

# Pacific Institute *for the* Mathematical Sciences

Year in Review 2014



University  
of Regina



Simon Fraser University • University of Alberta • University of British Columbia • University of Calgary  
University of Lethbridge • University of Regina • University of Saskatchewan • University of Victoria  
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## *From the Director*

**The year 2014 was especially important for PIMS, as we were able to secure funding from NSERC for the 2014-19 cycle.** Indeed, our funding increased to \$6.25 million, an increase of almost 14%. I am extremely grateful to our colleagues in BC, Alberta and Saskatchewan who worked so hard to prepare a competitive proposal and to our exceptional staff for their crucial support.

Soon after receiving the excellent news from NSERC we heard from the Alberta Government that our funding had also been renewed – they will provide \$1.2 million over the next three years. This funding will be used exclusively for programs based in the Province of Alberta, which will greatly benefit mathematical scientists, educators and students affiliated with the universities of Alberta, Calgary and Lethbridge.

Our proposal contained a number of new ideas, foremost among them is the PIMS Postdoctoral Training Centre in Stochastics, which will create a training platform for PDFs working in probability and related areas across the PIMS sites. This builds on the excellence of Western Canada and the US Pacific Northwest in this area and the remarkable achievements by faculty at PIMS universities. Martin Barlow (PIMS current interim deputy director) will be coordinating this program, which has already attracted substantial support from the US National Science Foundation through our University of Washington site. We will also be providing dedicated support for the newly established Canadian Statistical Sciences Institute (CANSSI) as well as the Atlantic Association for Research in the Mathematical Sciences (AARMS).

In 2014 PIMS launched two new Collaborative Research Groups: *Applied Combinatorics* and *Applied, Algebraic and Geometric Topology*. These CRGs have already organized a number of very successful events which you can read about on pages 4 and 5. The topics of these and future CRGs illustrate the impressive quality and diversity of proposals that are adjudicated by the PIMS Scientific Review Panel.

In July, PIMS hosted a focus period on the *Mathematics and Economics of Systemic Risk*, organized by Rene Carmona, George Papanicolaou and Ivar Ekeland. This included a spectacular summer school with world class speakers and a workshop involving academics, regulators and folks from the financial industry (see page 10-11). In August, PIMS co-organized (with IMA) the *Mathematical Modeling in Industry Workshop*, with significant participation from industry. Students from all over North America benefited from this event, which took place in Vancouver for the first time.

The IGTC in Mathematical Biology wrapped up its excellent work, under the leadership of Dan Coombs. This program trained some truly outstanding students and helped create a robust network of math biologists in Western Canada. Meanwhile, the PIMS postdoctoral program continues to attract top level talent to PIMS universities; in 2014 PIMS funded over 40 postdoctoral fellows either through CRGs or our standard competition.

I also want to mention the incredibly vibrant educational programs that take place at PIMS, due to the remarkable leadership of our educational coordinators: Melania Alvarez (UBC); Malgorzata Dubiel (SFU); Sean Graves (UAlberta); Indy Lagu (Calgary); David Leeming (UVic) and Harley Weston (URegina) – a hearty thanks to all of them! Our programs include (just to mention a few) math competitions, summer camps for Aboriginal students, workshops for teachers, the yearly *Changing the Culture* conference (held at SFU), the PIMS Education Prize and the publication *Pi in the Sky*.

We are also very grateful to our individual and corporate donors for making our educational and outreach activities possible, particularly to Darrell Duffie, Haig Farris, Ahmad Jawad, Vaho Rebassoo, Brian Russell, Ken Spencer, Anton Kuipers and Andy Wright.

A handwritten signature in black ink, appearing to read 'Alejandro Adem'. The signature is fluid and cursive, with a large initial 'A'.

Alejandro Adem, *Director*



# About PIMS

**The Pacific Institute for the Mathematical Sciences was founded in 1996; it is a consortium of universities in the Pacific Northwest and Western Canada.**

**Member universities:** Simon Fraser University, University of Alberta, University of British Columbia, University of Calgary, University of Lethbridge, University of Regina, University of Saskatchewan, University of Victoria and University of Washington.

**Affiliate:** Portland State University.

The PIMS mandate is to promote research and applications of the mathematical sciences of the highest international caliber, to facilitate the training of highly-qualified personnel at the graduate and postdoctoral level, to enrich public awareness of mathematics through outreach, to enhance mathematical training for teachers and students in K-12 and to create mathematical partnerships with similar organizations in other countries, with a particular focus on Latin America and the Pacific Rim.

