Physics
UNIVERSITY OF TORONTO

Spring 2022

INTERACTIONS

The Department of Physics Newsletter

McLennan Physical Labs
(credit: University of Toronto)

MESSAGE FROM THE CHAIR

Welcome to the Spring 2022 issue of Interactions, the Department of Physics newsletter!

Dear Physics community,

Another eventful term is coming to a close. We started off the year with a return to virtual classes due to the Omicron variant, then moved back to in-person teaching after Reading Week. The University is gradually opening up again and we hope that sixth wave recedes soon. Here in the Department, we are working our way through interviews for six faculty searches and looking forward to recruiting some new colleagues.

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We are excited to be hosting the annual Welsh Lectures in person from May 4 to 6. Nigel Goldenfeld from the University of Illinois and Jeff Dahn from Dalhousie University are this year's speakers – all are welcome to attend their public talks and colloquia. Then on May 12, Nicole Yunger Halpern from NIST and the University of Maryland will be giving a public lecture about her book on Quantum Steampunk and how quantum physics is transforming our understanding of information and energy. Also, if you missed this year's J. Tuzo Wilson Lecture in February, given by Catherine Johnson from UBC, her talk about the magnetic fields of terrestrial planets is available at https://tuzowilson.physics.utoronto.ca/.

In January, we were very pleased to welcome two new members to the Department: NuRee Lee joined us as Physics and Astronomy Librarian, in a joint appointment between the Department of Physics and the David A. Dunlap Department of Astronomy & Astrophysics, and Arman Molki is the new Director of Physics Learning and Research Services. The Newsletter includes an interview with NuRee Lee, as well as profiles of EAPP Research Associate Heba Marey, EHEP PhD Student Matthew Basso, and Physics Specialist and Math Major Muhammad Mohid. Our Emeriti Profile features condensed matter physicist John Perz, who retired in 2000, but then spent more than a decade helping to establish the University of Ontario Institute of Technology. Our Alumni Profile introduces David McDonald, who put his physics degree to good use in multiple roles, particularly in the forest industry.

The Research Spotlight in this issue is on Laurelle Veloce and the upgrade of the inner tracker for the ATLAS experiment at the Large Haldron Collider at CERN, a major initiative that the Department's ATLAS group is actively working on. As always, research highlights and other stories can be found at Physics News.

Congratulations to our fourteen November 2021 PhD graduates and to Milica Banic, who is the recipient of the 2022 Xanadu Award for an Outstanding Publication by a PhD Student for her paper "Generation of photon pairs by stimulated emission in ring resonators". Physics students and faculty continue to garner awards and recognitions, including an Editors' suggestion in APS Physical Review Applied for a paper by Xiaoqing Zhong, last year's winner of the Xanadu Award, although for a different paper! Amar Vutha's Canada Research Chair was renewed; Jason Harlow is the recipient of a 2021-2022 Faculty of Arts & Science Outstanding Teaching Award; Hoi-Kwong Lo was recognized as one of the most productive and impactful authors in the field of quantum cryptography; and Yong-Baek Kim was awarded both a 2022 Simons Fellowship and a Guggenheim Fellowship. In addition, Qinya Liu has been promoted to the rank of Professor, Tenure Stream and Jason Harlow has been promoted to the rank of Professor, Teaching Stream, both effective July 1, 2022. Congratulations to all!

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Our 2021-22 Physics Career Accelerator Program (physCAP) will soon be wrapping up. There were 49 mentor/mentee pairs this year, with several networking and career events held earlier this term. The Newsletter also highlights two Outreach in Action initiatives. One is our Pursue STEM program to encourage Black and Caribbean students to pursue studies in science, technology, engineering and math, which is now in its second year. A new cohort of 39 grade 10 students joined 32 returning grade 11 students at the launch event in February. Six of the latter presented their 2021 capstone projects at the BE-STEMM conference organized by the Canadian Black Scientists Network, and Gigi Adetunji and Shornelle Halsted won the Founders Award for Outstanding Senior Science Fair proposal for their "smart mask". All six students went on to present their projects at the Canadian Black Scientists Network Youth Science Fair in April, and Pursue STEM teams took two of the top three spots and will move on to the Canada Wide Science Fair in May! Also highlighted is the Canadian Association of Physicists High School Exam Workshop, which was revived by Professors Ania Harlick and Ziqing Hong, along with ten U of T students, as a virtual event held in March and attended by 30 enthusiastic high school students.

Upcoming outreach events include the Science Rendezvous virtual street festival on Saturday, May 7, and Doors Open Toronto tours of some areas of the McLennan Physics building on May 28 and 29.

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McLennan Physical Labs
(credit: Daisy Yuan)

We have two upcoming retirements to mark in this issue: David Bailey and Stephen Morris are retiring on June 30. Both have contributed to the life of the Department in many ways over the years, especially to our undergraduate program and outreach initiatives. We hope to be able to celebrate them and other recent retirees in person this year.

With a lovely tribute by Henry van Driel, we remember Robin Armstrong, who passed away in December. Between 1969 and 1990, Robin served the Department of Physics as Associate Chair and Chair, and the University as Dean of Arts and Science, before being appointed President of the University of New Brunswick. Robin was a major figure in the Department and in Canadian physics, and is greatly missed by his colleagues and former graduate students.

You may recall from the Fall Newsletter that we are establishing the new Momentum Builders Scholarship to encourage greater diversity in physics by supporting Black and Indigenous students. I'd like to thank everyone who generously responded to our Fall Appeal. Donations are still welcome and will increase the number and value of the scholarships we can award. Please consider making a donation to support a new and diverse generation of physicists.

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

I wish everyone a healthy, happy, and restful summer.

Kimberly Strong
Professor & Chair

McLennan Physical Labs Undergraduate Wing and Lash Miller Fountain (credit: Stephen Morris)

Events

2022 Harry L. Welsh Lectures

Public Lectures

Thursday, May 5, 2022

Koffler House - 569 Spadina Avenue - Room 108 and online

1:45-3:00pm

Nigel Goldenfeld

guava.physics.uiuc.edu/~nigel/

Department of Physics, UC San Diego

What can theoretical physics tell us about the evolution of early life?

3:30-4:45pm

Jeff Dahn

www.dal.ca/diff/dahn/people/jeff_dahn.html

Department of Physics and Atmospheric Sciences, Dalhousie University

"The Role of Electrical Energy Storage in the War on Climate Change"

More info here: welsh.physics.utoronto.ca

The Welsh Lectures in Physics have been held annually since 1975 in honour of H.L. Welsh, a distinguished former faculty member in the Department of Physics. They are the major public event in the life of the Department of Physics and celebrate discoveries in physics and their wider impact. They are intended to be broadly accessible to an audience drawn from across the University, other academic institutions and the interested public.

Events

Science Rendezvous 2022

Saturday, May 7, 2022

Join U of T for virtual activities in science, technology, engineering, art, and math (STEAM).
All are welcome to this family friendly event!

More:
https://www.physics.utoronto.ca/physics-at-uoft/outreach/science-rendezvous/

Quantum Steampunk: The Physics of Yesterday's Tomorrow

Join us on:

Thursday, May 12, 2022

6:30-8:00pm

Speaker: **Nicole Yunger Halpern**

NIST physicist and Adjunct Assistant Professor of Physics and IPST at the University of Maryland.

Register here:
https://my.alumni.utoronto.ca/quantumsteampunk

A genre of science fiction and fantasy is coming to life at the intersection of quantum physics, information science, and energy science.

Steampunk is a movement in literature, art, and film. It features futuristic technologies, such as time machines and automata, in Victorian settings, such as Sherlock Holmes's London and the Wild West. The Victorian era witnessed the birth of energy science, as thinkers strove to understand the machines that were powering the Industrial Revolution. Their massive steam engines contrast with technologies that leverage quantum physics, which governs small numbers of particles. For instance, quantum computers will someday outstrip every conceivable non-quantum supercomputer.

Describing such futuristic technologies requires us to reenvision 19th-century energy science for the 21st century. I call this scientific program quantum steampunk, which has roared to life over the past decade. I'll overview the field's background, achievements, and future, showing that, what steampunk fans dream, today's quantum scientists live.

Doors Open Toronto

Saturday , May 28, 2022 and Sunday, May 29, 2022

Join us for Doors Open Toronto 2022!

Universities are sites of constant renewal, where students are forever young and new knowledge is constantly being generated that allows renewal of science, technology, and society.

Visitors will have the opportunity to visit the 15th floor roof of the McLennan Physics tower and look over the University campus and Downtown Toronto, seeing buildings historic, modern, and under construction.

Our understanding of how science is best taught has undergone great change in recent decades, so modern teaching spaces will be on display.

Visitors will have the opportunity to meet with scientists and students who will be demonstrating physics, both old and new science.

All are welcome to attend this family friendly event!

More information here:

www.physics.utoronto.ca/physics-at-uoft/outreach/doors-open-toronto/

Librarian Profile

NuRee Lee

Physics and Astronomy Librarian

Welcome to U of T Physics NuRee!

You did your Honours BSc in Ecology & Evolutionary Biology & Cell Systems Biology at and your Master of Information Science U of T. How does it feel to back at your Alma Mater?

It is exciting to be back! It's interesting to see how the campus and city have changed since I left six years ago.

I'm excited to relearn what the school is like now that I'm returning in a working capacity. I took a first-year physics course back in my undergrad, so I didn't have much exposure to the department. I know every department has a culture different from others, so I'm looking forward to getting to know what Physics is like.

After your BSc, you pursued a Master of Information Science - what made you interested in this field?

During my undergraduate research experiences, I gained an interest on how research data were being organized. For example, topics like how to efficiently hand over data and other related materials so the PI or a new member could understand the contents. This led me to pursue a Master of Information Science to learn the theory behind knowledge management and how I could apply that to benefit researchers in an academic environment. I found that research data management was an interest of many faculty members, but they lacked resources on how to get started. Over time, I realized that approaching it as an academic librarian specializing in research data management services would be a viable venue to work with faculty and students.

Your previous work experience includes working as the Molecular Plant Science Information Specialist at Purdue University in Indiana. Can you tell us about this role and what you did?

This position was my first out of graduate school, where I was hired to help a new institute (The Molecular Plant Sciences Institute) organize their data in a meaningful way to facilitate interdisciplinary work amongst faculty. I participated in things like designing a data repository to determine how data should be organized to help people discover what data was being created and where it might have interesting overlap with their own work.

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Other roles included helping faculty and graduate students with their research data management in their labs or writing about it for grant applications. Finally, teaching was also a large part of my role to help educate researchers about data management principles and how it could be incorporated into their own research activities.

