Interactions

Message from the Chair

Welcome to the Spring 2015 issue of Interactions. Inside, you can catch up on the latest Department news and events, and the achievements of our students and faculty. We have profiles of people from across our community: Professors both new and not-so-new; some of our talented and dedicated support staff; and of course our amazing graduate students and undergrads.

You can read about how our students are engaging with broader problems in the world, through the Centre for Global Change Science (page 17), and the Polanyi Conference (page 2) organized by undergraduate Emma Hansen. I attended the Polanyi Conference. It was a deeply interesting and thought-provoking event, and I am proud that the Department of Physics was associated with it.

As you look at some of the photos in the Newsletter, you will see that there is still a gender imbalance in physics. This is a difficult issue, but I am committed to redressing this imbalance, in the belief that change is essential not only for fairness but also for the future of physics. Thus, in the student profiles you will see that there is a focus on women physicists. Also, this year our Department is for the first time hosting the Women In Physics Canada conference from 30 July to 1 August. This conference is intended to help early career women physicists achieve their short-term career goals and sustain them over the long-term in science careers. Professors Sabine Stanley and Kaley Walker, and their enthusiastic team of graduate student volunteers, have taken the initiative in organizing this meeting, and you can read about it on the conference website . You can look forward to a report in our next issue.

This has been an eventful term. We welcomed Nicolas Grisouard as a new professor in the Earth, Atmospheric and Planetary Physics group (he is profiled on pages 8 and 9); we have continued to work hard at designing our new undergraduate laboratory space; and in March we hosted our largest-ever recruitment weekend for incoming graduate students. The term was, as many of you will know, dominated by the strike of CUPE Local 3902 Unit 1, which includes our Department's graduate student TA's, Lab Demonstrators and markers. The strike lasted from late February through most of March, and it was a challenging period with difficult decisions and choices for everyone. The issues that led to the failure of CUPE and the University to reach a negotiated agreement were, I hope, less a problem in our Department than elsewhere in the University; nevertheless for our TA's there were important principles at stake, and the TAs made their point forcefully but respectfully, even when this meant picketing through the coldest days of March. The strike had a significant impact on our undergraduate program, so it was a great relief when the strike ended in time to rescue the term for our undergraduates.

Inside, you will find a number of stories about how our faculty and alumni are engaging with our undergrads through mentorship programs and our new Physics Career Accelerator Program (pages 5 and 6). We want you to help us with these activities! We need experienced people with a physics background to advise and help our students in their academic and post-graduate plans. I guarantee that you will really enjoy getting to know our students – they are a truly dedicated, interesting and committed group. For suggestions on how to get involved, look inside!

Finally, I want to extend an invitation to all of you to attend our Welsh lectures on Friday, 8 May (page 19) and our Spring Reunion event on Saturday 30 May (page 3). I hope that we will see you there.
Your Sincerely,

Stephen Julian

E.F. Burton Fellowship in Physics – Established in 1956 in honour of Professor Frank Burton

Front Row Left to Right: Department Chair Stephen Julian, Samantha Stuart, Andrew Stuart and Garrin McGoldrick
Back Row Left to Right: Pranai Vasudev, Graduate Chair William Trischuk, Russell Blackport, Oliver Watt-Meyer, Graham Edge, Gregory Gomes and Zaheen Sadeq

University of Toronto alum Andrew Thomas Burton Stuart (MASc, Chemical Engineering, 8T7) is the trustee of the C.L. Burton Trust - E.F. Burton Fellowship Fund. His family has a long history with the University of Toronto: both his parents attended the University of Toronto and his great grandfather Charles Burton established this fund to honour his brother Professor Frank Burton. Professor Burton and his graduate students, James Hillier and Albert Prebus built the first transmission magnetic electron microscope right here at the Department of Physics in 1938.

On Friday, October 31, 2014, a lunch was held at the Faculty Club that provided an opportunity for Mr. Stuart to meet the recipients of the this year's fellowship and to hear about their research.
Continued on page 3.

Polyani Conference - November 2014
The Responsibility of a Scientist to Science and Society

On November 15, 2014, 2nd year undergraduate student Emma Hansen brought together members of the University of Toronto community to consider social issues in the sciences for the inaugural Polanyi Conference on Science and Social Responsibility – a forum for a fresh, interdisciplinary discussion. The Vivian and David Campbell Conference facility at the Munk School of Global Affairs was at capacity for this conference that coincided with the Canadian Pugwash Group Annual Meeting; this international organization works to reduce the danger of armed conflict and seeks solutions to threats to global security. The topical focus of the Polanyi Conference was Canada's stance toward nuclear deterrence and the keynote speakers were Dr. John C. Polanyi and Dr. M.V. Ramana.

Dr. Polanyi, a long-time faculty member in the Department of Chemistry at the University of Toronto, was awarded the Nobel Prize in Chemistry in 1986. His talk titled "Reflections on the Responsibility of a Scientist to Science and Society" discussed the role of imagination in science and our ability to confront the menace of nuclear weapons. Dr. Ramana is a physicist at the Nuclear Futures Laboratory and the Program on Science and Global Security at the Woodrow Wilson School of Public and International Affairs

Keynote speaker John C. Polyani

at Princeton University. Dr. Ramana's talk titled "Taking Sides on the 'Double Movement': Scientists, Nuclear Weapons, and Peace", shed light on some of the roles scientists have played in public policy and the production of nuclear weapons.

There was also a panel moderated by Adele Buckley (former chair of the Canadian Pugwash Group) which offered diverse perspectives on nuclear deterrence. Please see side bar for panel topics and speakers.

The panel was followed by a question and answer session with Dr. Polanyi, providing the audience with the opportunity to have a dialogue about nuclear deterrence.

We asked Emma why she thinks it is important to keep the dialogue on nuclear deterrence open:

"I think that we, as a society, have forgotten the sheer magnitude of the destruction that nuclear weapons can inflict. Meitner and Hahn's discovery of nuclear fission was a tremendous scientific achievement, but it soon also became a paradigm shift for global security. We heard a lot of diverse perspectives on nuclear strategy at the Polanyi Conference from scientists and strategists alike. Without that kind of dialogue, stances on the issue become too polarized – and political leaders who treat nuclear deterrence as a panacea for all political ills tend not to be very good at listening to opposing voices. This is true whether those voices are calling for total abolition, or simply for the reduction of redundantly large arsenals, the de-alerting of nuclear forces, or doctrines of no first use. The "atomic age," as it's sometimes called, is still relatively young, and the way that nuclear strategy is managed now will almost certainly have ramifications for the remainder of human history."

This conference provided the perfect opportunity for the dialogue that Emma speaks of. Thanks to Emma Hansen and everyone involved in the first ever Polanyi Conference.

Panel Topics

"The Reform of Nuclear Deterrence"
Dr. Tom Nichols, U.S. Naval War College

"Atomic Canada"
Dr. Robert Bothwell, Department of History, University of Toronto

"Resilience and War"
Dr. Nancy Doubleday, HOPE Chair in Peace and Health, McMaster University

"Deterrence and the Folly of Nuclear Abolitionism"
Dr. Jack Cunningham, Bill Graham Centre for Contemporary International History

Chair Stephen Julian provided closing remarks

Student Emma Hansen facilitated the conference

Keynote speaker Dr. M.V. Ramana

Your Invitation to Spring Reunion 2015!

Spring Reunion is a campus-wide event and your chance to get together with your fellow alumni to celebrate your experiences, accomplishments and friendships at U of T. This special occasion brings together thousands of alumni for the chance to reconnect with old friends and make new ones. Enjoy dinners, socials, awards events, networking opportunities and, of course, what you know and love so much about U of T—stimulating talks on interesting topics by leading intellectuals.

The Department is participating in the festivities by hosting:

Tours, Talks, Wine and Cheese

Tours will take you to labs with cold atoms, scanning tunneling microscopy and pulsed laser deposition, as well as to physics technical services and undergraduate teaching facilities. The short talks will be on relevant topics such as climate change. Join us for an enlightening afternoon!