The central office is at the University of British Columbia, with a PIMS site office and a site director local to each of the nine member universities. The site director facilitates local opportunities and synergies, while the PIMS site offices provide administrative assistance for organizing local events. This distributed structure renders it quite unique, involving strong local site offices and activities, and allowing a broad impact across Western Canada and beyond.

The Board of Directors oversees the administration of PIMS, with membership consisting of the VP of Research from each of the member universities, as well as distinguished scientists and representatives from industry. An independent Scientific Review Panel composed of internationally renowned mathematical scientists assesses proposals for scientific events and programs.

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# 2014 Activity Overview

**PIMS is a leading mathematical institute in North America**, with worldwide impact on the mathematical sciences and their applications. PIMS has established innovative programs which have had a transformative effect on mathematical research and training of students and postdoctoral fellows.

**In 2014, PIMS helped to support more than 100 scientific activities.** These involved more than 6,000 participants who spent over 21,000 days at PIMS activities.

**Conferences and Workshops:** Across PIMS sites, 2014 was another activity-filled year, with more than 100 events being hosted or sponsored. Highlights include the workshop on *Economics and Mathematics of Systemic Risk*, as well as the highly successful *Math Strings Conference* in Edmonton.

**Summer Schools:** As has become the norm, summer was a time of heightened activity at PIMS sites. PIMS hosted and helped sponsor nine summer schools in 2014 including the *PIMS Summer School in Probability* at UBC and the *Undergraduate Summer School on Multiple Zeta Values* at SFU.

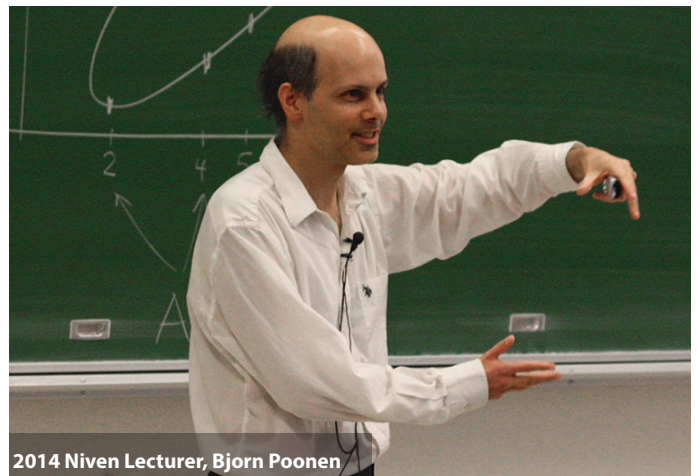
**Lecture and Seminar Series:** PIMS supports 28 seminar series at member universities each year. In 2014, these included several distinguished colloquia series across the sites, as well as the *Geometry and Physics Seminars* (organized by the CRG in that area), which are broadcast via teleconference from UBC to UAlberta and vice versa.

**Industrial and Applied Activities:** In 2014, for the first time, the *IMA/PIMS Mathematical Modeling in Industry Workshop*, was held in Vancouver, at PIMS' UBC site – industrial representation included the National Institute of Standards and Technology, Fisheries and Oceans Canada, ExxonMobil and The Boeing Company, and covered a wide range of topics. The *PIMS/Shell Lunchbox Lecture Series* continued in Calgary, exploring topics from *Mathematical Issues in Wind Turbine Aerodynamics* to *Oscillations in Microvascular Networks*.

**Distinguished and Public Lectures:** Once again, PIMS has had great success in attracting high level speakers, most notably Cedric Villani (2010 Fields Medalist), who delivered the fourth *Hugh C. Morris Lecture* at the University of Victoria. Other distinguished PIMS speakers in 2014 included B. Gross, A. Lubotzky, J. Nešetřil, D. Levermore, B. Poonen, R. Tibshirani, N. Kamran, L. Petzold and D. Spielman.



West Coast Algebraic Topology Summer School



2014 Niven Lecturer, Bjorn Poonen



Algebraic Topology- Methods, Computation and Science Workshop

# Collaborative Research Groups

**PIMS Collaborative Research Groups (CRGs)** develop research and training networks, establishing lasting interdisciplinary links between geographically dispersed groups of researchers at member universities. CRGs organize thematic activities, such as workshops, summer schools and seminars, make joint postdoctoral fellowship (PDF) appointments and/or develop joint graduate training programs. PIMS has developed 28 CRGs since its inception, in areas ranging across all the mathematical sciences. These have served as catalysts for producing mathematical research of the highest quality in Western Canada and attracting outstanding faculty to PIMS universities.

