



NEWSLETTER

Funding Announcements

PIMS Awarded \$7.45 Million in Funding From NSERC & the Alberta Gov't

PIMS is pleased to announce that it has received renewed funding from its government partners. This includes \$6.25 million in funding from the Natural Sciences and Engineering Research Council of Canada (NSERC) for 2014-19, as well as \$1.2 million from the Alberta Government over a three-year period.

“The recent generous grants from NSERC and Alberta Innovation and Advanced Education are vital to the health of PIMS and show that both the Alberta and Canadian governments are acutely aware of how important mathematics is to the growth of a modern economy in Canada based on science, engineering and technology” remarked Brian Russell, Chair of the PIMS Board.

The NSERC grant will contribute to the funding of multiple scientific, training and industrial activities throughout Western Canada, which include the support of conferences, workshops and lecture series, funding Collaborative Research Groups and hosting postdoctoral fellows and distinguished visitors. The funding will also provide dedicated support for the Canadian Statistical Sciences Institute (CANSSI), the Atlantic Association

for Research in the Mathematical Sciences (AARMS) and the establishment of a national institute innovation platform in the mathematical sciences.

The funding commitment by the Alberta Government’s Ministry of Innovation and Advanced Education will be disbursed through PIMS’ member universities in Alberta – the universities of Alberta, Calgary and Lethbridge – and will support PIMS activities in that province.

PIMS Director, Alejandro Adem, remarked, “We are very grateful to the Alberta Government for the renewal of its support for PIMS activities. This funding will be used for key scientific, training, industrial and educational activities, as well as for a strategic initiative connected to the energy sector. Alberta scientists play a leading role at PIMS and this support will have a significant impact.”



PIMS to Launch Training Centre in Stochastics

As part of our renewed funding, PIMS will be launching the PIMS Postdoctoral Training Centre in Stochastics (PTCS).

PIMS has world class groups in probability theory and its applications, and these groups have an excellent track record of postdoctoral supervision and placement. These groups will come together through the new PIMS PTCS to train an outstanding cadre of postdoctoral fellows in probability theory. The program has already attracted \$550,000 in NSF funds for our UWashington site, as well as support from the Province of Alberta. The PTCS will organize summer schools in probability and mathematical finance, develop networking between PIMS sites as well as with groups in Microsoft Research and Eastern Canada and support visits by distinguished visitors.

The program will be directed by Martin Barlow (UBC) and activities are scheduled to begin in 2015.

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Director's Message



Greeting from PIMS! It is with great pleasure that I write to our community about recent developments. I am delighted to report that PIMS has successfully renewed its funding from NSERC for the period 2014-19. Our proposal and reverse site visit in Ottawa went very well and the review committee showered PIMS with praise. This recognizes all the wonderful work

done by the PIMS team as well as the high quality and impact of our scientific, industrial and educational activities.

A few weeks later we learned that our funding from the Alberta Government was also renewed. These funds will flow directly to Calgary, Edmonton and Lethbridge, and provide a continuing boost to PIMS activities in Alberta.

I can also report that the NSERC Research Partnerships Program approved three years of funding for the establishment of the Institutes Innovation Platform. This joint project with our colleagues at CRM and Fields seeks to promote linkages between mathematical scientists and industry at every level. This will build on our existing programs, including the Industrial Problem Solving Workshops and the Mathematical Modeling in Industry Workshops (joint with IMA) both of which were introduced to Canada by PIMS.

In addition, our colleagues at UWashington have been awarded \$550,000 (USD) to fund postdoctoral activities in probability, an area where PIMS has launched a new program, the PIMS Postdoctoral Training Centre in Stochastics, building on the world class expertise at our member universities and our extensive connections to Microsoft. I am grateful to Martin Barlow for leading this effort and to Chris Hoffman for preparing the request to the National Science Foundation.

This adds to a total of over \$8 million in funding for the next five years, an amount that will be significantly leveraged by contributions from our member universities and other funding organizations.

Last month we also hosted a visit by a scientific committee of the CNRS in France, as part of the renewal of our status as an Unité Mixte Internationale. Their visit was a great opportunity for CNRS to hear first hand how positive the impact of our partnership has been, both for French visitors and their hosts. Mechanisms for strengthening our ties to France were also discussed during their visit.

