and Receptionist. For these past six years, Liz was the welcoming face of the Department on the third floor, issuing keys, fielding initial inquiries, distributing mail, and helping with many administrative and outreach tasks as they come up through the year. Liz's gift for putting people at ease and her helpful, organized and friendly presence will be greatly missed. Best wishes to Liz going forward, and happy retirement!

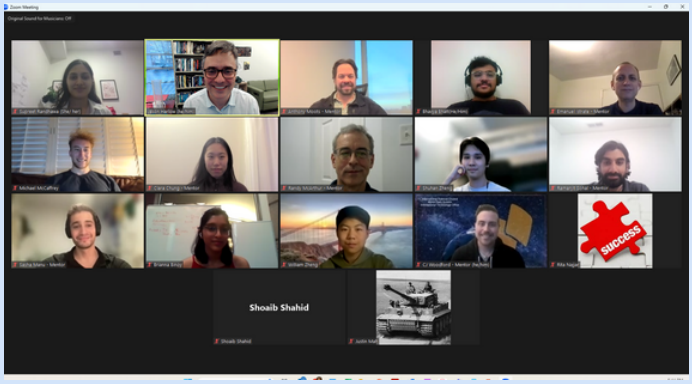
By Dylanne Dearborn and Jason Harlow

PhysCAP Recap

Updates from the Physics Career Accelerator Program.

Physics Mentorship Program

The 2023-24 Physics Mentorship midterm event took place on Thursday, February 22, 2024. The event was held virtually and was attended by Mentors and Mentees and was open to all undergraduate students seeking guidance for their career endeavours.



More information on the Physics Mentorship Program can be found here: https://www.physics.utoronto.ca/undergraduate/physics-career/mentorship/

The Canadian Association of Physicists (CAP) Professional Physicist (P.Phys.) Certification Information Session

The purpose of this program is to introduce students to the Canadian Association of Physicists Professional Physicist certification (P.Phys.) program.

Open to 2nd, 3rd and 4th year students in the Physics Specialist and Joint Specialist programs and Graduate Students.

The information session was offered by Professor Miriam Diamond and attended by over 40 students interested in learning about the certification.

More information on the CAP certification can be found at:
http://www.cap.ca/programs/pphys-certification/

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physCAP Careers Outside Academia

The 2023-24 PhysCAP Careers Outside Academia event was held on Thursday, January 18, 2024. Upper-year students attended a panel discussion by physics alumni who have pursued careers outside academia. Students learned about career opportunities relevant to their degrees in physics and about the skills that employers value. The event featured a diverse group of speakers who shared their personal stories and described the paths they had taken over the years and how their trajectories had shifted from their original plans. The 2024 alumni panelists are featured below:

Sheri Crawford
Director, Data Governance, Scotiabank

Christopher Main
Articling Student, OSSTF

Jane Dong
Hybrid Cloud Digital Enablement Lead and IBM Quantum Ambassador, IBM

Isaac Nikolai Fox
Copywriter and Creative Director, HIMSS

More information about the Careers Events can be found here:
https://www.physics.utoronto.ca/undergraduate/physics-career/physics-career-fair/

Outreach in Action

Physics, Music and Film: a Multimedia Performance

On November 4, 2023, a large audience gathered at the Isabel Bader Theatre to experience the Canadian premiere performance of "Patterns from Nature", a multimedia work blending music, film and physics. It is the latest endeavour in a longstanding collaboration between Quinsin Nachoff, a Canadian-American composer and saxophonist based in New York, and Professor Emeritus Stephen Morris of the Department of Physics.

The composition featured four pattern-themed movements, "Branches", "Flow", "Cracks" and "Ripples", with each movement paired with a film created in collaboration with a different filmmaker: Tina de Groot from the Netherlands, Lee Hutzulak from Canada, Gita Blak from NYC/Croatia, and Udo Prinsen from the Netherlands respectively.

The music, a blending of idioms of jazz and classical, was performed by a live chamber orchestra of sixteen musicians from both NYC and Toronto, with featured soloists pianist Santiago Leibson, the Molinari String Quartet, drummer Satoshi Takeishi, bassist Carlo De Rosa, clarinetist François Houle, trombonist Ryan Keberle, saxophonist Quinsin Nachoff and led by conductor JC Sanford.

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Each movement contained elements drawn from real physical experiments, including published data on icicle shapes from Prof. Morris's Icicle Atlas. The following day, the contributors discussed their work at a roundtable event sponsored by the ArtSci Salon, available on YouTube.

"Patterns from Nature" will be released on CD, vinyl and on streaming services in 2025.

