CAP-TRIUMF Vogt Medal for Contributions to Subatomic Physics

La Médaille Vogt de l'ACP-TRIUMF pour l'excellence en physique subatomique

Much is understood about the theory of the nuclear strong interaction, QCD (Quantum Chromodynamics), but far less is known about its behaviour at extreme conditions of temperature and density. What happens deep in the interior of neutron stars? What did the universe look like, only a few microseconds after the big bang? To provide answers to questions like those, a vigorous experimental program based on colliding heavy nuclei at large energies is currently under way at the Relativistic Heavy Ion Collider (RHIC) and at the Large Hadron Collider (LHC). Charles Gale's theoretical work has been used to motivate and interpret several generations of experimental collaborations. He has made many seminal contributions to the theory of relativistic heavy ion collisions, to finite-temperature field theory, and to relativistic many-body physics in general. Professor Gale is renowned for his work on the emission of electromagnetic radiation in high-energy nuclear collisions, for calculations of observables connected to the nuclear equation of state, and for development and use of relativistic viscous hydrodynamics to model the plasma of quarks and gluons created during the interaction of energetic nuclei. He is the author of more than 225 peer-reviewed papers, and he has also co-authored a textbook on field theories at finite temperature which has become a standard reference; it is being used by practitioners of nuclear and particle physics, and of astrophysics.

The 2017 CAP-TRIUMF Vogt Medal for Contributions to Subatomic Physics is awarded to Prof. Charles Gale, McGill University, for advances in theoretical nuclear physics including the theory and modelling of high-energy nuclear collisions.

La Médaille Vogt de l'ACP-TRIUMF pour l'excellence dans le domaine de la recherche théorique ou expérimentale en physique subatomique 2017 est décernée à Charles Gale, Université McGill, pour ses avances en physique nucléaire théorique, y compris sur le plan de la théorie et de la modélisation des collisions nucléaires de haute énergie.

Remarks by Charles Gale

It is an honour to be chosen as this year's recipient of the CAP-TRIUMF Vogt Medal for Contributions to Subatomic Physics. I have met Erich Vogt a few times in my career, and on each of those occasions I have been struck by his energy and his determination to promote science in general and Canadian science in particular. I feel fortunate to be associated with an award bearing his name.

Much of my work deals with the theoretical physics of strongly interacting matter in extreme conditions of temperature and density such as those that pervaded the Universe only a few microseconds after the Big bang. These exotic conditions can be recreated in the laboratory by studying the relativistic collisions of nuclei. As such, this research topic unites subatomic physics with astrophysics and cosmology: the physics of what happens at an infinitesimal scale influences and even regulates the large-scale behaviour of our world.

Recipient of the 2017 Medal / Lauréat de la médaille 2017:

Charles Gale

The physics of "heavy-ion collisions" has entered a Golden Age and now benefits from a wealth of data garnered at leading facilities around the world such as RHIC (the Relativistic Heavy-Ion Collider, at Brookhaven National Laboratory), and the LHC (the Large Hadron Collider, at CERN).

Those measurements have fueled important developments in theory. For instance, we now know that the quark-gluon plasma formed in those energetic collisions flows like a liquid with a specific shear viscosity smaller than that of any known substance. We also know that QCD jets propagating in the quark-gluon plasma will lose much of their energy, and that this quenching is quite revealing of the relativistic many-body physics occurring at the interface between the jet and the medium. At McGill, I am proud to report that our group has made important contributions to those topics. In addition, we have invested effort to understand how the plasma shines electromagnetically, and how this signal can tell us about the first fleeting moments of its existence. We have shown that photons, leptons, and hadrons calculated and analyzed in a holistic approach can indeed reveal features of the strong interaction that had remained elusive up to now. These are exciting times to be a subatomic theorist.

"Canada has a long and illustrious tradition of research in subatomic physics, and I am deeply honoured to have been chosen as this year's recipient of the CAP-TRIUMF Vogt medal. I thank all of my collaborators, and I am thrilled to share this recognition with them."

"Why do I enjoy doing this?", I asked myself as I was about to write these lines: I don't think every day about why I like doing what I do. After some introspection, I find this topic appealing as it straddles nuclear and particle physics, and combines subatomic physics with aspects of statistical physics, field theory, numerical modeling and simulation. Here, the many colours in the theory palette contribute to paint a rich picture.

« Le Canada a une longue et brillante tradition de recherche en physique subatomique et je suis fort honoré d'avoir été désigné lauréat de la Médaille Vogt de l'ACP-TRIUMF cette année. Je remercie tous mes collaborateurs et suis très heureux de partager cette reconnaissance avec eux. »

Early on, I have been fortunate to meet mentors whose passion has stayed with me. Among them, I am happy to name Subal Das Gupta, Joe Kapusta, George Bertsch, and Gerry Brown.

Finally, I have been blessed with patient collaborators and outstanding students and postdocs from whom I have learned much; I am happy to share this medal with them.

CAP-CRM Prize in Theoretical and Mathematical Physics

Le Prix ACP-CRM de physique théorique et mathématique

Raymond Laflamme completed his PhD on aspects of general relativity and quantum cosmology in the Department of Applied Mathematics and Theoretical Physics (DAMTP) under the direction of Professor Stephen Hawking at the University of Cambridge. From 1992-2001, Dr. Laflamme worked as a research scientist at Los Alamos Research Laboratory, where his interests shifted from cosmology to quantum computing. His work in this new area has focused on how to make quantum information processors more feasible.

The 2017 CAP-CRM Prize in Theoretical and Mathematical Physics is awarded to Dr. Raymond Laflamme, IQC/University of Waterloo for his ground-breaking contributions on quantum information.

Le prix ACP-CRM de physique théorique et mathématique 2017 est décerné à Raymond Laflamme, IQC/Université de Waterloo, pour ses apports innovateurs en information quantique.

Since the mid-1990s, he has developed theoretical approaches to quantum error correction, and has given experimental demonstrations of these techniques. In collaboration with Emmanuel Knill, Dr. Laflamme gave conditions for quantum error correcting codes, and established the fault-tolerance threshold, thereby showing that quantum computing systems could be practically useful. He went on to perform the first experimental demonstration of quantum error correction. Dr. Laflamme has also devised and implemented new methods to make quantum information robust against corruption in both cryptographic and computational settings. With colleagues, he has developed a blueprint for a quantum information processor using readily available linear optic components rather than exotic nonlinear devices. This work was recognized as one of the most influential achievements in quantum information in the period 2001-2009.