**PIMS had six CRGs operating in 2014:** Applied and Computational Harmonic Analysis (2011-2014); Optimization: Theory, Algorithms and Applications (2012-2015); Algorithmic Theory of Networks (2012-2015); Geometry and Physics (2013-2016); Applied Combinatorics (2014-2017) and Applied, Algebraic and Geometric Topology (2014-2018).

## Applied Combinatorics (2014-2017)

The CRG in Applied Combinatorics will address problems at the interface of discrete mathematics and the physical sciences. The key objects are beautiful and subtle combinatorial models, which are of interest to both pure and applied mathematicians and increasingly, play a deep role in a variety of phenomena in the sciences. This CRG will tie together researchers working in this area across Western Canada to form a self-sustaining research network.

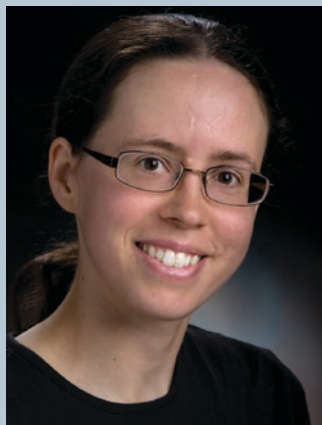
Topics to be considered include the combinatorics associated to: lattice models of polymers, quantum field theory, the statistical mechanics of jamming phenomena, models of RNA and DNA, nesting structures and secondary RNA structures, ancestral genome reconstruction, 3D lattice paths and the kernel method.

In 2014, this CRG supported the *PIMS Analytic RNA Combinatorics Workshop* (PARC) at SFU, as well as *Combinatorial Applications to Biology, Chemistry and Physics*, a conference, at the University of Saskatchewan. Activities envisaged include a summer school and workshop on physical combinatorics in 2015, a flagship research conference in 2016 and inter-university seminars connecting the three sites.

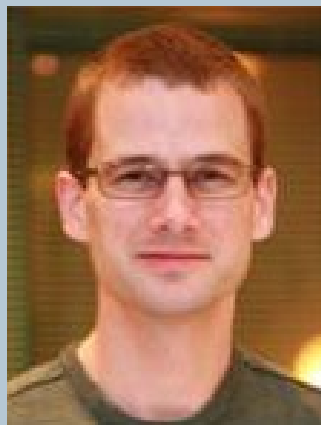
## CRG Leaders



Marni Mishna  
(SFU)



Karen Yeats  
(SFU)



Andrew Rechnitzer  
(UBC)



Chris Soteris  
(USaskatchewan)



# *Applied, Algebraic and Geometric Topology (2014-2018)*

Topology is a central area of mathematics, with broad interactions with many other fields as well as emerging applications to subjects such as robotics, economics, computer science and large data set analysis. The subject is often divided into its applied, algebraic and geometric constituents, each of which is a thriving subfield with interesting problems and lots of activity. However, this compartmentalization of topology makes the training of students and postdocs a major challenge, as there are many common concepts and natural opportunities for cross-fertilization that are lost by emphasizing a narrow focus.

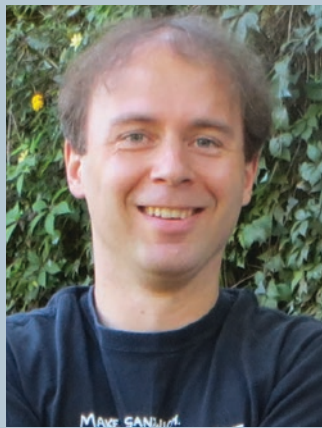
This CRG emphasizes all three aspects of topology mentioned above, providing opportunities for exploring new lines of research and for training the new generation of students and young researchers with emphasis on both depth and breadth. Recent exciting developments in topology such as the solution of the Kervaire invariant one problem, the proof of the virtually Haken conjecture, as well as the emergence of algebraic topology as a tool for analyzing large data sets indicate that this is an especially opportune time to organize thematic activities in this important discipline.

This CRG supported a number of activities in 2014, including the *Algebraic Topology: Methods, Computations and Science Conference* and the *West Coast Algebraic Topology Summer School* (both at UBC), as well as an ongoing topology seminar series. In 2015 they will be involved in the *PIMS Symposium on Geometry and Topology of Manifolds* at UBC, the *Combinatorial Constructions in Topology* workshop at URegina and the *PIMS Workshop on Applied Topology and High-Dimensional Data Analysis* at UVic.