Left to Right: Lee Hutzulak, Gita Blak, Udo Prinsen, Quinsin Nachoff, Tina de Groot, Stephen Morris

The event was supported by the Canada Council for the Arts, the Fields Institute for Research in Mathematical Sciences through the ArtSci Salon, and the University of Toronto Department of Physics. The Molinari String Quartet was supported, in part, by the Conseil des Arts et des Lettres du Québec.

More information here: https://www.artsci.utoronto.ca/events/patterns-nature-multimedia-experience-physics-film-and-music

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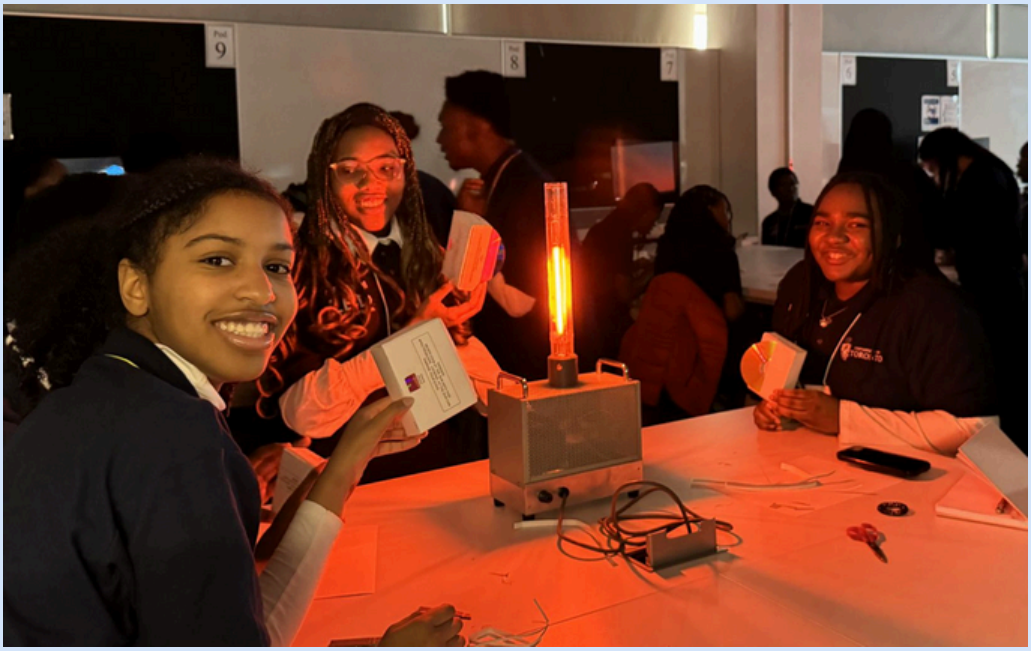
Outreach in Action

Pursue STEM

Regular readers of Department of Physics Interactions newsletter will be familiar with Pursue STEM, the Physics-Department-led initiative that encourages and supports high-achieving Black students interested in science and mathematics. The program launched its 4th year in February – bigger and better than ever.

At the first session on Saturday, February 7, the Department was crowded with over a hundred excited and enthusiastic students and parents. The Grade 10 students were taken across Huron Street to the Department of Earth Science, while the Grade 11/12 students analyzed sunspots with the Department of Astronomy. A week later, the Grade 10 students learned about Atmospheric Physics and built their own spectrometers.



This year the program has expanded to include sessions at the Department of Cell & Systems Biology and Victoria College sessions, optional March Break Activities, and support for participation in the Canadian Black Scientist Network Science Fair. Even with an expanded intake of 47 Grade 10 students, we could not accommodate all students who applied.

We also are providing very well-received short presentations and discussion with parents so they can learn a bit about what their students have done that day, the science and scientists behind it, and possible career paths.

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The profile of the program continues to expand, and last year the Pursue STEM students were invited to attend David Suzuki's retirement celebration at the CBC Broadcast Centre.

Pursue STEM is part of the Leadership By Design (LBD) program of the Lifelong Leadership Institute (LLI). In addition to Astronomy and Astrophysics, Chemistry, Computer Science, Earth Sciences, Mathematics, School of the Environment, Physics and Statistics, Pursue STEM is also supported by the Dunlap Institute, the Canadian Institute for Theoretical Astrophysics, the Office of Student Recruitment, and the Provost's Access Programs University Fund.

More on Pursue STEM: https://www.physics.utoronto.ca/physics-at-uoft/outreach/pursue-stem/

MP Building (Winter 2022), Amar Vutha

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Outreach in Action

U of T Physics School Visit Program

On November 9, 2023, students in grade 11 and 12 from Greenwood College visited the Department for an activity on light by graduate student Joscelyn van der Veen, followed by a first-year lab tour by Prof. Ania Harlick.

