Interactions

Message from the Chair

Welcome to the Spring 2017 issue of Interactions, the Department of Physics newsletter. This year marks a milestone for UofT Physics, with the 50th anniversary of the opening of the McLennan Physical Laboratories. This 'iconic' (the polite term for its 'brutalist' architecture) building has welcomed tens of thousands of undergraduate students for lectures and labs, and it has been home to thousands of MSc and PhD graduate students, and not a few professors as well! It has seen many discoveries, both major and minor, and it is one of the leading physics centres in North America. It can't be denied that our building has its peculiarities. For example, it is not normal for a science complex to repudiate, quite so comprehensively, open concept design: spreading researchers thinly across 14 floors does not encourage spontaneous collaboration. Another mystery is the name: why "Physical Laboratories" rather than "Physics Laboratories"? But some of us are truly attached to this place, and so to mark this occasion we are having a special "Spring Reunion" (page 2). We hope to see lots of former students, faculty and friends. Please come, even if your memories are not as fond as mine!

In this issue:

In this edition, we have profiles of two faculty members, Joseph Thywissen (page 4) who has an amazing lab where ultra-cold atoms are manipulated to produce exotic quantum effects, and Luyi Yang (page 5), our newest professor, who uses light to investigate the properties of exotic materials.

We also have features on grad students Jennifer Sears (page 8), who uses neutron and x-ray scattering to study the properties of exotic magnetic systems, and Hudson Pimenta (page 7), a theorist investigating fundamental aspects of quantum mechanics that may revolutionize telecommunications and cybersecurity. You can also read about some of our wonderful undergrads, Jenny Wu (page 3), Bianca Ciungu (pg 9) and Wilson Wu (page 10), as well as alumnus Ernest Chan (class of 1988, page 11).

Pages 12 to 13 report on some of our mentorship events for undergraduates. We are happy that so many alumni participate in our mentorship program, but we can always use more! Please contact Sheela mentorship@physics.utoronto.ca to get involved. A little bit of your time can make a big difference to one of our students. We especially want people who graduated with a B. Sc. in Physics and then went on to other careers. Please get in touch!

Sincerely,

Stephen Julian

50th Anniversary of the Opening of McLennan Physical Laboratories

On Saturday, June 3, 2017, join us for a celebration of the 50th anniversary of the opening of McLennan Physical Laboratories.

This event will take place at the same time as the University of Toronto's Spring Reunion.

Details on page 2.

Official Opening of McLennan Physical Laboratories on September 14, 1967. In this photo: O.M. Solandt, H.L. Welsh, J.H. Sword, R.A.K. Richards and G. Herzberg

Your Invitation to:
The 50th Anniversary Celebration of McLennan Physical Labs and Spring Reunion 2017

McLennan Physical Laboratories, named in honour of Sir John C. McLennan, opened its doors on September 14, 1967. For 50 years this building has been home to hundreds of physicists and housed some amazing discoveries.

On this 50th Anniversary of McLennan Physical Labs, come hear about the history of the building, see some historical instruments, hear stories from the early days, and reunite with your professors and fellow students while enjoying some light refreshments.

Saturday, June 3, 2017

9:30am-3:30pm
McLennan Physical Labs
60 St George Street
Toronto ON M5S 1A7

Join us for one or all of the events listed below!
Register for Spring Reunion events here: https://springreunion.utoronto.ca/

Historical Instrument and Photograph Display - 9:30am-2:15pm

The event will feature a display of archival photographs depicting the history of the McLennan Building. This will be accompanied by a selection of historical artifacts representing the teaching and research that has taken place in the building over its history.

Historians from the Institute for the History and Philosophy of Science and Technology (IHPST) will be on hand to discuss this historical material with attendees.

Kid's Passport U of T - 9:30am-12:30pm

You and your children can travel to a variety of faculties and departments, learning exciting facts from professors and grad students. Drop in for a morning of discovery with the kids. Especially suited to 4-12 year-olds and their grown-ups.

At Physics, the children (and grown ups) will be amazed by how the world works! Come tinker with pattern formation and chaos theory. Check out everything PHYSICS from kinematics to superconductivity.

50th Anniversary Talk by Stephen Morris - 12:00-2:00pm

Hear about the history of McLennan Physical Labs from the design to the construction. The talk will be followed by reminiscences about the early days in the Department by Emeriti who were there at the time. Come share your stories or just come and hear the stories that will be told and enjoy some light refreshments.

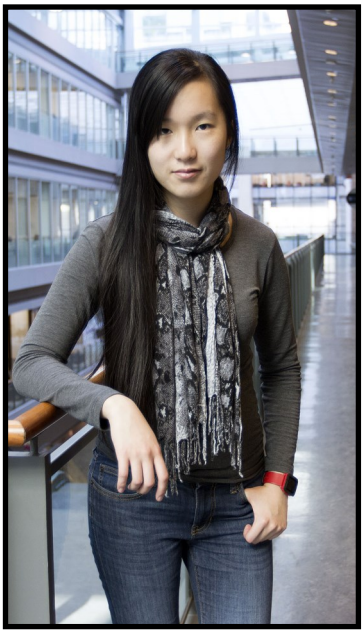
Stress Free Lecture by David Bailey - "Everyone Screws up Sometimes - Scientific Uncertainty in a Post-Truth World" 2:30– 3:30pm *

** note this event will take place in Sidney Smith Hall - 100 St. George Street - room 2135*

Large scientific errors happen much more frequently than expected. This may be an almost inevitable consequence of how complex systems fail, but it should never discourage researchers (as well as politicians, pundits, pollsters, and the public) from constantly asking themselves "How well do I know what I think I know?".