Recipient of the 2017 Prize / Lauréat du prix 2017:

Raymond Laflamme

Dr. Laflamme holds the Canada Research Chair in Quantum Information and has authored or co-authored over 170 academic papers. He also co-authored a book, Introduction to Quantum Computing, with Michele Mosca and Philip Kaye in 2006. Dr. Laflamme founded the Institute for Quantum Computing in 2002 and has been its Executive Director since its inception.

Remarks by Raymond Laflamme

It is a true honor to receive the 2017 CAP-CRM Prize in Theoretical and Mathematical Physics.

It is a very special to me, in particular because, when I was a student in the mid 1980s, Werner Israel used to visit the group I belonged to in Cambridge. I remember with great pleasure discussions with him about the work he was doing. Werner is an inspiring figure and I looked up to him wandering what would the future hold for me when I reach his seniority. Werner was the first CAP-CRM Prize in Theoretical and Mathematical Physics, so I am deeply honored to join him and many of my colleagues in this group of distinguished researchers.

"As a student in Cambridge, Professor Werner Israel regularly visited Professor Stephen Hawking. I remember looking up to him as an eminent scientist and someone to emulate. Being considered alongside Werner and the impressive group of researchers awarded the CAP-CRM prize in the past, is truly an honour."

« À titre d'étudiant à Cambridge, je me rappelle que je considérais le professeur Werner Israel, qui visitait régulièrement le professeur Stephen Hawking, comme un éminent scientifique et une personne à prendre pour modèle. Le fait d'être considéré en parallèle avec Werner et l'impressionnant groupe de chercheurs qui ont déjà été lauréats du prix de l'ACP-CRM est un véritable honneur. »

Quantum mechanics was discovered more than a hundred years ago. For its first 50 years, it was similar to astronomy: a descriptive science successfully explaining observations, but since the 1950 however research in quantum mechanics went from what I would call a passive to an active science, one where technologies have been created that are based on quantum effects: the laser, magnetic resonance imaging, the transistor.

The trend to shrink the size of transistor in the last 50 years, has been such that we are reaching the limit of atomic size where quantum effect become pervasive. Quantum effects can be turned into an advantage leading to the discovery of computers based on the laws of quantum mechanics with powers which is shattering the foundation of computer science, of unbreakable cryptographic systems, of new methods of for time keeping, lithography and other technologies.

Quantum information processing promise to develop devices that are more powerful than their classical counterparts. It does so by encoding and manipulating information in states that are either difficult or impossible to reach classically. Unfortunately these states are typically extremely fragile. To turn the ideas of quantum information processing into reality, we need to make quantum information robust to imperfection and imprecision inherent to realistic devices. In the mid-1990s, a theory of quantum error correction was discovered and accuracy threshold theorems were proved showing that error can be controlled using a reasonable amount of resources as long as the error rate is smaller than a certain threshold. I have contributed to these discoveries both at the theoretical and experimental level leading to a theory demonstrating how to control quantum systems in a scalable way. This is opening the way to develop quantum technologies that will have societal impact.

I am grateful to my mentors and colleagues that have helped me during the many years when this research was accomplished. I would also like to thank my wife Janice and my children Patrick and Jocelyne, who support me in the good days and the challenging ones, and for teaching me the intuitive approach to error correction.

CAP-COMP Kirkby Medal

La Médaille commémorative Peter Kirkby de l'ACP-OCPM

Recipient of the 2017 Medal / Lauréat de la médaille 2017:

Jerry J. Battista

Dr. Battista is an award winning Medical Physicist based in London, Ontario, Canada. He serves as the Director of Physics Research and Education at the London Regional Cancer Program and the past Chairman of the Department of Medical Biophysics at Western University in London, Ontario, Canada. Dr. Battista has supervised a number of graduate students who have become international stars in the world of radiation therapy physics.

The resultant new technologies developed by them are now used worldwide as part of highly precise image-guided radiation therapy – the modern standard of practice. Dr. Battista is known for excellent communication skills that have resulted in multiple teaching awards, including receiving top honours at Western University. He is known for successful use of analogies bringing complex subjects to understandable levels. Furthermore, his research supervision of graduate students has resulted in award winning research papers both in the Canadian and broader international medical physics communities.

The 2017 CAP-COMP Peter Kirkby Memorial Medal is awarded to Jerry J. Battista, Western University, for his outstanding and lifelong contributions to Medical Physics in Canada that have fundamentally altered worldwide practice. In addition to being an outstanding teacher, researcher, and mentor, Dr. Battista has steadfastly advocated for his field through his work on many professional and accreditation committees, his service as an advisor to the Ontario Ministry of Health and Cancer Care Ontario, and his coordination of Canada's largest residency training program in clinical physics.

La Médaille commémorative Peter Kirkby de l'ACP-OCPM 2017 est décernée à Jerry J. Battista, Université Western, pour les contributions exceptionnelles de toute sa carrière à la physique médicale au Canada qui ont fondamentalement modifié la pratique mondiale. Outre sa qualité d'enseignant, chercheur et mentor exceptionnel, le Dr Battista a défendu farouchement son domaine par son travail auprès de nombreux comités professionnels et d'agrément, par son service comme conseiller du ministère ontarien de la Santé et des Soins contre le cancer et sa gestion du programme de formation de résidence spécialisée en physique clinique.

For many years, Dr. Battista has also served as the coordinator of the Medical Physics residency training program for the Province of Ontario. This program has long served as the model of medical physics education and training such that the graduates are highly sought after in both Canada and the US. Dr. Battista's very positive and open attitude with his students, his peers and the general public epitomize what Peter Kirkby stood for — a vision of a strong physics community dedicated to efforts that support open communication, fairness and honesty.

Remarks by Jerry J. Battista

I was honoured to receive the 2017 Kirkby Award from the CAP and COMP organizations. I share it proudly with family, students, and colleagues in medical physics — past and present. I served as Chairman of the Division of Medical & Biological Physics (DMBP) in 1986-87, but did not have the pleasure of meeting Dr. Peter Kirkby. However, a mental image of this special individual has emerged from an article published in *Physics in Canada* (March/April 1995): meticulous care and attention to detail; proper documentation; respect for applied science; development of professionalism or risk extinction; continuity, consistency and fair play; promotion of science in young students; support of the community activities; hard-working; highly approachable individual. I admire and share many of these Kirkby traits. He also taught an interesting 'Physics for Poets' course to non-physics students. It is an activity that I also truly enjoy — minimizing "physics-o-phobia" by explaining physical principles of nature and technology that can be easily observed in everyday life.

