Concordia University
Arts and Science
Department of Physics

CONCORDIA PHYSICS

CONCORDIA PHYSICS NEWSLETTER, Vol. 4 No. 1 Fall 2017

Taking Pride is Your Professional Duty

Embrace Your Physics Identity

Alexandre Champagne, Chair, Department of Physics, Faculty of Arts and Science

Whether you are a first year undergraduate student or a senior faculty member, if you invest your time and energy into studying physics: **you are a physicist!** Most physicists are in denial: Do I really have enough brain power to call myself a physicist? Do I know enough physics yet? This is not healthy. Let's embrace our passion, and feel confident about our identity as physicists and biophysicists. This is important for several reasons: being positive will help us focus on our work and be productive, it will help us accept others around us as real physicists, reinforce a community that works as a team, and we will have more fun! Taking pride means embracing everyone, including ourselves. It is a great antidote against both arrogance and exclusion.

How can you, and the Department, help reinforce your physics identity? We find that students identify more as physicists when they get involved in extra-curricular activities such as research internships, Co-op terms, and special projects (e.g. Space Concordia, District3). Another important factor supporting a sense of belonging is to be part of a tight knit class or group where you can discuss and work with your peers. To strengthen this aspect we are continuously working on providing more interaction opportunities within the Department. For instance, we have a study room dedicated to our BSc students (SP 365.14), we provide weekly Colloquiums, and together with student representatives we are organizing on November 6th, 2017 an Undergraduate Physics Symposium (page 7) featuring both academic and career focused talks. We are redesigning our laboratory courses to foster more group interactions (new courses are in the approval process), and we are increasing the number of problem solving tutorials offered (modestly in Winter 17, but very significantly as of Fall 18).

This newsletter features several exciting student experiences and accomplishments, and highlights opportunities for all students. We provide updates about selected activities within our Department, and mark our progress towards developing into a full-fledged Hub for Quantitative Multidisciplinary Science, with the coming of Prof. Ingo Salzmann (Electro-optics of Nanomaterials) as a new Faculty in January 2017, and two new faculty positions for 2018-19 (Molecular Biophysics in Human Health, and Theory of Quantum Materials).

Teaching Laboratories: Almost $200k have been re-invested in our teaching labs' equipment and software over the last two years. (Image) Magnetic Resonance Imaging system.

In This Issue:

A Celebration of Student Excellence
2017 Physics Award Ceremony

On February 17th, 2017, we held the annual Department of Physics Award Ceremony where we recognized the academic accomplishments of five undergraduate students (Jeremie, Fernanda, Wyatt, Amanda, and Daniel) and two graduate students (Matthew and Tabassom) with awards. The event was a fun gathering with many students, parents, faculty and staff members, our Associate Deans, and Shon Boublil offering us a guitar performance. The awards were generously funded by the Showleh Family, Marlene Pring Family, Mukerji and Upreti Families, Ms. Lorraine Gosselin, as well as by many of our faculty, part-time faculty and staff members.

Back row from left: Matthew Storms, Jeremie Moussa, Pablo Bianucci, Daniel Andrews, Alexandre Champagne, and Sushil Misra. Front row from left: Fernanda Rodrigues Machado, Wyatt Wright, Amanda DiNitto, Tabassom Hamidfar, Joseph Shin, Christophe Grova, Kim Sawchuk, and Miranda D'Amico.

Apply Now!
Call for the 2018 Department of Physics BSc Awards

Students wishing to be considered for the three awards below are requested to submit their names to the Department (marie-anne.cheongyoune@concordia.ca) before January 19, 2018.

One award of $1,500 (Physics First Year Award) to a student having completed 9 to 18 credits in Physics program courses by the current Fall session, and who will take at least 9 credits of physics courses in the coming Winter session. The winner will be the candidate with the highest GPA since registering in their physics program.

One award of $1,500 (Physics Second Year Award) to a student having completed 21 to 45 credits in Physics program courses by the current Fall session, and who will take at least 9 credits of physics courses in the coming Winter session. The winner will be the candidate with the highest GPA in the Winter, Summer and Fall 2017 semesters.

