Concordia University
Arts and Science
Department of Physics

CONCORDIA PHYSICS

CONCORDIA PHYSICS NEWSLETTER, Vol. 3 No. 1 July 2016

Student Career Development and Community Outreach

The Key is Our Alumni !

Alexandre Champagne, Chair, Department of Physics

Concordia and our Department are committed to training professionals. It means teaching our students to become their own teachers by the time they graduate. This allows our graduates to enter career paths which are flexible and morph at various stages of their lives. While offering great courses is an important part of our mission, in today's world: it's not enough. Our faculty and staff members go out of their way to provide one on one mentoring, research experiences and career advice to students to give them an edge to build their CV and career skills. At the university level, Concordia is increasingly investing in developing students' "soft skills" such as communication, leadership and career hunting both at the undergraduate and graduate levels.

The truth be told, what a young - or not so young - person entering the workforce needs the most is help from a friend, a mentor or an alumni! Concordia Physics is a caring department with dedicated faculty and staff, and wonderful students. We unfortunately have lost touch with most of our large and accomplished alumni base. We miss this connection for practical reasons (above), but also we just miss the joy of sharing with our former members. Being a physicist is most fun when we have people to talk to about physics and life after a physics degree. Our students need a broader range of mentors than just our faculty members. We hope that you (our alumni) will re-claim *your* Department and University. Join us in mentoring the next generation of physicists, and re-connecting with some of your old friends. Our Department and faculty members will always remain available for both our recent and long-time graduates. To jump start this renewed communication, we are sending you this newsletter (only a few per year, and you can always opt out). We are also organizing a Department of Physics Anniversary for our alumni to visit us on September 24th as part of the Concordia Homecoming 2016 weekend.

We hope that many alumni will join our faculty and staff at this reunion. We will also invite a few current students to attend so that our alumni will have a chance to meet today's students. To learn more about this event and register, please visit the Concordia Homecoming 2016 page. In this newsletter, you will read about some recent news from our students and faculty, and learn a bit about our history and ongoing development projects.

Visit *concordia.ca/homecoming*

Department of Physics graduates: it's your reunion!

In This Issue:

- Recent Celebrations
- Faculty Profile
- Student Experience
- Brief History of the Department
- Development Plan of the Department
- More

A Celebration of Student Excellence
2015-16 Physics Award Ceremony

On February 15th 2016, we held the annual Department of Physics Award Ceremony where we recognized the academic accomplishments of four undergraduate students (Amanda, Crystal, Daniel, Mariya) and three graduate students (Ashton, Kathleen, Tugba) with various awards. The event was a pleasant gathering with several parents joining us, and student Shon Boubil offering us a guitar performance. Our Dean and many of our faculty and staff members were present. The awards were generously funded by the Showleh Family, Mukerji and Upreti Families, Ms. Lorraine Gosselin, as well as many of our faculty and staff members.

Back row from left: Dean André Roy, Daniel Andrews, Peter Collins, Alexandre Champagne, Crystal Harmer, Valter Zazubovits, Pablo Bianucci, Front row: Joseph Shin, Kathleen McGarvey-Lechable, Ashton Arsenault, Tugba Ozturk, Amanda Di Nitto and Mariya Krasteva. Inset: BSc physics student and artist Shon Boubil performed at the event.

Celebrating a Life's Work
Dr. Truong Vo-Van's Retirement

On May 31st 2016, we celebrated the retirement of Professor Truong Vo-Van. There was a lot to celebrate, given that Prof. Vo-Van has been an accomplished researcher for 40 years, highly appreciated teacher and occupied several administrative positions (including senior ones) at both Concordia and Université de Moncton. Most recently, Dr. Vo-Van was our Chair (2009-2015), and beloved colleague. He will remain active in research for the coming years. Bonne retraite cher Truong!

Sitting: My-Lien Vo-Van and Truong Vo-Van. Standing: Colleagues and graduate students.

Faculty Research Profile

Valter Zazubovits: Photosynthesis, Proteins and Quantum Biophysics

An extremely narrow-band laser in the Zazubovits laboratory allows precise measurements of energy and charge transfer times.

