



# Pacific Institute *for the* Mathematical Sciences

Year in Review 2015



Simon Fraser University • University of Alberta • University of British Columbia • University of Calgary  
University of Lethbridge • University of Manitoba • University of Regina • University of Saskatchewan  
University of Victoria • University of Washington • Portland State University

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## *From the Director*

**The year 2015 saw a significant leadership transition at PIMS.** After ten years at PIMS, first as deputy director and then as director, Alejandro Adem stepped down from his position here on February 1 to become the new CEO of MITACS. Under Alejandro's leadership PIMS has grown enormously in stature; we look forward to a similar period of growth in the next decade.

We are delighted to welcome UManitoba as a full member of PIMS. The mathematics department there is in the process of renewal and we are very excited by the new possibilities, in terms of research networks, education and innovation that come with UManitoba's membership.

In 2015 PIMS launched two new CRGs: Explicit Methods for Abelian Varieties and Applied Partial Differential Equations: Modeling, Analysis, and Computation. (Please read more about these on pages 4 and 5.) We have an excellent pipeline of future CRGs, which exhibit the richness and diversity of our mathematical and scientific base.

Our Postdoctoral Training Centre in Stochastics was launched this year, and our first cohort of postdocs, representing UCalgary, UAlberta and UBC, attended an inaugural two-day retreat at BIRS. (Read more on page 6.)

At the beginning of this year Michael Lamoureux joined PIMS as our Innovation Coordinator; this is a new position funded by the NSERC Institutes Innovation Platform. (See page 12.) I would like to highlight the two very successful workshops run this year – the *PIMS Industrial Problem Solving Workshop* at USaskatchewan and the *IMA/PIMS Mathematical Modeling in Industry* workshop in Minneapolis. The industrial problems at these events cover a very broad spectrum of mathematics, and I would recommend them strongly to all our HQP trainees. Many of our graduate students and postdocs will take positions in industry or business, and attending these workshops may provide a valuable introduction to this world.

Our education program continues to run very successfully, due to the excellent leadership of our education coordinators: Melania Alvarez (UBC); Malgorzata Dubiel (SFU); Sean Graves (UAlberta); Darja Kalajdziewska (UManitoba); Indy Lagu (UCalgary); David Leeming (UVic) and Harley Weston (URegina). A new program, run in Vancouver this year, was a summer school for in-service teachers. This was attended by 20 teachers, and received very positive feedback.

We are very grateful to our individual and corporate donors for making our educational and outreach activities possible, particularly to Brian Russell, the Actuarial Foundation of Canada, Haig Farris, Hampson Russell/CGG and the Willow Grove Foundation.

A handwritten signature in black ink, appearing to read 'MT Barlow'.

Martin Barlow  
*Interim 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 Manitoba, 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 ten 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 ten 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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# 2015 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.

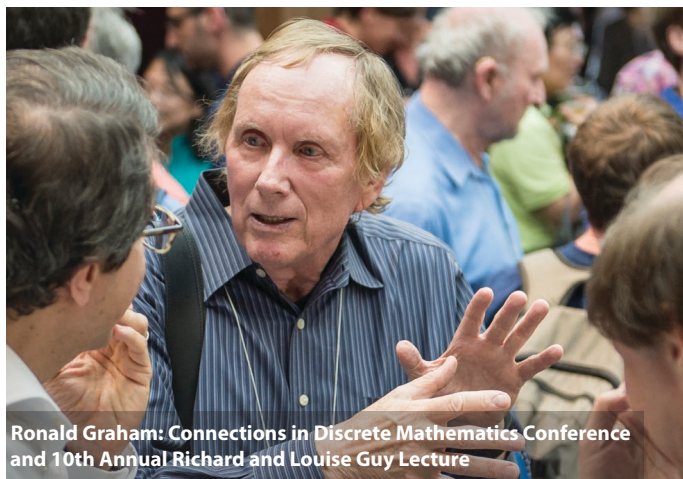
**In 2015, PIMS supported more than 100 scientific activities.** These involved nearly 6,000 participants who spent over 25,000 days at PIMS activities.