Date: Saturday, May 30, 2015
Time: 1:30-4:30pm
Location: McLennan Physical Labs
60 St. George Street
Toronto, ON, M5S 1A8

For more information and to register for Spring Reunion events, please visit: *https://springreunion.utoronto.ca/*

Questions? Please contact alumni@physics.utoronto.ca

E.F. Burton Fellowship in Physics - *Continued from page 1*

This year, the lunch was also attended by Mr. Stuart's daughter, Samantha Stuart, a first year Materials Science and Engineering student at U of T, continuing the family tradition! Also present at the lunch were Department Chair Stephen Julian, Graduate Chair William Trischuk and Jackie Vanterpool from the Faculty of Arts and Science.

The graduate students described their research to the Stuart family, and the topics included cold atoms, CERN, lasers, photonic band gap materials and biophysics, providing insight into the great work that our graduate students are doing. Mr. Stuart also had the opportunity to share his experiences and family history at U of T with the students, making this lunch an enlightening experience for all.

Physics Flashback -
History of E.F. Burton and the magnetic transmission electron microscope

Professor Burton, who succeeded Sir John Cunningham McLennan as the chair of the Department of Physics in 1932 was behind the project to build a magnetic transmission electron microscope at the University of Toronto. Professor Burton graduated with honours in mathematics and physics from the University of Toronto and worked under McLennan for two years. He then went to the University of Cambridge and worked under J.J. Thompson (who had recently discovered the electron).

Prebus (left) and Hillier (right) working with the microscope in 1938

At Cambridge, Professor Burton worked with colloids and determined that with an electron microscope, he would be able see and study colloid particles directly and thus recognized the potential of an electron microscope for research.

In 1938, at the Department of Physics, Albert Prebus and James Hillier, who were graduate students of Professor Burton, began the project of building the first compound, transmission, magnetic microscope in North America.

To read more on this story, please see the article by former graduate student, H.L. Watson, on the Department of Physics website: http://uoft.me/microscope

Backpack to Briefcase

Backpack to Briefcase is a Faculty of Arts and Science program that provides students the opportunity to understand their education in a broader context. Students are involved in discussions with alumni, faculty members, staff and peers about life after graduation. Alumni are invited to meet with students, offer encouragement and career advice as students go from "backpack to briefcase" and into the working world. Alumni, Faculty and Students from the Department of Physics participated in a some sessions this past year. Please see below for the details on two of the sessions.

Career Panel with Astronomy/Physics/Chemistry - September 23, 2014

A panel of alumni from the Departments of Astronomy, Chemistry and Physics came together to discuss their U of T educations, the value of their degrees and their pursuits for successful careers to a room full of curious students.

Panel Members:

Department of Physics
Asif Khan
HBSc 2T3
Tax Manager, Scientific Research and Experimental Development – SB Partners LLP

Department of Chemistry
Duncan Jones
BSc 8T3 / MSc 8T6 / MBA 8T9
Principal – Hexagon Innovating

Department of Astronomy & Astrophysics
Martin Durant
PhD 2T6
Image Processing Researcher – Sunnybrook Health Sciences Centre

Left to right: Asif Khan, Duncan Jones, Martin Durant

For information visit:
http://www.alumni.artsci.utoronto.ca/sciences-career-panel/

Mentorship Meal – October 30, 2014

Students from the Department of Physics were invited to dine with physics alumni and faculty at the Faculty Club. The purpose of this meal was to tell the career stories of alumni who have successfully transitioned into the working world and provide students with the opportunity to connect with successful alumni. Also, alumni enjoyed the opportunity to interact with students and fellow alumni, visit their alma mater and share stories of navigating through the professional world.

Professor Andrew Meyertholen attended as a faculty representative from the Department of Physics. Alumni from the Department of Physics were:

- **Dr. Ernest Chan,** Managing Member – QTS Capital Management, LLC.
- **Anthony Moots,** VP Business Development – Builder Lynx
- **Dr. Sudharshan Sathiyamoorthy,** Vice President – Alignvest

Left to right: alum Sudharshan Sathiyamoorthy, Students Emma Hansen and David Han, alum Anthony Moots and Professor Andrew Meyertholen

We would love for you to be involved in Backpack to Briefcase! Interested? please contact mentorship@physics.utoronto.ca

Physics Career Accelerator Program (physCAP)

Launched in 2014, the physics career accelerator program or "physCAP" was created to enhance the post graduate career plan of undergraduate students. physCAP offers programs to help students transition to the world of work, graduate studies, and a professional career. This year, physCAP offered: 1) An enhanced version of 3rd/4th year Undergraduate Mentorship Program, 2) A new job shadowing program called "Explore More", 3) A preparation program for the Canadian Association of Physicists Professional Practice (P.Phys) certification and 4) a Career Fair

The physCAP received major support from the University of Toronto's Faculty of Arts and Science Step Forward Program which emphasizes student reflection. In each physCAP program students complete reflective activities on their experiences using Step Forward's "Connect/Reflect/Project" Framework.

Please see below for details on each physCAP opportunity and how you can be involved.

Physics Mentorship Program

3rd and 4th year students are encouraged to join this valuable program as the advice and help of a mentor can be of great benefit as Physics students prepare to make their way into the working world or move into graduate work. Likewise, mentors have the chance to find out about the current crop of students, and discover more about the hottest and emerging research areas at the Department.

We are always looking for alumni mentors from industry and academia. You would be invited to attend an opening, mid-term and closing event and you would meet your mentee once a month for the academic year. If you are not in the GTA and cannot meet your mentee in person, we have had great success in online mentoring.

Job Shadowing/Explore More

2nd and 3rd year students visit the workplace of alumni to view Physicists at work and to understand additional competencies they might need to acquire in the post-graduate transition.

We are always looking for alumni to host students at their workplace for a full or half day.

The Canadian Association of Physicists (CAP) Professional Physicist (P. Phys.) Certification Exam Preparation Program

The purpose of the physCAP P.Phys. Preparation Program is to prepare students for the professional practice exam sponsored by Canada's Society of Professional Physicists.

We are always looking for alumni who have their Professional Physicist Certification and would be willing to come and talk to students about their experiences and the benefits of having the P.Phys. certification.

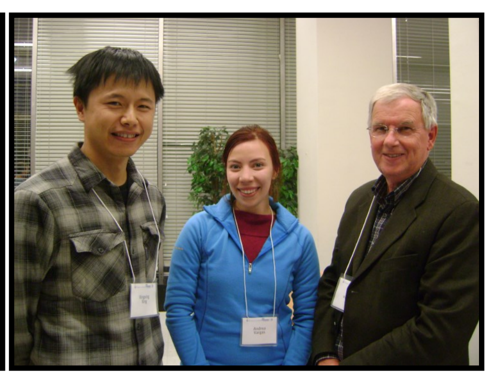
Physics Career Fair Event

An opportunity for 3rd and 4th year students to meet prospective employers to network with, be interviewed and possibly be recruited by.

We are always looking for alumni who would be interested in networking with or hiring a physics graduate or summer student.

If you are interested in being involved in any of these programs, please contact: mentorship@physics.utoronto.ca

Students participating in a reflective activity at the Mentorship Program launch event in October 2014



Mentors Xingxing Xing, Andrea Vargas-Sanchez and Professor Henry van Driel at the Mentorship Program launch event

Mentors Asif Khan and Martin Nicola at the Mentorship Program launch event

Celebrating Henry van Driel

Professor Henry van Driel retired in June of 2014. With local help from Professor John Sipe and Helen Iyer and support from the Department of Physics, two of Henry's former graduate students, Professor Jeff Young from the University of British Columbia and Dr. Nir Rotenberg organized a day of events on October 25, 2014 to celebrate Henry's career and the lives and work of his former graduate students and postdoctoral fellows. The morning and afternoon consisted of a series of technical presentations and reminiscences, held at McLennan Physical Laboratories, by former members of Henry's research group and colleagues. In the evening, dinner took place in the Senior Common Room of the University of St. Michael's College, where Henry and his wife were both once undergraduate students.

Celebrating Henry van Driel (front row 4th from left) dinner in the Senior Common Room of the University of St. Michael's College

2014 - 2015 Physics Mentorship Program Events

On Thursday, January 15, 2015 participants in the physCAP (physics career accelerator program) Mentorship Program were invited to the Mentorship Program Mid-Term Party. Mentees and mentors had the opportunity to reflect on their experiences to date, network and have a bite to eat.