## *CRG Leaders*



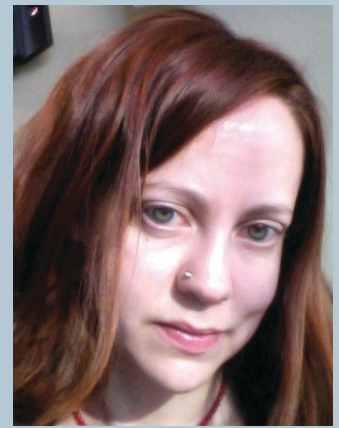
Kristine Bauer  
(UCalgary)



Ryan Budney  
(UVic)



Donald Stanley  
(URegina)



Alexandra Pettet  
(UBC)

## *Marsden Memorial Lecture*

On April 7th, at the Instituto Nacional de Matematica Pura e Aplicada (IMPA) in Rio de Janeiro, Mathieu Desbrun's (Caltech) lecture on *Geometric Discretization for Computational Modeling* attracted an audience of nearly 130 attendees. Desbrun's lecture was stimulating, humorous and well-received, generating substantial discussion. Two of the three previous Marsden Memorial Lecturers (A. Weinstein and R. Montgomery) were in attendance.

*The Marsden Memorial Lecture Series is dedicated to the memory of Jerrold E Marsden (1942-2010), a world-renowned Canadian applied mathematician. He did extensive research in the areas of geometric mechanics, dynamical systems and control theory and was one of the original founders in the early 1970's of reduction theory for mechanical systems with symmetry, which remains an active and much studied area.*



# International Graduate Training Centre in Mathematical Biology

**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 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. Additional support was also received from PIMS member universities and the Banff International Research Station (BIRS).

The IGTC program differs from standard PIMS CRGs by its focus on student training. The IGTC activities, and especially the research summits, were particularly important for the training of students at the smaller sites, since they do 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. Student participants engaged with topics such as: sea-lice infections of salmon and plant succession on 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 BIRS; it 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 tips for the current students.

The IGTC motivated and facilitated a series of successful summer schools in BC and Alberta, as well as other events including 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.

The Centre’s success can be measured quantitatively in terms of student numbers, papers, events and alumni, as well as by its success in bringing together scientists from all PIMS universities in a richly collaborative group. This applies to faculty, who benefit from an established network of contacts, expertise and friendships, as well as 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, the next regional summit is being planned for early 2015 – marking the beginning of a new phase of development.

## Acknowledgement

PIMS expresses special thanks to the 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.



# Education



**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. An integral part of the PIMS mandate is to enrich public awareness of mathematics through outreach and to enhance mathematical training for teachers and students in K-12. PIMS is also a strong advocate for Aboriginal and First Nations students.**

This summer, PIMS' SFU site offered the inaugural SFU Academic Summer Camp for Aboriginal Students. While PIMS has been hosting summer camps for Aboriginal students at its UBC site for a number of years, we are proud to support even more students, through this newly established camp.

The summer camp was delivered through a partnership of the Department of Mathematics and the Office for Aboriginal Peoples at SFU and the Interdisciplinary Research in the Mathematics and Computational Sciences Centre (IRMACS), with the support of Natural Sciences and Engineering Research Council of Canada (NSERC), the SFU Faculty of Science and PIMS. The main organizer of the camp was Veselin Jungic, Deputy Director of the IRMACS Centre and Associate Chair of the SFU Department of Mathematics.

The camp, which was held from July 2 to August 1, encouraged its 25 enrolled Aboriginal students (from grades 8-11) to pursue post-secondary education through helping them to accelerate in mathematics and English, while also exposing them to the university environment and experience.



## Aboriginal Scholarship

Summer camps, scholarships, mentorship programs, math manias and math clubs provide a students with math skills that prepare them for a post-secondary education.

## Changing the Culture

An annual one-day workshop that brings together mathematicians, mathematics educators and school teachers from all levels to improve teaching.

## Math on the Move

Visiting communities in Saskatchewan with inquiry-based mathematics activities for grades 9 and 10 students.

## ELMACON

A yearly event for Grades 5 to 7 students from Lower Mainland BC and the Victoria area that provides an opportunity to experience mathematics as an exciting sport.

## Math Central

A tool for teachers, attracting answer submissions from around the world including Italy, Romania, Turkey and Indonesia. (Maintained by PIMS URegina.)

## Math Mania

Presents a variety of interactive demonstrations, puzzles, games and art designed to demonstrate fun ways of learning math.

# Postdoctoral Fellows

Every year PIMS sponsors numerous postdoctoral fellows (PDFs), attracting outstanding young scientists who contribute to PIMS research programs, many of whom later become faculty members at Canadian universities. PDFs are distributed throughout PIMS sites on a competitive basis. In addition, each CRG is allocated a number of PDFs, the selection of which is determined by an assessment panel. In 2014 PIMS supported a total of 42 PDFs distributed among all its sites.