**Conferences and Workshops:** Events across the sites in 2015 delved into a broad range of mathematical areas. Some of these included *Building a Bioanalytical Theory for Analysis of Marine Mammal Movements* at UBC, the *12th Annual Young Researchers Conference* at UCalgary, the *MSI-PIMS Workshop on Conformal Field Theory and Related Topics* at the Australian National University in Canberra, the *Connections in Discrete Mathematics* conference at SFU, *Frontiers in Biophysics* at UBC and the conference on *Applied Topology and High-dimensional Data Analysis* at UVic.

**Summer Schools:** PIMS' summer schools provide participants with the opportunity to join fellow researchers and academics for an intensive period of focused activity. In 2015, the calendar included the *AARMS-PIMS Summer School in Differential Equations and Numerical Analysis* at Dalhousie University, the *Séminaire de Mathématiques Supérieures* on "Geometric and Computational Spectral Theory" at the Université de Montréal, the *CRM-PIMS Summer School in Probability* at McGill University and the *PIMS-SFU Undergraduate Summer School on Rigorous Computing* at Simon Fraser University.

**Lecture and Seminar Series:** PIMS supports 28 seminar series at member universities each year. In 2015, these included several distinguished colloquia series across the sites, including the new *Abelian Varieties Multi-Site Seminar Series* (organized by the CRG in that area) a monthly seminar on the theme of explicit methods in abelian varieties. The talks, which will continue into 2016, are held at one of the participating institutions and broadcast via video conference, as well as being recorded and posted on [mathtube.org](http://mathtube.org).

**Distinguished and Public Lectures:** Each year, PIMS sites play host to numerous high profile speakers. 2015's speakers included: Ingrid Daubechies (Duke University); Kai Behrand (UBC); Yann Brenier (École Polytechnique); Jill Pipher (Brown University); Tom Hou (Caltech); Ronald Lewis Graham (University of California, San Diego); Barry Merriman (Human Longevity, Inc) and Fairouz Kamareddine (Heriot-Watt University).



# *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 30 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 five CRGs operating in 2015:** Geometry and Physics (2013-2016); Applied Combinatorics (2014-2017), Applied, Algebraic and Geometric Topology (2014-2018), Explicit Methods for Abelian Varieties (2015-2018) and Applied Partial Differential Equations: Modeling, Analysis, and Computation (2015-2018).

## *Applied Partial Differential Equations: Modeling, Analysis, and Computation (2015-2018)*

The scientific focus of this CRG is to study nonlinear partial differential equations (PDEs) with particular emphasis on problems involving pattern formation, defined in the broadest sense.

There are three primary goals of this CRG. The first is to create new mathematical and numerical methodologies for the analysis of pattern formation problems in diverse applications through the fostering of new and lasting collaborations between the rather diverse membership of the CRG and with international researchers. This will be achieved through the hosting of both short-term (two-day-long CRG Summits) and longer term (five-day workshop) events, as well as from the shared mentorship and training of postdoctoral fellows and graduate students with CRG members in Western and Atlantic (AARMS) Canada. The second goal is in regard to the cross-fertilization of mathematical and numerical techniques and methodologies to scientific communities outside mathematics where pattern formation problems arise in concrete applications. The third goal is to offer high level training for graduate students and postdoctoral fellows in the analytical and numerical methodologies needed to study and model pattern formation problems in a variety of areas of application. This training will be done through a month-long AARMS summer school held in 2015, a two-day graduate student summit in 2016 and a three-day short course on stability theory in 2016.