One award of $1,500 (Physics Third Year Award) to a student having completed 48 or more credits in Physics program courses by the current Fall session, and who will take at least 6 credits of physics courses in the coming Winter session. The winner will be the candidate with the highest GPA in the Winter, Summer and Fall 2017 semesters.

New in 2018: The Concordia Physics Undergraduate Summer Research Award, $6,000 stipend ($4500 award + $1500 from the supervisor) to do a research internship in the Department in Summer 2018. It will mirror the CUSRA and USRA programs offered by Concordia and NSERC. The students applying to the CUSRA will automatically be considered for the Concordia Physics USRA.

These awards are generously offered by the Faculty, Part-time Faculty and Staff members of the Department. The friends of the Department support several other BSc and graduate awards (Gosselin, Mukerji and Upreti, Pring, Showleh) for which our students are automatically considered.

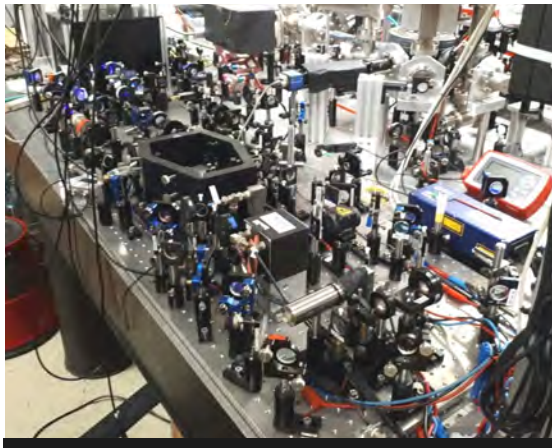
The 2017 Summer of Mariya Krasteva, BSc Honours in Physics

A Life Changing Research Experience in Germany!

For my summer 2017, I was fortunate to be selected by the program of Research Internships in Science and Engineering (RISE) DAAD to work in a quantum optics lab in Germany. This program is an amazing opportunity for undergraduates. Students from Canada, the UK, and the United States are selected and sent across Germany to work in a variety of fields from Biology to Engineering.

Mariya Krasteva (center) with DAAD-RISE Colleagues.
Photo by DAAD-RISE

I started my journey at the Heinrich-Heine-Universität in Düsseldorf working in the field of physics exploring the interaction between light and matter on a sub-microscopic scale. My job was to develop a laser system to excite Ytterbium atoms in ultracold gases into so-called Rydberg states. Rydberg states are short-lived very excited states of atoms. This implies that the orbital radius of a Rydberg electron is very large (~ μm). If the core of an atom were the size of a pingpong ball, normally its electron would be at a distance equivalent to one soccer field away from the core. But in a Rydberg state, the electron would be one city away (~ 10 km). The fundamental understanding of Rydberg atoms has important repercussions in the development of quantum computing (computing with wavefunctions rather than with zeros and ones).



Mariya's work station: state-of-the-art quantum optics.
Photo by DAAD-RISE

The first step to achieve these Rydberg states is to cool down the atoms close to the absolute zero temperature with laser light and magnetic fields. This immobilizes the atoms as much as possible to be able to perform quantum measurements on them. The second step is to excite the atoms. My main task was to build a system to output a blue laser light (394 nm) needed to excite the cold ytterbium atoms into Rydberg states. To build this blue laser, I used a frequency doubling cavity and a diode laser operating at 788 nm in the infrared. Ytterbium atoms have two valence electrons. This will later enable us to optically control/probe the atoms by using one valence electron, while the other electron is excited into a Rydberg state.

Throughout this work term, I came to understand the true meaning of perseverance. I kept on trying harder by rebuilding the laser system completely more than seven times. The truth about experimental physics is that most of the time the setup is not working. However, the problems that I encountered were essential to my learning and development. By the last week of my stay, my system produced the desired output and excited Ytterbium atoms into Rydberg states!