## 2014 Incoming Postdocs:

Alexander Bihlo *USaskatchewan*

Jesse Daniel Raffa *UWashington*

Nicholas W. Reichert *UWashington*

Duncan Hewitt *UBC*

Jaegil Kim *UAlberta*

Khoa H Nguyen *UBC*

Kui Yu *SFU*

Nicholas Beaton *USaskatchewan*

Minghua Lin *UVic*

Stephen Scully *UAlberta*

Julien Courtiel *SFU*

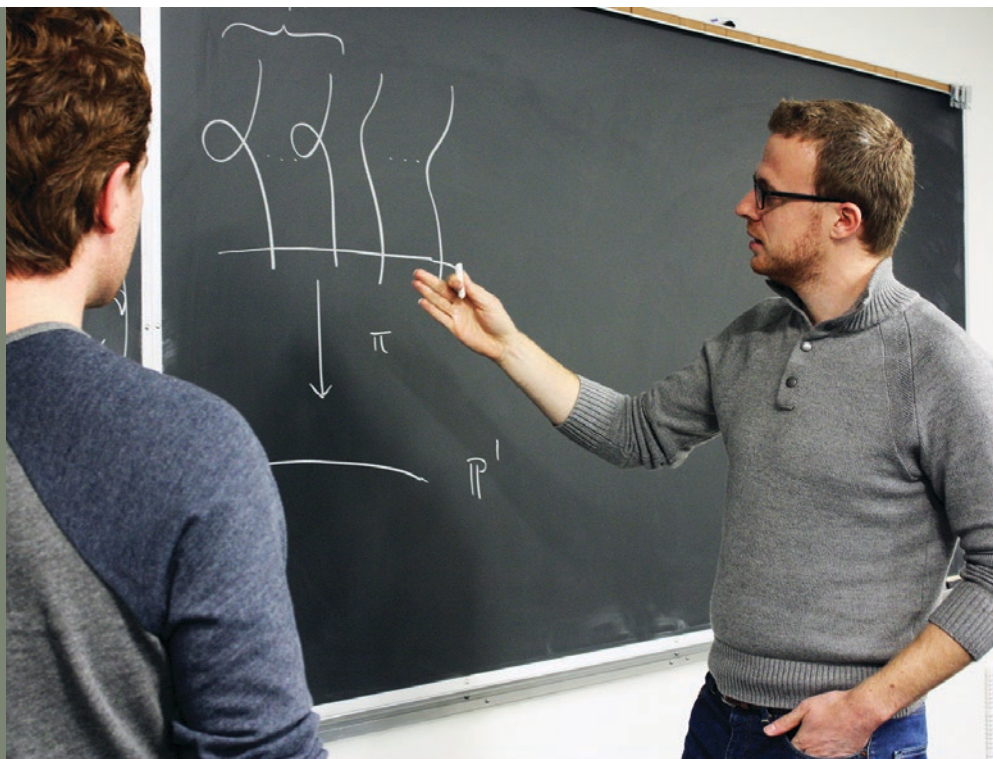
Juliette Bouhours *UAlberta*

Peter Kling *SFU*

Bin Xu *UCalgary*

## Featured Postdoctoral Fellow: Martijn Kool

“Before joining PIMS in September 2013, I completed my doctoral studies at the University of Oxford (2010) and worked as a postdoc at Imperial College. My area is algebraic geometry, which is concerned with the study of spaces defined by algebraic equations. Two of my main research topics are parameter spaces of vector bundles on toric varieties and enumeration of singular curves on complex algebraic surfaces. Together with Vivek Shende and Richard Thomas, I showed such enumerations only depend on the topology of the surface, the degree of the curves and the number of singularities. Our proof uses modern invariants of algebraic varieties known as Donaldson-Thomas invariants.



Kai Behrend and Jim Bryan are two of the leading experts in Donaldson-Thomas theory, so I was thrilled by the opportunity to come to UBC. This year I worked together with Jim Bryan (and parts with Benjamin Young) on the calculation of Donaldson-Thomas invariants of local elliptic surfaces using motivic methods and torus localization. This allows us to break up the invariants into smaller pieces, which we compute using the topological vertex. As an application, we found a new proof of Katz-Klemm-Vafa conjecture (primitive case) from string theory. The novel feature of our work is the application of the topological vertex to non-toric geometries.

As a PIMS CRG (Geometry and Physics) postdoc, I organized a biweekly joint seminar with UAlberta. This allowed me to invite and interact with many important algebraic geometers. My time in Vancouver provided the ideal preparation for my tenure track job at Utrecht University starting in January 2015.”