### *CRG Leaders*



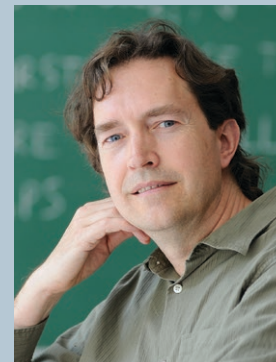
Thomas Hillen  
(UAlberta)



Theodore Kolokolnikov  
(Dalhousie U)



Steven Ruuth  
(SFU)



Michael Ward  
(UBC)



Juncheng Wei  
(UBC)

# *Explicit Methods for Abelian Varieties (2015-2017)*

Abelian varieties are fundamental objects in algebraic geometry with a long, rich history of study. They are indispensable in number theory, and an important source of practical settings for cryptography. Although there are wide-ranging general structure theorems, efficient explicit computational tools required for applications are only available in the simplest cases.

Although many powerful theoretical advances have led to significant breakthroughs (eg. the Taniyama-Shimura-Weil Theorem and Fermat's Last Theorem, Weil descent and the elliptic curve discrete logarithm problem), efficient explicit methods for computing with abelian varieties in general are not known. For example, all abelian varieties by definition have a group law, but to date efficient methods to compute it are restricted to Jacobian varieties of algebraic curves, and most existing literature treats only the simplest cases of elliptic and hyperelliptic curves. Similarly, explicit methods to compute arithmetic data on abelian varieties, or even to tabulate interesting examples and tables of abelian varieties, only exist for relatively simple cases. Cremona's extensive tables of elliptic curves over the rationals of bounded conductor are a well-known resource that has proved to be valuable to many researchers, but there is very little data available for other types of abelian varieties. Even for the simplest case of algebraic curves, there is considerable interest in improving the state of the art of explicit methods.

The CRG on Explicit Methods for Abelian Varieties represents an extensive network of regional, national, and international researchers focused on improving the state of the art in this area. Building on existing relationships, we plan new partnerships and joint activities that will enable us to continue working together for years to come.

## *CRG Leaders*



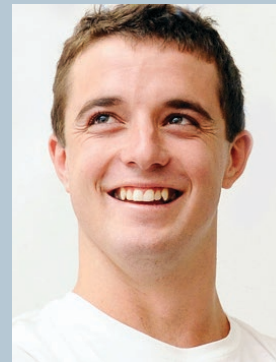
Jeff Achter  
(Colorado State U)



Amir Akbary  
(ULethbridge)



Nils Bruin  
(SFU)



Craig Costello  
(Microsoft)



Laurent Imbert  
(CNRS & LIRMM)



Michael Jacobson  
(UCalgary)



David Jao  
(UWaterloo)



Kumar Murty  
(UToronto)



Andreas Stein  
(UOldenburg)



Bianca Viray  
(UWashington)

# *PIMS Postdoctoral Training Centre in Stochastics (PTCS)*



**PIMS launched its Postdoctoral Training Centre in Stochastics in 2015. With existing world class groups in probability theory and its applications, PIMS has an excellent track record of postdoctoral supervision and placement.**

These groups have joined forces through the new PIMS PTCS to train an outstanding cadre of postdoctoral fellows. The program has already attracted \$550,000 in NSF funds for our UWashington site, in addition to the support from the Province of Alberta. The PTCS will organize summer schools in probability and mathematical finance, develop networking between PIMS sites and with groups in Microsoft Research and Eastern Canada and support visits by distinguished visitors. The program is directed by Ed Perkins (UBC).

The First Annual PTCS Retreat was held September 18 to 20 at the Banff International Research Station (BIRS). It was attended by ten young researchers and seven supervising faculty. The purpose of the meeting was for the postdoctoral fellows in the program, supervising faculty and other senior graduate students to get acquainted with each other, as well as to give the young researchers an opportunity to present their recent work to the Western Canadian probability community. Four of the five postdoctoral fellows in the PTCS inaugural class attended (the fifth, Zhenan Wang [UWashington]), was unable to obtain a visa in time). Richard Balka (UBC), Jonathan Chavez (UCalgary), Khoa Le (UAlberta/UCalgary) and Mathav Murugan (UBC) all gave 40 minute lectures on their research, as did six senior PhD students from UAlberta, UCalgary, UBC and UWashington.