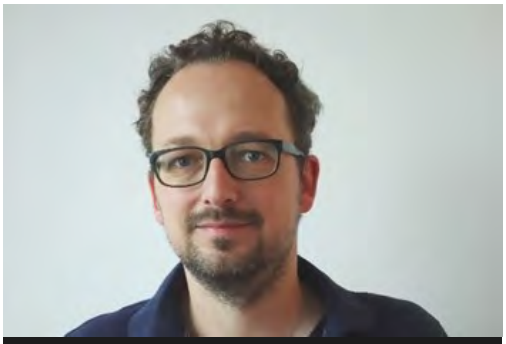
The main reason I applied for this project was to get lab experience and learn about fundamental physics research. As a second-year student, I had very little knowledge about quantum optics prior to my internship. It was very important to me to use my Co-op work term to dive into something that I had never done before, and to learn about myself both as a person and a professional. After three months in Germany, I can say with certainty that this experience changed my career path and opened my eyes to new possibilities.

This Fall 2017, for my third Co-op term, I am working at the European Space Agency on the Gaia mission, in the science department. I am being exposed to what it is like to work outside of academia, able to meet amazing scientists and engineers daily, learn about many new career opportunities, as well as attend mission design sessions and launch events. My experience in both Germany and the Netherlands have enabled me to open myself to new cultures, new ideas, and new challenges. It highlighted for me the international scale of science, and has opened new doors all around the globe.

New Faculty Member Joining Us in January 2017 - Prof. Ingo Salzmann

How Can We Extract Energy and Light Out of Plastic?

I, Ingo Salzmann, will join the Department of Physics in January 2018 in a joint appointment with the Department of Chemistry and Biochemistry. Currently, I have the pleasure of working as a Visiting Professor at the Institute of Solid State Physics (ISSP) at the University of Tokyo (Japan) until the end of the year. Originally coming from Austria, I did my undergraduate studies in Technical Physics and Astronomy in Graz, and moved for my PhD to Humboldt University Berlin (Germany), where I also worked as a postdoc and Senior Scientist in the Department of Physics for the last several years. In Winter 2018, I will start by teaching PHYS 252 (Optics), while building up a research laboratory (L-SP 540.05) combining the physics and chemistry of materials.


Prof. Ingo Salzmann

Being both rooted in the Departments of Physics and Chemistry at Concordia reflects well the interdisciplinarity of my research. I study the fundamental properties of conjugated organic molecules and polymers (or plastics) that can be used as organic semiconductors. I am interested in the complex microstructure of these materials, and how this structure affects their electronic and optical properties. **I also explore how we could use these "plastics" in novel electronic applications, such as organic and hybrid (i.e. combined organic & inorganic) photovoltaics.** You might know these light-emitting devices since they are currently used in your OLED-based cell phone or TV. Like in inorganic semiconductors (e.g. silicon), the key to technological breakthroughs using these plastics is gaining control over their electronic properties via charge doping. However, the fundamentals of doping physics in organic semiconductors are not currently well understood, and their fascinating potential for applications in flexible and lightweight (leaflet-thick) displays cannot be fully accessed.

In our research program at Concordia University, we will strive to better understand the differences between organic and inorganic semiconductors. We will explore the physics of doping materials by using organic chemistry to control (engineer) this doping. Dopants in organic semiconductors are generally also conjugated organic molecules designed to accept or donate electrons. These dopants are only weakly bonded to their host and diffuse through the functional multilayer structures of devices, and finally chemically interact with the organic semiconductor (active region of the transistor). In our recent research, we could show that one of the main factor limiting the performance of organic semiconductors is this chemical interaction between the semiconductor and the dopant species. From these findings, we were able to design new strategies for increasing the doping efficiency and performance of organic semiconductors. We aim to achieve a full control over the charge density in these plastics in order to realize flexible and low-cost devices, e.g. for wearable electronics. To augment our Concordia laboratory work, we will do a lot of research at national and international synchrotron radiation facilities to perform grazing-incidence X-ray diffraction and photoelectron spectroscopy. These extremely powerful X-ray microscopes will allow us to get detailed structural information in our chemically synthesized materials. We will then use this structural information to explain the electronic and optical properties we measure in our Concordia lab. In the long term, we believe that organic electronics will achieve crucial new functionalities (flexible, printable, recyclable) compared to today's inorganic semiconductor devices.