"I am deeply honoured to receive the Kirkby memorial award. It spans the wide range of physics contributions to Canadian society, including radiation medicine. I follow in big footsteps of "Jack" Cunningham, an outstanding role model, and Erv Podgorsak, an educator and scientist with uncompromising attention to physics details. This is truly rewarding and inspiring."

« Je suis fort honoré de recevoir la Médaille commémorative Kirkby, qui englobe le vaste apport de la physique à la société canadienne, y compris en médecine des rayonnements. Je dois suivre les traces marquantes de « Jack » Cunningham, modèle de rôle exceptionnel, et d'Erv Podgorsak, enseignant et scientifique scrupuleusement attentif aux détails de la physique. C'est vraiment valorisant et inspirant. »

Medical physics is focused on the improvement and safety of diagnostic or therapeutic procedures. Physicists possess a unique education and thinking mode to advance these fields. This has catapulted the field up to 3D/4D imaging using ultrasound, computed tomography (CT), magnetic resonance (MRI), positron emission (PET), not to mention prior key biological discoveries using X-ray diffraction, electron microscopy, and lasers. Megavoltage linear accelerators are common in most cancer centres, equipped with 3D image guidance systems and beam gating. They deliver shaped dose distributions from x-ray or electron beams much more precisely — "hitting the cancer while missing the patient", as one of my clinical colleagues used to say. Looking ahead, one might anticipate that heavier particle accelerators (e.g., for carbon ions) might one day fit well within hospital budgets and space!

The mid-1970s was marked by ambivalence about the role of professional organizations as either common ground for individuals with similar scientific interest or as a springboard for professional lobbying and recognition. The need for professionalism in hospital-based physics reached a crescendo when other specialists were recognized more firmly in provincial legislation. The malaise also cut across other sub-disciplines of physics, as highlighted and addressed by Dr. Kirkby who had a productive career in industry. External pressures were being felt mainly from engineering. The Canadian College of Physicists in Medicine (CCPM) was formed in 1979 and it has now certified over 425 clinical physicists. As Division Chair (1986-87), I was in the middle of a separatist movement leaning away from the parent CAP. An independent "Canadian Organization of Medical Physicists (COMP)" was eventually formed in 1989 and it now has over 850 members, mainly working in hospitals. The CAP biomedical division continues its activities as a parallel option for biophysicists.

The synergy between fundamental and applied research has always required a delicate balance and moderate level of friction to move forward. This is seen in today's research grant agencies; the pendulum keeps swinging between fundamental and applied science! Future discoveries in personalized radiation medicine will require interdisciplinary collaboration across physics, chemistry, and biology; nature hides its secret in combos. My advice to today's students is to understand physics as deeply and rigorously as possible, but embrace the diversity of exploration at the fringes of physics. The best is yet to come.

CAP Medal for Outstanding Achievement in Industrial and Applied Physics

Médaille de l'ACP pour des réalisations exceptionnelles en physique industrielle et appliquée

The 2017 Medal for Outstanding Achievement in Industrial and Applied Physics is awarded to Dr. Simon Fafard, Université de Sherbrooke, for his new developments covering 20 years of research in applied solid state Physics, coupled with his strong efforts in commercializing these through patents and the establishment of his own companies.

La Médaille de l'ACP pour des réalisations exceptionnelles en physique industrielle et appliquée 2017 est décernée à Simon Fafard, Université de Sherbrooke, pour ses avances couvrant 20 années de recherche appliquée en physique des solides, conjuguées à ses grands efforts visant à les commercialiser par des brevets et l'établissement de ses propres compagnies.

A professor at the Université de Sherbrooke and an adjunct professor at the University of Ottawa, Dr. Simon Fafard's research focuses on advanced optoelectronics at the International Joint Unit "Laboratoire Nanotechnologies Nanosystèmes (LN2)" (CNRS, France/Université de Sherbrooke) and the "Institut Interdisciplinaire d'Innovation Technologique (3IT)" (Université de Sherbrooke). He is also President of Azastra Opto in Ottawa and Director of Scientific Partnerships for the "MiQro Innovation Collaborative Center (C2MI)", linking applied research and the rapid commercialization of microelectronic products. An expert in nanostructures, heterostructures, III-V semiconductor epitaxy, and optoelectronic devices, Dr. Fafard has led numerous key scientific contributions and technological innovations in the fields of material and renewable energy, with publications in prestigious scientific journals such as Science and Nature.

Recipient of the 2017 Medal / Lauréat de la médaille 2017:

Simon Fafard

Dr. Fafard is the inventor of over 30 patents and the founder of various companies involved with solar energy and optoelectronic devices. He has raised over $20M of private and venture capital funding in addition to numerous research grants. Dr. Fafard is a recognized pioneer in nanostructures with a vast experience at the forefront of innovation, device development, and commercialization for various photonic and optoelectronic applications. This helped Cyrium Technologies become a lead developer and manufacturer of one of the highest performance multijunction III-V solar cells and, more recently, has led Azastra to manufacture the highest performance III-V phototransducer products. This recent breakthrough, featuring the highest optical to electrical conversion efficiency ever for any type of devices, is now being presented at several invited international presentations.

As an entrepreneur, Dr. Fafard cumulates over 25 years of experience in optoelectronics and photonics, developing and commercializing numerous semiconductor devices and products in the industry at Azastra, Aton, Cyrium, Alcatel Optronics, Kymata, and also in research labs at Université de Sherbrooke, the National Research Council Canada and the University of California, Santa Barbara.

Remarks by Simon Fafard

I am very much honored to have been recognized by the Canadian physics community with the CAP Medal for Outstanding Achievement in Industrial and Applied Physics. Physics has always been my passion. In particular in the context of industrial applications, I trust that physics is the fuel for the innovations that drive todays' technology world. And, I have been determined to build organizations that can win and dominate a market segment and the only way to achieve this is by introducing new products. To be successful in the market place, such new products need to be competitive, and at the basis of the competitiveness there has to be some strong physical principles allowing enhanced device properties.