On February 23, 2024, grade 11 and 12 students from Huron Heights Secondary School attended a workshop on "Laser Diffraction" by Prof. Brian Wilson, followed by cool physics experiments in the lab Prof. Ania Harlick. This was followed by a campus tour.

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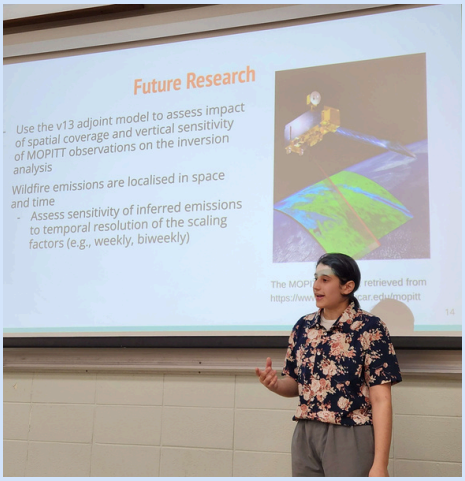
On February 27, 2024, grade 8 students from the Market Lane Public School attended the Starburst Rock Cycle workshop by Prof. Daniel Gregory. This was followed by a guided tour of the campus.

Are you a high school teacher who wants to bring your class to the Department of Physics for a visit or participate in a virtual visit?
For more information visit:
https://www.physics.utoronto.ca/physics-at-uoft/outreach/school-visits-students/

Outreach in Action

Not Quite a Lecture



Supported by the Outreach Committee, "Not Quite a Lecture" is a student-initiated and directed program that aims to promote physics and STEM education amongst high school students in the GTA. We made our debut Fall 2023 and have since had undergraduate students present approachable talks in over a dozen high schools in Toronto, Mississauga, and the York Region. The topics ranged over many areas of interest, including Fluid Dynamics, Computational Physics, Oceanography, Relativity, and Quantum Mechanics. As we prepare for a new set of visits throughout May and June, we hope that this program becomes a longstanding tradition of student-driven science communication in our department.

By Ivan Ovchinnikov

For more information, please contact us at: *notquitealecture.uoft@gmail.com*

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Outreach in Action

Canadian Association of Physicists High School Exam Workshop

High school students attended a two-day virtual workshop to prepare for the Canadian Association of Physicists (CAP) High School Exam. This workshop was held on Saturday, February 10 and March 23, 2024, along with some virtual office hours. About thirty students attended from the Toronto area, and other regions of Canada.

This workshop introduces high school students to the CAP exam, gives them the opportunity to work through previous exam questions, and provides tips on test-taking. The goal of the workshop sessions is to have the students who participate leave feeling more confident with physics and test-taking in general.

The workshops were facilitated by Professors Ziqing Hong, Ania Harlick, and Boris Braverman, with the assistance of U of T Physics undergraduate and graduate students. The high school students commented on how they found interacting with U of T students and faculty very useful.

Professors Hong and Harlick wowed students with physics demos, including the popular liquid nitrogen train to demonstrate superconductivity, while Prof. Braverman shared his experience as a former high school CAP exam participant.

More: https://www.physics.utoronto.ca/physics-at-uoft/outreach/u-t-physics-high-school-cap-exam-preparation-workshop/

PhySU Activities

The Physics Student Union (PhySU) has had a highly successful year, organizing a wide range of social and academic events that resonated strongly with our diverse undergraduate community. In addition to our popular annual themed events like "PhySU HallAUween" and "PhySU LoveSU," we offered a variety of small-scale activities such as foosball tournaments, trivia nights, movie screenings, and an enjoyable ice-skating outing. Our esteemed Prof Talk series continued to engage audiences with insightful lectures from Professors David Curtin, Erica Rosenblum, and Hae-Young Kee, complemented by the launch of a new weekly undergraduate colloquium series.

We also provided valuable support to first-year students through tailored study sessions led by upper year students and conducted workshops on Python, Mathematica, and LaTeX to enhance technical skills. This year marked the introduction of the First-Year Representative for courses PHY131/PHY132, a role aimed at strengthening our connections with physics students outside the program. We have made significant strides in creating a more inclusive and diverse atmosphere at our events. Furthermore, our collaborative efforts with other course unions have expanded, leading to successful joint events with the Astronomy, Philosophy, and Computer Science Unions.

By Adi Khandelwal, PhySU Representative

Continued on next page.