To find out more about my research, you can browse my recent publications at:
https://www.researchgate.net/profile/Ingo_Salzmann

Editor's note: As of January 2018, Prof. Salzmann will be actively recruiting students at all levels (BSc, MSc, PhD) to participate in his research group for projects and internships. Contact him.

The 2017 Summer of Victor Matassa, BSc Specialization in Physics

Co-op Work Internship at the McGill U. Health Centre

Victor Matassa (far right) with his MUHC Colleagues

During the summer of 2017, I completed my second Physics Co-op work internship as a database report writer for the McGill University Health Centre, in the Departments of Radiation Oncology and Medical Physics. I worked under the direct supervision of Dr. John Kildea, a medical physics professor at McGill University and Dr. Tarek Hijal, a radiation oncologist. I learned about the role of medical physicists in a hospital setting, and how they interact with other hospital workers. Using radiation physics and health physics, a medical physicist helps create and analyze plans to treat cancer patients with radiation therapy. They also provide information and knowledge to the physicians and technicians to ensure the best possible treatments for the patients. When I started studying physics as a first year student, I would never have imagined that a degree in Physics or Biophysics might lead to the medical sector.

During the summer, my main responsibilities consisted in extracting information from the hospital's databases or creating tools (reports) that allowed the department's physicians and physicists to extract the information themselves. This allowed the hospital to produce departmental statistics to use locally or to be reported to other organizations such as the Government's MSSS. For example, I produced a report that allowed physicians to see a referred patient's average waiting time for a consultation. This helped the department gauge its performance in serving their referred patients. As I had little experience with big (massive) database management, I had to learn how to use new and interesting tools to complete my work. During my internship, I learned several programming languages. First, I learned MySQL, a programming language specialized in dealing with databases. It allowed me to view and pull information from the Hospital's networks. Next, I studied Perl, an object-oriented programming language that I used to process the data I queried from the databases. Finally, I learned how to use HTML to format and display the data in web browsers.

This summer internship has allowed me to discover another application of Physics, and enabled me to see how my analytical and problem solving skills can be applied in the real (non-academic) world. Moreover, I had the chance to simultaneously utilize and develop skills from my other area of study, computer science, to learn new software and informatics technologies. Finally, I have learned a great deal about the medical terminology and medical equipment used in hospitals. Since I enjoyed the experience, and the team appreciated my work, I was offered another Co-op internship at the MUHC for this Fall 17 semester. I look forward to continuing to develop personally and professionally while working here until the end of December. I will return to a full-time course load in the Winter 2018 to complete my BSc Specialization in Physics (Co-op) with a Minor in Computer Science.

Editor's note: The Co-op program admits first year students (or second year for 120-credit students). There is also an equivalent program for second and third year students: the Professional Experience Program (PREX). In this program a student can complete only one or two work terms, while accessing the same internships. Our Co-op/PREX Director is Prof. Claudine Gauthier (on leave until Jan. 1st), until then contact Prof. Champagne.

Physics Grad Selected as Spring 2017 Arts and Science Valedictorian

Address to Fellow Students by Daniel Andrews (BSc 17)


Daniel Andrews, B.Sc. Physics (Hons.)

Physics was the third degree program I enrolled in at Concordia. I started in Economics, switched to Computer Engineering, then to Physics – the program from which I graduated in the spring of 2017. Of all my degree programs, I found Physics to be the most rewarding and empowering.

Uncertainty about the future always exists, but at the same time we are in a unique age of scientific discovery and opportunity. We need a way to sift through mountains of data, and to maximize our agility in a rapidly evolving technological landscape. A physics education gives you this flexibility through its emphasis on technical skills and its modeling approach to understanding the world.