I will let you browse the newsletter to catch up with other news. We continue to receive a large number of excellent proposals for CRGs and other scientific events. Indeed, our pipeline is as healthy as it has ever been. The quality and diversity of the proposed activities are quite remarkable and this will be in evidence as we roll out new programs over the next few years.

Last but not least, I would like to take this opportunity to recognize the fantastic contributions by the PIMS staff both here at UBC and at our other sites; they are essentially important members of our team and we greatly appreciate what they do for the organization.

With best wishes,

Alejandro Adem
Director, PIMS



Pacific Institute *for the*
Mathematical Sciences

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Thank you to:



NSERC
CRSNG

PIMS Emerging Aboriginal Scholars Summer Camp

PIMS is dedicated to increasing public awareness of the importance of mathematics and encouraging students to see mathematics as a subject that opens doors to careers in many exciting fields. PIMS is also a strong advocate for Aboriginal and First Nations students; for the past four years Melania Alvarez, PIMS' BC Education Coordinator, has worked in collaboration with UBC's First Nations House of Learning to deliver the Emerging Aboriginal Scholars High School Summer Camp at UBC. This camp has been proudly sponsored by the UBC Mathematics Department, the Government of British Columbia, the UBC Faculty of Science, the Vancouver Foundation and a number of private donors.

This five-week summer camp provides an innovative program of learning for Aboriginal students at the high school level. In addition to 90 minute classes of both math and English every morning, three afternoons each week are spent working with UBC faculty and researchers in a field of the students' choosing. With program options ranging from engineering to microbiology to forestry to human resources, the students really get an opportunity to experience the university work and research environment, shape their career aspirations and interact with some amazing teachers and mentors.



At the Department of [Microbiology and Immunology](#), Matthew and Sabine worked in a lab with faculty member David Oliver. One project they worked out was on microbes, in which they had the opportunity to enact the scientific process: make hypotheses, test them and draw conclusions from the findings. "I was interested in exploring science" said Matthew of his choice to join this cohort, "and I wanted to go more in depth than I already had."

In the Faculty of [Forestry](#), Keisha, Ocean and Blaise worked with professor Lori Daniels' team on a number of projects including one to detect marker tree-rings associated with the 1964 Port Alberni Tsunami study. "It has been a pleasure having Blaise, Ocean and Keisha work with us in the Tree Ring Lab. Through their internships, they have contributed to a range of research projects that are helping to make a difference in the way we conserve and manage BC's forests" said Daniels.



Nakoda and Erik (twin brothers) spent their work opportunity touring a number of locations within the [Electrical and Computer Engineering](#) Department. In the Alpha Power Laboratory, they learned about power supply technology used in UBC's smart grid, at the Robotics and Control Laboratory they saw the Da Vinci surgical robot and at the System on Chip Laboratory they saw the tools used to develop new computer chip architecture. Erik excitedly recalled some of the hands on experience they received using ultrasound machines and MRI equipment and how when they visited the circuitry lab they got to build and test their own working circuit.



PIMS educational programs aim to narrow the historical gaps that exist between men, women and underrepresented minorities and their interest in the mathematical sciences. We believe that providing increased opportunities and programs will challenge existing stereotypes and boost students' interest and passion for mathematics in challenging and meaningful ways.

Around the Sites

University of British Columbia MARTIN BARLOW

As usual, the UBC site was at its busiest throughout the spring and summer. Activities included: a joint lecture with UBC Statistics featuring Rob Tibshirani (Stanford); the annual *Niven Lecture*, given by Bjorn Poonen (MIT); a public seminar, delivered by Jim Gates (Maryland) and PIMS/UBC Distinguished Colloquia featuring Alexander Lubotzky and Benedict Gross. Also significant were the summer schools in probability and algebraic topology, as well as joint conference and summer schools on string math and the economics and mathematics of systemic risk and the financial networks (see page 4). The site also hosted the annual *Mathematical Modeling in Industry Workshop* (joint with IMA); the participating companies included: National Institute of Standards and Technology; Fisheries and Oceans Canada; KLA-Tencor; ExxonMobil; StatOil; The Boeing Company and Siemens and TU Munich.