Register for Spring Reunion events here:
https://springreunion.utoronto.ca/

Powering change through physics: Jenny Wu, Marie Curie Sklodowska Award Recipient



Jenny Wu
(Photo Credit: Jackie Shapiro)

U of T has a proud history of fostering pioneers in Physics, like Nobel laureates Bertram Brockhouse and Arthur Schawlow . To honour the groundbreaking work of another legendary scientist, the Marie Curie Sklodowska Association founded the Marie Curie Sklodowska Award in 2007. The Award is presented each year to outstanding female physics students.

When Jenny Wu, a fourth-year physics student at U of T, found out that she had received the Marie Curie Sklodowska Award in 2015, she was overjoyed. The award helped make her dream a reality – the opportunity to study at one of the world's leading research universities and become a member of its talented and diverse Physics community. Jenny explained, "I was very honoured to have received this award. It definitely reminded me that women had a place in the Physics community, and it inspires me to strive to be worthy of an award bearing Marie Curie's name."

It was in high school that Jenny was introduced to the work of Marie Curie, she recalled, "I learned of Curie's contributions to physics and chemistry, becoming the first woman to win a Nobel Prize and on top of that, winning in two different fields as well. During high school, my physics teacher loved to tell us about how even her cookbook is still radioactive from the samples that she used to carry around, and must be sealed away." Like Marie Curie, Jenny is passionate about pursuing physics breakthroughs that will have a positive societal impact.

During her first and second undergraduate years, Jenny worked at the Princess Margaret Cancer Centre through the University Health Network, which is affiliated with the University of Toronto. As a summer research student, she was given an opportunity to lead an exciting project. "We were making a prototype medical device that could deliver and monitor light as part of a cancer treatment for hollow organs such as the bladder and the throat. It was minimally invasive, which means that it got rid of cancer cells with the least amount of damage to the healthy cells. We're hoping to make treatments like these a reality."

Now in her fourth year, Jenny is working on a research project with Professor Daniel James of the Department of Physics on theoretical quantum physics. "It's actually my first time doing theoretical research," Jenny said. "While it's very challenging, it's also a lot of fun." The future is an exciting prospect for Jenny. She hopes to continue her studies and earn her PhD.

Jenny sees this as an exciting time for quantum physics too. She explained, "Quantum physics has two very exciting applications right now: one is in speeding up telecommunications, the other is quantum computing." Rather than using the traditional zeros and ones encoded by 'bits', the properties of quantum physics can be used to make quantum bits, or 'qubits' that are capable of encoding a lot more information. Qubits could then be used to speed up the process of calculations and increase the speed at which codes could be broken. A quantum computer could utilize qubits to solve problems or simulate physical systems that current traditional computers are not capable of doing. "We're quite far from that, but we are taking little steps to build it eventually. It has the potential to revolutionize security, which is of special interest to banks and governments."

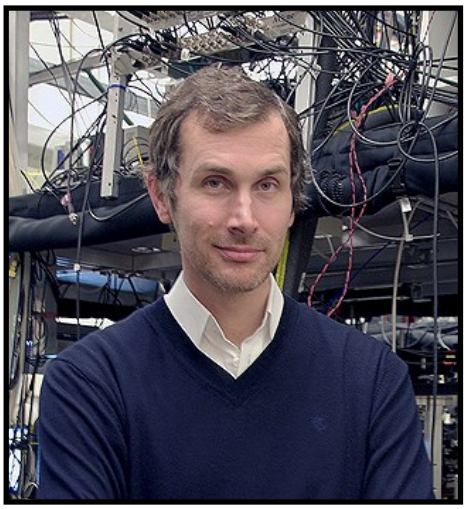
As she explores different options available for future research, one aim remains central to Jenny's work – an aim that echoes all true pioneers in her field; "I really want to work on something that's wholly new and contributes to the knowledge database."

To support students like Jenny, please make a donation at www.donate.utoronto.ca/physics

Faculty Profile

Joseph Thywissen

Professor
Physics



Joseph Thywissen

Your BS (1994) from Harvey Mudd College is in Physics and Engineering and your Doctorate (2000) is in Applied Physics from Harvard. What was your original inspiration for pursing physics?

Harvey Mudd is a small undergraduate institution, with less than two hundred people per year enrolled. I went to university to study engineering, and HMC is known for its "systems" approach to engineering, to provide a unified perspective on mechanical, chemical, and electrical engineering. The turn towards physics should be credited to the fantastic faculty at HMC, whose classes communicated their love for physics. I took more and more physics classes, eventually sufficient for a full Physics degree, while also completing the requirements for a BS in Engineering. On graduation day, they handed me two diplomas!

Your postdoctoral work was in Paris. How did that period affect your professional development?

My doctoral work was fairly applied – perhaps natural for someone who started out as an engineer. But my research interests became progressively more foundational, so the postdoc was a re-orientation into fundamental research. I joined a group that studied Bose-Einstein condensates, which are superfluid-like gases of neutral atoms. This was a new field at the time (started in 1995), so we were able to ask basic questions, for instance about what determines a critical temperature. Also in Paris I had the opportunity to work for Alain Aspect, whose mentorship had a tremendous effect in how I run my research group today.

In 2003 you were awarded the prestigious John Charles Polanyi Prize in Physics, what did being the recipient of this prize mean to you?

The Polanyi Prize was as much a vote of confidence as it was a recognition of my prior work. While I was just setting up the lab, here was John Polanyi telling me I would do great work. You can imagine that it was a morale booster! But it was also a reminder of what a fantastic opportunity it was to start a research group at the UofT.

Your work at U of T focuses on ultra-cold alkali gases, including both fermionic and bosonic species. Can you tell our readers what the goals of your research are?