There was a healthy mix between the latest developments in probability theory in such areas as the Brownian map, heavy tailed random walks on graphs and stochastic partial differential equations on one hand, and a number of applied modelling results in energy pricing, filtering equations and big data parameter estimation on the other.

The tone of the meeting was informal with an open problems session generating discussion that extended into the evening. For example, a problem posed by UBC student Brett Kolesnik, on coexistence for a pair of annihilating branching random walks, led to continued discussion with many participants and an ongoing project with Kolesnik, Omer Angel and Nathanael Berestycki.

There were opportunities for future planning for the program including broadcast seminars, outside speakers and short courses. Participants clearly enjoyed the informal atmosphere and plans were made for visits to various PIMS sites. Everyone was happy to learn that this will be an annual event for the program.

Special thanks to BIRS for supplying the spectacular venue for a highly successful meeting.

## *2015 PTCS Postdocs*

**Jonathan Allan Chávez Casillas** (UCalgary)

**Mathav Murugan** (UBC)

**Richard Balka** (UBC)

**Khoa Le** (UCalgary/UAlberta)

**Zhenan Wang** (UWashington)



**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 students.**

## *Feature Project 2015*

In terms of education, the reality is that many teachers, especially in elementary schools, do not have the necessary math knowledge or experience to feel comfortable teaching mathematics. Therefore, it is important to provide further teacher training. To this end, the UBC Mathematics Department and PIMS joined forces to develop a summer school for in-service teachers. The first session was held June 29 to July 24. Twenty teachers attended.

The goal of the summer school was that teams of teachers would return to their schools and begin to foster a cultural and academic shift with respect to the learning and enjoyment of mathematics by:

- increasing teachers' capability, confidence and attitude with regard to math
- educating teachers to strive for and expect success for all their students
- incorporating meta-cognition strategies so that teachers will understand their own learning processes for math, as well as that of their students
- making these teachers PIMS' ambassadors for institutional change by transforming their attitudes toward the teaching and learning of math at their schools
- familiarizing other teachers with PIMS' educational resources so that they can help to develop a variety of their own mathematical activities

One method of measuring success will be to follow the level of mathematical activity and academic progress at the participants' schools by monitoring:

- the establishment and continuity of a math club
- students' success based on grade 4 and 7 standardized tests
- whether math achievement is improved at the school
- how students are performing in math contests
- to what extent students participate in activities with a mathematical content

# 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 2015 PIMS supported a total of 51 PDFs distributed across its sites.

## 2015 incoming postdocs:

Abbas Mehrabian (SFU and UBC)

Elsa Maria Dos Santos Cardoso-Bihlo (UVic)

Xiangke Chang (USaskatchewan)

Hoan Bui Dang (UCalgary)

Fiachra John Knox (SFU)

Shashank Kanade (UAlberta)

Asghar Ghorbanpour (URegina)

Alia Hamieh (ULethbridge)

Ahmed Moussaoui (UCalgary)

Aghil Alaei Khanga (UAlberta)

Dinakar Muthiah (UAlberta)

Justin Tzou (UBC)

Johanna Hennig (UAlberta)

Ben Krause (UBC)

Diego Vela (UVic)

Jens-Dietrich Bauch (SFU)

Aurore Guillevic (UCalgary)

Dániel Tamás Soukup (UCalgary)

Ha Nguyen Thanh Tran (UCalgary)

Paul Arnaud Songhafouo Tsopmene (URegina)

Andrew Fiori (UCalgary)