I, Valter Zazubovits, joined the Department of Physics in 2005, after five years of postdoctoral work at Ames Laboratory, USDOE, and Iowa State University, and since then have been involved in a wide range of photosynthesis related research. The obvious purpose of photosynthesis research is to find better ways of satisfying energy needs of the humankind without burning non-renewable fossil fuels and inducing climate change. Sun consistently delivers to Earth orders of magnitude more energy than is consumed by the human civilization. Photosynthesis utilizes part of this energy to produce various useful compounds. As a result of evolution, proteins performing the first steps of photosynthesis are amazingly effective. How does one find out how Nature's solar cells (photosynthesis) work? We use mostly optical methods, since photosynthesis involves interactions between proteins and light. High-resolution frequency-domain spectroscopy is used to determine the characteristic times of various physical processes. (Yes, this is where knowing about Fourier transforms from your Optics class comes in handy.)

There are also less obvious ways to employ photosynthetic proteins in applied research. They can serve as model systems in the studies of general protein properties and energetics. Proteins' ability to perform their designated tasks depends critically on their tertiary structure, achieved as a result of folding. But how do proteins "know" how to fold properly? Proteins are believed to possess a series of shapes (folds) with decreasing energy. This folding energy landscape can be explored using optical spectroscopy. Proteins involved in photosynthesis have built-in fluorescent molecules (chlorophylls) which are very sensitive to their local environment, and we use these probes to study protein folding. In case this sounds too biological to a "pure" physicist's ear – the same optical methods are being utilized to explore the dynamics in condensed matter systems (inorganic materials), particularly the low-temperature dynamics of disordered glasses and polymers.

Photosynthetic reaction centers utilize light energy to transfer electrons through cell membranes. A number of substances can inhibit this process, for instance commercial herbicides or explosives. Several years ago, my group showed inhibition of electron transfer in Photosystem II using nitric explosives, demonstrating a biosensor capable of detecting explosives. Recently, Daniel Modafferi (a chemistry BSc honours student who is now a physics MSc student), Dr. Laszlo Kalman and myself (Zazubovits) attempted to utilize the more robust reaction centers of a purple bacteria for the same purpose. Unexpectedly, it turned out that some explosives do not prevent the charge separation (conversion of light energy into electric energy), but rather trap the charge-separated state for a long time (store energy like in a battery). Previously, such slowdown of charge recombination (biological nanoscale capacitors) could be achieved only with the help of expensive designer lipids. Stay tuned, because many of the mysteries of photosynthesis are yet to be unraveled.

Editor's note: Dr. Zazubovits is our dedicated BSc student advisor and maintains an open door policy.

Student Experience (Marc Collette, PhD candidate)

2016 March Meeting of the APS: What a Conference!

After leaving the parking lot here at the Loyola Campus early Sunday morning, it didn't take us long to reach the Canada-USA customs, where we told the Border Patrol Agent that we were entering the United States to attend a week-long conference about physics. The agent told us that he had a daughter that was looking to enroll in a master's program in physics, which was the first of many opportunities we had to talk about Concordia University on our trip. This year, Alexandre Champagne and three of his students (Matthew Storms, Gareth Melin and myself) attended the APS (American Physical Society) March Meeting in Baltimore, Maryland. The conference took place in the Baltimore Convention Center, located at the heart of downtown Baltimore and a ten minute walk from both stadiums where the Baltimore Ravens and the Baltimore Orioles play.