Your study of physics will enrich your mind and push you to your limit. The workload is massive and the core concepts are difficult to understand. Through these challenges you will refine how you see and relate to the world and to yourself. **When you work to succeed academically and deepen your understanding of reality, you develop your mind's endurance and capability for abstraction. Your intellectual ability grows in ways that you could not anticipate.** You mature, your sense of independence develops, and you prove to yourself and to others that you can tackle any problem you are presented with. Physics forces you to put aside common assumptions and demands that you ask the question that will reveal the truth. The truth is almost never what you expect and is rarely what you hoped it would be. A physicist embraces this ambiguity. She/he acknowledges her/his technological and personal limitations and strives to transcend them. She/he seeks accurate solutions to the most complex problems we all face.

The practical skills you acquire through your Physics education will let you function at a high level in any technical field. You are free to choose many career paths with a physics degree. **You will stand out among university graduates as an independent thinker and a motivated problem solver.** When you graduate from Physics, you will be best equipped to master complexity and seize opportunity.

I'm often asked about strategies for academic success and I always give the same answer. First, do the work. Solve every assigned problem and do not submit anything until you know that every solution you have reached is correct, or at least until you have tried everything you can to get to a correct solution. Solve as many unassigned problems as you can to broaden your skill base. Above all, aim for understanding. Be able to explain in plain language how you solve problems and what their solutions imply.

Now that I've graduated from Physics, I'm starting my Master's degree in Biomedical Engineering at McGill University, with a focus on developing a novel MRI method for high-resolution white matter tractography. I aim to acquire 3D images of the network structure of the brain at an unprecedented level of detail. I then plan to use deep learning (artificial intelligence) techniques on these images to understand the role of the brain network structure in cognitive functions.

This MEng work may at first seem only tangentially connected to physics. That's why I mention it. A physics education prepares you for many quantitative intellectual challenges, perhaps especially the ones branching out of physics. This is a vision and mindset which I nurtured throughout my physics degree. **During my studies at Concordia, Physics proved itself to be the best program for a broadly interested student like me.** I hope that it will be for you as well. Your Concordia University physics degree will open doors wherever you go.

Fall 2017 Physics Colloquiums - Open to all

Room: L-CC 115, Mondays @ 3pm (Coffee at 2:30pm)

October 2: **Understanding light-matter interactions at the single-molecule level**, **Esther Wertz**, **Rensselaer Polytechnic Institute.**

October 13: **Search for ttH production with Higgs decays to b-quarks at the ATLAS detector**, **Nedaa Asbah**, **DESY/Humboldt University.**

October 16: **Time-Resolved EPR studies of electron transfer in natural and artificial photosynthesis**, **Art Van der Est**, **Brock University.**

October 30: **The physics of hockey,** **Alain Haché**, **University of Moncton.**

November 6: **Microfluidics for health, energy and synthetic biology applications,** **Steve Shih**, **Concordia University.**

November 13: **CHIME, the world's newest radio telescope, built in Canada to unravel the mysteries of cosmic evolution,** **Matt Dobbs**, **McGill University.**

November 20: **Topics in theoretical biological physics - Title TBA,** **Juan Vanegas**, **University of Vermont.**

December 4: **From string theory to quantum dot experiments,** **Ian Affleck**, **University of British Columbia.**

The Winter Colloquium series will be announced in early January, several speakers from major international institutions will join us.

$1.5M+ for Research Infrastructure

Two separate Canada Foundation for Innovation (CFI) grants were awarded to our members in the past months.

One grant (Gauthier) will serve to expand the ultrasound medical physics imaging capabilities at PERFORM.

The second grant (Champagne) will provide a large ultra-low temperature cryostat (0.01^0C above the absolute zero) with extensive high-frequency electronics to explore quantum materials.

Fall 17 Undergraduate Physics Symposium

For BSc students: Great talks, free food, and mingling with your classmates !

On **November 6th, at 10:30am until 1:30 pm in Loyola RF 120 and RF 100**, with coffee, snacks, pizza, and talks from Professors and Alumni, as well as BSc students who have completed research projects and job internships.