## Featured Postdoctoral Fellow: Johanna Hennig

“I completed my doctoral degree in spring 2015 at the University of California, San Diego under supervision of Efim Zelmanov. My research is on locally finite Lie algebras, which are infinite dimensional analogues of the classical finite dimensional Lie algebras. I enjoy all types of mathematics and have always found it hard to specialize in one particular area. I’ve always known that at heart I was an algebraist, but was attracted to Lie theory in particular because of its interdisciplinary motivations and connections. I really enjoy using tools from algebra along with those from other fields of mathematics. For example, I have used tools from analysis, such as ultrafilters and  $C^*$  algebra methods, in my study of direct limit Lie algebras. I also love making new connections between (seemingly) different types of mathematical objects. Recently I’ve shown a connection between the representation theory of these Lie algebras and noncommutative geometry, which was very exciting.

In the fall of 2015 I started working at the University of Alberta as a PIMS-Max Wyman postdoctoral fellow, and am very much enjoying the research environment thus far. I am learning new methods such as nonabelian cohomology from Arturo Pianzola, and we are working to apply these methods to locally finite Lie algebras over nonclosed fields. I also enjoy being part of a large group of researchers and postdocs in areas related to algebra, such as mathematical physics.”



# 2015 Prizes & Awards

## CRM - Fields - PIMS Prize

**Kai Behrend (UBC)**

Behrend is an internationally recognized leader in the field of algebraic geometry, whose contributions to the subject are noted both for their depth and scope. He has obtained fundamental results in the theory of algebraic stacks, Gromov-Witten theory and the study of Donaldson-Thomas invariants. In particular, his pioneering works on the construction of a “virtual fundamental class” played a key role in laying the algebraic foundations of the Gromov-Witten theory. In his earlier work, Professor Behrend obtained an important generalization of the Lefschetz trace formula for algebraic stacks, presently known as Behrend’s trace formula. The ideas put forward by Kai Behrend have already proven to be immensely influential and will undoubtedly have a lasting impact on this area of mathematics.



## CAIMS/PIMS Early Career Award in Applied Mathematics

**Jane Heffernan (York University)**

Heffernan’s research centres on understanding the spread and persistence of infectious diseases and plays a vital role in designing pandemic mitigation strategies. Her Modelling Infection and Immunity Lab focuses on the development of new biologically motivated models of infectious diseases that describe pathogen dynamics in-host (mathematical immunology) and in a population of hosts (mathematical epidemiology).

Heffernan was cited “for the novelty, depth and breadth of her work at the interface of immunology and epidemiology” and for the “rare ability to clearly connect mathematics to applicable treatment strategies and public policy.”



## PIMS Education Prize

**Dragos Hrimiuc (UAlberta)**

Hrimiuc has taught many courses and received outstanding assessments from students who praise both his dedication and ability to inspire in them a love and understanding of mathematics. He has committed himself significantly to mathematical outreach. He has been a board member of the Alberta High School Mathematics Competition, the first province-wide high school mathematics competition in Canada, since 1999 and is its current president. He is also one of the founders of Pi in the Sky, a PIMS publication intended for high school teachers and their students, and is a regular contributor to the magazine, writing articles on problem solving strategies as well as editing the Math Challenges section.





## *Conference on the Mathematics of Sea Ice*

This conference was held at the Harbour Centre Campus of SFU from September 24 to 26. It brought together many of the world's leading sea ice theorists, as well as interdisciplinary students, postdocs and early-career investigators, to focus on the mathematical aspects of research on sea ice and its role in Earth's climate system.

A broad range of powerful methods and tools spanning many different areas of mathematics and theoretical physics can be applied to sea ice. These mathematical techniques can help improve our understanding of sea ice structures and processes, advance how sea ice is represented in global climate models, and ultimately improve projections of climate change and the fate of Earth's ice packs.

The major goals of this conference were to explore how these many areas of mathematics can, and are, being applied to sea ice, and to spur new advances through the sharing of different ideas, approaches and perspectives. This was accomplished by bringing together researchers – all with an interest in sea ice – from different mathematical and scientific backgrounds, including partial differential equations, numerical analysis, large scale models, dynamical systems and bifurcation theory, fractal geometry, diffusion processes and statistical physics.