You come to us from McGill University, where you were the Liaison Librarian to Engineering and Physical Sciences. Can you tell us a little bit about what you did there and what you enjoyed about it?

After some time in the US I became comfortable with my skills, so I wanted to slowly make my way back to Canada as the specializations I have as a librarian are not quite common here.

I was lucky enough to land a position working with Engineering and Physical Sciences where I could apply my knowledge in data management and other activities as a librarian. Engineering and Physical Science always had really great faculty who were open to collaborating in teaching or working on new projects where they believed I could provide valuable input. All my great experiences with physical science disciplines led me to decide to pursue this position with Astronomy, Astrophysics and Physics at the University of Toronto.

What are you most looking forward in your new role as Physics and Astronomy Librarian?

I'm really looking forward to building relationships and finding ways I can work with all the students, staff and faculty in the two departments. Being able to focus my time on two departments will give me an opportunity to hopefully present my talents as a librarian that can benefit everyone going forward.

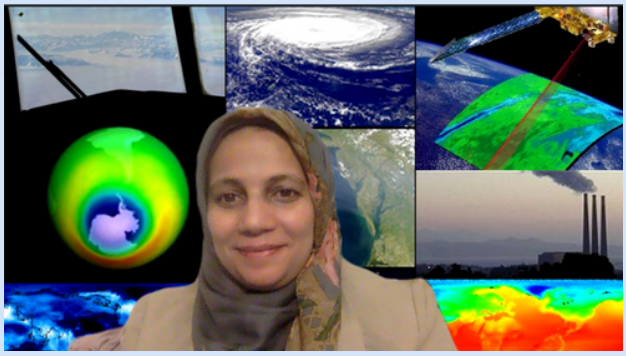
I hope that members of the Department of Physics will approach me with any questions, suggestions or ideas they have!

Finally, what are you most looking forward to, being back at U of T and in Toronto?

Hiking has always been a hobby of mine, and unfortunately, I've been spoiled by all the mountains that Quebec has. I've been away from Ontario long enough that I haven't been able to explore what's out there, so if anyone has any input, I'm looking for suggestions on trails I can explore.

Research Associate Profile

Heba Marey



Dr. Heba Marey has been working in University of Toronto, Earth, Atmospheric and Planetary Physics group, since October 2017. She conducted her PhD research at the National Center of Atmospheric Research (NCAR) through a three-year excellence based scholarship that allowed her to gain a strong experience in using remote sensing satellite data for atmospheric science and climate applications. She chose to study the formation, dynamics and transport of severe air pollution episodes, called "Black Clouds" and her research work was recognized in the NASA article, "Sensing our Planet".

Through her role as a postdoctoral researcher at the University of Alberta, she ran a research project that assessed the potential use of current satellite data for air quality monitoring and climate change over Alberta. She presented the first detailed analysis of optical aerosol and carbon monoxide (CO) characterization over Alberta based on satellite data analysis, AERONET data and the available ground measurements. She also investigated the impact of climate change on the spatio-temporal methane (CH4) variations over Alberta using data from the Atmospheric Infrared Sounder (AIRS) from 2003 to 2013. The outputs of these studies were published in the journal of *Atmospheric Physics and Chemistry* and presented at the conferences of the American Geophysical Union.

At the Department of Physics, Dr. Marey conducted a comprehensive study of the issue of “cloud clearing” for measurements by the Measurements of Pollution in the Troposphere (MOPITT) satellite instrument to enhance MOPITT data coverage.

Currently, Dr. Marey is comparing MOPITT V9 CO products with CO measured by the Infrared Atmospheric Sounding Interferometer (IASI) to understand the differences in the information on variations in atmospheric CO that the two instruments provide.

Main fields of study are:
- Atmospheric Remote Sensing
- Atmospheric Chemistry
- Air Quality
- Satellite Data Analysis

Link to "Sensing our Planet":
https://spl.cde.state.co.us/artemis/ucbserials/ucb611110internet/ucb6111102011internet.pdf

Graduate Student Profile

Matthew Basso

PhD Candidate in Experimental High Energy Physics

Matthew chose to study physics because he wanted to contribute to our understanding of the fundamental interactions between matter and the universe. He was inspired to pursue studies in this direction by his high school physics teacher, who demonstrated the subject's captivating qualities while making it accessible and fun.

Coming rom Kelowna, British Columbia, Matthew completed his Bachelor of Science with a major in Physics and a minor in Mathematics at the University of British Columbia's Okanagan Campus. After finishing his bachelor's degree, Matthew was unsure of the precise focus of his research program but knew there would be excellent opportunities for exploring different areas of interest at the University of Toronto. So he chose U of T Physics for his graduate studies because of the breadth and the quality of the research topics within the Department.

At U of T, under the supervision of Professor Robert Orr, Matthew studies particle physics with the ATLAS Detector at the Large Hadron Collider in Geneva, Switzerland. He performs precision measurements of Higgs boson production, providing stringent tests of the Standard Model of Particle Physics, with a focus on Higgs bosons decaying to pairs of weak bosons. He also contributes to ATLAS's charged particle tracker upgrade, where he studies the performance of irradiated silicon technology.

Matthew's research provides insight into the behaviour of the universe on the smallest scales. By stress-testing the Standard Model, he offers glimpses into where Beyond the Standard Model physics may lie, as the Standard Model is known to be an effective theory of nature. He achieves this by utilizing and advancing techniques and technology with applications ranging from large-scale computing to medical imaging.

Outside of his studies, Matthew is an avid runner. He loves spending time in nature, both as a hiker and as a gardener. Matthew also plays Dungeons & Dragons with his friends in British Columbia and in the Department of Physics at the University of Toronto.

Undergraduate Student Profile

Muhammad Mohid

Program: Physics Specialist and Math Major
Year of Study: 3

Why did you decide to major in Physics? What was your inspiration?
I didn't really have any inspirations. I've always wanted to gain a deeper understanding of the world, and, if possible, add to that knowledge myself. Moreover, I've been into physics for as long as I can remember.

What do you enjoy most about the Physics Program?
There are two key aspects of the Physics Program that I enjoy the most – the large number of research opportunities available, whether it be through organizations like NSERC or via supervised research courses, and the large variety of physics courses offered, especially in the fourth-year. This provides the perfect opportunity for undergraduate students to understand the theoretical aspects, but then also apply it in fields of their interest. All in all, the combination is ideal for gaining experience in both experimental and theoretical physics (I used to avoid the former but have learned my lesson!).

What other extra-curricular activities are you involved in during your degree?
Besides being a TA in the Math Department for the last two years, I haven't been involved in many extra-curricular activities. I am in fact currently in the process of applying for some research opportunities for the summer. Hopefully, I'll have more to say about my extra-curricular activities in the future.

What are your research interests?
I'm interested in Quantum Field Theory, String Theory, and Nuclear Physics.

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What is your favourite course and why?
PHY356: Quantum Mechanics II. The course itself was quite interesting of course, but the opportunity to do it with Professor Sajeev John was simply amazing. He was able to introduce the mathematical rigour while simultaneously providing physical motivations and applications of the concepts. There were times where I would honestly spend several days working on his problem sets; not necessarily because they were hard, but more so because they were very interesting and would give us the opportunity to thoroughly understand the relevant concepts.

What are your future goals?
I plan on applying to graduate school either in the US or the UK, and eventually pursue a PhD in Physics.

Where do you see yourself in 10 years?

Best case scenario: I'm hoping to have made some significant contribution in whatever field I end up in by then! Realistic scenario: I see myself doing research in or on something related to Quantum Physics. To be honest, I haven't planned this far ahead. I'm a person who likes to take things just one day at a time, and instead simply let the future unfold itself.

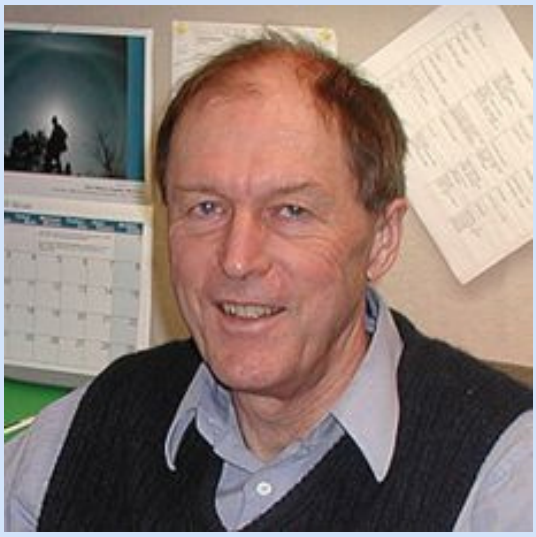
Tell me something interesting about yourself.
Well, a week before I began my undergraduate studies at U of T, I was enrolled in Political Sciences and International Relations. I was still of course doing a few Math and Physics courses, but during the orientation week, I had a pep talk with Professor Stephen Julian. Later that day, I went onto Acorn, dropped all my Political Science and International Relations courses and have been in the Physics Program ever since. So really had it not been for Professor Julian (who probably doesn't remember the talk), I wouldn't have been in this program!

Red-tail Hawk outside University College (credit: Aephraim Steinberg)

Emeriti Profile

John Perz

Welcome to the Emeriti Profile where we ask one of our emeritus faculty questions about their careers and what they have being doing since retirement. Is there a faculty member that you recall from being a student and are you wondering what they are up to? Do you have fond memories of a certain instructor? Tell us who they are and we will try and connect with them for an update.



How many years were you a faculty member?
I was a Lecturer and a Research Associate in 1965 and was hired as an Assistant Professor on January 1, 1966. I retired in July 2000.

Can you tell us about your educational background from your undergraduate degree to your PhD?
BASc Engineering Physics U of T 1960, MASc Electrical Engineering U of T 1961, PhD Physics University of Cambridge 1964. I started my education in Engineering, but became interested in solid state physics during a summer job in 1960. I took a solid state physics course, taught by Professors Archie Hallett and Malcolm Graham, during my MASc program and got so interested in the field that I did my PhD program in physics, at U of Cambridge.

What was your PhD on and why? Attenuation of Sound in Superconductors. When I began my PhD studies in 1961, there was a great deal of interest in studying superconducting materials in the light of the microscopic theory of super conductors published 4 years earlier by Bardeen, Cooper and Schrieffer (BCS). Among other predictions, the BCS theory provided an interpretation of the decrease in attenuation of ultrasonic waves in metals below the superconducting transition temperature and allowed for deduction of the superconducting energy gap from such measurements. At the time I was starting my research, there was particular interest in transition metals, and I carried out attenuation measurement in niobium, which has the highest superconducting transition temperature of all elements. I also performed ultrasonic attenuation measurements on tin to characterize the anisotropy of the energy gap in this tetragonal metal.