On Thursday, March 26, 2015, mentors and mentees attended the Mentorship Program Closing event, an opportunity to socialize and say thanks to our mentors. The 2014-2015 Mentorship Program was the most successful to date, with 64 mentees and 51 mentors. Our mentors consisted of Alumni, Faculty and Grad Students.

If you are interested in being a mentor in this rewarding program, please contact mentorship@physics.utoronto.ca.

Mentors and mentees at the Mentorship Program Mid-Term Party...

….and at the Mentorship Program Closing Party

Congratulations to our November 2014 PhD Graduates!

Left to Right: Alma Bardon, Philip Heron, Martin Keller, Federico Duque Gomez, Patrick de Perio, Hoi Kwan Lau and Cynthia Whaley

Physics Ph.D Degrees Awarded in November 2014 at the University of Toronto

A. B. BARDON, “Dynamics of a Unitary Fermi Gas”, (J. H. Thywissen).

B. H. BURGESS, “The Applicability of Kraichnan-Leith-Batchelor Similarity Theory to Inverse Cascades in Generalized Two-dimensional Turbulence”, (T. G. Shepherd).

P. DE PERIO, “Joint Three-Flavour Oscillation Analysis of Disappearance and Appearance in the T2K Neutrino Bean”, (J. F. Martin).

F. DUQUE GOMEZ, “The Response of Particles in Periodic Potentials to External Forces: New Perspectives”, (J. E. Sipe).

P. J. HERON, “Mantle Dynamics Following Supercontinent Formation”, (J. P. Lowman).

D. M. JERVIS, “A Fermi Gas Microscope Apparatus”, (J. H. Thywissen).

M. KELLER, “Mitigating Model Errors in CO Emission Estimation”, (D. B. A. Jones).

H.-K. LAU, “Practicality of Quantum Information Processing”, (H.-K. Lo and D. F. V. James).

Z. MARIANI, “Infrared Emission Measurements of Radiation and Trace Gas Variability in the High Arctic”, (K. Strong).

K. PLUMB, “Inelastic Neutron Scattering Studies of Novel Magnets”, (Y. J. Kim).

N. PRENT, “Characterization of Muscle Contraction with Second Harmonic Generation Microscopy”, (V. Barzda).

J. RAU, “Unconventional Symmetry Breaking in Strongly Correlated Systems”, (H.-Y. Kee).

A. A. REIJNDERS, “Optical Spectroscopy of Novel Materials”, (K. S. Burch).

A. L. ROZEMA, “Experimental Quantum Measurement with a Few Photons”, (A. M. Steinberg).

L. SANDILANDS, “Optical Spectroscopy of Two-Dimensional Electronic Materials”, (K. S. Burch).

C. WHALEY, “Improvements to Our Understanding of Toronto-Area Atmospheric Composition”, (K. Strong).

Faculty Profile

Nicolas Grisouard

Assistant Professor
Earth, Atmospheric and Planetary Physics Group

Professor Grisouard joined the Department in January 2015. He is a geophysical fluid dynamicist whose research focuses on the theory of internal waves in the oceans. He is primarily interested in modelling non-linear processes associated with internal inertia-gravity waves.

He became interested in this topic in 2004 when he was a physics undergraduate student looking for a summer internship. He was actually interested in Astronomy and Astrophysics and applied to the OHP (an astronomical observatory in southern France). The group that got back to him was an atmospheric physics group and the proposed internship consisted of processing data from an automated LIDAR (Light Detection and Ranging) and he went for it. Professor Grisouard says "In practice, the work was very simple: design an algorithm, that would automatically extract how often cirrus (thin, high-altitude clouds) would show up in the data. Nothing from my intensive physics training was required but I had found a project which had meaning for me: every day when going to and from work, I would look up and wonder if I could see any cirrus that day."

The following year, he decided to keep studying the Earth, but wanted to find an undergraduate project which would put his physics training to better use. Something more mathematical with "an active feedback loop from nature," he says. He also wanted to combine this with his favorite class as an undergraduate student, fluid dynamics. He found an internship at Scripps Institution of Oceanography in San Diego, studying internal gravity waves. He really enjoyed this topic and says "I could use my knowledge about wave physics and my training in scientific programming. Moreover, when compared to other sub-fields of physics like quantum physics or non-linear optics, this field had been left relatively untouched and it felt like large advances, with concrete impacts for society, were within reach" .

Professor Grisouard got his PhD from the University of Grenoble, followed by post-doctoral work at the Courant Institute and at Stanford.

How did the ocean inspire you and impact your research?

Fluid dynamics had been my favorite topic as an undergraduate, but this class probably was simply the trigger of something which was simmering deeper down. I would often be mesmerized by fluid dynamics phenomena, like smoke or river flows. Nothing conscious, it would just happen, and I would snap out of it and resume my activities of the time. Only when I took my first fluid dynamics class did I realize that this was actually a thing, like supernovae or electricity.

But teaching of fluid dynamics was, and still is, often geared towards engineering applications, and somehow that did not resonate with me. Only when I did the internship at Scripps and started reading books on oceanic flows did I realize that this could actually be a job. The rotation of the Earth and the variation of densities across the ocean would introduce physics unlike anything I had ever heard of and the diversity of oceanic fluid dynamics phenomena was just a bottomless well where I could find inspiration.

Later on, I would realize how important the ocean is for the climate system, which also resonated with concerns I had as an ordinary citizen. As my career progressed, observing the ocean (to this day, it is still an immense pool of dark water as far as our knowledge of it is concerned), and properly integrating my research with the larger oceanographic and geophysics community have become new and exciting challenges for me.

Can you give me an example of a non-linear process that you have worked on and its significance?

My most recent work involves a very peculiar phenomenon happening when internal waves reflect against the surface of the ocean from below. The sub-surface of the ocean is peppered with "fronts", which are physically the same type of flow that you hear about in weather forecasts ("a cold front will sweep through Toronto", things like that), except that they are much smaller in the ocean. These fronts can capture internal waves, which are then squeezed towards the surface and reflect against it. When they do, and this is where the internal wave physics is unlike any other, they do not reflect against it in a specular manner, like light against a mirror or sound against a wall. Instead, the angle of propagation of their energy is modified after reflection, and if the conditions are right, this angle can even be parallel to the ocean surface, effectively trapping the waves in a thin and very energetic layer just below the surface. As it turns out, and this is one of the many small miracles happening in this problem, the "right conditions" are often met in the ocean: the waves simply have to oscillate at the same frequency as the rotation rate of the Earth, and the ocean finds many ways to create such waves.

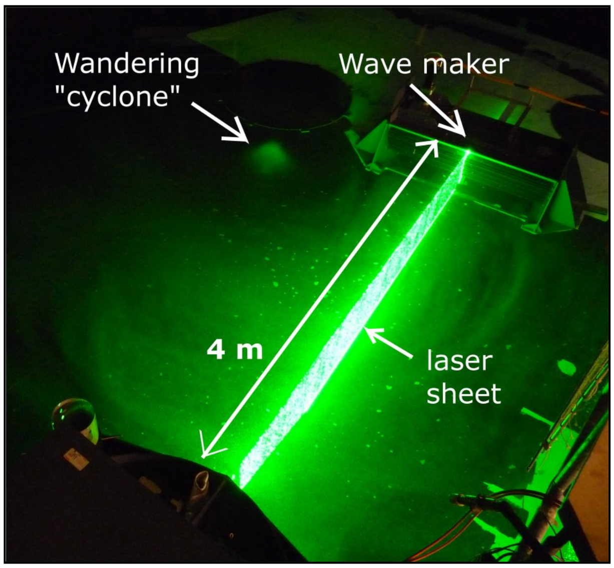
Continued on next page.

When focused in this thin, energized layer, the waves become very non-linear, break and dissipate. They don't do it with a whimper but a bang: some of the energy associated with the front dissipates with it, one of the other small miracles associated with this seemingly abstract problem.

Why is it important? Fronts occupy a special place in oceanography; for example, they host intense ecosystems. In our case, we were interested in the fact that they are where the ocean's kinetic energy, which is mainly stored in vortices that are much larger than fronts, dissipates, although in ways that are still mysterious.

Our study provides the oceanographic community with a new process, which could partially explain how internal waves make this dissipation happen.

You use numerical simulations, laboratory experiments and analytical modelling to model non-linear processes, can you give our readers an example of one of your experiments? What was the outcome?