Over an intensive three-day schedule a wide variety of relevant subjects were explored, ranging from small scale processes and the fundamental physics of sea ice to large scale processes and the role of sea ice in global climate. Lunchtime and evening discussions on new research ideas were common amongst the attendees. A mix of well-established and early-career speakers ensured that a vibrant array of new ideas and perspectives were shared, fostering new professional relationships and developments in the field. By the end of the conference, perspectives were broadened, interesting new questions emerged and a new community in the mathematics of sea ice was solidified.



# Events in Combinatorics



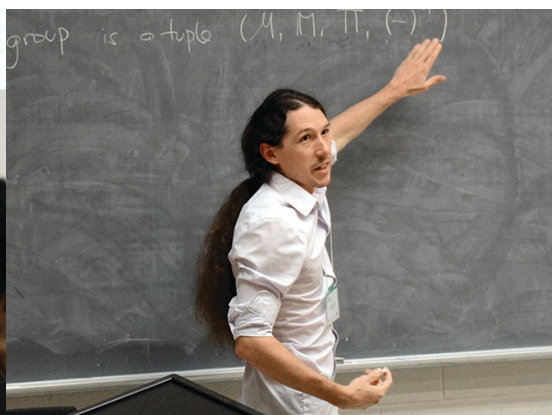
**Combinatorial Constructions in Topology | A Workshop, August 17-21, at the University of Regina run by the PIMS CRG in Applied Algebraic and Geometric Topology.** The main theme of the meeting was the interplay between algebra, geometry and topology related to combinatorially defined topological spaces. These include constructions such as toric varieties, configuration spaces, hyperplane arrangements and generalized moment-angle complexes. The meeting brought together 21 speakers and approximately 40 participants – experts with somewhat varied areas of specialization, many of whom had not previously met – from Belgium, China, Colombia, Germany, Japan, Korea and Switzerland, as well as the US and Canada.

With its diversity of themes and participants, the meeting helped promote dissemination of information and cross-fertilization between several fields of mathematics, setting the stage for future collaborations and new ideas. The meeting also helped to develop existing connections between the topologists at Regina at the time (Sarkar and Stanley) and the Russian and East Asian schools of toric topology.

**Applied Combinatorics | A Summer School for Graduate Students, May 18-29, 2015 at the University of Saskatchewan run by the PIMS CRG in Applied Combinatorics.** Lectures were given by Éric Fusy (École Polytechnique and PIMS postdoctoral fellow), organizer Andrew Rechnitzer (UBC), Erik Panzer (Institut des Hautes Études Scientifiques) and Christine Heitsch (Georgia Technical Institute).

Both weeks devoted substantial time to working problems. The students were engaged in the work and came away with both practical and theoretical skills to match their new knowledge on these topics. Participants also learned to program using SageMath – an open-source mathematical software system.

The participating students had a variety of backgrounds and came from across Canada, the US and Europe. They displayed a high level of engagement, sharing details of their own research and working in groups to solve problems and prepare presentations.



# Industrial Platform

**The three Canadian Math Institutes: Fields, CRM and PIMS have received three years of funding for the *Institutes Innovation Platform*, which aims to develop and support collaborations in the mathematical sciences between academics and industry partners.** In light of this funding, Michael Lamoureux (University of Calgary) was appointed as PIMS Innovation Coordinator in January, 2015. This newly established role positions Lamoureux as PIMS' conduit between the academic and industrial sector, while also interacting with the NSERC RPP and regional sector. He is a resource for faculty, students and postdocs seeking industrial connections and a liaison between the PIMS Industrial Advisory Board, industry and the math science community. Locally, he is facilitating faculty and students seeking to become involved in industrial projects and helping them locate resources through the institutes, Mitacs, NSERC RPP and other partners.