10:30-10:35 Opening - Student Representatives and A. Champagne
10:35-11:05 Prof. Laszlo Kalman - Biophysics Research
11:05-11:20 Alumnus - Patrick Janeiro (BSc 15), Nuance Communications
11:20-11:35 BSc Student - Fernanda Machado, BSc Specialization in Physics

11:35-11:50 Coffee & snacks - mingle and talk to the speakers one-on-one

11:50-12:20 Prof. Pablo Bianucci - Optics and Condensed Matter Research
12:20-12:35 Alumnus - James Porter (BSc 11, MSc 15), McGill U. / Biomedical
12:35-12:50 BSc student - Anastasia Kolokotronis, BSc Honours/Co-op in Biophysics

12:50-13:30 Closing & Lunch (pizza) - mingle and talk to the speakers one-on-one

Physics BSc organizers:
Fernanda Cristina Rodrigues Machado - fernandacristina@icloud.com
Celeste Melize Ferrus - celestemelizef@gmail.com

Our student short-listed for the Rhodes Scholarship

Congratulations to Ms. Anastasia Kolokotronis who was selected as one of Concordia's five short-listed candidates for the Rhodes Scholarship. Good luck for the final selection round!

Selected 2017 Research Publications

Why does research matter? You have heard many good reasons as to why it does, but did you ever consider this one. High-impact publications are worldwide and independent peer reviews of the quality of the training we provide to our MSc students, PhD students, and postdocs. Below is a taste of our most recent research, for more consult our research pages.

Slow light in mass-produced, dispersion-engineered photonic crystal ring resonators, K. McGarvey-Lechable and P. Bianucci, *Optics Express* **25**, 3916 (2017).

Giant electron-hole transport asymmetry in ultra-short quantum transistors, A. C. McRae, V. Tayari, J. M. Porter, and A. R. Champagne, *Nature Communications* **8**, 15491 (2017).

Bulk Higgs with a heavy diphoton signal, M. Frank, N. Pourtolami, and M. Toharia, *Phys. Rev. D* **95**, 036007, 1-17 (2017).

Investigation of the confounding effects of vasculature and metabolism on computational anatomy studies, C. L. Tardif, C. J. Steele, L. Lampe, P.-L. Bazin, P. Ragert, A. Villringer, C.J. Gauthier, *NeuroImage* **149**, 233-243 (2017).

Comparison of the spatial resolution of source imaging techniques in high-density EEG and MEG, T. Hedrich, G. Pellegrino, E. Kobayashi, J. M. Lina, C. Grova, *NeuroImage* **157**, 531-544 (2017).

Successful Science and Engineering Teaching in Colleges and Universities, C. S. Kalman, Second Edition, *Information Age Publishing* (2017).

EPR and FMR of SiCN ceramics and SiCN magnetic derivatives, S. K. Misra and S. I. Andronenko, Chap. 10, *Frontiers in Magnetic Resonance: EPR in Modern carbon based nanomaterials* (2017).

Exchange, correlation, and scattering effects on surface plasmons in armchair graphene nanoribbons, M. Bahrami, P. Vasilopoulos, *Optics Express* **25,** 16840-16853 (2017).

Nanosecond polarization modulation in vanadium oxide thin films, T. V. Son, V. V. Truong, J.-F. Bisson, and A. Haché, *Appl. Phys. Lett.* **111**, 041103 (2017).

Probing Energy Landscapes of Cytochrome b_6f with Spectral Hole Burning: Effects of Deuterated Solvent and Detergent, A. Levenberg, G. Shafiei, M. A. Lujan, S. Giannacopoulos, R. Picorel, V. Zazubovich, *J. Phys. Chem. B* **121**, 9848–9858 (2017).

Prof. Panagiotis Vasilopoulos named
2017 Outstanding Referee of the American Physical Society

In the top 150 APS Referees out of the 57,000 active Referees !

Research News

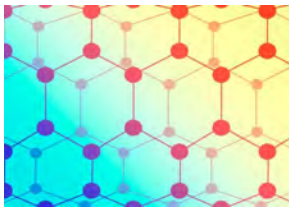
Read online news

She Traps Light

(PhD Student, Tabassom Hamidfar)

He Traps Electrons

(PhD Student, Andrew McRae)



She Records Dreams

(MSc Student, Aude Jegou)

A Great Alumni Reunion: a year ago already - all the pics here
Thank you for staying in touch! We care. (Grads from the 60s to Today)

Give mentoring to young physics grads?
Connect with physics Alumni?