This is an annotated picture of the set-up in action, taken from the observation platform above the fluid. The laser sheet illuminates Styrofoam particles that "tag" the fluid. A movie of the particle motion allows retrieval at the motion of the water.

In 2009, we performed a tank experiment in Grenoble, France on the largest rotating tank in the world: 13m diameter, the whole facility being able to rotate with the tank in order to reproduce the Earth's motion. We wanted to understand the processes by which internal waves break down into ever-smaller waves, eventually breaking down into turbulence, which mixes waters of different densities vertically.

Instead, we were surprised to observe the contrary: rather than creating smaller and smaller scales, the flow was creating larger and larger vortices. It was as if a fast, messy process was giving rise to a smooth and coherent type of motion, seemingly lowering the entropy in the tank (the readers may rest assured that no fundamental law of physics was broken in the end).

Although we ended up only re-discovering a process that was known in other areas of fluid dynamics, we were surprised by the strength of it, and started to think that this process was underestimated in the ocean, which would keep me busy in the years to come, and still to this day!

What are your plans for research at the University of Toronto? What is exciting?

The University of Toronto offers a fantastic environment for research and a stronger integration inside the climate science community than I am used to. I find it very exciting, a source of inspiration as well as a natural evolution of my career.

For example, my arrival in the department also coincides with the future launch of the SWOT (Surface Water and Ocean Topography) satellite, to which the Canadian Space Agency is a contributor. This satellite will revolutionize how scientists observe the ocean's currents, but the correct interpretation of the future data will require making important advances in how we understand the fluid dynamics. This is a new and exciting challenge to me, because it requires work not only at the laboratory scale, which I am used to, but also to integrate such basic research within a community consisting of government agencies, large engineering teams, and hundreds of scientists. I have to say that even though I have only been here for a few weeks, I have already been able to tap into the atmospheric physics group's expertise in operating in such a complex research environment. What would have been an overwhelming endeavor had I been elsewhere already feels like a success within reach here.

William Trischuk

Chair of graduates studies & Professor in High Energy Physics

For Professor Trischuk, particle physics as a research interest began when he was 12 years old, when he had the unique opportunity to visit CERN and see some of the experiments that were going on. This stuck with him and later when he had the choice between doing physics and doing math, he says "Somehow in math if you said 2+2=5 you got 0 credit. In physics it is more about the uncertainties and there was much more scope for understanding 90% of what was going on and making progress. I guess that is why I ended up being an experimentalist. I enjoy tinkering with things, trying to figure out how they work, taking them apart and (90% of the time) putting them back together in working order"

Professor Trischuk received his BSc from McGill University in 1986 and his PhD from Harvard in 1990.

You received your PhD from Harvard in 1990. Your thesis work resulted in the precise measurement of the W boson mass. Can you tell our readers the significance of this?

There are two kinds of measurements in particle physics: searches for new particles (like the recent discovery of the Higgs Boson at the LHC) and precision measurements of particles that have already been discovered. 99% of the time, searches come up empty, we look and don't find anything. Then we try to quantify how heavy or light a new particle could still be and yet we might have missed it – this is called "setting limits on the existence of new particles". Precision measurements of existing particles test our description of how those particles interact or influence each other. Often they can lead to predictions for where additional new particles might be found. That was the case with the W boson in the 1980s. It had just been discovered at CERN (I was 3 years too late to be involved in the discovery) but the Fermilab collider was just about to produce 10x (and eventually 100x) more W bosons than the CERN collider. The standard model of weak interactions (that already predicted the existence of the Higgs boson at that time) makes very specific predictions about how W boson, top quark (which also hadn't been seen in the 1980s) and the Higgs boson should interact. Essentially the W boson becomes a little more massive if the top quark is light and if the Higgs boson is light. The measurement I made in my thesis experiment strongly favored a heavy top quark (the experiment I was working on was also actively looking for evidence of the top quark even then – it would only be discovered 10 years later).
But mostly the measurement of the W boson mass that we made was 50x more precise than anyone had ever made before. We had to understand the calibration of our detector at least 50x better than anyone had ever done before and prove it to our colleagues and competitors at CERN. This is how science advances. The W mass itself was just one framework upon which we were able to make progress at the time.

Your research on Hadron collisions gave access to the highest energy collisions. Can you tell our readers what kind of discoveries these collisions can lead to?

Protons are the heaviest particles we can routinely accelerate to the highest energies and quantities in particle accelerators. So they were a natural choice of projectile when CERN was designing their next energy frontier machine – this too actually started in the 1980s, when I was still a graduate student. Now that we have collisions at the LHC, there are many new physical processes that could emerge, for example, new particles or new interactions are possible. The observation of the Higgs boson was one high profile possibility, upon which much of the rationale for the LHC energy and collision rate was based. It wasn't a sure thing that we'd find *the* Higgs boson, but there were predictions that if we didn't find it, we'd find something similar – perhaps it might have been something even more interesting. It was a nail-biting five years as we turned the accelerator on, took the first data and began to understand what Higgs boson decay signatures we could see. We then pieced the signatures we saw independently in the two LHC experiments together into a consistent picture of a single Higgs boson.

We are about to increase the energy of the beams in the LHC – almost doubling it - to make 13 TeV proton-proton collisions. One thing we will want to do with the new data is check that the Higgs boson is still being produced. We expect the higher energy collisions should produce it three times more often than at the lower energies. This is an example of a modern-day precision measurement testing our theory of how Standard Model particles behave. Probably before we are able to re-measure properties of the Higgs boson with the new data we will actually explore new territory for heavier new particles.

With the data we have already, we've been able to rule out the existence of many (most?) extensions to the Standard Model that include new particles lighter than about 1 TeV in mass (10x as heavy as the W/Z bosons, 7 times heavier than the Higgs or 5 times heavier than the top quark). But the higher energy collisions give us 10x higher probability of producing new particles as heavy as 2 TeV and 100x higher probability to produce new particles as heavy as 5 TeV. So if there are some new particles out there between 2 and 5 TeV then we should be able to see them in the new data-set after only a few months (as opposed to the few years we've already been looking at the initial LHC collision energies). The coming year is going to be an exciting time at CERN.

Continued on next page.

Are you still involved in the detector R & D program (CVD Diamond Radiation Detector Development)? If so, what is the most exciting thing that has emerged recently?

Over the last 5 years I have spent more of my time trying to build 'real particle detectors' that use CVD diamond to measure the position and time of passage of charged particles in the ATLAS experiment.

While I am still co-spokesperson of the CERN-based diamond detector R&D program, the most exciting thing to emerge from this work recently is the actual use of diamonds in our experiments. In 2007 we installed a small set of eight diamond pad detectors in eight locations in ATLAS with one readout channel each that measures very precisely the time of arrival of charged particles at these eight locations. They are located less than 5cm away from the LHC beams and only 2m from the ATLAS interaction point. These detectors were originally designed to watch for evidence of beam instabilities that could have devastating consequences for the rest of the ATLAS experiment, and then send an urgent signal to the LHC to abort the beams, in a controlled way, if they became dangerous. The diamond sensors were ideally suited for this application as they could survive the harsh radiation environment near the beam and they produce much faster signals than other sensors that could have been chosen.

In the end, this detector system has worked reliably to protect the ATLAS experiment, only calling for two beam aborts over the course of the first three years of LHC operation – both times when other systems were just becoming aware of the danger the beam posed – thus in hindsight they were fully justified requests.

But even more exciting has been the other uses for these detectors. With their very precise timing resolution, they have been able to observe features of the LHC beams that have allowed us to increase collision rates beyond the initial design of the machine and they have been used to measure the collision rates with a precision of better than 1%. – almost five times better than similar detector systems were able to do at previous generations of particle colliders.

Much of what we do in designing a particle physics experiments has to be predicted/justified with a high degree of precision. The detectors are so expensive to build that we have to make sure we do it right and make the right cost/benefit choices so they are not over designed. It is gratifying to see small detector systems that can revolutionize the way measurements are done in novel/un-expected ways.

Tell me about your work at ATLAS?

The thing that I really grew to enjoy about experimental particle physics as a summer student but certainly from the time I was a grad student onwards, is the variety of things one has to be good at to be a successful experimentalist. It starts with the design of the particle detectors themselves. Making the particle collisions is a pretty expensive proposition. If there is anything we can do to make our particle detectors 10% more sensitive or twice as long-lived it will pay for itself many times over in terms of being able to reliably measure particle collisions and make more precise observations of the collisions we do record.