University of Regina DONALD STANLEY

Greetings from Regina! The main event this summer at the Regina site was the *Western Canada Linear Algebra Meeting*. Keynote speakers for this successful meeting included Joel Friedman (UBC), Roger Horn (University of Utah), Mitja Mastnak (Saint Mary's University) and Maya Mincheva (Northern Illinois University). As part of the *Community Education and Outreach* initiative, the Department of Mathematics and Statistics is once again offering a series of free problem-solving sessions aimed at Grade 7-10 students, and is assisting the Mother Teresa Middle School students in their after-work homework sessions.

Simon Fraser University NILS BRUIN

The main summer event at SFU was the *Undergraduate Summer School on Multiple Zeta Values*, with undergraduates visiting from all over North America. The CRGs on Applied Combinatorics and Algorithmic Theory of Networks held summer schools and workshops. In addition, we hosted the *Pacific Northwest Number Theory Conference, Symposium on Mathematics and Computation* and an interdisciplinary workshop on HIV treatment and prevention. Education events included the *Changing the Culture* conference for mathematics educators, Math camps in Burnaby and Surrey and our flagship event, the SFU academic summer camp for Aboriginal students.

University of Washington CHRISTOPHER HOFFMAN

This past spring, UWashington hosted Dan Spielman as the *MathAcrossCampus* lecturer, as well as for a colloquium in the math department. We also hosted the *West Coast Optimization* meeting. The site is also pleased to have received an National Science Foundation grant to complement the PIMS Postdoctoral Training Center in Stochastics; postdoctoral hires in probability will likely begin fall 2015.

University of Victoria ANTHONY QUAS

We are excited to be hosting the *Hugh Morris Lecture* for 2014, at which Cedric Villani (University of Lyon and Institut Henri Poincaré) will give a lecture for the general public on “The Mathematics of Bats.” Around this, we are organizing a two-day workshop on kinetic theory and related topics in honour of the retirement of Reinhard Illner (former PIMS Site Director). We have a number of Math Mania school outreach events planned.

University of Lethbridge AMIR AKBARY



NUMBER THEORY SESSION AT ALBERTA MATHEMATICS DIALOGUE

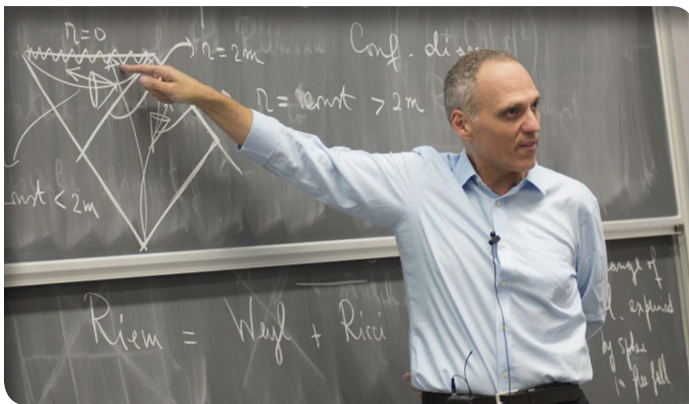
The sixth annual meeting of *Alberta Number Theory Days* was held in April at BIRS. In May, Amir Akbary (Lethbridge) and Peter Zvengrowski (Calgary) organized a *Number Theory Session* in the *Alberta Mathematics Dialogue* at the Augustana Campus of UAlberta, in addition to Minhyong Kim (University of Oxford and POSTECH) delivering a series of lectures on *Arithmetic Fundamental Groups and Diophantine Geometry*. In July we hosted the *Workshop on Algebraic Design Theory and Hadamard Matrices* which, in part, honoured the 70th birthday of Professor Hadi Kharaghani. There were 58 participants (faculty, postdocs, and graduate students from Canada, the USA, Europe, Asia and Australia). It was followed by a two-day workshop in BIRS.