What kind of physics did you teach? And why? I taught a range of physics courses from introductory first year courses to graduate courses in solid state/condensed matter physics. I especially liked to teach first year courses, and I always tried to teach in a way

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that focused on understanding concepts and principles. Most of my undergraduate teaching was done on the Scarborough Campus of U of T, while my graduate courses were taught on the St. George Campus.

What are your fondest memories of being a faculty member in the U of T Physics Department?

I have many good memories of the Department, but one that stands out is the friendliness and cohesiveness of the Experimental Condensed Matter group. Especially in the early days we always had lunch together and had occasional social dinners; we always met to reach a consensus on matters that affected the group.

How has the Physics Department changed since you were a faculty member?

Although the Department has always been one of the premier physics departments in Canada, it has steadily aimed for higher standards, both in research and teaching, throughout the time that I have been a member.

What have you been doing during your retirement?

After two years of retirement I was recruited to be Acting Dean of Science for the University of Ontario Institute of Technology (UOIT), recently re- branded as Ontario Tech University), which was to open its doors in 2003. I was responsible for the initial hiring of faculty and staff, and design of research and teaching labs. Although I did not want to start a new full-time career, I worked part-time for UOIT until 2013 in a variety of administrative posts. It was a very rewarding time, as I saw a new university arise from 943 undergraduate students in 2003 to over 10,000 graduate and undergraduate students.

Anything else you would like us to know or share?

Throughout my years with the Department of Physics, I have always felt a high level of support for my career and my well-being. The Department feels like a family! I know that is not true in some other departments at U of T.

John Perz and his wife Carole from their 50th wedding anniversary celebrated in Providenciales, Turks and Caicos Islands

Alumni Profile

David McDonald

BSc Physics 1974 - University of Toronto
MSc Physics 1978 - McMaster University

I never thought a lot about what I would do for a living. That decision always seemed somewhere in future. When I look back on my career path, it appears to be a series of logical steps and progressions. However, in reality, it was chaotic random walk combined with a lot of dumb luck.

When I was in elementary school, I collected insects, turtles and snakes and was fascinated with natural world but I didn't realize that this could become a profession. I had a compelling curiosity about the world around me.

In junior high school, the guidance counselors seemed exasperated when I did not know what I wanted to do. To avoid these frustrating discussions, I finally told them I wanted to be a medical doctor. I really didn't but it got them off my back during our regular meetings.

My best subject in high school was mathematics so I thought I would major in this area. But university mathematics courses emphasized rigor and were very dry with little sense of wonder or discovery. I had interests in number theory and topics such as the distribution of prime numbers and the Riemann hypothesis. I didn't have the patience to go through the many courses to get there but I did stick it out through calculus, differential equations and complex analysis. In second year, a course given by John Polanyi, encouraged me to take some third-year chemistry courses but they left me looking for a deeper understanding of nature. That's when I decided to concentrate on physics.

My favourite part of the physics courses were the laboratories (electromagnetism, electronics and modern physics) where you put your understanding of physics to the test. Most labs didn't follow a recipe, they were open-ended and the student had to design the experiments. This was an important lesson for the real world where you don't have a manual to guide you. I was also pleased, that in my other physics courses, I had learned how to use mathematics as a tool to describe physical phenomena.

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So, at the end of four years, I majored in physics but I also had an eclectic background in mathematics, chemistry, biology and computer science. I wondered if and how I might use this knowledge. Now was the time to find out because I was ready to find a job.

I come from a family of engineers which meant that I was occasionally asked “What was I going to do with a physics degree?” I never had a good answer. When you are in the protective cocoon of the academic system, you simply go step by step: high school to undergraduate to grad school, post-doc and finally a job in the system. I had summer jobs making refrigerators and in construction to pay for school but the world outside academics still seemed far away.

But now I had to find a real job. I sent out many letters and had interviews with companies like Dofasco and Ontario Hydro. With an undergraduate degree, I found out that most positions would be at the operator or technician level. That wasn’t too appealing but it would pay the rent. I also looked into teacher's college (more education) to teach high school mathematics and physics. However, after several depressing months of job hunting, I was hired as a computer programmer in the high energy physics group at U of T. This was a two-year contract where I gained solid experience programming in Fortran on a DEC10 computer to analyze bubble chamber photographs from Fermilab, SLAC and Argonne. Working closely with the graduate students, who were part of massive projects, I realized that if I went to graduate school, I would prefer to have a small, independent experiment.

This was an exciting period in elementary particle physics and I was fortunate to witness attempts to confirm the existence of quarks. We scoured our data for the presence of the Ψ particle (a pair of charmed, anticharm quarks) without success. Later, the Nobel Prize was awarded for this discovery. I also listened to Murray Gell-Man give a talk about quarks at a symposium in honour of Harry Welsh’s retirement.

I had always planned to go graduate school. My interest was in the properties of metals and after talking with professors at U of T, they suggested that I approach Bertram Brockhouse at McMaster University. I became his last and at the time, his only graduate student, studying photons in silver by means of inelastic scattering of neutrons from the reactor in Chalk River. He was the most intuitive physicist that I have known. In his courses, in solid state and neutron physics, he would leap from one concept to another leaving a yawning chasm of unexplained steps. It was just obvious to him. Fortunately, my U of T undergraduate education allowed me to fill in the gaps.

I sometimes wondered how much he knew when he gave unsatisfying answers to my questions. However, I soon figured out that his philosophy of teaching was that you only

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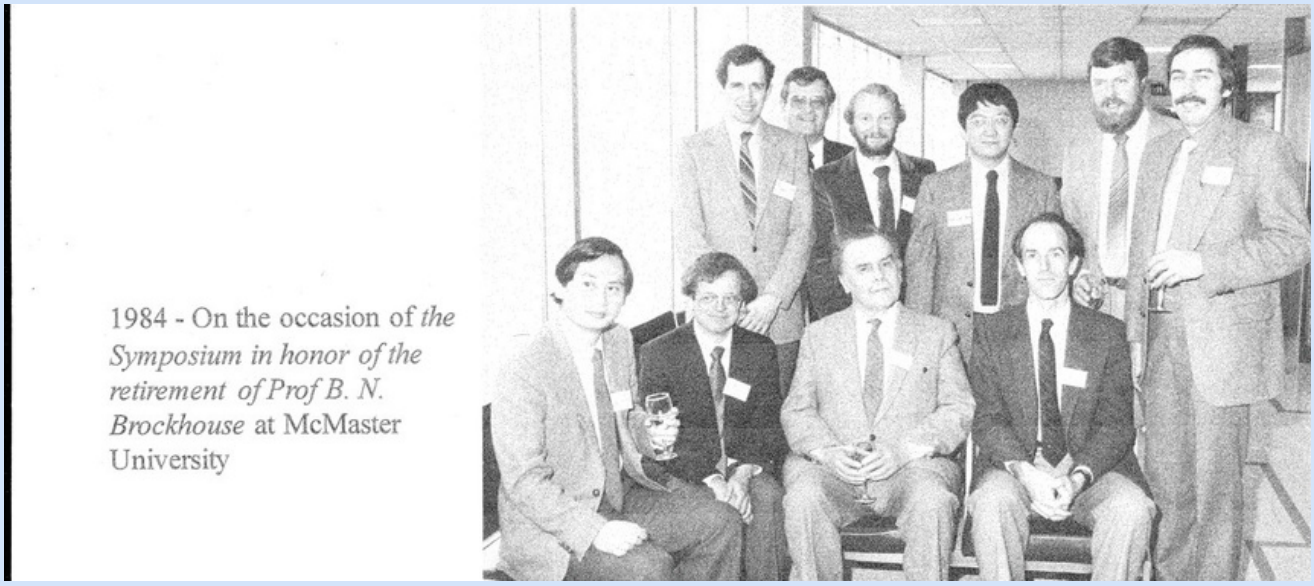
learn by discovering something yourself. He knew the answer but he would only give me hints.

He also taught me to be humble. I was often invited to his house for dinner when famous physicists were in town. When one praised his work, he said “my work is insignificant when compared to that of Banting and Best”.

And by the way, he did receive the Nobel Prize in physics in 1994. I realized that no matter how hard I worked, I would never reach his level of competency. For that reason and the fact there were almost no academic positions, it was time to look for work rather than pursue a PhD.



Former graduate students of Bertram Brockhouse.
David McDonald is standing, third from the left.

After never-ending interviews with Atomic Energy and Ontario Hydro, I was hired by Abitibi Paper Company as a mathematician to work in their research centre. My post-graduate degree plus my background in computer programming and electronics exactly matched their job description. This was the dawn on the computer age for scientific and technical computing and I was well equipped to program their PDP11 mini-computer for these tasks.

To put this in context, there were no laptop or desktop computers at this time. Most computers were large mainframes in air-conditioned rooms and were programmed with punched, paper cards. The mini-computer was the first step in making computers available to a larger group of users. During my undergraduate degree, we did not even have calculators and used slide rules for calculations. This gave me an appreciation for significant digits which has been lost on many from the current generation.