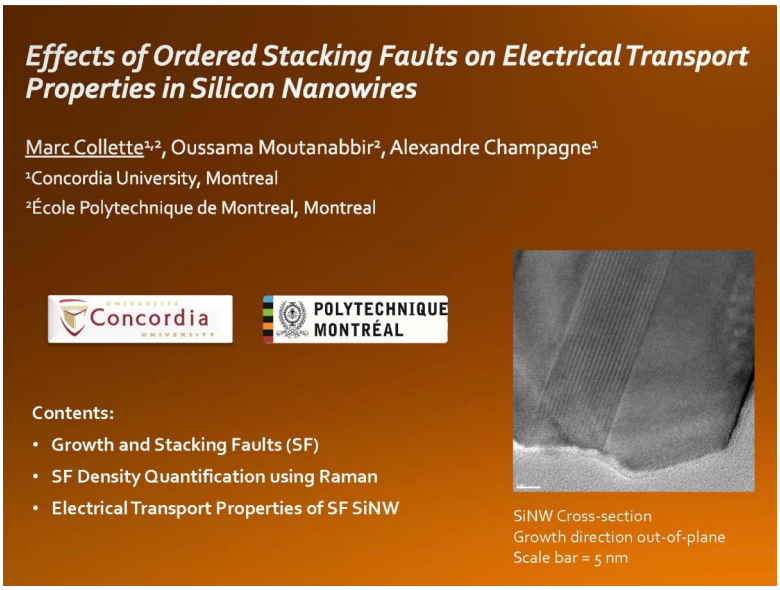
Almost 10,000 physicists from around the world attended this year, presenting just over 9,000 abstracts at the **world's largest annual physics conference** which took place on March 14-18th, 2016.

In order for thousands of talks to be held in only five days, dozens of 12 minute oral presentations are being shown in parallel using all the rooms available in the convention center. Each room showed only talks that belonged to a particular subfield, so we usually separated each day to attend whichever session was more relevant for our interests. For example, Gareth would often attend talks about nano-optoelectronics, Matthew would find presentations on the electrical and mechanical coupling in bilayer graphene, and I would go see semiconductor physics sessions.

The best part about attending such a large conference was the chance to meet with all the prominent groups working in related areas of research. The opportunity to discuss in person with the leading experts in our field was invaluable to help our projects move forward. It was also enjoyable to talk with other students in the community to exchange anecdotes about our work. Often, the talks they gave included data and results not yet published, allowing us an insight into the next research trends and a preview of future literature.

We also had the chance to visit Baltimore, the city where Edgar Allan Poe's grave can be found. This great American poet's influence is everywhere. Bits of poetry are written on the sides of buildings as you walk around downtown. Their NFL team (Ravens) shares the name of Poe's most famous work. Even the local beer (National Bohemian) has a one-eyed man named Mr. Boe (Poe's look alike) saying "Oh boy, what a beer!" on the label.

On Thursday morning, at the end of the Thermoelectrics session, I presented my talk titled "Effects of Ordered Stacking Faults on Electrical Transport Properties in Silicon Nanowires", summarizing the recent results obtained for my PhD project. We then hopped into Alexandre's car again for our drive back to Canada. Arriving late at night, we saw the lights from Montreal's skyline welcoming us back home. We felt ready to continue working on our research using everything we had learned at the APS March Meeting.



Where We Come From:

A Brief History of Concordia Physics

[Edited text from Dr. Calvin Kalman] The Department of Physics of Concordia University was created by the merger of the Departments of Physics of Loyola College, and Sir George Williams University in the 1970s. Our merged department included 14 faculty members and was located in the Hall building on the Sir George campus, downtown. While the Department was initially focused on teaching at the undergraduate level at Loyola, and on both teaching and research (with a PhD program) at Sir George, it rapidly evolved into a major research unit. Several faculty members present at the time when the original Concordia Dept. of Physics was formed are portrayed in the photograph below (taken on November 13th, 1988).

Normal times in the early days (1970s) of the department, saw Prof. Rudi Kovacs playing soccer with the students, and the occasional impromptu snowball fight between students and faculty. In the 1980s, the year often began with a student faculty picnic at a location such as Saint Helen's Island.

In 1985, the infamous Air India Plane Crash hit the department hard. Nishith Mukerji was a beloved teacher at Loyola High School who completed a BSc, MSc and PhD in our department. Gyan Upreti was a Visiting Associate Professor with our department and shortly before leaving Montreal was informed that he had been promoted to full professor at the Indian Institute of Technology at Kanpur. Dr. Mukerji and his wife, and Dr. Upreti with his wife and young son all perished in the Air India Crash.