University of Calgary CLIFTON CUNNINGHAM

In addition to a number of small seminar series and guest speakers, Calgary continued to keep busy into the fall semester with the first *Calgary Mathematics & Philosophy Lecture*, “Univalence as a New Principle of Logic,” by Steve Awodey (Carnegie Mellon) and the *9th Annual Richard and Louse Guy Lecture Series*, by Ed Doolittle (First Nations University). The popular *PIMS/Shell Lunchbox Lectures* continue, with recent lectures covering “Adaptive Diversification And Evolutionary Dynamics In High-Dimensional Phenotype Spaces” and “Long Term Asset Allocation for the Patient Investor.” In October, the site also hosted the Shimura Varieties Course masterclass, by Patrick Walls, made available by teleseminar to other PIMS sites.

Niky Kamran is James McGill Professor in the Department of Mathematics and Statistics at McGill University. Kamran, who has spent his career working in the areas of analysis and differential geometry, has far-reaching interests, with the two main directions of his research being in the theory of exterior differential systems and Lie theory, a central area of the geometric analysis of systems of partial differential equations, and the mathematical analysis of general relativity.

Kamran's love for mathematics began in high school, with a teacher who presented the high-achieving students with additional problems to work on. "Some of these problems were quite challenging and I quickly became hooked" says Kamran. He soon decided to pursue a university degree in mathematics. In the final year of his undergraduate degree at the University of Brussels, he worked on an honors thesis under the supervision of Professor Robert Debever, a well-known researcher in mathematical general relativity who was also a generous mentor. "I was able to solve a small open problem that he suggested on exact solutions of the Einstein equations. This led to my first publication." This small success gave him confidence and led him toward his PhD. "The years I spent as a post-doctoral fellow at the centre de recherches mathématiques and as a member of the Institute for Advanced Study in Princeton were a tremendous help in getting me started in my career" states Kamran.



As for his research foci, Kamran recalls his graduate work under the supervision of Ray McLenaghan (at the University of Waterloo). "Ray had a beautiful research program aimed at understanding the links between symmetry operators and separation of variables for relativistic wave equations in curved space-time. This program was inspired in part by the remarkable separability properties of the Kerr black hole geometry." McLenaghan generously shared this program with Kamran and this enabled him to contribute some results, notably on the link between the existence of conformal Killing-Yano tensors and the separability properties of the type D solutions of the Einstein-Maxwell equations. This work, while largely differential geometric, contained the seeds for further analytical developments.

As a post-doc, his interests broadened into the works of Elie Cartan on the method of equivalence and exterior differential systems, and for many years, he collaborated with Peter Olver on equivalence problems in the calculus of variations and other topics related to the geometry of differential equations. However, his interest in wave equations on curved space time was rekindled after reading a very interesting preprint by Felix Finster, Joel Smoller and Shing-Tung Yau, which proved that the Dirac equation in the Schwarzschild black hole geometry has no normalizable time-periodic solutions. This led him to think that the separability of the Dirac equation in Kerr geometry could perhaps be exploited to prove a similar non-existence result in Kerr, which in turn, led to an extensive collaboration on the long-term behavior of solutions of wave equations in the Kerr geometry.

In terms of applications of his research to the real world, Kamran thinks that "an in-depth understanding of some of the mathematical underpinnings of a subject such as general relativity, which allows for very precise experimental verifications on the astrophysical scales, is a worthy goal to aim for." He is currently working with Alberto Enciso on singular initial-boundary value problems for linear and non-linear wave equations in asymptotically anti-de Sitter (AdS) manifolds. This work is motivated, in part, by the need to better understand the mathematical foundations of the AdS/CFT correspondence, a correspondence (still conjectural from a mathematical perspective) between conformal field theories on the time-like conformal boundary of asymptotically AdS manifolds and Einstein metrics on the manifold itself.

Niky Kamran is a member of the PIMS Scientific Review Panel and the recipient of the 2014 CRM - Fields - PIMS Prize. On April 7, 2014, he visited PIMS – UBC and delivered the CRM-Fields-PIMS Prize Lecture, entitled "General Relativity, Differential Geometry and Differential Equations; Stories From a Successful Menage-a-trois" to a packed lecture hall.

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 Around the Sites continued...