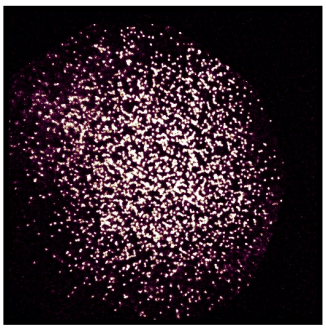
We try to understand how material properties emerge from interacting quantum systems. You can think of cold atoms as "stem cells" for materials. Depending on the environment and conditions, the atoms in our lab can become a metal, an insulator, or a superconductor. Watching these identities develop allows us to understand the "why" of materials, even though we study dilute gases.

Last year, your lab made some headlines when one of your graduate students accidently discovered distinct features of a gas dominated by p-wave interactions. What was so significant about this surprise discovery?

P-wave interactions occur when two atoms spin around each other as they come together. When cold enough, liquid Helium 3 condenses in a superfluid of p-wave pairs; and also electrons in a material called strontium ruthenate make p-wave pairs to superconduct. However these superfluids have strange properties, and are not well understood. In our lab, we showed that some surprisingly simple observables reveal p-wave interactions, which will ease future work on these exotic correlations.

What is new and exciting in the Thywissen Lab these days?

We've recently built a microscope that can image individual trapped atoms. See the image below, where each dot shown corresponds to a one potassium-40 fermion. The images alone are mesmerizing, but they will also allow us to watch how atoms move in a crystalline environment. Haven't you always wanted to know what atoms do while they think you're not watching? Perhaps we can catch them misbehaving.

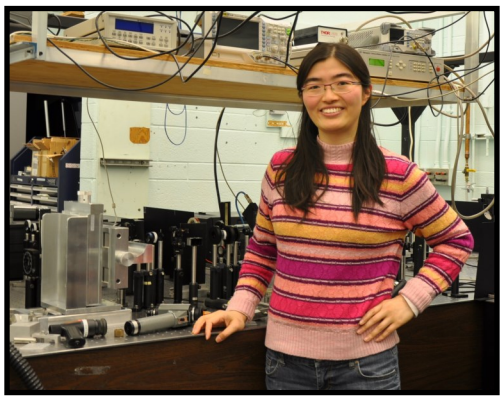


Fluorescence image taken in the Thywissen Lab shows fermionic potassium atoms. A camera collects roughly a thousand photons from each atom, which is pinned in place with standing waves of laser light. The exposure time is two seconds. The pictured area is roughly 0.1mm across.

Faculty Profile

Luyi Yang

Assistant Professor
Condensed Matter
Physics



Luyi Yang

Welcome to the Department of Physic Dr. Yang! You did your B.S. (with Honors) at Tsinghua University in Physics and Mathematics and your PhD at the University of California at Berkeley in Physics. Why did you decide to do your PhD in Physics? What was your inspiration?

I became interested in physics when I started learning physics in high school. I was amazed that the world around me could be explained by simple and beautiful physics principles and formulas. I was the best student and was not satisfied with the textbook knowledge, so I studied some more advanced physics courses by myself. Encouraged by my physics teachers, I participated in local and national physics competitions and won a few First Prizes. I was also inspired by Marie Curie, who has been my role model. I wanted to have a career as a physicist and to unveil the mysteries of the universe. I am very proud that I was able to pursue my BS and PhD degrees at Tsinghua University and UC Berkeley, respectively. I am also very lucky to continue my dream here at U of T.

Can you tell our readers a little bit about your time at Berkeley and your research on ultrafast spin dynamics in semiconductors?

I greatly enjoyed my time at Berkeley. It is a great place for doing research and many other things. For instance, I am a big fan of volleyball. At Berkeley, I attended Cal's volleyball games every weekend and became friends with some of the players. The team was terrific. They beat Stanford and won the PAC10 Championship. The captain was later on the US national team and went to Rio2016.

The research was as exciting as the volleyball games. I worked with Prof. Joseph Orenstein, who is an inspiring and creative advisor. Our lab was at Lawrence Berkeley National Laboratory, which is located in the hills above the UC Berkeley campus that offers spectacular views of San Francisco Bay. Our group was small (one postdoc and 2-3 graduate students at a given time), and we had a lot of opportunities to discuss the research with Prof. Orenstein. I also want to keep my group small at U of T so that I can interact with my students on a daily basis.

I worked on a very interesting project: spin transport properties in a two-dimensional electron gas in GaAs quantum wells. Spin transport properties hold the key to future spin logic devices. However, they are not well understood, because unlike charge transport, spin transport (spin diffusion and spin mobility) cannot be probed directly by conventional techniques. I developed a very powerful new optical technique, Doppler spin velocimetry, for probing the motion of spin polarization. This technique, based on Doppler velocimetry, is capable of resolving displacements of spin polarization at the level of 1 nm on a picosecond time scale. I applied this technique to measure the motion of a current-driven spin texture in GaAs quantum wells. The experiment provides a detailed picture of electron spins as they diffuse, drift and turn under the action of an electric field, and encourages a deeper understanding of the underlying physics of spin propagation in two-dimensional metallic systems.

You did your post-doctoral fellowship at National High Magnetic Field Laboratory at Los Alamos with Dr. Scott Crooker. What kind of research did you do there?

Los Alamos is a small town in the middle of nowhere, but with the highest percentage of people with doctoral degrees in the world. The National High Magnetic Field Laboratory has a very good research environment for postdocs, Dr. Scott Crooker is a very nice person to work with, and I was very productive during my three years at Los Alamos.