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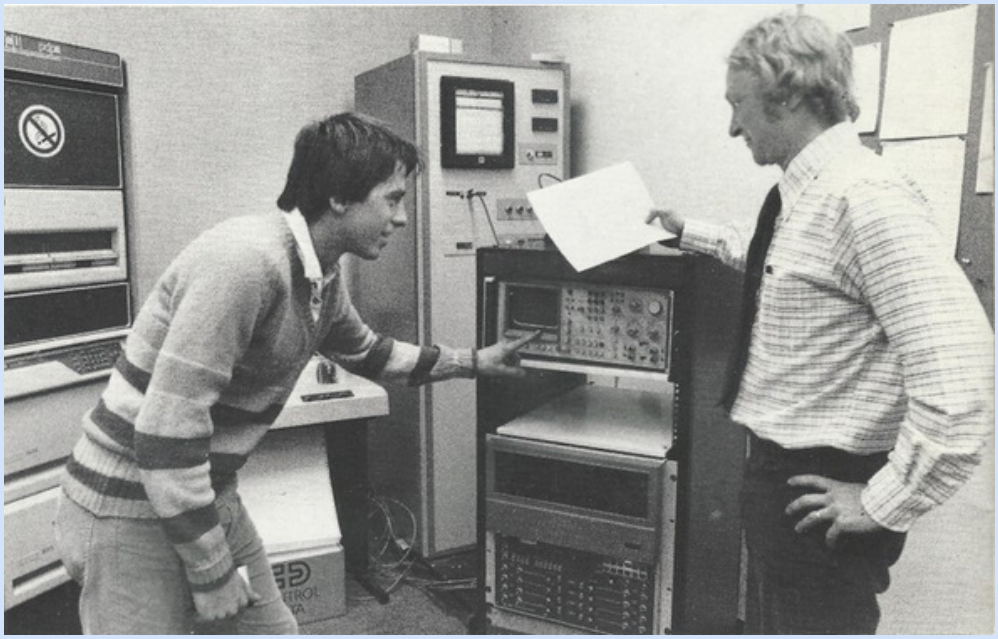
My first project was to solve a vibration problem on a paper machine. For me, this was a straightforward problem of masses attached to springs and dashpots. In a couple of weeks, I wrote a computer program that modelled the system and found possible solutions. My job was done and I gave this to my boss expecting someone else would follow-up. To my surprise, I was told to be at the mill the next week to oversee the changes. When I arrived, the machine was apart. Metal rolls that are over 6 metres long weighing many tonnes were spread over the floor looking much different than my ball and spring model. I felt a pang in my stomach when the engineers said, "We have made the changes based on your recommendations. We will see you tomorrow morning when we start up the machine." Well, it didn't work. Sometimes you have to eat humble pie. Elegance is less important than results in the real world. But they did give me another chance. I took some measurements, revised the model and the next time, to my relief, it did work.

I went onto many other projects including a monitoring system for paper machines using the Apple IIe micro-computer. I wrote the software and designed the custom electronics for what was considered Abitibi's top invention during a 10-year period. This technology was successfully applied in all Abitibi-Price's North American mills.



The PDP11 computer (on the left) which was a major step in computing power, had less capability than current laptops. David McDonald (right) when working for Abitibi Paper Company.

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After 6 years, I left Abitibi to join the Pulp and Paper Research Institute of Canada (Paprican) in Montreal. Although many paper products appear to be low tech, the processes to make them are anything but. In my own research, I used my knowledge in classical mechanics and differential equations, to model and improve papermaking and pulping. At Paprican, I rose through the ranks to become Vice President Research and Education. Along the way, I managed a group of chemists. My chemistry background meant I could speak their language which was useful in applying their research on preserving the optical properties of paper. Although this chemical to prevent yellowing from UV radiation was too expensive for paper, it is now used in clear coat stains for wood.

Over 20 years ago, I decided that the forest sector should be looking for opportunities in nanotechnology and instituted a program of research in this area. All those courses in quantum mechanics were now useful in understanding the behaviour of particles of nanometer size. We found that the nanocrystalline form of cellulose has unique optical and strength properties that can be exploited in a variety of products. This led to creation of CelluForce and the construction of the world's first commercial plant to make large quantities of cellulose nanocrystals (CNC).

I am now an independent consultant and an adjunct professor at McMaster University. I have worked in a variety of projects including building a Canadian university network for the forest sector consisting of 100 professors and 400 students, advising work in genomics, green chemicals and biomaterials as well as serving on boards of companies and technical consulting around the world. I am still writing technical papers and have received the highest honours from the forest industry (the John Bates gold medal in Canada and the Gunnar Nicholson gold medal in the United States).

Looking back on my career, my only advice is be flexible and get the broadest education possible. Because you never know where life will take you.

U of T Campus
(credit: Rodolfo Capdevilla)

Research Spotlight

Laurelle Veloce

The ATLAS experiment at the Large Haldron Collider (CERN) is preparing for a major upgrade of the Inner Tracking for the Phase-II LHC operation (HL-LHC).

This is an international collaboration of 29 institutions in 13 countries.

We asked Laurelle Veloce, who is working on the University of Toronto Department of Physics contribution to the upgrade, some questions about the project.

What is the purpose of this upgrade?

To discuss the purpose of the inner tracker upgrade, let's first step back a bit and discuss the purpose of the High Luminosity LHC upgrade. Essentially, this upgrade will increase the amount of data collected by ATLAS by about a factor of 10 over the LHC's design value. This will allow for the Standard Model of particle physics to be studied in greater detail, including observations of rare processes not accessible at the LHC. This boost in performance also increases the potential for discoveries of new and rare unknown physics processes.

However, the HL-LHC will present an extremely challenging environment for ATLAS, as the expected amount of data exceeds the design requirements of our current detector. The conditions will be so extreme that many parts of the ATLAS will need to be upgraded in order for it to function at all. In particular, the ATLAS inner tracker itself will be completely replaced with an all-silicon inner tracker known as the ITk.

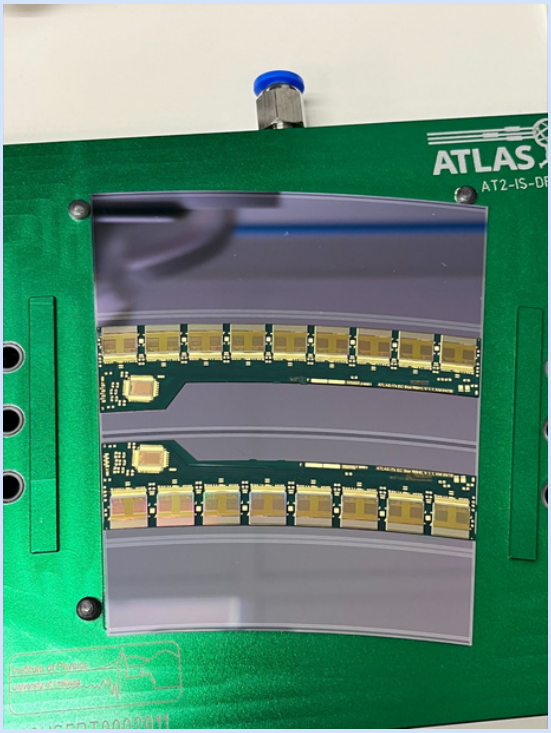
The process started in 2011 and will be complete in 2026, can you tell our readers why something like this takes 15 years?

The goal of the ITk project is to essentially build an entirely new detector, which will have to function under conditions that have never existed before. This process requires a huge amount of research and development. Every part of the detector (including even such mundane things like glue) need to be thoroughly tested to ensure that they will still function under the extreme radiation environment expected in the HL-LHC. Once the detector itself is designed, it then has to be built, which itself is also a huge undertaking. All of this requires time - eventually the years add up!

Continued on next page.

Can you tell us what an upgrade of this scale consists of?

As mentioned, an upgrade of this scale involves many institutions from all around the world. The project itself is quite complicated, even from just a production flow perspective, and requires the coordinated effort of many universities, laboratories, and companies from all around the world. We are building something that has to work in an environment that has never been seen before, so every part of the detector must be carefully measured, tested, and validated to ensure that everything is working exactly as expected. This means that all steps in the fabrication of the ITk must be carefully planned and managed. In addition to this, production of the modules which eventually form the detector is ramped up in phases. Here at Toronto, we have completed the prototyping and first phase of pre-production for the module readout boards, and are in the process of prototyping the modules themselves. Once prototyping is complete, we as a collaboration will move on to production. All of this is a huge effort, which explains why so many people from all over the world are involved!



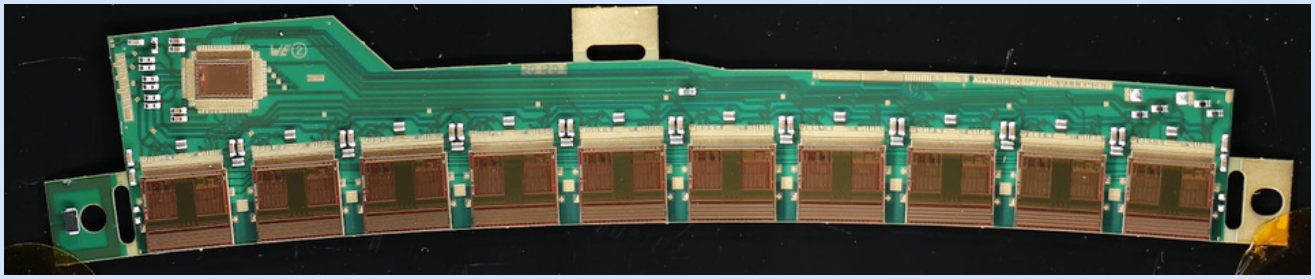
A mechanical R0 module which was built at UofT at the end of 2021. This is one of the two types of modules that we will be building in Toronto.

What will this upgrade allow researchers to do and see that they could not before?

The HL-LHC will allow us to collect an unprecedented amount of data, which means that we will be able to study the Standard Model in more detail than we have ever been able to do before. In some cases, we expect to observe processes that simply aren't accessible in the LHC, such as the Higgs-self coupling, but of course what we are really hoping for is the possibility of observing something new. We will see what happens!

Continued on next page.

What is the University of Toronto's and your team's contribution to the upgrade?
Here in Toronto, we are involved in the silicon strip portion of the detector upgrade. We will specifically be fabricating silicon strip modules which will eventually make their way into the end-caps of the final ITk detector. A module itself consists of a silicon strip sensor and a readout board with readout chips. These modules, because they will be mounted onto the circular end-caps, come in 13 unique shapes. Our industrial partner, Celestica, will fabricate all 13 readout boards types, and will fabricate two of the module types. This process involves gluing and wire bonding the various layers of the modules together, and of course then testing the components at each stage to ensure that everything is working as expected. These tests will be performed both at Celestica and U of T, depending on which stage of the fabrication process we are at. In addition, we built some of the specialized tooling that will be used by our collaborators around the world and we perform quality assurance tests of the silicon sensors at the U of T, as well as many other various tasks which contribute to the overall success of the project!



A prototype readout board assembled in Toronto, prior to wire-bonding. This is one of the 13 types of hybrid readout boards that will be glued and wire bonded in Toronto.

How often are you at CERN and what is that like?
Thanks to the COVID-19 pandemic, I haven't been to CERN for several years. In ordinary times, I typically traveled to CERN a couple of times a year or so. Traveling to CERN, especially for collaboration meetings, is always a wonderful experience! As someone who is based primarily in Toronto, all of my meetings are usually online, so traveling to CERN gives me the opportunity to meet and work with many of my colleagues in person. In addition, I have always found being at CERN to be quite inspiring. There's just something amazing about knowing that the detector that I spend so much time studying is basically right below my feet.

Continued on next page.