But once we have a design then there is a building, quality assurance, integration and commissioning phase. Getting 15 different kinds of detectors to work together in a confined space (around the particle collision region), to run 24 hours a day, 7 days a week for years at a time, with essentially no down-time, is no small challenge. Then there is recording and analyzing the data that these detectors produce and finally there is understanding how the hypothetical (or already known) particle decays should look in the detector.

I've had the privilege of spending 6 months to several years in each of these phases on three different particle physics experiments over the course of my career. The variety ensures that it never gets boring and each of the different phases provides feedback to the others. If you design a lousy detector then your ultimate physics measurements will be limited in some way. Next time you do it, you try to avoid those limitations – but usually find others. When you are finally operating a full experiment you see how individual design choices limit the experiment and you try to learn from that for the future.

I understand that you recently returned from a sabbatical and you spent some time at CERN?

Yes, the LHC has just undergone a two-year refurbishment, to allow it to reach its design collision energies. The trigger for my sabbatical came at a Canadian funding review of the ATLAS project. One of the reviewers made the observation that, with the machine being shutdown, we could save a lot of Canadian taxpayer money by cutting back on our presence at CERN during the shutdown. At the time I begged to differ with the reviewer. Shutdowns are the time when one can actually get back 'in' to the detector and fix all the things that are limiting its performance. The premise that 'somebody else' was going to do all of this, absolutely critical work, 'for us' and then we would return when things were running smoothly again, was counter to everything I thought I understood about being an experimental physicist. I ended up spending about 18 months at CERN and brought two of my graduate students and one postdoc with me. I think we have had a positive impact on the success of the ATLAS refurbishment in preparation for the next run. *Continued on last page.*

Graduate Student Profile

Jennifer Yu
PhD
Experimental
Condensed Matter

Jennifer Yu is a 4th year PhD candidate and a member of Professor Stephen Julian's group. Her research is focused on the physics of materials under extreme conditions, such as high pressure, ultra-low temperature, high external magnetic field or some combinations of the three. Since high school Jennifer had always been interested in physics and mathematics where she had performed strongly. But she was not sure at the time whether to pursue physics or mathematics for her future studies. It was chance that first initiated her into experimental condensed matter physics: the professor of her first year physics laboratory course, whom she had bumped into at a coffee shop, had invited her to work in his lab in the summer as he was in need of summer students. This opportunity had opened her eyes to this vast and exciting area of research. She found that one had to solve a lot of practical problems in this discipline and it required a lot of creativity. This hands-on approach appealed greatly to Jennifer and she was also excited to be part of such a large and dynamic community as condensed matter.

At the University of British Columbia, Jennifer earned a combined honours bachelor's degree in Mathematics and Physics. When it came time to choose an area of focus for her graduate degree, Jennifer selected experimental condensed matter without hesitation.

Jennifer Yu

Her current research involves probing different materials using various methods, but they all serve one essential purpose: to study the behaviours of materials under extreme conditions. These materials are interesting precisely because studying them could potentially lead us to new discoveries, sometimes even technological breakthroughs. The transistor, the keystone of modern computers, was made possible only through extensive research on semi-conductors.

Sometimes the materials they study in Professor Julian's group are "exotic" crystals that are not found naturally but created by chemists or physicists using clever methods with certain goals in mind. For example to make a novel high temperature superconductor, the researchers use extreme conditions, such as high pressure and low temperature, to bring out the most interesting phenomena in these materials and study why they behave this way.

For instance, Jennifer studies the quantum critical point of certain heavy fermion materials, where one can tune the phases of matter from one to another through pressure but only at absolute zero temperature. At this point the conventional theories do not apply and experimentalists search for signs that may support one theoretical model or, most excitingly, contradict all existing models. This way our understanding of the materials and the underlying physics can be furthered and perhaps one day lead to yet another technological breakthrough (among the holy grails there is, of course, room temperature superconductivity).
To create these extreme conditions, sometimes the researchers have to solve some practical problems. Jennifer's own research involves high pressure in a pressure cell known as the clamp cell. The general design has been made standard through years of research, but to use it for her specific purpose she has had to make adjustments and design new parts. For this Jennifer needed to know some practical skills such as using CAD design software and the elastic properties of materials.

Currently she is testing out a new type of pressure seal in these pressure cells to bring the in-cell pressure to above 25kBar (1 atmosphere pressure = 0.001kBar).

Jennifer has received NSERC CGS-M and NSERC PGS-D3 awards during her graduate program.

When she is not working, Jennifer would most likely be found either in one of the numerous bookshops in Toronto or reading a book from her ever growing collection. She also enjoys going to theatres, concerts and operas of which Toronto has some of the finest offerings in the country.

Graduate Student Profile

Sylvia Swiecicki
PhD
Theoretical Quantum Optics

Sylvia Swiecicki is in the 4th year of her PhD and works in the group lead by Professor John Sipe.

Her research is focused on understanding the optical response of materials to non-uniform electromagnetic fields at the microscopic level. This is an important problem in the theory of light-matter interaction, because a number of optical processes depend on the variation of electromagnetic fields throughout material. Examples include, among others, the optical activity of solids and the optical response of metamaterials (artificial structures composed of "meta-atoms" with dimensions that are a non-negligible fraction of the wavelength of light).

The description of the optical response of crystals to non-uniform electromagnetic fields is a complex problem, with proposed theories often being largely phenomenological. Interestingly, a related but simpler problem of the response of an isolated molecule has been addressed at the microscopic level a number of years ago. In her PhD project, Sylvia is working towards expanding the theory proposed for the molecule to the case of a crystal.

Sylvia Swiecicki

What she finds particularly interesting about her project is that it involves employing methods developed by two physics communities and building connections between them. Sylvia has obtained her undergraduate degree in Physics from Jagiellonian University, located in the old and beautiful city of Krakow in the south of Poland. During her undergraduate studies, driven by the enthusiasm for travelling she applied for the NSERC Undergraduate Summer Research position, which she was awarded and held at the University of Toronto. Having enjoyed the research opportunities and the international environment that UofT had to offer, she had decided to come to Toronto for her PhD.

Sylvia is a recipient of several awards and scholarships, including the NSERC CGS-M, NSERC CGS-D, and the Ontario Graduate Scholarship.

When she is not working, Sylvia stays active and plays tennis in the athletic centre. She also enjoys baking different kinds of desserts.

Release of Professor Stephen Morris' Giant "Icicle Atlas"

Professor Stephen Morris and his team have released the "Icicle Atlas", a giant trove of data on icicle shapes and growth. The Atlas contains over 230 thousand images and hundreds of time lapse movies of icicles grown under controlled conditions in the laboratory. It's all free for download! To learn more and to download the atlas, visit: http://www.physics.utoronto.ca/Icicle_Atlas/

Professor Morris

"Like snowflakes, every icicle has its own unique charm" - Professor Stephen Morris

This image shows 13 random images from the Icicle Atlas.

Undergraduate Student Profile

Emma Hansen
Physics and Philosophy

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

A particularly insightful and enthusiastic high school physics teacher, Mr. Koiter, sparked my interest in physics. It is because of his classes that I began to see physical science as a fascinating way to see the world, and an enterprise in which there is plenty of room for creativity.

I read Manjit Kumar's history of quantum physics in Grade 12, and the dialogic nature of the process of discovery really struck me; in short, I didn't want to put down that book or leave the physics classroom until I'd reached the frontier of understanding in the field.

What do you enjoy most about the physics program?

In my classes last term, Prof. Meyertholen and Prof. Morris presented the second-year curriculum in very engaging ways that helped us to understand the material both heuristically and technically. The department also creates great opportunities for undergraduates to learn about research. I took PHY189, Physics at the Cutting Edge, with Prof. Steinberg last year. In addition to bringing in some very interesting and accomplished guest speakers, Prof. Steinberg encouraged us to enjoy our part of the discovery process as much as the older scientists who were giving the colloquium lectures. I loved the opportunity that class afforded us to see the breadth of physics as an area of study.