I investigated a new type of two-dimensional (2D) material: monolayer transition metal dichalcogenides. Examples include MoS_2, $MoSe_2$, WS_2 and WSe_2. These 2D materials are currently a very hot topic, with recent reviews in, e.g., Science and Nature, and invited symposia at international conferences. These materials are analogous to graphene (the world's first 2D material) in that they are atomically thin crystals with a hexagonal honeycomb structure.

In contrast to graphene, these materials have a semiconductor bandgap, which makes them very useful for a variety of optoelectronic applications including: solar applications, light-emitting diodes, semiconductor electronics, spintronics, and valleytronics[1].

Importantly, similar to the spin degree of freedom in semiconductors, the valley degree of freedom in these new 2D semiconductors can also be controlled by light. I explored both the spin and valley properties of these novel materials using optical Kerr rotation spectroscopy and observed, for the first time, very long-lived spin/valley relaxation and spin coherence. These studies provide direct insight into the intrinsic physics underpinning spin and valley dynamics of resident carriers in these 2D materials, and pave the way for future applications.

In September 2016, you were awarded the prestigious CIFAR Azrieli Global Scholar Fellowship for early career researchers, congratulations! What did winning this award mean to you?

The competition was fierce. There were several hundred applicants from all over the world. The selected candidates from different disciplines were invited to a two-day onsite interview, during which we were divided into groups. I was the only physicist in my group. I explained my research to biologists, computer scientists, medical research scientists, social scientists, economists and journalists in a plain language, while normally I present the research results to experts in my field. It was an unusual experience. I am glad that I won this prestigious award. The award is a recognition of my past work, supports my current research, and encourages me to work hard and build a world-class ultrafast optics laboratory at U of T. Through my membership in the CIFAR Quantum Materials program, I am connected to other research initiatives around the world. I attend the biannual Quantum Materials meetings, give presentations and form new collaborations. In addition, the Global Scholar program also provides training in leadership and communication.

Some of your research involves the development and use of advanced optical spectroscopies to study light –matter interactions in condensed matter physics. Can you tell our readers a little bit about what that is?

My group focuses on the development and application of advanced optical techniques to probe condensed matter systems. We measure quantities such as transmission and reflection coefficients, Faraday and Kerr rotation, and nonlinear optical properties. Typical experiments involve the use of light pulses with femtosecond (10^{-15} s) durations. Fundamental interactions in solids, which often occur on sub-nanosecond time scales, can be directly followed with these ultrafast pulses. The idea of time-resolved experiments is to use a laser pulse ("pump") to generate a nonequilibrium population of electrons in a material. Another pulse ("probe"), delayed by a controlled amount with respect to the pump, measures the optical absorption (reflection, Kerr rotation, etc.) spectrum of the excitations induced by the first pulse. From such time-resolved spectroscopy experiments we learn important information about the recombination and scattering rates of photo-generated excitations. For example, in III-V or II-VI semiconductors, electron spin polarization can be injected by a circularly polarized light pulse. After the pump pulse initialization, the subsequent spin relaxation dynamics can be monitored by a time-delayed linear polarized probe pulse via the optical Faraday or Kerr effect.

What are some real-world implications of your research?

Some of my research is closely related to an emerging technology – spintronics. We have known that Moore's Law may come to an end by 2020. Many leading chipmakers in the world are seeking radical alternatives to the technology that has sustained computing for more than half a century. Intel says, "We'll have to adopt fundamentally new transistor technologies in 4-5 years. Spintronics is a leading candidate." Spin-based electronics would open the possibility of logic operations with much lower power consumption than equivalent charge-based logic operations, which is important for many principal uses of computing today such as cloud computing.

To exploit the energy-saving potential of spin currents it is essential to understand and ultimately be able to control spins. I have studied extensively electron (and hole) spin dynamics in many low-dimensional semiconductor systems ranging from conventional III-V semiconductor quantum wells and quantum dots to novel two-dimensional materials (e.g. monolayer MoS_2). My research has revealed many important properties of spin relaxation dynamics and transport properties in these materials. The studies will guide scientists and engineers to design new devices based on electron spin degree of freedom.

Can you tell us a little bit about the research you have planned here at the Department of Physics?

I am setting up my lab with two graduate students. They are good. With a little bit of instruction, they can figure out what to do by themselves. The first experiment that we are working on is to study the optical properties of $RuCl_3$, which is a candidate for quantum spin liquids. We will build more experiments in the next couple of years to study interesting materials such as 2D semiconductors and strongly correlated materials. The future projects involve primarily "tabletop" experiments, which are ideally suited for student involvement.

We welcome motivated graduate students and undergraduate students to join us!

[1] Besides the real electron spin, information can also be encoded in the "valley pseudospin", for example, whether the electron resides in the K or K' valley of the materials' hexagonal Brillouin zone.

Graduate Student Profile

Hudson Pimenta

PhD
Quantum Optics

Hudson Pimenta

Hudson Pimenta is pursuing his PhD in the Physics program. He is currently in his fourth year, working with Professor Daniel James in the Quantum Optics group. Hudson is originally from Brazil and he moved to Canada in 2013.

Hudson's passion for physics began in high school, where it was his strongest subject. His teachers strongly encouraged Hudson to seek a Physics program and pursue a career as a scientist. With this goal, Hudson joined the University of São Paulo, where he completed his undergraduate studies and a Master's program, both in Physics.

During his Master's, Hudson began to consider the pursuit of a PhD program abroad. His Master's supervisor completed his PhD in Canada and suggested that Hudson should consider going to Canada too. Hudson accepted an offer from the University of Toronto Department of Physics.