The ITk cleanroom at the U of T Physics.

What is your favourite part about working on such a large international collaboration?

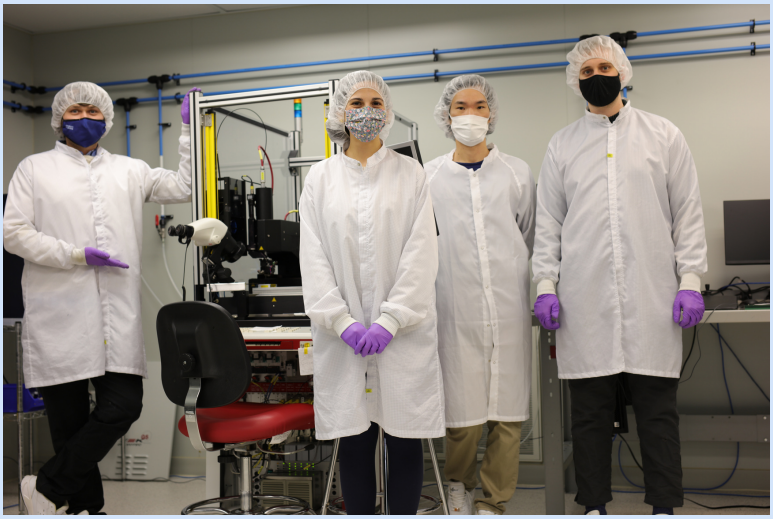
My favourite part of working with the ATLAS collaboration is exactly this - that it is such a large international collaboration! ATLAS, and other scientific ventures like it, are wonderful examples of what we can accomplish when we collaborate to pursue fundamental research.

Finally, what excites you the most about this upgrade?

I am probably most excited to see the first physics results after the upgrade is complete. While I don't necessarily expect that the first measurements will provide any surprises, it will be just amazing to see that the end goal of this project - to produce physics analyses which study the Standard Model in more detail than we ever have before - has been accomplished.

More:

https://atlas.cern/updates/news/preparing-ATLAS-for-future
https://inspirehep.net/files/ff5329ced468cca7d6a57687ab06252b



Benjamin Crick, Laurelle Veloce, Jia Jian Teoh, and Michael Vansteenkiste with the wire bonding machine at U of T.

Awards

Milica Banic is the 2022 Xanadu Award Recipient

PhD candidate Milica Banic is the 2022 recipient of the Xanadu Award for an Outstanding Publication by a PhD Student.

With support from Xanadu, the Faculty of Arts & Science and the Department of Physics have established this $5,000 scholarship, which is awarded to one or more PhD students in the Department of Physics in recognition of the publication of a peer-reviewed article in an academic journal on a topic related to quantum information and quantum optics.

This award is the result of a donation of $25,000 over five years 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 and Xanadu continues to work with U of T Physics faculty through the MITACS Program.

Due to their current and past relationships with the University of Toronto, 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.*"

Application requirements include a peer-reviewed article on a topic related to quantum information and quantum optics and a cover letter explaining the significance of the paper in one or two paragraphs.

Milica Banic was selected by the Xanadu Award Committee of the Department of Physics in winter 2022. She received the award for her paper "Generation of photon pairs by stimulated emission in ring resonators".

Milica describes the paper - "*We study the generation of photon pairs by a nonlinear process called stimulated third order parametric down-conversion (TOPDC). We discuss some differences between this pair generation scheme and others which are commonly employed, and by calculating its efficiency in a microring resonator, we argue that it should soon be possible to demonstrate this process in integrated photonic device*s."

Continued on next page.

When asked what this award means to her she says "*Our hope is that publishing this work will lead to interest from the community in integrated TOPDC, which has not been seriously discussed in the literature. I especially hope to see efforts towards the design of platforms for TOPDC. Progress in this area could eventually make other TOPDC processes viable, which would open the possibility of generating different types of non-classical light for use in larger systems. I see this award as a sign that this work could indeed have the impact that we envision, which is very encouraging.*"

Read the award winning paper here:
https://opg.optica.org/ol/fulltext.cfm?uri=ol-47-7-1802&id=470891

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/xanadu-award-2022/

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

https://www.theglobeandmail.com/business/article-toronto-quantum-computer-startup-xanadu-eyes-100-million-funding/

https://whatsyourtech.ca/2020/10/12/all-you-need-is-quantum-cloud-from-canadian-tech-startup-xanadu/

U of T Physics Library
(credit: Lilian Leung and Pius Santiago)

November 2021 PhD Graduates

Congratulations to our November 2021 graduates!

Boudjada, Nazim - Symmetry-broken phases and transport in multiband systems (Supervisor A. Paramekanti)

Bourassa, Eli - Strategies for noisy photonic quantum technologies: quantum computation to quantum key distribution (Supervisor H. K. Lo)

Casha, Albert - Higgs boson measurements in leptonic final states with the ATLAS detector at the Large Hadron Collider (Supervisor R. S. Orr)

Chern, Li Ern - Magnetic field induced phases in Kitaev magnets: A semiclassical analysis (Supervisor Y. B. Kim)

Choi, Wonjune - Quantum dynamics and topology of the Kitaev materials (Supervisor Y. B. Kim)

Conklin, Randy - Gravitational wave echoes: theory and application (Supervisor B. Holdom)

Mahon, Perry - Theory of electronic response to electromagnetic fields in crystalline solids (Supervisor J. E. Sipe)

Ojeda, Martina - Measurement of Higgs couplings to top quarks and τ leptons with the ATLAS detector (Supervisor P. Savard)

Patri, Adarsh - Exotic phenomena emerging from localized multipolar degrees of freedom (Supervisor Y. B. Kim)

Roche, Sébastien - Measurements of greenhouse gases from near-infrared solar absorption spectra (Supervisor K. Strong)

Smale, Scott - Observation of a transition between dynamical phases in a harmonically trapped degenerate Fermi gas (Supervisor J. H. Thywissen)

Sorn, Sopheak - Topology and magnetism in quantum materials (Supervisor A. Paramekanti)

Stavropoulous, Panagiotis - Emergent phenomena in correlated materials with strong spin-orbit coupling (Supervisor H.-Y. Kee)

Yuan, Bo - Neutron scattering study of magnetic excitations in quantum magnets Bi2CuO4 and CoTiO3 (Supervisor Y. J. Kim)

Awards

Amar Vutha among U of T's 33 new or renewed Canada Research Chairs

The program supports exceptional work across a wide variety of fields. At U of T, that includes everything from marine epidemiology and precision medicine to research into sustainable bioproducts.

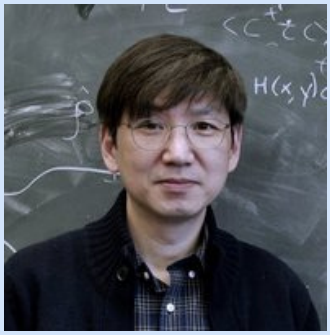
More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/amar-vutha-among-u-of-ts-33-new-or-renewed-canada-research-chairs/

Simple Multiuser Twin-Field Quantum Key Distribution Network

Dr. Xiaoqing Zhong's paper has been chosen as an Editors' suggestion in APS Physical Review Applied. The project is a collaboration between U of T Physics Prof. Hoi-Kwong Lo and Prof. Li Qian's group in the Department of Electrical and Computer Engineering. Dr. Zhong was a co-supervised student.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/simple-multiuser-twin-field-quantum-key-distribution-network/

Professor Yong-Baek Kim Awarded 2022 Simons Fellowship



Professor Kim was awarded the fellowship for his project "Emergent Quantum Phases in Strongly Interacting Quantum Matter".

The Simons Fellows program extends academic leaves from one term to a full year, enabling recipients to focus solely on research for the long periods often necessary for significant advances.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/professor-yong-baek-kim-awarded-2022-simons-fellowship/

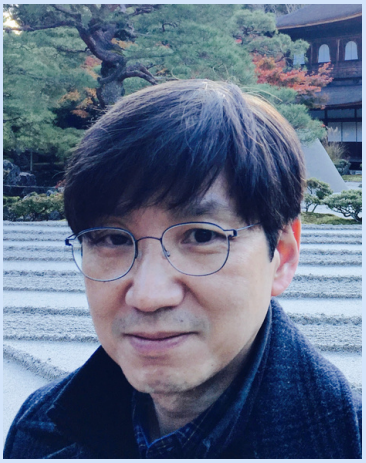
Professor Hoi-Kwong Lo Among Most Productive and Impactful Authors

The list appeared in the paper "Quantum Cryptography Research: A Scientometric Assessment of Global Publications during 1992-2019" in the journal Science and Technology Libraries.

The study examined global “Quantum Cryptography” research on a set of quantitative and qualitative metrics to understand the status of research in the subject at global, national, institutional, and individual level. The analysis was based on publication data in the subject comprising a total of 10801 publications as indexed in the Scopus database covering the period 1992–2020.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/professor-hoi-kwong-lo-among-most-productive-and-impactful-authors/

Professor Yong-Baek Kim Awarded 2022 Guggenheim Fellowship



University of Toronto Department of Physics' Professor Yong-Baek Kim was awarded the fellowship in the physics category. His fellowship project title is "Quantum Entanglement and Dynamics in Quantum Matter."

He says, "*Receiving the Guggenheim fellowship is a great honor for me. While I have done my research to mainly pursue my own curiosity, it's wonderful to be appreciated by peer intellectuals. I have been privileged to meet and work with so many talented people, especially my former and current students and postdoctoral fellows. I thank them for generously sharing their insights*."

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/professor-yong-baek-kim-awarded-2022-guggenheim-fellowship/

Professor Jason Harlow is the Recipient of a 2021-2022 Faculty of Arts & Science Outstanding Teaching Award for his Exemplary Teaching

Jason Harlow, Associate Professor, Teaching Stream in the Department of Physics has been named as the recipient of a 2021-2022 Faculty of Arts & Science Outstanding Teaching Award.

Jason has been a pillar of the Physics Department's undergraduate program since first being appointed as Lecturer at U of T in 2005. His contributions to curriculum development and teaching innovations, including the redesign of the undergraduate laboratories, have led to the active-learning model now employed in our first-year physics courses.

More:
https://www.physics.utoronto.ca/news-and-events/news/physics-news/jason-harlow-recieves-the-arts-science-outstanding-teaching-award/

U of T Campus
(credit Rodolfo Capdevilla)

Recognitions

Jason Harlow

Has been promoted to the rank of Professor, Teaching Stream, effective July 1, 2022.