Emma Hansen

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

My interest in the history of science quickly led me to a few unsettling realizations about the applications of scientific research. The physics community seemed to be internationally-minded and very open, so it was difficult to learn, for example, that the first human-made object to enter orbital space was a Nazi V-2 rocket. My distaste for such destructive applications of science has shaped my extracurricular interests.

I'm involved in a couple of peace-related NGOs. I did a disarmament-related internship with Pax Christi International in Belgium this past summer, and I'm involved with Science for Peace here in Toronto.

I also love to write. I was the associate science editor of *The Varsity* last year, and I've been doing a little bit of freelance work, most recently in the *Bulletin of the Atomic Scientists*.

I also orchestrated the inaugural Polanyi Conference on Science and Social Responsibility last term, which dealt with issues at the intersection of science and society. I was so grateful to Prof. John Polanyi and the other speakers for agreeing to lend their time, learning, and insight to the conference.

What is your favorite course and why?

My favourite courses so far have been the two foundational year Vic One courses. I was in the Arthur Schawlow Stream for Physical and Mathematical Sciences in its first year, the two courses and the associated community continue to enrich my experience at U of T.

What are your research interests?

I'm looking forward to gaining a better understanding of quantum physics. Reading about its history is enthralling , and I have a lot of work to do before I'll be able to understand the recent advances in the field. I'm enjoying my journey towards that understanding.

I'm also interested in political philosophy, especially issues related to the nature of the social bond. The more I learn about disarmament and responsible management of science, the more I realize how intertwined these issues are with questions of justice more broadly, and philosophy seems like a great way to continue exploring those questions.

Please see page 4 for Emma's work on the Polyani conference.

Undergraduate Student Profile

Jeong Yeon Yook

Physics Specialist and Mathematics

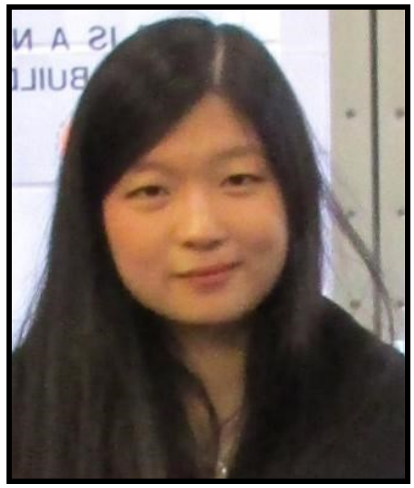
I search for answers to questions about the universe....

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

I decided to study physics because I search for answers to questions about the universe. I find it meaningful. I am curious about a lot of things. I have considered studying philosophy as well, but I chose physics because I believe physics provides a more productive method to search for answers.

What do you enjoy most about the physics program?

I like that I am studying what I love. I can't really think of anything else I would want to do. I also like that people in the department are friendly and helpful. I also like small class sizes in upper years.



Jeong Yeon Yook

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

I am currently the president of Physics and Astronomy Student Union (PASU). I organize events for undergraduate students and manage the PASU lounge. I think I have learned a lot about how to work in a group and leading people from this role.

What are your research interests?

I am interested in high energy physics and cosmology. I think they are fundamental in understanding the nature of the universe. I have worked on two ATLAS projects and I enjoyed it. I find other branches of physics interesting as well. I wish I had time to learn them all.

What is your favorite course and why?

I would say one of my favorite course is the supervised reading course about the search for dark matter with Prof. Pekka Sinervo. Prof. Sinervo is a wonderful supervisor and dark matter is fascinating. I also like the applied math general relativity course. This course introduced me to Riemannian geometry and I find its applications to physics exciting.

What are your future plans?

I applied to graduate schools for September and I want to stay in academia.

Where do you see yourself in 10 years?

I have no idea. I really hope I can be a physicist in 10 years, but who knows. Maybe I will have my own place and a pet.

Tell me something interesting about yourself.

For some reason, this question is harder than my last problem set. I can finish a carton of ice cream at one go.

2015 CAP University Prize Exam Results -

Physics Students at the University of Toronto proved once again that they belong to one of the top educational facilities in Canada.

Chao Wang – 1st place

Ramanjit Sohal – 7th place

Oguzhan Can – 8th place

Jeremy Li – 9th place

The 2015 CAP University Prize is a national competition open to students across the country who are enrolled in an undergraduate program at the time of exam. This year, the exam was written by 65 students. Students from the University of Toronto took 1st, 7th, 8th and 9th of the top 10 spots.

CONGRATULATIONS TO THE TEAM AND THANKS TO THE COACH PROFESSOR ROBIN MARJORIBANKS!

2015 CAP Medal Recipients
Pierre Savard & John Martin from the Experimental High Energy Physics Group

The 2015 CAP-TRIUMF Vogt Medal for Contributions to Subatomic Physics - awarded to Pierre Savard, University of Toronto / TRIUMF, for his contributions to particle physics and in particular for his leadership of the Higgs -> WW analysis, which was an important ingredient in establishing that the discovered particle was, in fact, the Higgs boson.

The 2015 CAP Medal for Lifetime Achievement in Physics - awarded to John F. Martin, University of Toronto / IPP, for his contributions to experimental particle physics and his leadership role in the international physics community.

Update on our Undergraduate Laboratory Renewal Project

As reported in previous Newsletters, the Department of Physics has embarked on an effort to renew our Undergraduate Experimental Physics space and pedagogy. We have at this point achieved two important goals.

First, we better integrated lectures and labs in our first year Physics stream courses using the *Physics Practicals* pioneered by David Harrison and others that has proven so successful in our Life-Science stream courses. To do this we created in spring 2014 an interim renewed space for our First Year Labs for Physics Majors and Specialists and completely transformed the labs and tutorials into the Practicals format.

Second, as of fall 2014, we have completed an expansion, renovation, and refurnishing of the computer lab in MP257. The result is a beautiful and functional collaborative space where students can work individually or in teams on computational projects (see the accompanying photos). Students have expressed appreciation of the new space and we look forward to officially piloting it in our computational physics courses in the fall.

These renovations were accomplished with Departmental resources. We are now seeking support from outside the Department to carry out an end-to-end renewal of the laboratory spaces.

We always welcome your ideas and support, so please contact us (outreach@physics.utoronto.ca) if you have comments.

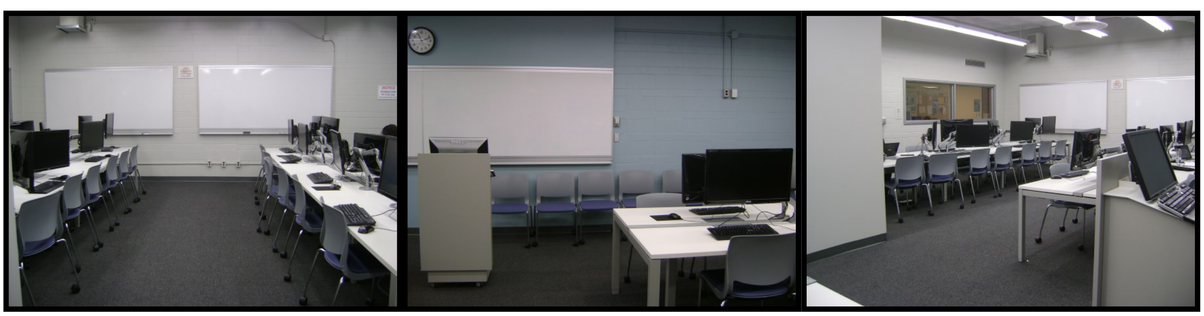
HELP RENEW OUR UNDERGRADUATE LABS!

Are you interested in supporting the Department of Physics in our efforts to make the undergraduate labs more effective, interactive spaces that help students learn physics better?

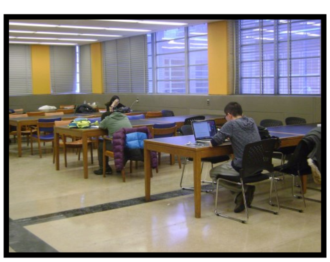
We have set up a 1:1 matching fund for donations toward the undergraduate lab renewal project (up to a maximum of $50,000).

To donate to this fund, please visit: https://donate.utoronto.ca/physics

Thank you for your support!



Renovated MP 257



This is the south side of the library that was recently opened up to create more study space

Library Renovation Project

Our plans to re-envision and renovate the library space on the second floor continue to progress.