PIMS funds a variety of activities under this platform, including joint academic/industry conferences and workshops, roundtable discussions on industrial issues, the PIMS Lunchbox Lecture Series, the Industrial Problem Solving Workshops and Graduate Math Modeling in Industry Workshops and travel to industry-focused conferences for academics presenting in non-traditional venues. PIMS is working with our partners in NSERC Partnerships Programs and Mitacs Business Development officers to identify opportunities for collaborations between mathematical scientists at universities and researchers in industry and non-profits. These collaborations can be supported by the NSERC Engage and RPP grants and Mitacs Accelerate and Elevate internships.

Two event highlights in 2015 were the PIMS Industrial Problem Solving Workshop held at USaskatchewan this June, and the joint IMA/PIMS Math Modeling in Industry Workshop held in Minneapolis in August. The IPSW brought together 35 academic and industrial researchers for one week to work on five industry-generated problems, including the optimal scheduling of mining operations, detection of hydraulic fracturing

events for enhanced oil and gas production, design of an agricultural products exchange, measuring the effectiveness of advertising campaigns and the design of quantum computer gates. The success in this year's program in Saskatoon was due in large part to the excellent problems presented by applied researchers from the Western Canadian organizations Potash Corp, Fotech, Inshgtrix, The Ag Exchange, and the Institute for Quantum Science and Technology. Participants included students and faculty members from across the country. Many thanks to the organizers Walid Abou Salem (USaskatchewan), Michael Lamoureux (PIMS), Cristian Rios (UCalgary), Ray Spiteri (USaskatchewan) and JF Williams (SFU).

The IMA/PIMS Graduate Math Modeling in Industry workshop focuses on the training of graduate students by working on real industrial problems with mentors from industry. This year's event in Minneapolis brought together eight mentors and 45 students from across North America to work on problems in optical scanning of precision electronic assemblies, production of industrial components in high temperature ovens, seismic imaging, image scanning, design and modeling of power tools, and design of algorithms for quantum computers. PIMS extends our thanks to all the industrial partners, including two from Canada (Jiajun Han of CGG/Calgary, and Pooya Ronagh of IQbit Techlogies/Vancouver), five from the US (Ravindra Akarapu of Corning Inc., John Hoffman of CyberOptics, Chai Wah Wu of IBM, Jesse Berwald and Janet Keel of Target Corporation) and one from overseas (Vera Nuebel of Hilti Corporation, Liechtenstein). Remarkable progress was made on each individual project, with a great deal of work done in understanding the mathematical challenges and coming up with feasible approaches to a solution. After ten days on the projects, each team presented a report on their progress, and final reports have been written for publication. Organizers were Michael Lamoureux (PIMS), Daniel Spirn (IMA) and Carlos Tolmasky (IMA).