"I am much honored to be recognized by the Canadian physics community with the CAP Medal for Outstanding Achievement. Realizing successful applications in Industrial and Applied Physics is rewarding in itself. I feel very privileged to receive this award and I hope it inspires others to work hard in this area."

I feel indeed very privileged to have been one of the pioneers in the field of self-assembled quantum dots and nanostructures. My early work at USCB and at NRC allowed me to start to gain some vast experience at the forefront of physics and innovation. The device development and the related commercialization efforts followed for various photonic and optoelectronic applications. For example it allowed me to position Cyrium as lead developer and manufacturer worldwide with one of the highest performance multijunction III-V solar cells. And this turned out to be the basis that led Azastra to manufacture the highest performance III-V phototransducer products. I am very proud that our achievements enabled devices that are featuring the highest optical to electrical conversion efficiency ever.

Like every achievements, there is always a team working together and infrastructure to nurture the work. I would therefore like to thank Université de Sherbrooke for providing a great environment encouraging the entrepreneurship and innovation spirit. There I have been able to focus my research on advanced optoelectronics. This includes within the International Joint Unit "Laboratoire Nanotechnologies Nanosystèmes (LN2)" (CNRS, France/Université de Sherbrooke) and the "Institut Interdisciplinaire d'Innovation Technologique (3IT)" (Université de Sherbrooke). In particular of course I would like to thank all my co-authors on the technical contributions that we have made in the field, including Dr. Mark York, Prof. Vincent Aimez, Prof. Richard Ares, Prof. Karin Hinzer, Dr. Matt Wilkins, Dr. Christopher Valdivia, Lise Richard, and all my students and postdocs that contributed to the work, many others that contributed to the innovation. Substantial provincial, federal, and private funding have been invested and I grateful for all that trusted us with the research and development efforts. I have also been fortunate to be the Director of Scientific Partnerships for the "MiQro Innovation Collaborative Center (C2MI)", linking applied research and the rapid commercialization of microelectronic products. Centers like that are key to fostering innovation and bringing such innovations from ideas to achievements at an industrial level. And I am particularly proud to be part of a strong team of colleagues, as an adjunct professor at the University of Ottawa.

« Je suis très honoré d'avoir été fait lauréat de la Médaille de l'ACP pour réalisations exceptionnelles par la collectivité canadienne de la physique. Concevoir des applications fructueuses en physique industrielle et appliquée est valorisant en soi. C'est pour moi un privilège de recevoir ce prix et j'espère que cela en incitera d'autres à travailler fort dans ce domaine. »

Very importantly, want to thank my colleagues at Azastra, in particular Dr. Denis Masson with whom I co-founded Azastra which recently got acquired by Broadcom Limited, a large public company in the sector. I would also like to thank Francine Proulx and Philippe-Olivier Provost from Azastra for all their hard work and their countless contributions. Cyrium, the company in the solar cell business that I founded earlier, was also key in making outstanding achievements in the important field of solar cells. I would therefore also like to thank Dr. Norbert Puetz, Dr. Bruno Riel, Dr. Steven Wallace, Ing. Eric Desfonds, Dr. Sarah Langstaff, Aline Rugwizangoga, David McMeekin, and Allan Moore.

On a personal level, I believe that, like Steve Jobs once said, the only way to be truly satisfied is to do what you believe is great work, and the only way to do great work is to love what you do. I love physics and I love what I do! Realizing successful applications in Industrial and Applied Physics is rewarding in itself. But I feel very privileged to receive this award and I hope it inspires others to work hard in this area.

CAP Medal for Excellence in Teaching Undergraduate Physics

Médaille de l'ACP pour l'excellence en enseignement de la physique au premier cycle

Admired by colleagues and students alike for his unparalleled dedication to the thousands of undergraduates he has taught, Martin's enthusiasm and passion for teaching physics are truly inspirational. Martin's skills in the large lecture hall are exceptional: he successfully turns an auditorium seating 500+ students into a dynamic, engaging setting for student-focussed learning, incorporating countless innovative strategies from current research in physics education. Martin has contributed to the betterment of physics education through his commitment to all students at the University of Guelph, his scholarly work leading to the publication of books and journal articles, his design and development of new approaches to fundamental undergraduate physics courses, as well as his service to the community through his involvement in the executive of the Division of Physics Education at the CAP and the Ontario Association of Physics Teachers (OAPT). Martin Williams is a truly deserving recipient of the CAP Medal of Excellence in Teaching Undergraduate Physics.

The 2017 CAP Medal for Excellence in Teaching Undergraduate Physics is awarded to Dr. Martin Williams, University of Guelph for his exceptional ability to lead students to high academic achievements in physics through excellence and innovation in teaching and mentoring, for his contribution to curriculum design inspired by the results of Physics Education Research, and for his leadership in promoting the adoption of innovative research-based instructional strategies within the Canadian physics education community.

La Médaille de l'ACP pour l'excellence en enseignement de la physique au premier cycle 2017 est décernée à Martin Williams, Université de Guelph, pour sa capacité exceptionnelle à mener ses étudiants à des résultats élevés en physique par l'excellence et l'innovation en enseignement et mentorat, pour sa contribution à la conception de programmes inspirée des résultats de la recherche sur l'enseignement de la physique, et pour son leadership à promouvoir l'adoption de stratégies d'enseignement innovatrices fondées sur la recherche dans la collectivité canadienne de l'enseignement de la physique.

Interview with Martin Williams, July 2017 (by Daria Ahrensmeier)

Daria: Congratulations on your teaching medal.

Martin: Thank you very much.

Recipient of the 2017 Medal / Lauréat de la médaille 2017:

Martin Williams

Daria: In a few words, can you describe your teaching accomplishments?

Martin: I think the citation says I was awarded this medal for my work in curriculum development, for my passion for teaching, and for my perceived ability to teach and actively engage really large classes. I have been trying to develop a different model for teaching large classes, which is significantly different to teaching smaller classes. I've tried to come up with a way that works for large classes, because not many people have experience with this and not many institutions have it. The worst thing that you could possibly do is to try to teach a large class the way that you teach 50 or 75 students. You have to come up with a completely different model. So, that is something that I worked on over a number of years and I think that I must be getting success to some extent, because students seem to really appreciate it.

Daria: What is this model you developed for large classes?