THE LIBRARY RENOVATION PROJECT:

This fund will support the Department of Physics' plans to turn the library into a beautiful interactive study space that will enhance its central role in the teaching and learning mission.

A 1:1 match will be provided for donations to this fund (up to a maximum of $50,000).

To donate to this fund, please visit: https://donate.utoronto.ca/physics

Centre for Global Change Science – Graduate Student Research Symposium – February 2015

The fifth Centre for Global Change Science Graduate Research (CGCS) Symposium was held on February 19 & 20, 2015. It showcased the results of research awards and highlighted the thesis research of several senior graduate students.

The CGCS was established in 2005 with support from the Faculty of Arts and Science "Academic Initiatives Fund' to serve as U of T's focal point for research and education in Global Change Science. CGCS fosters new interactions among the various departments involved: Cell and Systems Biology, Chemical and Physical Sciences at UT Mississauga, Chemical Engineering and Applied Chemistry, Chemistry, Ecology and Evolutionary Biology, Forestry, Geography, Geology, Physical and Environmental Sciences at UT Scarborough, Physics and Zoology. The CGCS is organized around five interacting areas of study: climate models and dynamics, atmospheric chemistry and global change, global change and the biosphere, global change and the hydrosphere/cryosphere and space-based remote sounding of global change.

This year, the symposium included 8 graduate students from the Department of Physics: Ian Chan, Deepak Chandan, Hesam Salehipour, Kevin Olsen, Keven Roy, Ilya Stanevitch, Oliver Watt-Meyer and Xiaoyi Zhao. Their contribution was either in the form of a poster or an oral presentation, covering topics such as: bromine explosions in the high Artic, the measurement of atmospheric methane, equatorial balance theory, ocean mixing, stratosphere-troposphere mixing, mantle viscosity constraints from the U.S. East coast and determining the mid-Pliocene sea level to assist with making climate projections.

Opening and closing remarks were by Professor W.R. Peltier from the Department of Physics, who is also the Director of the CGCS. Student presentation sessions were led by invited talks from Dr. Heidi Swanson (University of Waterloo), Dr. Andreas Zuend (McGill University) and Professor Peltier . The organizing committee consisted of Department of Physics graduate students Keven Roy and Oliver Watt-Meyer.

We asked Keven Roy some questions about the symposium.

What is the significance of bringing together different departments for this symposium?

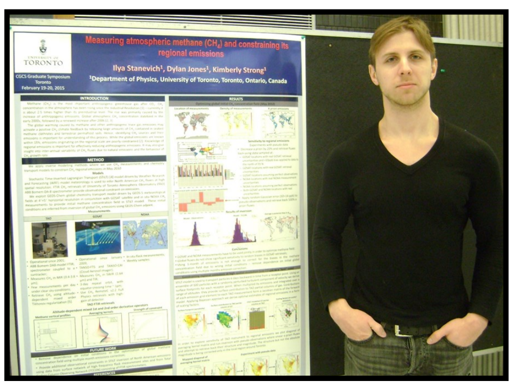
I think that it emphasizes the fact that the study of the environment and of the changes it has been undergoing benefits greatly from a multi-disciplinary approach, a feature that the Centre has been pushing forward. This type of event promotes communication between students of different departments, and I strongly believe we all benefit from the different perspectives brought by the wide range of student projects that have been supported by the Centre.

What was your favorite part of this year's symposium?

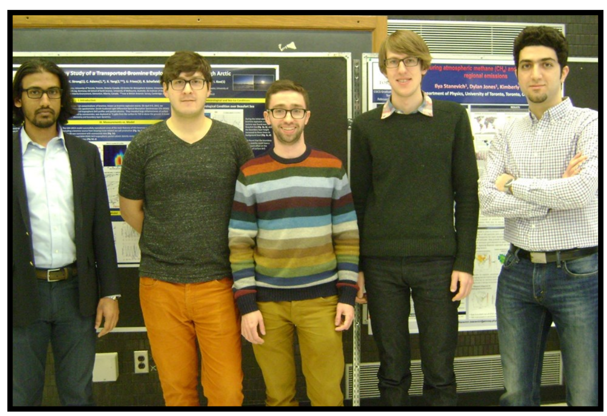
I think it was having the opportunity to meet so many graduate student colleagues from other departments and learn about their projects. I also really enjoyed the presentations done by our invited speakers, who were very kind to join us for this very unique student-led event.

For more information on the Centre for Global Change Science, visit: http://www.cgcs.utoronto.ca/

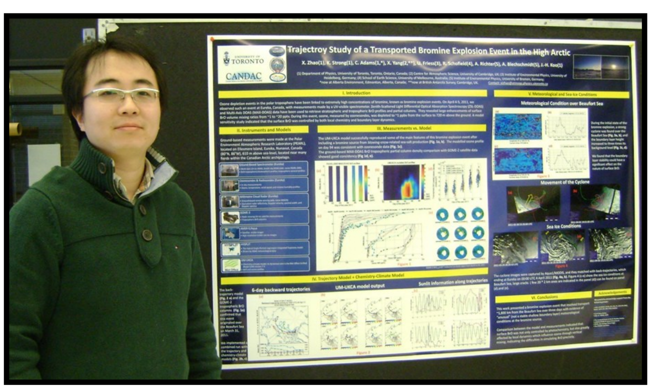
Ian Chan



Ilya Stanevitch



Left to Right : Physics students Deepak Chandan, Kevin Olsen, Keven Roy, Oliver Watt-Meyer, Hesam Salehipour all presented their research at the symposium this year.



Xiaoyi Zhao

Left to Right: Physics student Deepak Chandan, Earth Sciences student April Dalton and Professor Peltier at the poster presentation.

Announcements

Nicolas Grisouard
Nicolas Grisouard arrived in January 2015 to begin his role as Assistant Professor in the Earth, Atmospheric and Planetary Physics Group.

Nicolas is a geophysical fluid dynamicist whose research focuses on the theory of internal waves in the oceans. He obtained his PhD from the University of Grenoble, followed by post-doctoral work at the Courant Institute and at Stanford. See page 8 for a full profile on Prof. Grisouard.

Peter Hurley
Peter Hurley took over as Chief Administrative Officer at the Department of Physics in July 2014, replacing John Muto.

Previously, Peter was the Director of the Physics Learning and Research Services.

Peter started in the Department as an undergraduate in 1975, and has also been a graduate student, research assistant, research associate, industrial collaborator, and major project manager here.

Crystal Liao
Crystal is the new Departmental Assistant in the High Energy Physics group as of November 2014, replacing Winnie Kam. Crystal has been the Geophysics Departmental Assistant since 2007 and will continue in both roles.

David Rogerson
David took over as Director of the Physics Learning and Research Services in January 2015, replacing Peter Hurley.

Previously, David was the supervisor of the Electronic Services in the Physics Learning and Research Services.

Paul Woitalla
Paul is the newest member in the Mechanical Workshop in Physics Learning and Research Services, he arrived in January 2015.

He will be responsible for the student work area and will teach the student workshop courses.

Retirements

Winnie Kam
Winnie Kam has been the long-standing administrator of the experimental high-energy physics group starting in the late 1980's. During that time, she saw to the needs of the faculty, graduate students and postdoctoral fellows in the group. She managed the grant funds of up to four large research projects at any one time, and a host of other projects that the particle physicists were involved in. More recently, she also supported the observational astrophysics group. This led to a very busy office, with her need to manage the affairs of the research group from as far east as Japan to as far west as Switzerland. She did this all with aplomb and efficiency. Though already missed, we wish her a very happy retirement.

Celebrating 20 years

In this edition of the newsletter we are pleased to recognize two of our Physics Learning and Research Services (PLRS) staff members who have been with us for 20 years.

Phil Scolieri
Phil Scolieri is the Supervisor of the teaching labs. When he first started twenty years ago the experimental apparatus was mainly custom built so his electronic and fabricating skills were a valuable asset. Since then the equipment that students use have become primarily computer based. While he continues to use his electronic skills, Phil went from managing 20 to over 200 computers.
In addition to his supervisory duties he maintains apparatus, ensures demonstration equipment is in place during lectures, assists students in the teaching labs as well as co-chairing the department's Health and Safety Committee.