At the Department of Physics, Hudson joined the Quantum Optics group led by Professor Daniel James. His work is on quantum-state tomography, the field concerned with developing and improving techniques for characterizing quantum states. One application of quantum-state tomography would be in the development of quantum computers, where it may be used to characterize how accurate a quantum bit (qubit) can be initialized.

More recently, Hudson has also been interested in studying physical systems with strongly-interacting photons, which hold potential for implementing quantum gates and quantum memories.

Moreover, these systems may be used to further probe the predictions of quantum mechanics.

During his free time, Hudson likes spending time outdoors by: biking, exploring the city and going camping or hiking with his friends. One of his major hobbies is photography, a perfect match for his exploration activities. During these adventures, Hudson carries a DSLR camera, which he uses to register all sorts of landscapes. Some of his work as a photographer is available online through social media, and he is also a member of one of the oldest camera clubs in Toronto.

Some samples of Hudson's work can be seen below.

Toronto at Night

King College Circle (U of T) Looking South

Graduate Student Profile

Jennifer Sears

PhD
Condensed Matter

Jennifer Sears

Jennifer Sears is a 4th year Ph.D. student in experimental condensed matter physics working under the supervision of Dr. Young-June Kim.

Jennifer completed her undergraduate degree in Chemical Engineering at the University of Toronto and then worked in industry for several years before returning to the University of Toronto to continue her education with graduate work in physics.

Jennifer has been interested in physics for many years, and was drawn to condensed matter physics because of the way that complex behaviours can arise in systems made up of large numbers of simple components.

Since she also enjoys the variety and hands-on aspect of working in the lab, experimental physics was a natural choice for her. Her work has focused on understanding the unusual magnetic behaviour of various transition metal compounds using the techniques of neutron and x-ray scattering. These powerful methods take advantage of the wave nature of the neutron or photon probes and can be used to get information about many aspects of the structure and dynamics of regular, crystalline structures.

The material that her work has focused on is a previously little studied material, α-$RuCl_3$, that has seen a lot of interest in the past few years. This recent interest was prompted by the observation that this material was a good candidate to realize a much sought after type of spin liquid. If found, the unusual magnetic behaviour of such a material could make it useful in fault-tolerant quantum computing applications.

Jennifer finds condensed matter research in general to be an exciting and promising field. With virtually limitless possible combinations of elements and crystal structures, there are sure to be many new and surprising materials to be discovered.

In her free time, Jennifer enjoys floor hockey, rock climbing, and spending time outdoors. She especially enjoys canoe camping and hiking trips in the summer and skiing in the winter.

Spin Liquids: It was long believed that in crystalline insulators containing magnetic transition metal ions the magnetic ions would always "freeze" into a magnetically ordered state at a sufficiently low temperature. Then it was shown that in theory at least, this is not necessarily so - theory allows for the existence of "spin liquids", in which the moments do not "freeze" even down to absolute zero, rather they continue to fluctuate. Unfortunately, experimental examples have proven very difficult to find, hence the interest in α-$RuCl_3$.

Undergraduate Student Profile

Bianca Ciungu

Physics Specialist

Bianca Ciungu

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

My first run-in with Physics was when the Large Hadron Collider was turned on and the news channels claimed it could form a black hole that would bring the world to an end. I was very upset, but when I went to read about the experiment I was instantly hooked on the strange and wonderful theories that motivated the building of this machine. I have always loved science growing up, but it was my attraction to the fundamental questions that physics aims to answer that motivated me to pursue it in University.

What do you enjoy most about the physics program?

Although I will continue in experimental physics I have most enjoyed the theoretical courses. All the core courses have been extremely well-taught and have deepened my understanding and appreciation of experimental work. The problem sets throughout the years have been challenging but very fun. I really enjoyed talking about the concepts behind these problems with other students in the program.

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

I enjoy being involved in the Physics student community. I am on the Physics Student Union executive committee as well as a Peer Mentor for the Physics First Year Learning Community. When I am not busy with course work I burn-off extra energy dancing.

What are your research interests?

I am most interested in experimental particle physics, specifically related to the Higgs mechanism. I enjoy working on the analysis of data collected by the Large Hadron Collider but more recently have also taken an interest in the detectors used for the experiment.

What is your favorite course and why?

My favourite course has been the research course (so much so, that I decided to take it twice!). It has allowed me to learn more about specific topics not taught in class that I was really interested in. It was great to get some exposure to research in the field before committing to a graduate degree in that area.

What are your future plans?

I will be starting my graduate studies at the University of Toronto this fall and will be staying in the ATLAS group to study particle physics.

Where do you see yourself in 10 years?

Hopefully I will have my PhD and be working on solving an interesting problem. I would like to think that I will still be in the same branch of physics that I am in now, but there are so many exciting projects to work on even outside of physics, it is hard to say.

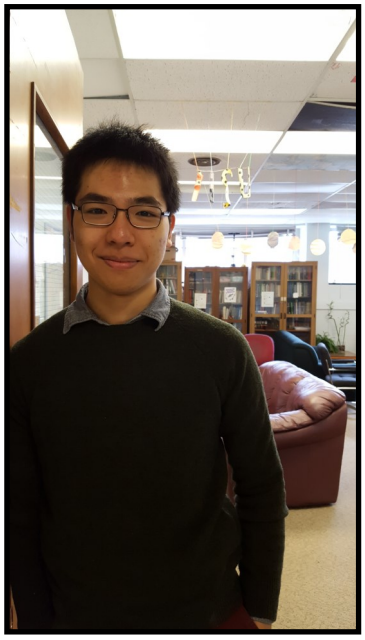
Tell me something interesting about yourself.

I have a small tattoo on the inside of my left ankle of the symbol phi, for the Golden Ratio.