University of Saskatchewan RAJ SRINIVASAN

Stavros Stavrou, our outreach coordinator, is working in nine classrooms in seven schools in Saskatoon, engaging students in hands-on math activities that includes content from the curriculum and First Nations perspectives. Nicholas Beaton (University of Melbourne), a postdoctoral fellow for the Applied Combinatorics CRG will join USaskatchewan in December. As well, the Dept. of Mathematics and Statistics and the PIMS CRG in Applied Combinatorics sponsored a satellite conference to CAIMS 2014 on *Combinatorial Applications to Biology, Chemistry and Physics*. The applied math seminar series has been extremely successful; a speaker's list can be found at math.usask.ca/~ammmp



The Economics and Mathematics of Systemic Risk: *Summer School and Workshop*

July 21-30, 2014

The University of British Columbia

Financial markets are not physical systems. The rules they operate by are determined by regulation and the operators try their best to influence and circumvent these regulations insofar as they thwart their own ends. Asset prices are modelled by stochastic processes, as if the randomness came from an outside source, but the markets themselves generate much of the noise. Risk is the downside of randomness. The PIMS Focus Period on Systemic Risk focused on the way the markets generate and propagate risk, and what kind of regulation can mitigate it.

The activities included a highly successful summer school with 70 student participants from around the world, as well as a stellar cast of speakers:

- Rama Cont (Imperial College, London)
Channels of Contagion in Financial Systems
- Darrell Duffie (Stanford University)
Risk Sharing in Over-the-Counter Markets
- Jean-Pierre Fouque (University of California, Santa Barbara)
Diffusion Models for Systemic Risk
- Paul Glasserman (Columbia University)
Contingent Capital and Financial Networks
- Jean Charles Rochet (Swiss Finance Institute, University of Zurich)
Financial Stability
- Yuliy Sannikov (Princeton University)
Economies with Financial Frictions: A Continuous Time Approach

After the summer school, PIMS hosted a specialized workshop, which involved a series of invited lectures involving topics such as: Strategic Complementarity, Fragility and Regulation; Optimal Control of Interbank Contagion; Systemic Risk in Energy Market and Mining; Equilibrium Analysis of Large Populations and Mean Field Games and Intermediary Leverage Cycles and Financial Stability.

In addition, a panel discussion featured academic, regulators, central bankers and industry representatives who presented from their own perspective on systemic risk and helped to define a research agenda, especially targetted for young applied mathematicians and financial engineers. The panelists were: Christine Cumming (VP, Federal Reserve Bank of New York); Joe Langsam (University of Maryland [formerly at J.P. Morgan]); Andrew W. Lo (Massachusetts Institute of Technology) and Bernd Schwaab (European Central Bank).

This event was masterfully organized by Rene Carmona (Princeton), Ivar Ekeland (Paris Dauphine) and George Papanicolaou (Stanford).

Generously sponsored by:



ORGANIZER, RENE CARMONA, INTRODUCES PANELISTS



YULIY SANNIKOV



SUMMER SCHOOL PARTICIPANTS

Program Conclusion

BY IGTC CHAIR, DAN COOMBS

The PIMS International Graduate Training Centre (IGTC) in Mathematical Biology (2007-2014) enhanced student training and leveraged the strength and depth of the PIMS-area mathematical biology community through summer workshops, an annual student summit, student exchanges, as well as fellowships. The IGTC also developed close links between faculty at PIMS sites and set the stage for collaborative work and future events. The program was supported by PIMS and the British Columbia and Alberta governments and later, received significant funds from mPrime, allowing a two-year continuation beyond its original end-date. Our meetings and summer schools received additional support from PIMS member universities and the Banff International Research Station. We gratefully acknowledge all of these contributions.

Mount St Helens; mountain pine beetle control and tuberculosis epidemiology in Canadian First Nations communities; models for neuron spiking patterns and how animal memory can influence movement patterns; computational biology and modelling HIV infection. The final “official” summit of the IGTC was held at The Banff Centre (kindly supported by BIRS) in snowy November. This summit reflected on the IGTC and made plans for the future of mathematical biology activities in BC and Alberta. The session on career transitions featured pre-recorded interviews with seven IGTC alumni discussing their career paths after graduation and giving tips for the current students.