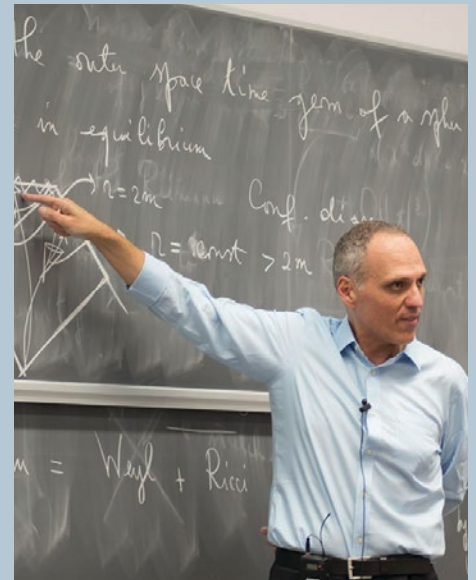
# 2014 Prizes & Awards

## CRM - Fields - PIMS Prize

**Niky Kamran (McGill)**

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 is a superb expositor, and has contributed influential survey articles and monographs. His work is remarkable for its brilliant, original insights, in combination with a deep mathematical culture, representing a wide and varied range of topics of interests. Kamran's contributions will have a lasting scientific impact on Canadian mathematics and on the global mathematical community.

*Kamran has been a member of the PIMS Scientific Review Panel since 2011.*



## CAIMS/PIMS Early Career Award in Applied Mathematics

**Geoff Wild (University of Western Ontario)**

Wild has been cited "for his creative use of mathematical modelling to address fundamental questions in evolutionary biology." He harnesses approaches from dynamical systems and stochastic processes to investigate the adaptive significance of animal behaviour and has tackled a variety of topics, including parental investment in offspring, animal movement, altruism and pathogen virulence. Wild's most recent work focuses on the evolutionary transition of populations of solitary individuals into those with more complex, social organization.



## PIMS Education Prize

**Susan Milner (University of the Fraser Valley)**

Milner's interest in mathematics curriculum has led her to become an active member of the BC mathematics community. Her expertise in popularizing mathematics led her to bring PIMS Math Mania to schools in the Fraser Valley where, since 2007, she (often accompanied by her team of colleagues and volunteers) has visited scores of schools. These visits have inspired some of the schools to organize their own Math Mania events. In 2013, the University of the Fraser Valley recognized Susan's work by awarding her the 2013 Dean of Science Awesome Achievement Award in Outstanding Outreach.

Milner has enhanced and enriched PIMS' Math Manias, by adding many of her own favourite activities, including origami and puzzles. Using puzzles to teach mathematics and to attract people to mathematics has been one of Susan's passions.





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

The PIMS Focus Period on Systemic Risk (July 21-30) investigated the way financial markets generate and propagate risk and what kind of regulation can mitigate it. The activities included a **summer school and workshop**. The summer school was comprised of six courses of three lectures each. The lecturers – senior economists, finance academics, and mathematicians – were of the highest caliber, and leaders in their respective fields of expertise.

The courses raised a wide range of issues, and the choices of topics were radically diverse. The tools brought to bear to tackle these issues were as varied as the backgrounds of the lecturers. The presentations ranged from the most mathematical models, including sophisticated stochastic game models (Sannikov), high dimensional stochastic dynamical systems and mean field games (Fouque), to the one or two period models leading to explicit solutions highlighting investor behavior at the source of bank runs (Rochet). The courses also covered the analysis of the complex networks underpinning the system of financial transactions and the impact of regulatory constraints like clearing and capital requirements (Cont, Glasserman). Finally, investor behavior and over-the-counter markets were given a sound mathematical foundation in game theoretic frameworks (Duffie).

The diversity in the backgrounds of the lecturers was mirrored in the attendance of the 70 enrolled participants, which were a patchwork of PhD students and young researchers from around the world and representing the fields of economics and applied mathematics in approximately the same proportions. The lecturers challenged and engaged the participants and the spirited exchanges made the event lively and entertaining. The high level of the speaker-audience interactions were a hallmark of the summer school.