Martin: The model is not a rigid, strict "step 1, step 2, step 3". The use of technology is important, because obviously, in a large classroom, you don't have the luxury of that personal interaction that you have with students in smaller classes—you don't know the names. For example, in all of our large classes, you must use some engagement technology such as iClickers or something along those lines. It's the least that you can do to let students feel that they are part of the class.

"I am extremely honoured to receive this award. I must acknowledge, however, the immense pleasure and fulfilment I already derive just from being in the classroom in my current role. This award thus recognizes the stellar support of my department and peers at Guelph, the suffering of countless students and the enduring patience of my family"

The other thing about teaching large classes, I think, is to recognize that it is not possible to engage with all these students through office hours. Thus the role of TAs becomes really crucial, and developing a TA system effective in terms of training is an essential part of that system.

Developing the assessment mechanisms for large classes is really important. We do not do the typical midterms and that sort of stuff. Instead we moved to a mastery approach model where students take five quizzes in a semester (a quiz every three or four weeks) to prove mastery of each concept. Each quiz is worth 10 per cent of their final grade and they have up to three attempts at each quiz to demonstrate that they've mastered the concept covered by that quiz. A score of 80% is required to show mastery. This can either be obtained in a single attempt at the quiz, or can be a cumulative score. Thus, by using this method, students have an opportunity to achieve mastery throughout the span of the three attempts.

But the best part of that system is the students get instant feedback. They walk in, they try to do the quiz and, immediately after writing the quiz, they sit down with the TA who walks them through the quiz, marks it, assesses the quiz right in front of them, and gives them feedback. The students walk away from the quiz saying, "OK, I need to go back and figure out how to do these conservation of energy problems, because that's where my issue is." It's a diagnostic tool that gives each student feedback as a way to strengthen weaknesses. The students can go back, look at that stuff, and come back and try the quiz again. Where we started initially, we'd say no deadline, but what happened is that students procrastinated; they tried to do all five quizzes, which are worth 50 per cent of their grades, in the last two weeks. So, after a while, we introduced boundaries by saying, "The first quiz must be finished by week 2; the second quiz, you must finish it by week four — or whatever it is. However, if you feel that you understand a concept, you can take the quiz any time before the deadline, so you don't have to wait. This way you can learn at your own pace." This is something that is unique to our large classes.

How we teach, how we assess those large classes, is not a perfect system, but the student feedback is really quite interesting — our students have over the years said that their best first-year experience is physics. At least science students.

« Je suis fort honoré de recevoir ce prix. Je dois toutefois reconnaître le plaisir immense et la satisfaction que donne le simple fait de jouer mon rôle actuel en classe. Ce prix témoigne donc du solide soutien de mon département et de mes pairs à Guelph, de la souffrance d'innombrables étudiants et de la patience sans bornes de ma famille. »

Daria: Now, tell us a little bit about your background and your training, where you're coming from. When did you decide to go into physics and why, and what kind of physics was interesting for you?

Martin: Yes, that's interesting, but a bit of a long story. Coming through high school, I distinctly remember that physics just made sense to me. I never thought that I was good at physics, but I thought that it made sense to everyone. When I was in grade 11, grade 12, I remember my physics teacher — who was not one for giving praise easily — said to me, "Williams, you know, you're actually good. You should think about doing physics at university." I said, "Really?"

So, I went to university to do physics, because I figured … if my teacher thinks that I'm good at this stuff then I should pursue it. But as I said, I never had this big, massive dream that "This is what I want to do, I want to become a physicist." It just evolved naturally. So, I went to university and I did physics and when I finished my first degree, they said to me, "We think you're actually good at this stuff. We'll put you up for a scholarship, if it's something you might be interested in." I said, "Sure." So, I went to grad school and took physics, and after grad school, I figured that I probably should teach, I should become a faculty member, because by then I was really passionate about physics, I really recognized that — especially the solid-state physics or modern physics, that was my thing. I did most of my research on quantum hall effect and fractional quantum hall effect. And one of my claims to fame is the guy who got a Nobel Prize for the quantum hall effect had his lab next to mine.

So I had it all planned. I just was going to do my research on solid-state physics, and just do the things that a faculty member would normally do. But what was really interesting is that I hated teaching when I started as a junior faculty member. I hated teaching with a passion simply for the reason that I knew nothing about teaching and I invested a lot of time in preparation for my lectures. I remember those first years, I'd spend two, three hours preparing every lecture and walk into the lecture and students would be completely oblivious, they would be chatting and doing everything else but paying attention. And that was so discouraging and disheartening, after I'd put three hours into a lecture. I'd be there saying, "This is amazing," and they'd look at me as if I was from a different planet or whatever. That rejection really turned me off from teaching. So, for a number of years, I just wanted to do my research and I just showed up in the classroom.

I think what really sort of eventually piqued my imagination was that I heard students who had taken a course with me, and in a subsequent semester had taken a physics course with another professor, chatting in the corridors saying, "This guy's amazing," speaking about another colleague. And I would think to myself, "That is an interesting statement." So, it's not that these students hate physics, it's me. I must really suck at this stuff. [Chuckles] And that was the start of an interesting experience.

I started sneaking in the back of the classes of my colleagues that students marveled at, just to see what it is they're doing in their class that I was not doing, and I started chatting with them.

So, I started to attend classes of my colleagues, all of these professors that I knew students marveled at. I started sneaking in the back of their classes just to see what it is they're doing in their class that I was not doing. I started chatting with them afterwards and I would ask, "How did you do that?". One colleague told me "There are simple rules to keep in mind such as students' attention spans and making sure you have planned your lectures. Make sure you always have them in the first 10 to 15 minutes. But when you get to the 15 minutes, as soon as you see their heads start to look down or whatever it is, you know you're losing them. It's an important point when you need to transition to something else. Whatever it is that you want to use to keep your students engaged."

That was my transition into teaching. I started implementing these little things and the change in my class was noticeable. I was completely hooked knowing that I can have that sort of impact on students, if I kept these simple rules. The rest is history. I think I became addicted to this thing after a while. And it's funny, if anyone had said to me that I'd be caring so much about teaching, 15, 20 years ago, I would have said, "You're out of your mind, you must be smoking something." I had no interest in teaching. And now… when I go the classroom, it's not a job. It's something that I'm tremendously passionate about. Even if I'm not having a good day, the moment I walk into that space, it's a completely different experience for me. I think people have jobs and people have careers and very few people get to do something that they're passionate about and like in life. So, to me, I think it's an absolute blessing just to be able to do and to be paid to do the stuff that I really like.