Go to: Concordia Alumni Connect

Back Page Bulletin Board

Academic Programs On the Move

We are continously working to improve our courses and program offering. Here are our latest curriculum projects.

Upcoming Programs: Minor in Biophysics - This Minor will bring the physics mindset and problem solving skills to a wider range of Science students. This new program has now been approved for 2018-19.

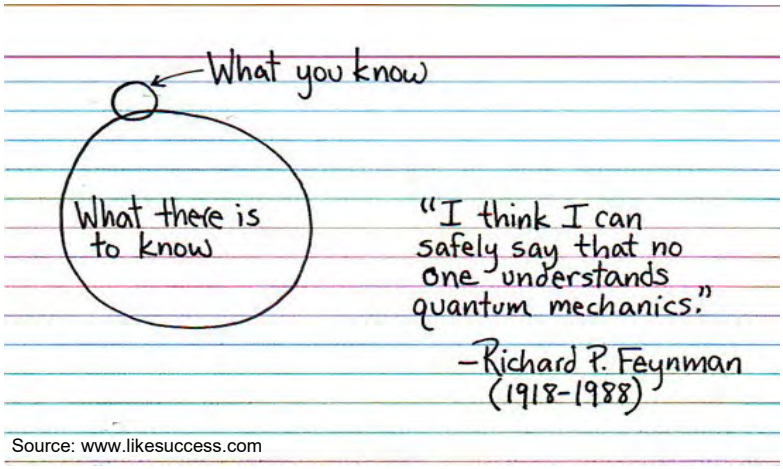
MSc/MASc in Nanoscience and Nanotechnology - This new Master's program would be based in a total of five Departments including ours and train students in both Science and Engineering. It is half way through the approval process.

New Courses: Online Service Courses - This Winter 2017 we are offering a brand new online course, PHYS 273 Energy and Environment. Recently, our Department has approved the development of online versions (lots of in-class options will remain) of two major service courses (PHYS 204 and PHYS 205) which are required courses for numerous students in Science and Engineering at Concordia.

Laboratory Courses - Two new courses called Experimental Physics 1 and 2 have been proposed and will become our standard experimental courses once their approval is completed. We expect to run a preliminary version (slot course) of Experimental Physics 1 in 2018-19.

Enhanced Student Support - We are stepping up our tutorial session offering for our program courses in Winter 2018, and expect to offer a comprehensive set of tutorials by Fall 2019.

Cegep Partnerships - With support from the Provost's office, we are developing curriculum partnerships with 3-year Cegep professional programs in Engineering Physics (John Abbott College, and André-Laurendeau) to permit credit transfer for their students wishing to pursue a BSc in Physics.



Source: www.likesuccess.com

Our Webpage Is Improving

We recently hired a graduate student (Mathieu Couillard) who will work part-time throughout the year to improve both the quality and quantity of information on our webpage. First, we did a round of improvements to the "Student Life" section, and we are now updating all of our research pages. More to come.

Development Fund

The Development Fund of the Department of Physics supports several student awards (page 2).

Currently almost all of the donations to this fund come from our Faculty, Part-time Faculty and Staff members. While the fund is sufficient to support the awards in 2017-18, we need more pledges to secure the awards for the longer term and to add more awards. If you would like to contribute, follow this link and write "Department of Physics Development Fund" in the "Gift Information" field. Thank you!

New Faculty Positions

We are hiring two new faculty members for 2018-19.

1. Tenure-track position on the Theory of Quantum Materials.
2. Canada Research Chair in Molecular Biophysics in Human Health.

Contact Us!

Assistant to the Chair
Marie-Anne.CheongYoune@concordia.ca

Chair
A.Champagne@concordia.ca

Academic Advisor and BSc Programs
Laszlo.Kalman@concordia.ca

Graduate Programs
Pablo.Bianucci@concordia.ca

Teaching Labs
Patrick.Doane@concordia.ca