Summer School Participants

## *Summer School Speakers:*

**Rama Cont** (Imperial College, London)  
*Channels of Contagion in Financial Systems*

**Paul Glasserman** (Columbia University)  
*Contingent Capital and Financial Networks*

**Darrell Duffie** (Stanford University)  
*Risk Sharing in Over-the-Counter Markets*

**Jean Charles Rochet** (Swiss Finance Institute, University of Zurich)  
*Financial Stability*

**Jean-Pierre Fouque** (UC Santa Barbara)  
*Diffusion Models for Systemic Risk*

**Yuliy Sannikov** (Princeton University)  
*Economies with Financial Frictions: A Continuous Time Approach*

The workshop that followed picked up where the summer school left off, with analysis of large systems and stress propagation through complex networks. The presence of regulators and researchers from US and European central banks and from the Office of Financial Research of the US Department of the Treasury gave a different tone to the interactions between the speakers and audience. While cutting edge mathematical analysis of systemic risk models were presented, legal issues and regulation took center stage the second day of the workshop. One of the highlights of the workshop was a panel addressing the aftermaths of the recent financial crisis including regulatory interventions. The unique perspectives offered by the diverse group of panelists: Christine Cumming (Federal Reserve Bank of New York); Joe Langsam (University of Maryland); Andrew W. Lo (Massachusetts Institute of Technology) and Bernd Schwaab (European Central Bank), got the audience excited and actively involved in a vibrant debate.

While the study of systemic risk is not yet a field of its own, vibrant research is conducted by economists, mathematicians and engineers and the synergy demonstrated during the PIMS program has all the signs of a nascent interdisciplinary field.

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

*Generously sponsored by:*



# *The 2014 Hugh C. Morris Lecture: The Mathematics of Bats*

The 2014 Hugh Morris Lecture, delivered by Cedric Villani (University of Lyon & Institut Henri Poincaré), winner of the 2010 Fields Medal, was held on November 14th at the University of Victoria. This public lecture boasted an attendance of over 300 people, including: high school and university students, university faculty members, University of Victoria senior administration and members of the community. In addition to being the 2014 Hugh C. Morris Lecture, Villani's lecture was also part of a larger conference, the *Workshop on Kinetic Theory and Related Topics*, which honoured Reinhard Illner (the original site director at PIMS UVic) on the occasion of his retirement.

The lecture was preceded by a reception held jointly by PIMS and the French Consul General in Vancouver. Villani and attendees were welcomed by Jamie Cassels, President of the University of Victoria and by Mathieu Leporini, Scientific Attaché to the French Consul General. The lecture was introduced by Alejandro Adem, PIMS' Director. Villani was then given a lively introduction by David Castle, Vice President Research at the University of Victoria, who summed up by saying "I've never been in the company of a math celebrity before!"

The lecture itself was a wide-ranging exploration of a circle of questions: What is mathematics? How does mathematics relate to nature and to other sciences? As well as a more personal perspective: How does mathematics relate to celebrity? (This was illustrated by photographs including one from the French magazine *Télérama*, in which Villani was compared to Lady Gaga.)



The lecture then focussed on its title: *The Mathematics of Bats*. Villani accompanied his lecture with beautiful graphics – a fantastic variety of pictures of ancient mathematical texts, portraits, bats (some cute, some ugly and others just strange) – and with quotations from great historical thinkers.

Villani explained the egalitarian nature of mathematics – how students and teachers can interact on an equal footing because the basic tools of proof are equally available to both without the need for costly research tools. The audience was treated to graphical computer simulations of what happens when a bat catches an insect – interestingly, the bat appears to miss, and then come back around to catch its prey. A perceptive audience member pointed out the relationship between the bat's hunting technique and Villani's lecturing technique in which a variety of provocative, but apparently unconnected parts are suddenly connected in the last instant.

The audience was clearly captivated – at the end of the lecture, a long stream of people waited to meet Cedric and speak to him on both topics of mathematics and celebrity.

Villani had come direct to Victoria from Lisbon and was then en route to Toronto, where a symposium celebrating his work would take place the following week.

*The Hugh C. Morris Lecture Series has been generously endowed by Dr. Hugh Morris, former Chair of the PIMS Board of Directors, and long-time friend of the mathematical sciences. The Series attracts the world's top mathematical scientists, who deliver presentations on current research topics to PIMS sites in Western Canada and Washington State.*



Cedric Villani [L] with Reinhard Illner [R]