Qinya Liu

Has been promoted to the rank of Professor, Tenure Stream effective July 1, 2022.

Reflection at Robart's Library
(credit Deepayan Banik)

PhysCAP Recap

Updates from the Physics Career Accelerator Program.

Physics Mentorship Program Mid-Term Event - January 20, 2022

The virtual mid-term event for the Physics Mentorship Program took place on Thursday, January 20, 2022.

This year, the program has 49 pair of mentors and mentees and they have been meeting throughout the academic year.

The event had a scavenger hunt and a networking session.

Mentees are 3rd and 4th year physics students and mentors are physics alumni, graduate students and faculty.

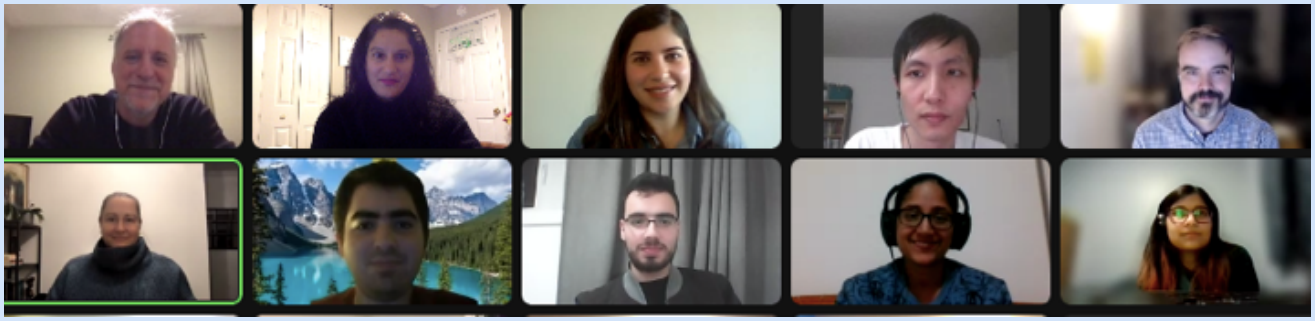
Mentees in this valuable program get advice on careers, academics and more. Mentors have the opportunity to meet the current crop of students, stay connected to and give back to the Department of Physics.

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

PhysCAP Recap

Updates from the Physics Career Accelerator Program.

physCAP Careers Outside Academia - February 2, 2022



On Wednesday, February 2, 2022, 2nd, 3rd and 4th year physics students heard from a panel of physics alumni who took career paths outside academia after their BSc in Physics. Students had the opportunity to find out what is possible with their degrees in physics.

Speakers:

Brian Bi

C++ library engineer

BSc (2014) - Major Physics, Major Chemistry

https://www.linkedin.com/in/brianbi/

Brian Bi's interest in particle physics since an early age led him to study physics as an undergrad at U of T, but he later realized that trying to pursue a research career in this sub-field wasn't the right choice for him. Brian has worked as a software engineer at Google on the Google Scholar team and at Citadel Securities, one of the world's largest high frequency trading firms. During his career, Brian has met several colleagues who also majored in physics. Brian believes that a physics education helps students develop excellent problem solving skills that can be applied to a wide variety of professions and has some tips for students who are curious about software engineering careers.

Jen Hoecht

VP Operations – Strata Health Solutions

HBSc (1999) – Physics (Major), Mathematics (Minor), Political Science (Minor)

https://www.linkedin.com/in/jen-hoecht-0951904/

Jen has worked in software since graduating, holding roles at a variety of levels and across different sectors. Her current role is responsible for teams that implement and support an application catering to the healthcare sector, which astonishingly rivals astronomy in its fondness for acronyms. The skills learned in the physics undergrad come in handy in a bunch of indirect ways – troubleshooting, analysis, problem solving and preference for elegant solutions – that have served well throughout her career.

Continued on next page.

Samantha Mauti
Meteorologist, Environment and Climate Change Canada
BSc (2013) – Major Physics, Major Physical Geography
Minor Math Post-Grad Certificate (2014) - Meteorology
https://www.linkedin.com/in/samantha-mauti-a1036084/
While studying for her BSc at U of T, Samantha developed a deep curiosity and passion for the Earth and atmosphere. A background in Physics and Math is needed to help understand the atmosphere's complexity. Samantha deepened this understanding after completing a certificate in Meteorology at York. In 2014, she began working as an Operational Meteorologist at The Weather Network. More recently, in August of 2021, Samantha moved to Edmonton, Alberta, where she works for Environment and Climate Change Canada as a Meteorologist within the Canadian Meteorological Aviation Centre.

Dylan Trotter
Founding Partner, Bit Complete
BSc (2005) Physics, University of Toronto
https://www.linkedin.com/in/dylantrotter/
Dylan Trotter has worked in software development for over 20 years in domains from computer graphics, to programming language compilers, to web applications. Originally from the GTA, he lived in the San Francisco Bay Area for 10 years where he learned to build teams and scalable software at YouTube and Thumbtack. Now he's back in Toronto where he co-founded Bit Complete, a consultancy with a mission to help startups and technology companies build great software. Throughout this journey the problem solving and communication skills he developed while working on his physics degree have played a big role in every project in which he's been involved.

More information physCAP Career Events can be found here:
https://www.physics.utoronto.ca/undergraduate/physics-career/physics-career-fair/

Interested in sharing you career path with students?
Email: mentorship@physics.utoronto.ca

University College (credit: Deepayan Banik)

Outreach in Action

Pursue STEM

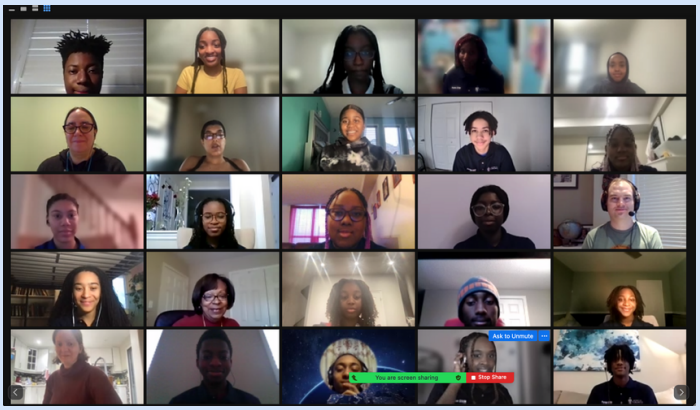
The launch event for the 2021-2022 Pursue STEM program was held on Thursday, February 17, 2022. This year, the outreach program for Black high school students has two cohorts for a total of 75 grade 10 and 11 students. There are 39 new grade 10 students and 32 returning grade 11 students.

The launch included a talk called "To Engineer(,) Be Human" and a conversation with Professor Philip Asare from the Faculty of Applied Science and Engineering. Students also got an introduction to the Pursue STEM team and what to expect from the Pursue STEM program.

Pursue STEM students will participate in activities from the Departments of Astronomy and Astrophysics, Chemistry, Computer Science, Earth Sciences, Math, Statistics and Physics and School of the Environment. Pursue STEM is a joint effort between U of T's Office of Student Recruitment, Leadership by Design (LBD) and the Department of Physics.

LBD is the signature program of the Lifelong Leadership Institute (LLI). The LLI is an educational organization that exists to inspire leadership and develop leaders, and dedicates its resources to advancing leadership competence and personal success among Canadian youth of Jamaican, Caribbean and Black heritage.

When students were asked why they wanted to be part of the program they said things like to expand their knowledge and to be exposed to a wide array of STEM topics. They also want the opportunity to work with people and gain knowledge, figure out what they want to do in the future, see what it is like to work in STEM, and develop to critical skills for the work environment.



Grade10 students participating in the Earth Sciences activity on March 5, 2022.

Chair of the Physics Outreach Committee, David Bailey says, “We are excited by the growth of the program and the new activities being offered by the participating departments for our Grade 11 students. We hope to finally be able to meet some of our participants in person.”

Also, on January 30, 2022, three groups from the grade 11 cohort presented their 2021 capstone projects at BE-STEMM, a conference that was organized by the Canadian Black Scientists Network (CBSN).

Students Gigi Adetunji and Shornelle Halsted won the Founders Award for Outstanding Senior Science Fair proposal at the conference for their "smart mask". The announcement of the award can be seen here: https://youtu.be/2NAjikybfrU?t=2613.

The other two projects were a Refill Itself Water Bottle by Gia Daniels and Zoe Ekhaguere and COVID Risk Investigation by Amina Hassan and Imani Reid.

The three groups then went on to present their projects at the Canadian Black Scientists Network Youth Science Fair in April 2022. Pursue STEM teams took two of the top three spots and will move on to the Canada Wide Science Fair (CWSF) in May 2022. Last year, only about four of the 400 students presenting at CSWF were Black, so the four Pursue STEM students going this year are a very significant contribution to reducing Black under-representation.

Also, the Smart Mask group was presented with the Sanofi Biogenius Award and scored highest in the Grade 11-12 category. Finally, one Pursue STEM student had the opportunity to participate in a Q and A with Andy Fillmore, , Parliamentary Secretary to the Minister of Innovation, Science and Industry.

Continued on next page.

The students are being mentored by faculty and graduate students from the Departments of Physics and Computer Science as well as mentors from the University of Calgary and Victoria.

We look forward to working with all of our Pursue STEM students!

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

More information on LBD here:
https://llileaders.com/leadership-by-design-lbd/

More information LLI here:
https://llileaders.com/

Grade10 students showing the Arduinos they hooked up in preparation for a Computer Sciences workshop.

Follow Pursue STEM on Instagram:
pursue_stem

Outreach in Action

Canadian Association of Physicists

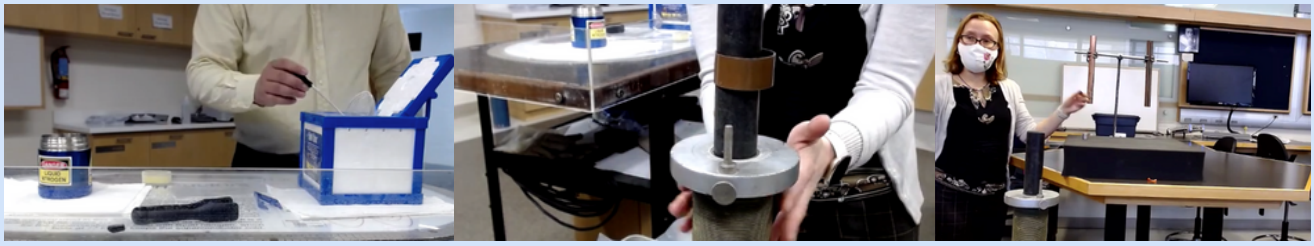
High School Exam Workshop - Saturday, March 26, 2022

After a two-year hiatus because of COVID-19, a virtual Canadian Association of Physicists High School Exam Workshop was held on March 26, 2022. 30 grade 9, 10, 11 and 12 students attended and there were students from the Toronto area, Quebec, Manitoba and one student from India.