From its beginning, the department emphasized good teaching. In the 1990s, many exceptional students either chose the department as a first choice or transferred from McGill. In the days before the 2000 tech crunch, major corporations particularly sought Concordia Physics students. The graduates seeking further training ended up in schools such as MIT, University of California at Berkeley, Oxford and Cambridge. Some former students are now professors at the University of Ottawa and Université de Montréal. Other graduates launched their own companies. Concordia Physics had several students winning the top Natural Science and Engineering Research Council graduate fellowship award most years. Perhaps for this reason, when the department underwent an appraisal in Dec 1993, it was discovered that the full-time equivalent student credits per faculty member (FTE/faculty) ratio was higher in Physics than in its sister science departments.

1988. Top row from left: Nelson Eddy, Arlin Kipling, John MacKinnon, Sushil Misra. Bottom row: Ramesh Sharma, Joseph Shin, Barry Frank, Calvin Kalman, Steve Dubas. Missing: Stan Morris, Rudi Kovacs, C. Eappen, Dave Charlton

In early 2000s, the Department moved to the SP building on the Loyola campus. For the first time in its history the department was Chaired by a woman, Dr. Mariana Frank, from 2003 until 2009. During her mandates, the department embarked on a complete overhaul of its research profile, and decided to focus future faculty hires in the fields of biophysics and nanophysics. This strategic vision, which has been supported by all members and Dr. Truong Vo-Van (Chair, 2009-2015), led to an exciting revival of our research capabilities, followed by an extensive revision of our teaching curriculum. Most importantly, we continue to attract wonderful students at all levels!

Where We Are Headed:

A Next-generation Hub for Multidisciplinary Physics

We recently fine-tuned and fleshed out our Development Plan (2015-16), but the main thrust of our vision has been very steady, and forward looking, since the early 2000s. We aim to teach and research physics which deeply interconnects with other fields of science (chem, bio, math, physiology) and engineering. Why do we believe that building such a department will benefit our students, Concordia, and the society?

Our strategic goal of developing our department into a "hub for quantitative multidisciplinary science" emerged from three observations. (i) Today's scientific reality is that many science and engineering disciplines have greatly matured (e.g. biology, material science, neuroscience) to a point where further progress requires the development of quantitative models and techniques based on theoretical and experimental physics. (ii) We want to connect meaningfully with Concordia's and Montreal's research strengths. Thus, we are focusing our research growth in nanophysics and biomedical physics, while maintaining existing expertise in particle physics and educational research. This allows us to leverage existing resources around us to right away be able to teach and research at a world class level. (iii) As a small unit which is developing rapidly, we have the unique opportunity to build a truly 2016 department of physics. We are adding multidisciplinary physics at the core of our research and teaching, something that much larger departments across Canada cannot do as quickly.

Nanophysics uses the quantum behavior (wave-like property) of electrons and atoms to create nanomaterials which transport electricity, light and information in novel ways.

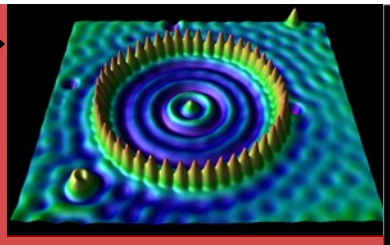
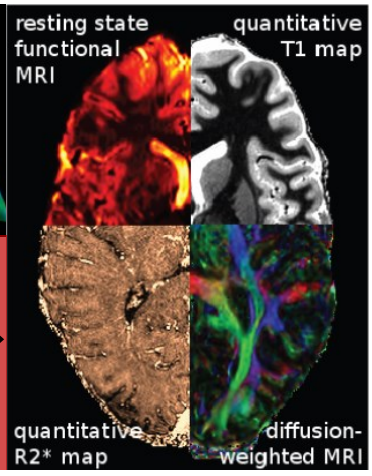


Image of single atoms arranged into a coral. The waves are electrons. From M.F. Crommie et al.