Undergraduate Student Profile

Wilson Wu

Mathematics and Physics Specialist
Computer Science Major



Wilson Wu

Why did you decide to major in Physics? What was your inspiration?
This is a bit of a funny question. We might often give explanations like "because physics is so fundamental" and "because it teaches analytical skills", but I think the real reason for me is that I somehow felt physics was the right choice. I had always been interested in the sciences, and it slowly became clear that I gravitated towards physics. Coming out of high school, I did not know what I was going to do for a living, but I knew that for my undergrad, I wanted to study physics.

What do you enjoy most about the physics program?
The physics, haha. However, I do in particular enjoy the community we've made here. Many people in the program spend a lot of time in the PhySU lounge (MP 217; drop by some time!), where we tackle problem sets and study together, often quite late into the evenings. I'm very appreciative of having this community to work with - the program would not be the same without it.

What other extra-curricular activities are you involved in during your degree?
I'm currently the president of PhySU, the Physics Student Union, and we do quite a bit of stuff over the year. We organize things like academic seminars, study sessions, and socials, but mostly it's fun getting to do things with the people you study with.

I'm also involved with the Space Systems division within the University of Toronto Aerospace Team (UTAT). We're on our second iteration of designing and building a satellite. It'll carry a biology payload - we're testing the changes to *candida albicans* under microgravity, a yeast naturally found in human gut flora. Our hypothesis is that they'll become more virulent in space, which may cause astronauts to become immunocompromised during long term space missions. To test this, we'll be tracking for changes in the gene expression of *C.albicans*. We recently petitioned successfully for a student levy to fund our project and launch costs. We're hoping for launch in 2019, fingers crossed!

What are your research interests?
That's very hard to say, since I'm just in second year. I've gotten very interested in quantum information and quantum cryptography, so I'll be trying to get some research experience in those areas. I'll have to see where that takes me first.

What is your favorite course and why?
So far in my undergrad, probably Thermal Physics, PHY252. We get to build the basic theory of statistical mechanics from ground up. We start from a single, fundamental postulate (roughly, it says that every possible configuration in a thermodynamic system is equally likely to happen), and we derive all the results we study in 252 from this postulate. It's very beautiful watching everything fall into place from a simple statement.

What are your future plans?
Mostly hoping to get into grad school.

Where do you see yourself in 10 years?
I don't know! It's both exciting and scary, but more the first one.

Tell me something interesting about yourself.
I'm quite fond of classical music, and I try to squeeze out free time to practice the piano.

Alumni Profile

Ernest Chan

BSc 8T8
Physics

Dr. Ernest Chan graduated from U of T Physics in 1988. He went on tocomplete his MSc and PhD in Physics at Cornell University.

After completing his PhD, Ernest has had a successful career in the field of machine learning, finance and investments. He has held positions doing statistical research at companies such as IBM's T. J. Watson Research Center, Morgan Stanley and Credit Suisse in New York.

He has also founded his own companies. His first company was founded in 2000 and it was called FirstTick.com. At FirstTick.com, he designed and developed web-enabled portfolio management and real-trading alerts. Currently, Ernest's positon is the Founder and Managing Member of QTS Management, LLC., which is a Commodity Pool Operator and Commodity Trading Advisor.

Ernest also lectures on finance. Until 2015 he was an Adjunct Associate Professor of Finance at Nanyang Technological University in Singapore and currently he is Adjunct Lecturer in the Predictive Analytics Program at Northwestern University.

Ernest has authored three books on finance. His latest book is titled "Machine Trading: Deploying Computer Algorithms to Conquer the Markets" and has been published by Wiley. It covers a variety of advanced quantitative trading and investment techniques.

When asked about how his training in Physics at the University of Toronto has helped prepare him for his career, he says "my education and training at the University of Toronto has given me concrete skills in mathematics, computation, critical thinking, problem solving, and being at ease with technology. Problem solving and analytical techniques are fundamental to my career."

Ernest Chan has stayed connected to the Department by participating in the Physics Mentorship Program for the last 3 years. He has mentored 3rd and 4th year Physics students, sharing his experiences, knowledge and offering career advice. You can read more about this program on page 12.

For more information on Ernest Chan visit his blog (epchan.blogspot.com) and/or Website: (www.epchan.com).

Want to share your career story and be featured in upcoming issues of Interactions?

Email:
newsletter@physics.utoronto.ca

Your Invitation to the 2017 Welsh Lectures!

The Department of Physics invites you to our 42nd annual celebration of physics:

THURSDAY, MAY 4, 2017 (PUBLIC TALKS)

MacLeod Auditorium, Medical Sciences Building, 1 King's College Circle

1:30 pm Professor Nergis Mavalvala (MIT)

The Warped Universe: The One Hundred Year Quest to Discover Einstein's Gravitational Waves

Abstract: In 2016, scientists announced the first-ever detection of gravitational waves from colliding black holes, launching a new era of gravitational wave astrophysics. Gravitational waves were predicted by Einstein a hundred years earlier. I will describe the science, technology, and human story behind these discoveries that provide a window into some of the most violent and warped events in the Universe.

3:30 pm Professor Leon Balents (University of California, Santa Barbara)

Strange Stuff: A Second Quantum Revolution

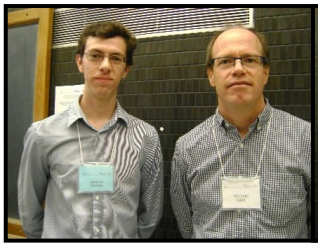
Abstract: Weird but true: quantum mechanics tells us that reality is not what it seems. The glass is not necessarily empty or full, but can be both at the same time. Erwin Schrödinger, one of the founders of quantum theory, imagined a cat that is simultaneously alive and dead. In practice, while such odd quantum states are common for microscopic particles, they are harder and harder to arrange for larger objects. But more recently, researchers have turned this question around to ask: what sorts of weird quantum states can be achieved? The answers are surprising. Quite strange quantum behavior is possible even in large assemblies of electrons and atoms, realizing new forms of matter. These ideas are influencing not only our understanding of matter, but also that of information and gravity. In my talk, I'll introduce you to this second quantum revolution and its implications for the future.