This workshop introduces high school student to the exam, gives them the opportunity to work through previous exam questions, and provided tips on test-taking.

The workshop was facilitated by Professors Ania Harlick and Ziqing Hong with the assistance of U of T Physics undergraduate and graduate students. The high school students commented how they found interacting with U of T students very useful.

Professors Harlick and Hong wowed students with physics demos, including the popular liquid nitrogen train to demonstrate superconductivity. Professor Hong also treated the students to a tour of his Dark Matter Lab in the McLennan Labs basement.



Professors Hong (left) and Harlick (middle and right) showing students some demos

Tour of Professor Hong's Dark Matter Lab

Thank you to U of T students:
Brendan Halliday
Andy Jiao
Arthur Pang
Ahmad Rayyan
Michael Sloan
Nicolas Sullivan
Ivan Tochovski
Morgan Watson
Joscelyn Vanderveen
Kai Zhang

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

Arrivals

NuRee Lee

NuRee, joined the Department on January 3rd, 2022 as the new Astronomy and Physics Librarian . She comes from McGill University, where she spent four years working as a librarian to a variety of departments such as Earth and Planetary Sciences, Bioengineering, Biomedical, Chemical, Materials and Mining Engineering. NuRee is a former graduate of U of T, where she completed both her undergraduate and graduate degrees. She is excited to be able to join the school to work with the various members of each department.

Arman Molki

Arman joined the Department on January 3rd, 2022 as the Physics Learning Research Services Director.

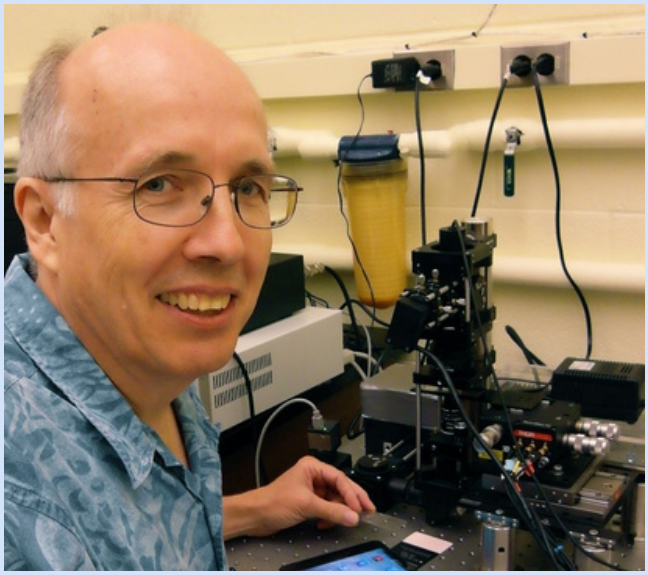
A lifelong learner, he has spent two decades serving the academic community. Prior to joining the Department he spent 12 years at the then newly established Petroleum Institute in Abu Dhabi. During his tenure, he worked closely with the University's leadership and faculty to develop and manage laboratory operations in the Department of Mechanical Engineering.

More recently, he was an R&D Engineer at Quanser, a leading manufacturer of educational and research solutions in the areas of controls systems, mechatronics, and robotics.

At Quanser, he worked with universities around the globe and developed a variety of engaging hands-on lab activities. He has authored over 40 publications in international journals and proceedings – including Physics Education – primarily in the areas of engineering education and STEM.

Departures

David Bailey



On June 30 Professor David Bailey will retire after 36 years (1986-2022) of research and teaching in the Department of Physics at the University of Toronto.

David Bailey joined the Department of Physics in 1986, having earned his BSc at Simon Fraser University and his PhD at McGill University, and following time spent as a Scientific Associate at CERN, in Geneva Switzerland. While at U of T, he worked on the ZEUS experiment, at the HERA collider in Hamburg, Germany, and later on the ATLAS experiment at the Large Hadron Collider. For the latter, he took part in early work related to the construction of the ATLAS forward calorimeter, which was built in part by the Toronto ATLAS group.

In the latter half of his long career, David's interests turned strongly to undergraduate education. He has a passion for this, in particular for the experimental side of the physics program. His catchphrase ¾ "how well do we know what we think we know?" ¾ has guided his approach to teaching experimental physics for decades. He has published research on pedagogy, been a mainstay in the Advanced Undergraduate Lab for many years, and served as the liaison between the Physics program and Engineering as the Engineering Science Physics Option Chair. Most significantly, from 2002-2009, he served as the Department's Associate Chair for Undergraduate Studies. In that position, in addition to the myriad day-to-day aspects of student advising, TA coordination, course assignments, and overall steering of the undergraduate program, he played crucial roles in a number of important undergraduate initiatives, including a major curriculum redesign, the transformation of the antiquated first-year labs into the redesigned Practicals, and the establishment of the Summer Undergraduate Research Fellowship (SURF) program that provides research experience to junior undergraduates. Indeed, David devoted himself so tirelessly to that position that when he left, the role of Associate Chair had to be split into two jobs, Associate Chair and TA Coordinator, as no one person could reasonably do the whole thing.

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David has provided exemplary service to the Department of Physics in multiple ways, and has been a dedicated mentor to our students. He also served as the UTFA Council Member for Physics and Astronomy from 2010-2016. Over the years he took on numerous roles in the Canadian particle physics community, serving as Secretary Treasurer of the Particle Physics Division (PPD) of the Canadian Association of Physicists (CAP) from 1989-2015 and filling the same role for the Institute of Particle Physics (IPP) from 2005-2014, except for 2009-2010 when he spent a now fondly-remembered sabbatical year in New Zealand.

David Bailey at Rutherford's Birthplace in New Zealand

David has also enthusiastically devoted a great deal of time and energy to public outreach. He really enjoys engaging with the community and teaching them about physics by making it fun. He has been Chair of the Department's Outreach Committee since 2017, coordinating our participation in Science Rendezvous at the largest scale ever; he created a carnival-like atmosphere in the lobby of MP and outside where hundreds of parents and children can participate in demonstrations, talks and tours. In 2018, the Department also began participating in Doors Open Toronto, a weekend-long event that draws thousands of participants. Most recently, David was instrumental in the creation of Pursue STEM. Launched in March 2021, this is a new multi-year outreach program that encourages and supports Black high-school students interested in science, technology, engineering and math (STEM). Students are given the opportunity to participate in STEM workshops starting in grade 10 and provided with support up to their first year of university. The goal is to encourage these students to pursue post-secondary studies. Other Departmental Outreach projects that David has been involved in can be found on the Outreach webpage.

We wish David a long and enjoyable retirement; he will be greatly missed but we hope to see him around the Department as he continues to be engaged in Pursue STEM and other projects.

By: Peter Krieger, with input from Mike Luke and Sheela Manek

Stephen Morris

On June 30, Professor Stephen Morris will retire after 29 years of research and teaching in the Department of Physics at the University of Toronto.

Professor Morris got his BSc and MSc degrees at the University of British Columbia. After a college teaching stint in BC, he joined the University of Toronto, obtaining his PhD in 1991.
Stephen did a post-doc at the University of California Santa Barbara, after which he returned to the U of T, initially teaching for two days a week at the Erindale Campus (now UTM) while running a research group downtown. From 2001, he was based fully at the St. George campus. From 2014 to 2019, Stephen held the prestigious J. Tuzo Wilson Chair in Geophysics.

Stephen is a highly original and influential scientist in the field of nonlinear physics and pattern formation. In an area dominated by mathematical and computer modeling, Stephen is famous for experiments whose elegance and visual impact hides a high degree of sophistication and technical difficulty.

Stephen initially got into the field of nonlinear physics during his PhD research with David May without his supervisor's backing, or even knowledge. This is of course, pretty rare. Dr. May had assigned him a project to use ring lasers to measure the Kerr effect in molecular gases. Finding this difficult and somewhat dull, Stephen began a side project, experimenting with the convection of smectic liquid crystals in the presence of an electric field. He happened to show his electro-convection measurements to a visiting colloquium speaker, whose enthusiasm led to Dr. May (a) finding out what Stephen had been up to; and (b) being persuaded that this was important research. To David May's lasting credit, Stephen was allowed to change his PhD topic, and the research was ultimately published in Physical Review Letters.

Professor Morris has published on a broad range of topics. His most highly cited paper describes the discovery of 'spiral defect chaos' (see picture above), during his post-doc at Santa Barbara.

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Stephen is also well known for his work on pattern formation in shrink-crack patterns in mud, which is related to the formation of basaltic columns such as the Giant's Causeway. On a 2005 sabbatical in Cambridge, UK, Stephen started new research on washboard roads, meandering syrup and icicles. The icicle work has had the most enduring fame (see picture below). It is a typical example of Stephen finding a meaningful scientific problem in an everyday phenomenon, and then creating elegant experiments to investigate it. It turns out that icicles are far from simple.

Pictures of icicles from Prof. Morris's "Icicle Atlas"

Stephen is also well known (for a physicist) to the public. His domino demonstration on YouTube has 4.2 million views and has become a common meme, recently tweeted by none other than Elon Musk. See Stephen's homepage for more media links.

Recently, Stephen has entered the art world, exhibiting his "scientific folk art" at local venues and establishing a new and highly original form of science outreach that reaches an audience that would normally not go near a physics department.

Over the years, Stephen has impacted our Department significantly. In teaching, he has won teaching awards, created new experiments for the Advanced Undergraduate Lab and, from 2010 to 2013, he served as Associate Chair for Undergraduate Studies. Perhaps his most enduring legacy will be his successful advocacy for establishing a Biological Physics group in the Department on the St. George campus.

In retirement, Stephen is planning to return to Vancouver, where he will continue to do his science-based art, and where the "rocks, trees and water" will give him new patterns in nature to think about.