Daria: That's a beautiful sentiment. Now let's go further back into your life. Where did you go to high school?

Martin: My parents are from South America, what used to be British Guiana, a small British colony. That's where I did my early stuff. And then, I went to England for my graduate studies.

Daria: Which university did you attend in England?

Martin: Imperial College.

Daria: When you compare different countries where you've lived, received an education, or taught in, what stands out to you?

Martin: I was lectured to in the British system. I was never taught, I was lectured to. And there's a fundamental difference. In a lecture, the expectation is that there's no way that the lecturer would ever cover everything, so you're provided with the basic sort of skeleton, and you are meant to flesh out all the bits. So, there was never a course textbook, there were multiple textbooks. You read them, and you found something that resonated with you and you understood. So, there were always multiple textbooks that were prescribed. When I came into the system here where there is a course with only one textbook, it made no sense to me, because when I read three books, three different explanations, by the time I had done that, I had gotten a fairly good understanding. So, sticking to one book never really made a lot of sense to me. But so, there are always pros and cons in a system.

Daria: Do you have a favourite topic that you particularly like to teach?

Martin: Modern physics, absolutely. I love to teach modern physics. One of my favourite courses used to be a second-year course we had called "The Experimental Basis of Modern Physics." It's not just the dry history, but it was developed to understand the thinking behind the concepts and how they evolved – these ideas that we just take for granted and just write on the board. Those experiments, that bit of modern physics, I've always found fascinating and I love to teach the whole — from about the 1890s right up to 1950. That's my favourite bit of physics.

Daria: Do you still do research in physics?

Martin: Oh, yes, we have to. At Guelph, we have a distribution of effort. So, traditionally, it's 40, 40, 20 for teaching, research and service. I do 60, 20, 20. I can choose to do more research and I can choose to do traditional research or physics education research. There's an implicit agreement that I would do physics education research because it's important for the department that I can feed that information back to my colleagues.

Daria: Does this mean that your education research is recognized as research?

Martin: Yes, and that's really important. I'm required to publish like anyone else, and if you write books, that is scholarship.

Daria: Is your research focused on the topic of large classes?

Martin: We've published some work on gamifications, so we were working on gamification for quite a while with my last graduate student. At the moment, my current grad student is working on labs. Before that, we did quite a lot of work on clickers and active engagement. We looked at what really occurs during peer instruction, whether it's peer instruction or peer pressure. So, what we tend to find is that if a third of my class understands a concept, they are much more efficient at transferring that information to their colleagues than I am, because they are familiar with their friends and can explain it in a way that's much more effective and efficient than I can.

The CAP Congress is the only conference for physics education research in Canada. It has been a pivotal and invaluable part of my growth and development as a teacher.

And then, I remember working with Ernie McFarland about the placement of questions in multiple choice exams and how it influences the results. We knew it had an effect. If you put a lot of easy questions right at the start of the multiple choice exam, students build confidence and feel that they can actually do this stuff. If you put really challenging questions right at the front of the exam, it psychologically affects students. So, we planted certain sets of questions at certain places. Some of the easy questions were at the front for some students and so we could see the students who had easy questions in front did better. But we couldn't find it to be statistically significant. But yes, that was one where we were disappointed.

Daria: Do you see any effect of the current funding situation on teaching in universities?

Martin: Oh, absolutely. Universities have tried to deal with a shortfall in funding by building bigger classrooms, which means that we ended up teaching classes of 600 students. No one can convince me that it's the same experience for students in the classroom with 60 students versus 600 students. If I had to choose, I would always choose to be in the 60. And so, that's the first direct impact, I think. The second impact that we dislike is the fact physics classes are not always held in the physics building.

Decisions about where classes are held are not based on the pedagogy, but based simply on space requirements. So, you're put into a room not because this is the best pedagogical experience for the students to have, but simply because universities have challenges with some space. All of our demonstration labs are next-door to the classrooms in our physics building, so we could literally wheel our demonstrations into the physics labs. But now we are sometimes taken out of the physics building and sent across different parts of campus and so lose access to those demonstrations.

Daria: If you had unlimited funds, what would you do about teaching?

Martin: For one, absolutely, there'd be smaller classes. I'd cap the class sizes to probably at most, at max, 100 students. For my TA budget, I'd double my TA budget because I think that — especially in a large group or large labs, students complain that they do not have enough attention from TAs and that frustrates them. So, I'd absolutely double my TA budget. And I think that would significantly enhance the learning experience for students. And of course, if possible, we'd hire more faculty. Another sort of fallout from funding cuts is that they have increased the number of courses that we have to teach in a year. So, typically a faculty member, at 40 per cent, taught two courses. Now, it's three. What that does, obviously, if you teach more, it affects research and the quality of teaching.

Daria: What's the value of the CAP and the CAP Congress for a teacher? What role does the CAP play for someone who's teaching in general?

Martin: I think that for a long while, I was completely oblivious to the lobbying role that the CAP plays and I think a lot of people are not familiar with the fact that they make budget submissions and they'll have meetings with the ministers and the MPs all through the year. So, the policy aspect in terms of representing all physicists across Canada, is really important and vital.

Of course, most people think of the CAP in terms of the CAP Congress and that is important because being associated with the Congress for more than 10 years has been a pivotal part of my growth and development as a teacher and invaluable. I've met so many people who have taught me so many things, so many good conversations in the corridors and networking and it has had the most significant impact in terms of what I've learnt about teaching. No one has really taught us about how to teach. And so, going to these presentations and talking to people, it has been absolutely invaluable, and just sharing with my colleagues, sharing in terms of sufferings and pains and challenges, and figuring out ways how to do things.

So, the CAP, for the area of physics education, it's the only place that I can go to meet colleagues in Canada. It's the only conference for physics education research in Canada. It is absolutely crucial for what I do and I don't think I've missed the CAP Congress for the last 12 or 13 years.

Daria: Thank you so much.

Martin: Not at all. Good luck to you!