# 2015 Event Highlights

## EVENTS, CONFERENCES AND WORKSHOPS

7 March	<b>Frontiers in Biophysics 2015</b> University of British Columbia
20-24 April	<b>Statistical Theory for Large Scale Data</b> Simon Fraser University
25 April	<b>BC Combinatorics Day</b> University of Victoria
25-26 April	<b>Cascade Topology Seminar</b> University of Victoria
1 May	<b>Secondary School Math Outreach</b> University of Victoria
2 May	<b>ELMACON</b> University of British Columbia
8 May	<b>Changing the Culture</b> Simon Fraser University
11-15 May	<b>Big Data in Environmental Science</b> University of British Columbia
16-17 May	<b>Lie Theory Workshop: Geometry and Lie Theory</b> University of Alberta
May (Dates TBC)	<b>Alberta Mathematics Dialogue</b> University of Lethbridge
May (Dates TBC)	<b>Alberta Number Theory Days 7</b> Banff International Research Station
11-14 May	<b>IMA/PIMS Hot Topics Workshop on Hydraulic Fracturing</b> University of Minnesota
20-22 May	<b>PIMS Workshop on Advances in Seismic Imaging and Inversion</b> University of Alberta
27-29 May	<b>PIMS Young Researchers Conference in Mathematics and Statistics</b> University of Calgary

## SUMMER SCHOOLS

2-27 June	<b>SFU/PIMS Undergraduate Summer School on Rigorous Computing</b> Simon Fraser University
15 June - 11 July	<b>CRM-PIMS Summer School in Probability</b> McGill & Université de Montréal
15-26 June	<b>Geometric and Computational Spectral Theory</b> Centre de recherches mathématiques
15-26 June	<b>Séminaire de mathématiques supérieures</b> Université de Montréal
6-31 July	<b>AARMS-PIMS Summer School in Differential Equations and Numerical Analysis</b> Dalhousie University

## COLLABORATIVE RESEARCH GROUPS

2015 - 2018	<b>Applied PDEs: Modeling, Analysis, and Computation</b>
2015 - 2018	<b>Explicit Methods for Abelian Varieties</b>
2014 - 2017	<b>Applied Combinatorics</b>
2014 - 2018	<b>Applied, Algebraic and Geometric Topology</b>
2013 - 2016	<b>Geometry and Physics</b>

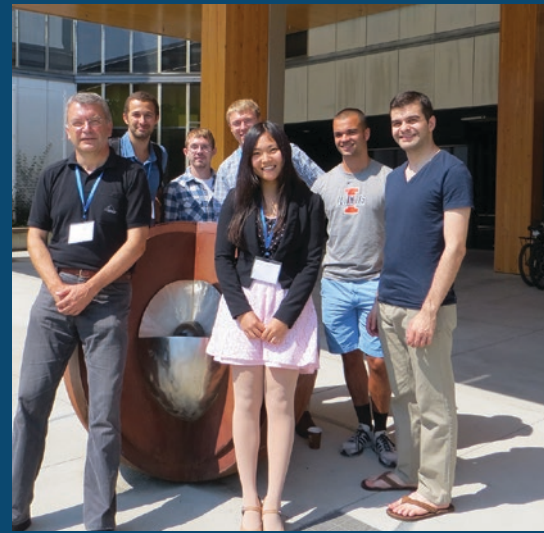
1-4 June	<b>Canadian Discrete and Algorithmic Mathematics</b> University of Saskatchewan
10-12 June	<b>Western International Workshop on Harmonic Analysis and PDE</b> University of British Columbia
11-14 June	<b>Theory Canada 10</b> University of Calgary
15-19 June	<b>Connections in Discrete Mathematics Conference</b> Simon Fraser University
17-21 June	<b>Canadian Undergraduate Mathematics Conference</b> University of Alberta
28 June - 6 July	<b>CMS Regional Math Camp</b> University of Calgary
29 June - 10 July	<b>PIMS Symposium on the Geometry and Topology of Manifolds</b> University of British Columbia
8-11 July	<b>Canadian Undergraduate Computer Science Conference</b> University of British Columbia Okanagan
13-17 July	<b>MSI-PIMS Workshop on Conformal Field Theory and Related Topics</b> Australian National University
5 August	<b>Graduate Workshop on Target Benefits</b> University of Toronto
August (Dates TBC)	<b>Prairie Discrete Math Workshop</b> Banff International Research Station
17-21 August	<b>Combinatorial Constructions in Topology</b> University of Regina
24-28 August	<b>Workshop on Applied Topology and High-Dimensional Data Analysis</b> University of Victoria

## PUBLIC & DISTINGUISHED LECTURES

19 January	<b>Olaf Schenk</b> University of British Columbia
30 January	<b>Tom Hou</b> University of British Columbia
2 February	<b>David Moulton</b> University of British Columbia
23 February	<b>Dan Hammer</b> University of British Columbia
13 March	<b>Jill Pipher</b> University of British Columbia
26 March	<b>Edgar Knobloch</b> University of Alberta
27 March	<b>Kai Behrend</b> University of British Columbia
30 March	<b>Oliver Jensen</b> University of British Columbia
July TBD	<b>Ingrid Daubechies</b> University of British Columbia

For more information and updates, visit  
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