You can see more pictures of the Icicle Atlas here:
https://www.flickr.com/photos/nonlin/albums/72157619114347064/with/16627102915/

By Stephen Julian with input from Stephen Morris

In Memoriam

Robin Armstrong

May 14, 1935 - December 17, 2021

A faculty member's impact is usually measured in terms of contributions to teaching, research and administration. Most do well in one, or even two of these areas. Robin Armstrong excelled in all three and was a major figure in Canadian physics for over four decades. He did all this alongside his wife of 61 years, Karen, with whom he raised two sons, Keir and Drew. Keir is currently an Associate Professor of Economics at Carleton University and a former Chair of his department. Drew is an Associate Professor and Director of Architectural Studies at the University of Pittsburgh. Karen recently published her first peer-reviewed article on nineteenth-century stone houses in Oxford County, Ontario (Journal of the Society for the Study of Architecture in Canada, 43, 27 (2018)).

Robin passed away on December 17, 2021 at the age of 86. His career, with dates and major awards, is nicely summarized in the obituary prepared by his son Keir and I will not attempt to repeat that here but rather provide a complementary perspective.

Robin's career was almost derailed before it got started. As a top undergraduate student in the honours Math, Physics and Chemistry (MPC) program at U of T, Robin had been recruited to be a graduate student by Harry Welsh in 1958. At the time, Harry had many graduate students (he would supervise 65 over his career) working on experimental infrared molecular spectroscopy and didn't spend much time with the energetic and ambitious newcomer in his first few weeks. Robin approached Harry saying that he was seeking a new advisor. Harry immediately gave Robin a challenging project into which Robin plunged, completing his PhD in 1961. It is difficult to imagine how Robin's career would have evolved without Professor Welsh's mentoring and friendship.

Towards the completion of Robin's PhD thesis, Harry saw him as a potential faculty member and colleague but advised that he could not become such in infrared spectroscopy since the Department was already strong in that area. Robin therefore took his NRC Rutherford Memorial postdoctoral fellowship to Oxford University and studied Nuclear Magnetic Resonance (NMR) spectroscopy. When he returned to Toronto in 1962 and established a research program in this field, he initially working with compressed gases as he had for his PhD.

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Thus began a prominent career in teaching, research and administration. Here are some highlights.

Teaching. Robin's first teaching assignment was the large first-year course for physics majors and life science students. He was so popular and engaging as a lecturer that students often commented that he should teach others how to teach. He produced his own course notes, assembled them in paperback form, and sold them to the students as early as 1966. By 1970, along with Jim King, he developed the notes into a textbook, which Prentice-Hall published as Mechanics, Waves and Thermal Physics. The text eventually saw wide adoption in Canada and around the world. A (contractually required) companion volume The Electromagnetic Interaction was published in 1973.

During the 1960s, the Department expanded greatly, moving into its present building in 1967. Undergraduate student enrolment grew to 3000 and the faculty complement more than doubled from 26 in 1960 to over 60 by 1970, including those appointed to the new satellite campuses of Scarborough and Erindale. In late 1968, Professor Welsh stepped down as Chair after six years. The new Chair, Jim Daniels, appointed two Associate Chairs, one to oversee graduate studies and the other undergraduate studies. The 33-year-old Robin accepted the latter position. This was a challenging time for the University partly because of the large increase in enrolment. In addition, by 1969, pressure from Ontario's Education Minister Bill Davis led the University to revamp undergraduate studies, doing away with the three-year general programs and the highly prestigious and demanding four-year honours programs in Arts and Science, including MPC. Robin was tasked with helping to develop the "new programs" in physics, with students given more choice in course selection through specialist and major programs. These reforms largely remain with us today. (Interestingly, the prestigious four-year Engineering Science program continues to exist to the present day and maintains connections to the Physics Department, especially through its various specialty options.)

Shortly after becoming Chair in 1974, Robin suggested to the faculty that a second-year course in quantum mechanics (QM) be offered. QM had never been taught below the third-year level. Many physicists felt that second-year students didn't have a strong enough foundation to handle QM concepts, even though chemistry professors at U of T, including future Nobel Prize winner John Polanyi, were already teaching first-year students how to solve Schroedinger's differential equation for the hydrogen atom! The Physics faculty finally came onside provided that Robin or Nathan Isgur, another inspiring young instructor, taught the course. Robin took up the challenge and once again developed his notes into a softcover text. He hoped to develop this into a textbook but increasing administrative duties overtook that ambition and Nathan eventually took over the course.

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Administration. Between 1969 and 1990, Robin served the Department of Physics as Associate Chair and Chair, and the University as Dean of Arts and Science. While Chair, and later as Dean, he helped start the careers of many new young faculty in the Department, including my own from the year 1976, having also earlier served as my PhD mentor. He also launched several major initiatives that continue to figure prominently in the life of the Department and Canadian physics today. Let's consider some of them.

On the occasion of Harry Welsh's 65th birthday in 1975, Robin, several of Harry's former graduate students, and the Physics Department, endowed an annual series of lectures to honour Harry's substantial contributions to the Department and University. At the inaugural lectures in May 1975, more than 40 of Harry's former students along with 500 others from across the University enjoyed listening to seven well-known physicists, including Nobel Prize winners. The President of the University, John Evans, attended the formal banquet along with members of the Department.

In the early 1980s Robin, together with members of the Department of Astronomy, argued vigorously with their colleagues to locate the Canadian Institute for Theoretical Astrophysics (CITA) at U of T with new, joint faculty positions. Many initially opposed the unique structure of CITA with its research professors, knowing that it would also "cost" faculty positions in other areas. However, other universities across Canada were also lobbying hard with their own bids. Eventually, the faculty saw CITA's merits and it continues as a jewel in the crown of U of T to this day.

Always a strong proponent of excellence, in the early 1980s Robin also worked tirelessly to establish the Canadian Institute for Advanced Research (CIFAR), becoming a Founding Director and serving on its Research Council from 1982 to 1989. This is today a major Canada-wide research enterprise. While Dean, he was also a founding member and President of the Canadian Institute for Neutron Scattering and served as a member of TRIUMF's Management Board in Vancouver. In 1990 he became President of the Canadian Association of Physicists.

In 1990 Robin accepted the Presidency and Vice-Chancellorship of the University of New Brunswick (UNB). During his six-year tenure he successfully launched and executed a major fundraising campaign, opened UNB St. John's first student residence, revised the student recruitment process, and established new research chairs and research centres in a number of fields, including space science, pulping technology, social policy and family violence. Because of all these initiatives and for his own research accomplishments, he was awarded an honorary Doctor of Science degree by UNB in 2001.

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Upon retirement from UNB in 1996, he became an Honorary Research Professor, retaining that title until 2001. In 1996 he and Karen also returned to his roots in Southwestern Ontario, purchasing a farm near Woodstock. They sold this in 2012 to move permanently back to Toronto. He became an Emeritus Professor at U of T in 1998. Even in retirement however, he continued in administration as Chair of the Board of Directors of the Canadian Arthritis Network, one of Canada's Networks of Centres of Excellence.

Research. Beginning in 1962, Robin established himself as one of Canada's most prominent NMR spectroscopists. Much of his research program over several decades centred on NMR probing of collision dynamics in gases and magnetic resonance imaging (MRI). (The word nuclear was dropped from NMR and NMRI around 1980 since the (typically non-radioactive) nucleus is only used as a passive probe and the word was considered too toxic or scary by many, especially health care professionals.) However, magnets are expensive and the NRC granting agency was unlikely to offer Robin a second one early in his career. So, hoping to expand his group with his meagre resources, he began a program in Nuclear Quadrupole Resonance (NQR) spectroscopy. Instead of the interaction of a magnetic dipole with an external magnetic field, which forms the basis of NMR, NQR involves the interaction of the electric quadrupole moment of certain nuclei with the local electric field gradient in a solid. The RF resonance frequency and the nuclear relaxation times are sensitive probes of lattice symmetry and phonon dynamics. This led Robin and his graduate students to probe displacive phase transitions in antifluorite and perovskite structures driven by "soft" phonon modes. By the mid-1970s Robin, knowing that NQR and neutron scattering are complementary probes of lattice dynamics and structure, established links with Atomic Energy of Canada scientists at Chalk River, including Bill Buyers, to also probe antifluorite and perovskite crystals with neutron scattering. Robin and his students spent many summers working at Chalk River. The research programs evolved to elaborate spin interaction in perovskite crystals, eventually confirming the existence of the "Haldane gap" in the spin-1 antiferromagnet CsNiCl3 in its 1-D phase (Phys. Rev. Lett. 56, 371 (1986)). Duncan Haldane was awarded the Nobel Prize in Physics in 2016 for, inter alia, his theoretical work on the existence of this gap and topological effects in 1-D spin systems.

Even while serving as President of UNB, Robin used his research reputation to acquire state-of-the-art MRI equipment and established a world-class facility that was used by his research group and many colleagues. He had also helped to establish a similar facility at Toronto Western Hospital in the 1980s.

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During his long and distinguished career, Robin mentored 31 PhD students and 20 postdoctoral fellows/research associates, all of whom owe much to his guidance. After he became involved in administration, beginning with the time-consuming Associate Chair position, every month he invited his research group to his house in Don Mills in the evenings to practice giving presentations based on a published paper. It was hard to decide which was more enjoyable, learning how to defend oneself against Robin and others in the group or relishing the coffee and pastries that Karen had prepared for us afterwards.

Most of Robin's graduate students had Canadian backgrounds, but beginning with Carlos Martin in 1972, five came from and returned to the University of Cordoba via the "Argentinian connection" as Carlos called it. Over the years they in turn established a major NMR program of their own which has continued to flourish despite a challenging funding environment. Robin and Karen visited Argentina twice, with Robin providing advice for the program and helping to mentor the graduate students and assist them in writing scientific papers in English. It is with pride that Robin accepted the designation Visitante Distinguido from the University of Cordoba.

Robin and some of his graduate students gather for Robin's 75th birthday at Henry van Driel's house in 2010

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In recognition of his considerable research contributions, Robin was awarded the 1973 Herzberg (Early Career) Medal and 1990 Gold Medal for Lifetime Achievement from the Canadian Association of Physicists, and Fellowship in the Royal Society of Canada in 1979.

Robin was indeed a very special person and will be missed by all who had the privilege of knowing him. To quote Gregory Baker, who obtained his PhD with Robin in 1970, "[his passing] is definitely a loss for all who knew him, for all who benefited from his life and from his work as an educator and scholar. He was indeed a perfect example of both, and a virtuous man as well. He always looked for the good way forward, cognizant of his responsibilities to others, always seeking to do the "right' thing."

By Emeritus Professor Henry van Driel

Obituary here:
https://www.legacy.com/ca/obituaries/theglobeandmail/name/robin-armstrong-obituary?n=robin-armstrong&pid=201074071

Arts and Science News Story here:
https://www.artsci.utoronto.ca/news/community-mourns-loss-former-dean

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