CAP/DCMMP Brockhouse Medal
La Médaille Brockhouse de l'ACP/DPMCM

Yong Baek Kim is a renowned condensed matter theorist whose research has had significant impact on our understanding of the physics of geometrically frustrated and highly correlated quantum materials. He has been working at the leading edge of the effects of large spin-orbit coupling on exotic ground states in materials, especially those arising from frustration and Mott physics. This has naturally focused on the very topical area of iridate physics, and there is no doubt that Yong Baek has been a key international figure in this field. He has produced a significant and well-cited body of work on iridate quantum magnetism in the presence of Kitaev and Kitaev-like interactions. This general theme – the role of spin orbit coupling in correlated electron physics – is one that has only just begun to be explored both theoretically and experimentally. However, the field possesses a large scope for interesting new exotic ground states due to 4d and 5d transition metal complexes, which are much less studied, at present, than their 3d counterparts.

The 2017 CAP/DCMMP Brockhouse Medal is awarded to Dr. Yong Baek Kim, University of Toronto for his leading work on the effects of large spin-orbit coupling on exotic ground states in geometrically frustrated and highly correlated quantum materials.

La Médaille Brockhouse de l'ACP/DPMCM 2017 est décernée à Yong Baek Kim, Université de Toronto, pour ses travaux de chef de file concernant les effets de l'ample couplage Russell-Saunders (spin-orbit coupling) sur les états fondamentaux exotiques dans les matériaux quantiques géométriquement frustrés et fortement corrélés.

Yong-Baek's theoretical efforts have been guiding and providing a framework through which this experimental work can be rationalized. It is easy to foresee that his work will become even more influential in the immediate future. Yong Baek Kim's body of work on spin orbit coupling, topological phases of matter and geometrical frustration is both highly original and proven to be influential to a large body of condensed matter physics research.

Finally, he has played a key leadership role on the international scene of quantum materials research as a co-organizer of many workshops and conferences related to geometrical frustration and topological properties of high correlated materials. He is unquestionably highly deserving of the CAP Brockhouse Medal.

Remarks by Yong Baek Kim

I feel very honoured to be recognized by the 2017 Brockhouse Medal. I would like to share this honour with my students and postdoctoral fellows as well as collaborators who have been involved in the research program on quantum materials with strong spin-orbit coupling. This has been an emerging area of research and as such it required a great deal of faith in the initial research program that I was proposing and pursuing. In this context, I would like to particularly thank my students for their trust in my research program.

"I feel very honoured to be recognized by the 2017 Brockhouse Medal. This award certainly reflects the contributions of talented students, postdoctoral fellows, and collaborators from whom I have learned a great deal of physics. I am also very grateful to numerous colleagues for generously sharing their knowledge and resource."

« Je me sens très honoré d'être reconnu par la Médaille Brockhouse 2017. Ce prix témoigne à coup sûr des apports d'étudiants talentueux, de boursiers postdoctoraux et de mes collaborateurs de qui j'ai beaucoup appris en physique. Je suis en outre reconnaissant à de nombreux collègues d'avoir partagé généreusement leur savoir et leurs ressources. »

I would also like to thank the members of the Quantum Materials program in the Canadian Institute for Advanced Research and other colleagues in the canadian condensed matter physics community, for numerous scientific discussions and generously sharing their knowledge and resources. Without such support, this research program would not have been successful.

Recipient of the 2017 Medal / Lauréat de la médaille 2017:

Yong Baek Kim

CAP Herzberg Medal

La Médaille Herzberg de l'ACP

Paul François is one of the world's leading experts in theoretical biophysics, in particular for the modeling of cellular behavior using tools from nonlinear, statistical and computational physics. In particular, François used Monte Carlo approaches to study directed evolution of nonlinear systems modelling gene networks, which led to several theoretical advances in the description of evolution and of systems ranging from immune recognition, biological nonlinear oscillators to vertebrate development. He is using phenomenological approaches inspired by physics to develop "phenotypic models", for instance explaining theoretically many contradictory experimental aspects of early immune recognition. In addition he has applied physical insights to the study of embryonic development. He has developed analysis tools to quantify embryonic development, model flows and diffusion of cells in embryonic tissue. More recently he has built oscillatory phase models explaining puzzling properties of development such as scaling of vertebrae with embryo size or coupling of multiple oscillators driving vertebrae formation. He has been collaborating with several international groups in quantitative immunology and embryonic development, to whom he has provided unique theoretical support. Prof. François' work has been published and featured in the most prestigious interdisciplinary science journals and his work has been recognized by major awards including a 2014 Simons Investigator award for mathematical modelling of biological systems.

The 2017 CAP Herzberg Medal is awarded to Dr. Paul François, McGill University for his seminal research in theoretical biophysics, particularly the use of methods from statistical and computational physics to model cellular processes as non-linear dynamical systems.

La Médaille Herzberg de l'ACP 2017 est décernée à Paul François, Université McGill, pour son travail de pionnier en recherche biophysique théorique, notamment dans l'application de méthodes de physique statistique et computationnelle à des modèles de processus cellulaires, tels les systèmes dynamiques non linéaires.

Remarks by Paul François

It is a tremendous honour to receive the CAP Herzberg medal. I would like to first and foremost thank the Canadian Association of Physicists. It is wonderful to see recognition for theoretical biophysical approaches.

There is still much to understand on how physical principles drive the « living matter ». I find amazing how physics sheds light on complex biological systems. As a theorist, I am convinced that we will discover more and more fundamental principles in biology very similar to what we already know in physics. Theoretical biophysicists already had a crucial role in the development of some of the most important biological ideas. I would say modern biophysics was born a bit less than one century ago, with the so-called "Quantum" model of gene proposed by Dellbruck. This was the basis of the aperiodic crystal model for genetic information discussed by Schrodinger in his famous book "What is life ?" in the 40s, that inspired the theoretical model of Watson and Crick. Another theoretical contribution I admire is the kinetic proofreading model by John Hopfield and Jacques Ninio, who essentially understood and quantified how biochemical processes such as DNA replication could "beat" thermodynamics with the help of energy injection. Such contributions had major impacts on our physical thinking of the cell, and modern biophysical tools allow now to observe such processes with great details, confirming those theoretical ideas, and allowing for the discovery and elaboration of other new principles. We are

"I am humbled and honored to receive the CAP Herzberg medal. I have been very lucky to work with tremendous students, postdocs and collaborators, and it is wonderful to see recognition for our biophysical approach."