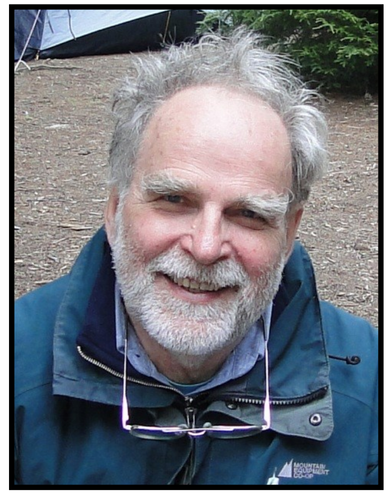
When not in the lab Phil's interests are his marine aquariums and fish pond. He still keeps his hands in electronics at home, enjoys sports and spending time at the cottage.

Robert Smidrovskis
Rob Smidrovskis is also celebrating 20 years. He started in the first year lab which he says was very different then as it only needed to be setup twice a year. Today the setup changes daily because of the many experiments available to the students. Rob now works in the advanced labs, a position he has held for the last nine years. Keeping equipment in good repair is essential for a positive student experience. Rob says that this has been his main challenge due to the increased student enrollment and demands on the equipment. In addition Rob also provides valuable assistance to students, teaching assistants (TA's), instructors and lab co-coordinators.

In his spare time Rob likes to build his own electronic projects. He is also a "shadetree mechanic" (a person who repairs cars in their driveway or garage) and maintains his house.

Thank you Phil and Rob for your work in enhancing the student experience in Physics and contributing to advancing education and research. Your contributions and those of the rest of the PLRS staff are helping make a difference in the lives of students and other department members. David Rogerson

In Memoriam - Professor George Luste



Professor George Luste 1940 - 2015

The Department of Physics is saddened by the loss of Professor George Luste.

Professor Luste joined the Department of Physics faculty at the University of Toronto in 1971 after his undergraduate degree at Mount Allison, PhD at Johns Hopkins, and postdoctoral work at SLAC National Accelerator Laboratory.

He joined the established "bubble chamber" experimental work in Toronto, but also helped in moving the group's efforts over the next decade into "counter" experiments, first at Argonne National Laboratory, then Fermilab.

At Fermilab he collaborated on a large spectrometer, some components of which were designed and fabricated in Toronto, running first in a photon beam, then a hadron beam. This was perhaps the first really large experimental facility at Fermilab and it produced a wealth of data on the newly found particles containing a charm quark. Both the production processes and the decay lifetimes were accurately measured, providing important tests for understanding QCD, the complex theory of the strong interaction. Several of Professor Luste's graduate students completed their PhD work on this experiment.

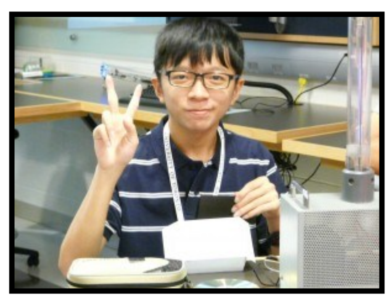
The enormous data rate stored to tape from this facility triggered his interest in large-scale computing, and he helped develop a system networking parallel processing units for analyzing the data at Fermilab and Toronto. The success of these early systems led him to question the wisdom of acquiring large main-frame computers for the university, and he was highly active in advocating cost-effective parallel computing solutions for intensive research computing in the 1980s and 90s.

Professor Luste was chair of graduate studies at the Department of Physics from 1982-1987. He served on the council of the University of Toronto Faculty Association for many years before being elected to president in 2002. He held this office until his retirement in 2012. In this role, he devoted himself to many aspects of faculty dealings with the administration, and was particularly active in matters concerning pensions, arguing strongly over many years for improved management of the pension fund.

His determination on pensions resulted in him becoming a member of the University's newly-formed Pension Committee in 2010, on which he served as chair from 2012 to 2014.

Professor Luste's name will live on in our Department with the George Luste (In Program) Scholarship, awarded to a 2nd or 3rd year undergraduate student in the Department of Physics with a demonstrated financial need and academic merit. If you would like support our undergraduate students and continue Professor Luste's legacy, please visit: https://donate.utoronto.ca/physics

Outreach in Action - University of Toronto Summer Camp 2015 applications are now open!



Registration for **"Science Unlimited Summer Camp"** at University of Toronto is now open.

Are you starting to plan summer activities and camps for your teenage son or daughter?

Send them to "Science Unlimited Summer Camp", this August at the University of Toronto! A once-in-a-lifetime opportunity for **high school** students to participate in a week of Physics, Astronomy, Earth Sciences, Computer Sciences, Math and Chemistry workshops.

For more information and to register, visit: http://uoft.me/scienceunlimited
10% discount available for children of U of T Alumni.

2015 Welsh Lectures

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

The Welsh Lecturers for 2015 are:
Professor William Bialek, Princeton University
Professor Serge Haroche, Collège de France
Date: Friday, May 8, 2015
Time: 1:30 to 4:30 PM
Location: Earth Sciences Centre, 33 Willcocks Street, Auditorium ES 1050.
For more information visit:
http://www.physics.utoronto.ca/news-and-events/special-events/lectures/welsh/welsh-2015

William Trischuk continued from page 11.

Can you tell me about the refurbishments that were done on ATLAS?

The refurbishments included building and installing another new, diamond based detector, in the ATLAS experiment. Based on the success of our modest, eight channel diamond system in Run I, we had already successfully proposed, and prototyped a much more ambitious set of 24 diamond sensors, each of which were patterned with 27,000 pixels (little pads ¼ of a mm long and 1/20th of a mm wide). At the University of Toronto we designed and built the support frames that each hold three of the sensors in a telescope arrangement that allow them to measure the position and direction of charged particles emerging from collisions in ATLAS. During the 18 months I was at CERN we received about 50 of the diamond sensors, with their sophisticated readout electronics (only a handful of the 27,000 pixels have any information in them in any given collision, so the electronics finds those pixels and sends out their location for later use in determining the position of charged particles). We built them into modules that could be installed in the experiment and performed quality assurance tests on them to select the best 24 for use in the experiment. We assembled them on the Toronto mechanics and installed the completed telescopes inside the ATLAS experiment. I oversaw the day-to-day operations of this assembly, testing and commissioning process while I was at CERN and continue to be as involved as I can be since I returned to Toronto last summer.

What is new at CERN?

I am spending about one week a month this winter/spring at CERN as we bring our diamond pixel detector into operation, along with the rest of the ATLAS experiment. It has been more than two years since the experiment has run together as a coherent system. It is a big challenge to get everything working again. Our original diamond system must also be brought back in to operation to protect the experiment and measure the collision rates. The students and postdocs who made it work in 2008 have long since graduated. I am trying to remember what we did and help get it in shape so that it functions as well as it did before. It turns out, in seven years, all the computers we relied upon to readout and control the detectors have become obsolete and their operating systems and command languages have had to be modernized. In many ways we are back to where we were in 2007 and 2008, starting from scratch. With the added complication that there are still exciting physics results, mostly precision measurements, that are coming out of the Run I LHC data – that occupies the time of at least half of our collaborators.

So we're re-commissioning the ATLAS experiment with some shiny new additions, but basically from scratch, with about half-as-many people as we had to do the job in 2008. The main advantage that we have this time is that we (kind of) know how it is all supposed to fit together and we've (more or less) agreed how we're going to do it. But actually getting things working together again smoothly is (at least) half the battle.

What does the future hold for your work? What can we expect from your group in the coming year?

If there is one thing I know about experimental particle physics is that very little 'comes from a group' in only one year. The diamond pixel telescope system we've installed has been on the drawing board since 2010. With some luck we'll have particle tracks measured with it before the end of the year. With a little more luck these tracks may teach us something more about how the LHC beams are colliding and, eventually, lead to safer LHC operation with possibly even higher collision rates than we have been planning on. If these diamond trackers work out we already have plans to use them for part of a replacement for the entire ATLAS tracker.

Our current detector is expected to survive until the early 2020s. At that point the collision rate, number of tracks and radiation damage associated with all the collisions they will have seen since 2009, will lead to a wholesale replacement. CERN has already planned a 3 year shutdown between 2022 and 2024 to install this new detector. We have ambitious plans to include several thousand of these diamond pixel tracking sensors in the upgraded ATLAS tracker. But that will only be approved (and hopefully get some support in Canada) if our current device is shown to work well over the next few months or years.

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