For more information visit: www.physics.utoronto.ca/~welsh/

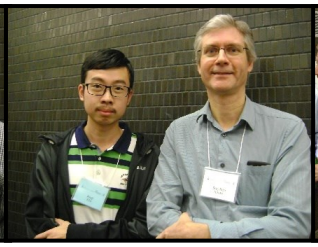
physCAP recap - Mentorship Program

Here are some photos from the 2016-2017 Mentorship Program. This year we had 49 student mentees and mentor matches. Our mentors consisted of alumni, faculty and graduate students who met with their mentees once a month. Mentees were given advice on careers, grad school and more. Mentors have told us it's a good feeling to give back and that they enjoy being helpful to students.

Mentorship Program Launch Party - October 13, 2016



Mentee Andrew Gomes and mentor Michael Luke



Mentee Anqi Mu and mentor Stephen Julian

Mentees Changhao He and Yuxin Kang

Mentee Edward Dacanay and mentor Julius Lindsay

Mentor Felipe Morgado and mentee Daniel Djayakarsana

Mentee Matt Walker and Mentor A.W. Peet

Mentees Xizi Luo and Danielle Denisko and Mentor Stephania Assimopolous

Mentee John Heisey and Mentor Lucas Durand

Mentorship Program Mid-Term Party - January 19, 2017

Group photo from the 2016-2017 Mentorship Mid-Term Party

If you want to be a mentor in this valuable program, contact mentorship@physics.utoronto.ca

physCAP recap - physCAP Career Fair

The Career Fair is designed to give 3rd and 4th year physics students a sense of what opportunities exist for them with the analytical and quantitative skills that are developed during an undergraduate physics degree program, and to give them some experience presenting themselves in a quasi-professional environment.

The Career Fair Program consisted of three events starting with an Information Session with a speaker from the Career Centre and hosted by Prof. Peter Krieger. Then a week later, a session from the Career Centre called Managing your Career Portfolio: Resumes, Cover Letters and LinkedIn. The first two sessions were in preparation of the Career Fair that took place on Friday, March 3. Please see below from some photos from the events.

Career Fair Information Session - January 23, 2017

Peter Krieger hosted almost 30 students for the Career Fair Information Session. Students learned about how to prepare for the Career Fair and what kinds of careers are available to physicists.

Peer Resume Advisor Mariam Jammal from the Career Centre gave students an overview on what services are available to them at the Career Centre.

Career Fair - March 3, 2017

Left to right: Ken Nurse, Zen Mariani, Parmjeet Panchhi, Mike Crombie and Bin Guo

The 3rd Annual physCAP Career Fair for 3rd and 4th year physics students was held on Friday, March 3, 2017 in the Graduate Lounge.

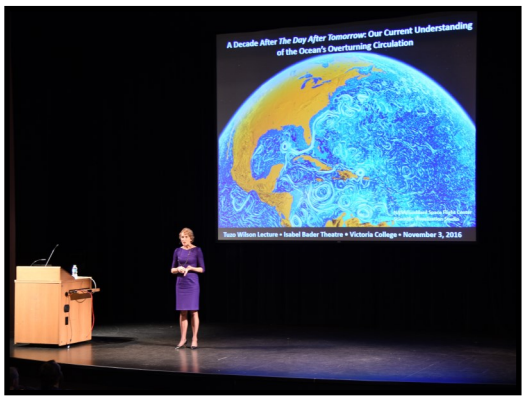
This year there were 5 speakers who were all alumni from the Department of Physics.

Our students had the opportunity to hear about the different types of careers a physics graduate can have and hear about the paths that these speakers took for their careers.

The Speakers were:
Mike Crombie - PhD Experimental Physics, currently president of MIN-AD Inc.
Bin Guo - PhD Experimental Physics, currently an analyst at Scotia Bank.
Ken Nurse - MSc Geophysics, currently working on his PhD in geophysics and has a 30 year career in hard-rock mining exploration.
Parmjeet Panchhi - BSc Astrophysics and MSc Laser Physics, currently President of Vaculayer Corp.
Zen Mariani - PhD Atmospheric Physics, currently a research scientist for Environment Canada and on the shortlist for the Canadian Space Agency's 2017 Astronaut Program.

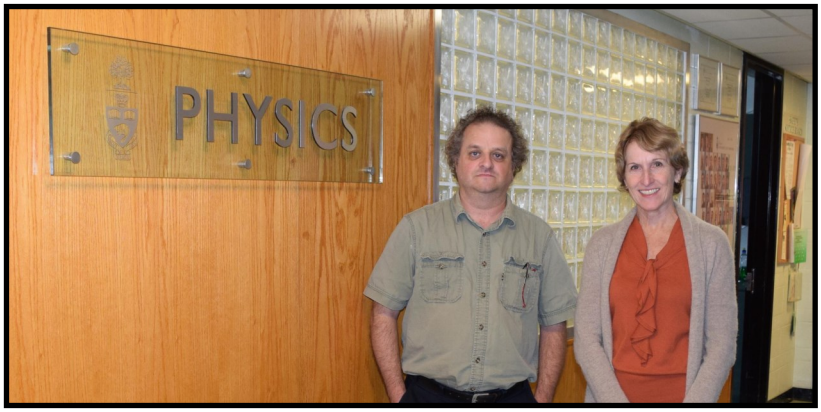
If you want to be a speaker at the 2018 Career Fair, contact mentorship@physics.utoronto.ca

2016 Tuzo Wilson Lecture



It was a full house at the Isabel Bader Theater on November 3, 2016 for the annual Tuzo Wilson Lecture. Hosted by the current Tuzo Wilson Professor Stephen Morris, this year's talk was by Susan Lozier from Earth and Ocean Sciences, Nicholas School, Duke University.