Biomedical physics uses quantum particles like protons and photons to image and study the structure, physiology and energetics of biological system (brain, proteins). *MRI image of a brain. From: C. Gauthier et al.*



So what is our action plan to continue building a multidisciplinary physics department? Our members agreed that to achieve our goals of providing a good course selection and world class research experiences to our students, we need to continue growing in terms of student enrollment and faculty complement. We set out a series of actions to double our enrollments (from 2015 to 2021) both at the undergraduate and graduate levels, as well as doubling the amount of service teaching we provide to students in other departments. Thanks to our improved student advising, co-op program, student recruitment, and the recent development of new programs and research teams, we are on track to exceed this growth target.

We are currently developing a new MSc in Nanoscience and Nanotechnology with partner departments, and a new Minor in Biophysics. In terms of faculty hires, we have an exciting ongoing faculty search jointly with Chemistry and Biochemistry. This hire aims at deepening the collaborations of the nanophysics and nanochemistry groups with the nanotechnology research in the Faculty of Engineering. We also recently proposed a hire in theoretical nanophysics which would be cross-appointed with Mathematics and Statistics to create synergy between our two theoretical groups. We are building a physics powerhouse!

Faculty and staff members of Concordia Physics at a recent gathering.

Back Page Bulletin Board

Recent External and Internal Awards

(a non-exhaustive list of the most recent awards)

BSc students

Daniel Andrews, NSERC USRA

MSc students

Aude Jegou, PERFORM MSc Award

PhD students

Kathleen McGarvey-Lechable, FRQNT PhD Scholarship

Postdocs

Ümit Aydin, FRQS Postdoctoral Scholarship

Research Visitors

Ipsita Saha, FRQNT PBEEE Award

Faculty

Pablo Bianucci, NSERC Engage Grant

Mariana Frank, NSERC Discovery Team Grant

Calvin Kalman, Keynote Lecture at Collège Laflèche

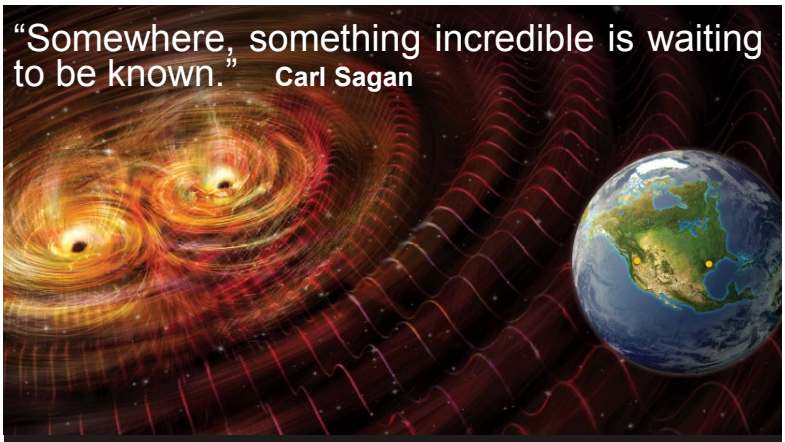
Claudine Gauthier, FRQS Chercheur Boursier Award

Christophe Grova, Savoy Foundation Grant

Valter Zazubovits, OVPRGS Seed Grant

New Physics eCourse - PHYS 284

Dr. Mario D'Amico is just completing the development of the online version of his "Intro to Astronomy" PHYS 284 course. The course is open to all, but mostly aimed at non-science majors. It is offered in Winter 2017.



Big Physics News: The very first gravitational wave detection was announced in February 2016 by the LIGO collaboration.
Image from Science News

Looking for a PHYS 496/497 project or curious about research?

Please visit the department website to learn about our faculty members' research interests, and contact them for a lab visit or a discussion.

Development Fund

Four years ago, the faculty and staff members of the department created the Development Fund to support new awards for our students.

Thanks to generous gifts we now support every year three BSc awards. Everyone is invited to contribute to secure these awards and create new ones. There are many needs: entrance awards, awards to promote diversity, awards to support financial needs. If you would like to contribute, follow this link and write "Department of Physics Development Fund" in the "Gift Information" field.

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