PhySU Activities

Physics Student Union organized PhySU's Pi Day fundraiser on March 14 celebrating Pi Day, with pie slices for sale and some pie-in-the-face fun. Professors Miriam Diamond, Ania Harlick, and John Sipe were among the faculty who volunteered for some fun in the event. There was a large participation from the student community as they lined up to take shots at their professors and executive team members! The event was a huge success, and we look forward to next year's Pi Day.

On April 8, PhySU organized a trip to witness the total solar eclipse along the Lakeshore in Hamilton, ON. A total of 40 students attended this trip and were able to successfully bask in the awe of totality for 1 minute and 50 seconds despite the cloudy grey skies leading up to totality. It was a totally awesome experience!

Physics News

Postdoctoral Interview with Yuxuan Zhang

Dr. Yuxuan Zhang is a postdoctoral fellow at CQIQC with an appointment at the Department of Physics. Yuxuan shares his research and describes how the field has evolved.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/postdoctoral-interview-with-yuxuan-zhang/

The 21st Century's "Music of the Spheres"

Professor Matt Russo, a physicist at the University of Toronto, collaborated with scientists at Harvard & the Smithsonian Center for Astrophysics to give voice to black holes, enriching the research experience and bringing wonders of the universe to new audiences.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/the-21st-centurys-music-of-the-spheres/

Karen Smith of UTSC and PhD student Michael Morris of Physics talk about the University's Climate Impacts Hackathon

The hackathon was organized by Prof. Paul Kushner, Prof. Karen Smith, Michael Morris, and Francisco Camacho, bringing together students, alumni, and members of the community, who worked in teams to investigate regional climate change impacts and propose solutions to adapt to these impacts.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/karen-smith-of-utsc-and-phd-student-michael-morris-of-physics-talk-about-the-universitys-climate-impacts-hackathon/

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U of T visiting scholar pairs Afghanistan advocacy with a passion for physics

Dr. Tahir Shaaran is a visiting scholar in the University of Toronto's Department of Physics. Dr. Shaaran is teaching the next generation of scientists and says he's once again reminded of education's power to drive change and social progress. A former director-general of Afghanistan's nuclear energy agency, Tahir Shaaran is keen to use education to help his country and drive change.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/u-of-t-visiting-scholar-pairs-afghanistan-advocacy-with-a-passion-for-physics/

Professor Amar Vutha comments on precision measurements and search for new Physics

Prof. Amar Vutha's group is searching for new physics beyond the Standard Model using precise measurements of atoms, taking advantage of improvements in technology and quantum science.

More:
https://pubs.aip.org/physicstoday/article/76/12/19/2923589/Precision-measurements-bring-the-search-for-new

https://www.optica-opn.org/home/articles/volume_35/january_2024/features/timekeepers_in_space/

Professor Kent Moore explains how the El Niño and La Niña weather events may impact Canada

This past winter, weather in Canada has been affected by an El Niño event, which is known for warm, above-average temperatures in the Pacific Ocean. While El Niño and La Niña events occur in the Pacific Ocean, they affect global weather patterns.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/professor-kent-moore-explains-how-the-el-nino-and-la-nina-weather-events-may-impact-canada/

A sad farewell to Professor Anton Zilman

The Department of Physics is deeply saddened to announce that Professor Anton Zilman passed away on Tuesday, April 23, 2024. He had been unwell recently, but we had been hoping for a return to full health. His passing was unexpected and has happened far too soon.

Anton joined the Department of Physics as an Assistant Professor in 2011, followed by promotion to Associate Professor in 2017 and to Professor in 2023. He earned his PhD from the Weizmann Institute of Science in 2004 and held postdoctoral fellowships at Rockefeller University (2004-2006) and in the Theoretical Division at Los Alamos National Laboratory (2007-2010) prior to coming to UofT.

Anton was a theoretical and computational biological physicist whose research spanned physics, biology, and biomedical engineering. He had collaborations with a wide network of local, national, and international colleagues, including experimentalists in biology, bio-engineering, nanoscience, and clinical science. He was widely known and highly respected for his work investigating the physical principles of biological transport and signaling processes on the molecular, cellular and population levels, and leveraging these principles for bioengineering and biomedical applications and method development.

Anton was a valued member of our Biological Physics research cluster and had an active and productive research group. He also taught many undergraduate and graduate students over the past 13 years, and was fully engaged in the life of our Department, as well as serving as UTFA Council Member for Physics, Astronomy and Astrophysics since 2020. His sudden passing is a huge loss to our community and to his many friends and colleagues around the world. We extend our deepest sympathy to Anton's family. He will be greatly missed.

University of Toronto Campus in the Winter, Aephraim Steinberg

Contact Us

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