Professor Lozier discussed our current understanding of the ocean's overturning circulation, its role in our global climate and what we currently do and don't understand about the mechanisms controlling its temporal change.



Stephen Morris (left) and Susan Lozier (right)

Outreach in Action - Girls in STEM Monthly Club

On Saturday, January 7, 2017, graduate students Madeleine Bonsma and Catherine Woodford took part in the Girls in STEM Monthly Club by running a workshop at the Physics Department.

This is a monthly program for girls in grades 6-9 and is run by the Department of Mathematics.

Seminars and workshops are held on the first Saturday of every month and they engage students in the various STEM (Science, Technology, Engineering and Mathematics) fields. The instructors are typically female.

At Physics, the girls took part in a workshop where they covered Forces, Motion and Uncertainty.

When the girls were asked to rate their instructors, they replied "They were really great"! Thank you Madeleine and Catherine for working to inspire future female physicists.

For more information on this program, visit:

http://mathplus.math.utoronto.ca/home/girlsinstem

Outreach in Action - Fall 2016 School Visits

As part of the Department's ongoing Outreach initiatives, the Outreach Committee continues to offer school visits for high school students. Usually, Physics teachers from high schools across GTA contact the department to arrange a visit for an entire class. The visits typically consist of a talk about the Physics Department, tours and/or workshops.

November 21, 2016
George Graydon Memorial Secondary School

First, these grade 10-12 students were given a talk about the Department by Paul Kushner. Then they took part in a workshop on Forces, Motions and Uncertainty which was run by Xingxing Xing. The visit ended with a tour of Stephen Morris' Lab and Joseph Thywissen's Lab

December 1, 2016
Glenforest Secondary School

Two classes of grade 11 students and their 2 teachers stopped by the Department for a talk and some tours.
Paul Kushner provided a talk on the Department, then students were taken on lab tours. They saw Dwayner Miller's Atomic Movie Studio and Laser Nursery, Kim Strong's Toronto Atmospheric Observatory and finally Amar Vutha's Lab where they were able to see lasers.

Employee Anniversaries

Ana Sousa—35 years

Mrs Ana Sousa has been group secretary for the Atmospheric Physics group for 35 years. In our group, and especially for the more senior members, the calendar is recorded in years BA and years AA. In the BA period the operation of the group was characterized by chaotic shifts between various sub-optimal states as various group secretary appointments appeared and disappeared. In the AA period since, we have all been spoiled by a level of professional attention to detail and personal thoughtfulness that can only be described as exemplary. Her care for the graduate students in the group as well as for the faculty is a major reason why we are able to function in the effective way that we do. Ana continues to be a wonderful friend and colleague to all of us. - *Professor Dick Peltier*

Announcements

Luyi Yang

Dr. Luyi Yang joined the Physics Department in September 2016 as an Assistant Professor. Her field is Condensed Matter Physics and a full profile on Dr. Yang can be found on page 5.

Luyi Yang

You are invited to Science Rendezvous - Saturday, May 13, 2017

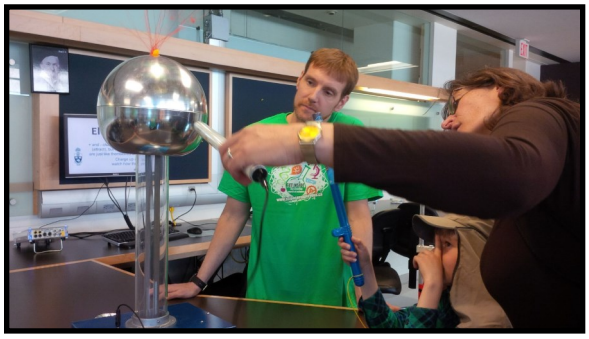
Science Rendezvous at the University of Toronto (St. George Campus) will feature numerous demonstrations and activities that integrate science, technology, engineering, mathematics, and human ingenuity. The event offers visitors of all ages a chance to meet with world-class researchers, conduct hands-on experiments and, above all, have fun while discovering science in a whole new way.

This year, the University of Toronto (St. George Campus) has a phenomenal festival in store to commemorate Canada's 150th Birthday and Science Rendezvous' 10th Anniversary! Come take a time-travelling journey through 150 years of Canadian research, innovation, and achievement in S.T.E.M.!

As you navigate through the exhibits we challenge you to discover Canada's rich scientific heritage, learning all about where we've been and where we can go!

More information can be found here:
http://www.sciencerendezvous.ca/university-of-toronto-st-george-campus/

At the Physics Department there will be a variety of demonstrations, tours and talks.



This is one of the Department's biggest Outreach events and we hope you can join us!

Saturday, May 13, 2017
11:00am to 5:00pm

McLennan Physical Labs
60 St. George Street
Toronto ON M5S 1A7

For more information, contact outreach@physics.utoronto.ca

Contact Us

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Email: newsletter@physics.utoronto.ca

Physics UofT **@uoftphysics**

Physics Funny

A neutron walked into a bar and asked, "How much for a drink?"

The bartender replied, "For you, no charge."