« Je suis très honoré et très touché de recevoir la Médaille Herzberg de l'ACP. J'ai eu la grande chance de travailler avec des étudiants, post-docs et collaborateurs exceptionnels, et c'est extraordinaire de voir notre approche biophysique reconnue. »

Recipient of the 2017 Medal / Lauréat de la médaille 2017:

Paul François

entering a golden age for physics applied to biology, with massive amount of data and much better external control of the cell considered as an out of equilibrium dynamical systems. As a professor, I show students how exciting and open this field is, and as a researcher, I am doing my best to build similar physical thinking on a variety of biological problems.

All of this requires interdisciplinary expertise and broad collaborative approaches. I have been very lucky to work with astounding experimental collaborators. With Olivier Pourquié (Harvard), Sharon Amacher (Ohio State), and Alexander Aulehla (EMBL), we have uncovered many fascinating aspects of non linear oscillators implicated in embryonic development. Grégoire Altan-Bonnet (NIH) brought me into the theory of immunology, which is beautifully connected to problems ranging from statistical mechanics to machine learning. I am also grateful to all my colleagues, students and post-docs, and I have very much enjoyed and benefited from the recent boom of biophysics within the McGill/Montreal environment. I am also very grateful to my three scientific mentors. Kirone Mallick, at CEA Saclay first introduced me to the joy and excitement of research, and to fascinating topics in out of equilibrium statistical mechanics very relevant for living systems. Vincent Hakim, my PhD supervisor at Ecole Normale Supérieure in Paris, taught me how non linear physics and computational Monte Carlo methods could be applied to biology. Eric Siggia, my post doc supervisor at Rockefeller University in New York, turned me into a real scientist able to bridge physics into biology. I am trying my best to provide to my own trainees guidance and support similar to what I have received myself.

Finally, I would like to thank my best friend and colleague, Audrey Moores, my wife, for her constant love and support.

CAP Medal for Lifetime Achievement in Physics
La Médaille de l'ACP pour contributions exceptionnelles à la physique

Mark Sutton is an internationally renowned experimentalist in condensed-matter physics. Sutton uses X-ray diffraction to study the behaviour of non-equilibrium condensed-matter systems. He has developed and applied, together with his colleagues, an important new X-ray technique called X-ray Photon Correlation Spectroscopy (XPCS), which makes use of the X-ray equivalent of optical speckle. This new probe directly measures the time evolution of equilibrium and non-equilibrium microstructures at length scales down to a nanometer with millisecond time resolution. The first demonstration of the use of coherent X-rays for XPCS was reported by Sutton et al. in Nature in 1991. This breakthrough paper has generated a very successful series of trend-setting papers and reviews.

The 2017 CAP Medal for Lifetime Achievement in Physics is awarded to Dr. Mark Sutton, McGill University, for pioneering the development of coherent and time-resolved X-ray scattering techniques for the study of materials, and his resulting contributions to our understanding of materials and phase transitions.

La Médaille de l'ACP pour contributions exceptionnelles à la physique 2017 est décernée à Mark Sutton, Université McGill, pour ses travaux en conception de techniques cohérentes de diffusion des rayons X à résolution temporelle destinées à l'étude des matériaux, et pour l'apport qui en découle à notre compréhension des matériaux et des changements de phases.

Recipient of the 2017 Medal / Lauréat de la médaille 2017:

Mark Sutton

The method was further developed by Professor Sutton and his collaborators to investigate important problems in condensed-matter physics involving phase transitions and complex fluids. For example, in his recent studies, last on AuAgZn2, where he determined its order-disorder critical temperature he directly observed critical fluctuations and critical slowing down. Sutton has also applied XPCS to polymer systems, measuring wave vector-dependent time constants in these technologically-important materials. Sutton has used XPCS to show that domain coarsening involves persistent large-scale fluctuations during phase separation during spinodal decomposition and order-disorder transitions. To put this achievement into context, it is probably the most significant experimental work on first-order phase transition kinetics in the last decade.

Sutton's research has always had two equally important main areas of development. The first is to develop better instrumentation and techniques for in-situ time-resolved x-ray scattering to help address his research interests in basic science. He has been involved in designing and building instrumentation at the world brightest x-ray synchrotron sources and the new x-ray laser at SLAC. The second focus is to understand the underlying physics by performing experiments on materials where microstructure plays an important role.

Remarks by Mark Sutton

First, I would like to thank the CAP for the surprise and honour of being awarded the Lifetime Achievement Medal for Physics. I have always said that I have been fortunate in my career to be able to work at my hobby and to be paid for doing it. Being recognized on top of this is the icing on the cake.

"I am honoured and delighted for the recognition of my work by the CAP. I wish to thank my many collaborators, students and postdocs over the years, not only were they fun to work with, I learned a lot from them."

« Je suis honoré et ravi de la reconnaissance de mon travail par l'ACP. Je tiens à remercier mes nombreux collaborateurs, étudiants et boursiers postdoctoraux avec qui il a été non seulement agréable de travailler mais de qui j'ai beaucoup appris au fil des ans. »

During my career, I have been fortunate at many levels. First, for the guidance of my PhD supervisor, Prof. Robin Armstrong, his insights and guidance still influence me in how I think about and do research. My post-doc supervisor Prof. R.J. Birgeneau, whose knowledge and passion for physics have also provided much guidance. I have been fortunate to have two long-time collaborators and friends whom I would like to mention, Dr. Brian Stephenson and Prof. Martin Grant. In addition, there are my many graduate students, postdocs and other collaborators with whom I have worked over the course of my « lifetime achievement ». Over the years, I have been able to pursue my hobby with them; not only were they fun to work with, but I have learned a lot from them as well.

I have also been fortunate to have been in the right place at the right time. My research uses x-rays to probe the structure and properties of materials and my career has spanned a revolution in x-ray scattering. I have been part of designing and building of x-ray diffraction beamlines at the beginnings of the National Synchrotron Light Source at Brookhaven in the early 1980s, the Advanced Photon Source at Argonne in the 1990s, the Linac Coherent Light Source at Stanford in the 2000s and again at the National Synchrotron Light Source II in Brookhaven in the 2010s. Research is generally easy when you have the best tools to work with. It is my opinion that one of the largest impacts that physics has had on society has been to develop the instrumentation and tools used by the many branches of science. Besides, with new instrumentation, one can look at nature and, simply by observing, see and discover new things.

As it turns out, with my research centered at labs around the world, I have been a «suitcase physicist». The Physics Department at McGill has been very supportive of this and I am grateful, as the research could not have been done otherwise.

Finally, needless to say, I thank my wife and my two daughters who have put up with this nonsense and made life most enjoyable.