The IGTC also motivated and facilitated a series of successful summer schools in BC and Alberta. The first summer school was at UBC in 2008, and covered topics on molecular processes



2008 SUMMIT



2011 SUMMIT



2012 SUMMIT

The IGTC program is distinguishable from PIMS’ Collaborative Research Groups program by its focus on student training. We proudly involved students from all the British Columbia and Alberta PIMS institutions. The IGTC activities, and especially the research summits, were particularly important for the training of students at the smaller sites, since they would not routinely have access to seminars or group meetings in mathematical biology. The program supported student research in a broad spectrum of mathematical biology, from relatively theoretical studies of predator-prey dynamics to very applied studies on the protocols for radiotherapy to control tumour growth.

The annual summits were a highlight and give a sense of the research activities. The first summit, held in 2007 at UBC Vancouver was organized by students Ryan Lukeman (now: associate professor, St Francis Xavier University) and Sandi Merchant (now: science education postdoc, UBC). The faculty speakers included Mark Lewis (the founding director of the IGTC) and myself (I took over as director in 2011). The student speakers included future IGTC alumni Jun Allard (now: assistant professor, UC Irvine) and Raluca Eftimie (now: lecturer, Dundee University), speaking on spatiotemporal dynamics of helical filamentous structures in cells, and on how inter-animal communication can influence the formation of swarms and flocks of animals in nature, respectively.

In the summits that followed, student participants engaged with topics such as: sea-lice infections of salmon and plant succession on

in the cell. Jonathan Martin, a student at the summer school, stated that “... [it] was a very rewarding experience. ...Each participant walked away with a new perspective on modelling which should prove useful in whatever field of research they decide upon.” Other events included a workshop on epidemic models, a summer school on *Mathematics for Biological Networks*, a course by Mark Lewis on *Models in Ecology* (delivered twice), a *Mathematics Behind Biological Invasions* course and the support of many distinguished visitors, special seminars and symposia.

Our success can be measured quantitatively in terms of student numbers, papers, events and alumni success, but as well, by its success in bringing together scientists from all PIMS universities in a richly collaborative group. This applies to our faculty, who benefit from an established network of contacts, expertise and friendships, as well as our trainees, who were able to meet their peers from across the region and develop a support structure as they moved along their career paths. Thanks to an anonymous donation to support student training in mathematical biology, we are beginning to plan the next regional summit for early 2015 - marking the beginning of a new phase of development.

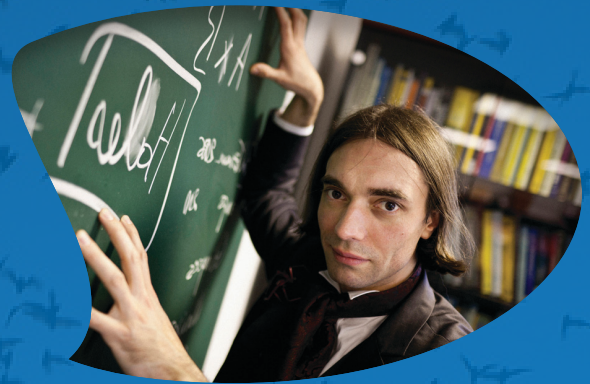
I would like to express special thanks to the brave IGTC administrators who ensured the success of the program over the last seven years: Gustavo Carrero, Caroline Bampfylde, Maryna Yaskina, Oriana Bella and Ruth Situma.

The Mathematics of Bats

2014 Hugh Morris Lecture

November 14, 2014

University of Victoria
Bob Wright Centre, room B150
6:45 pm



SPEAKER: Cédric Villani
(University of Lyon & Institut Henri Poincaré)

This PUBLIC LECTURE is open to the university community and beyond, with a special invitation to high school students and educators.

WEBSITE: <http://www.pims.math.ca/scientific-event/141114-hcmlcvlihp>

The Hugh Morris Lecture Series has been generously endowed by Dr. Hugh Morris (1932-2012), former Chair of the PIMS Board of Directors, and long-time friend of the mathematical sciences. Dr. Morris had more than 40 years of experience in the mineral industry, including a term as Chairman and Chief Executive Officer of Imperial Metals, and was a fellow of the Royal Society of Canada. Dr. Morris was a member of NSERC's Council and Chairman of the Board of Directors of the Lithoprobe Project.