# 2016 Event Highlights

## EVENTS, CONFERENCES AND WORKSHOPS

10-16 January	Conference on Quantum Information Processing Banff International Research Station
30 April - 1 May	Graduate Student Combinatorics Workshop University of Manitoba
7-8 May	Pacific Northwest Number Theory Conference Oregon State University
25-26 April	Cascade Topology Seminar University of Victoria
30 April	<b>ELMACON</b> University of British Columbia
April (date TBD)	<b>Dynamics Meeting</b> University of Victoria
14-15 May	<b>Western Canada Linear Algebra Meeting</b> University of Manitoba
16-17 May	<b>Prairie Discrete Math Workshop</b> University of Manitoba
13 May	<b>Changing the Culture</b> Simon Fraser University
16-20 May	<b>Emerging Mathematics Instructor Workshop</b> University of Manitoba
16-20 May	<b>Nicolefest: Conference on Functional Analysis</b> University of Alberta
16-20 May	<b>Homotopy Type Theory and Univalent Foundations</b> Fields Institute
16-20 May	<b>International Conference in Harmonic Analysis</b> University of Wisconsin, Madison
16-20 May	<b>Undergraduate Workshop in Supersymmetry</b> University of British Columbia
2-5 June	<b>Foundational Methods in Computer Science</b> University of British Columbia
13-16 June	<b>Young Researchers Conference in Mathematics and Statistics</b> University of Alberta
13-17 June	<b>Nonlocal Variational Problems and PDEs</b> University of British Columbia
20-24 June	<b>Conference of the Canadian Number Theory Association</b> University of Calgary
6-8 July	<b>Canadian General Relativity and Relativistic Astrophysics</b> Simon Fraser University
7-8 July	<b>Canadian Abstract Harmonic Analysis Symposium</b> University of British Columbia
10-15 July	<b>Rarefied Gas Dynamics</b> University of Victoria
10-15 July	<b>International Biometrics Conference</b> University of Victoria
25 July-19 August	<b>Statistical Causal Inference and its Applications to Genetics</b> CNRS, Montréal
8-13 August	<b>Graduate Math Modelling in Industry Workshop</b> University of British Columbia
15-19 August	<b>Joint CRM/Fields/PIMS Industrial Problem Solving Workshop</b> University of Toronto
(date TBC)	<b>Alberta Number Theory Days</b> Banff International Research Station

## SUMMER SCHOOLS

30 May - 11 June	<b>Séminaire de mathématiques supérieures: Dynamics of Biological Systems</b> University of Alberta
25 June - 6 July	<b>Mathematical Finance</b> University of Alberta
17-23 July	<b>Superschool on Derived Categories and D-branes</b> University of Alberta
27 July - 5 August	<b>Geometric and Topological Aspects of the Representation Theory of Finite Groups</b> University of British Columbia
15-26 August	<b>Women in Math</b> University of British Columbia and Simon Fraser University
22 August - 4 September	<b>Mathematical Physics</b> Sirince, Turkey

## PUBLIC & DISTINGUISHED LECTURES

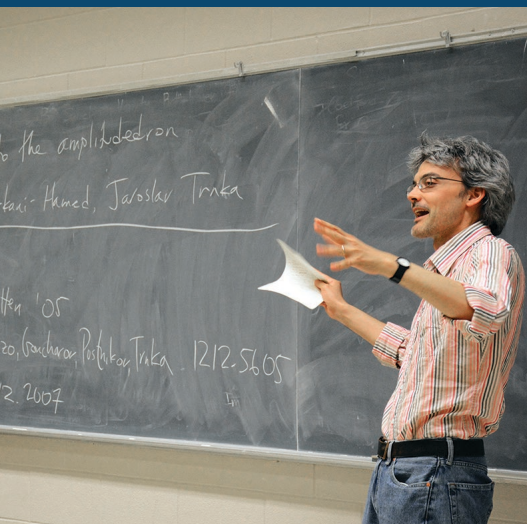
January 10	<b>Peter Lu (Harvard University)</b> University of Victoria
January 13	<b>Philippe Thieullen (Institut de Mathématiques de Bordeaux)</b> University of Victoria
February 1	<b>Bruce Sheperd (McGill University)</b> University of Victoria
February 18	<b>Maria Chudnovsky (Princeton University)</b> University of British Columbia
February TBD	<b>Bud Homsy (University of California, Santa Barbara)</b> University of Alberta
March 4	<b>David Aldous (University of California, Berkeley)</b> University of British Columbia
March 17	<b>Abdul-Aziz Yakubu (Howard University)</b> University of Victoria
March 18	<b>Jacob Lurie (Harvard University)</b> University of British Columbia
June TBD	<b>Richard Schoen (University of California, Irvine)</b> Banff International Research Station
September TBD	<b>Manjul Bhargava (Princeton University)</b> University of Calgary

## COLLABORATIVE RESEARCH GROUPS

2016 - 2019	Geometric and Cohomological Methods in Algebra
2016 - 2019	Geometric Analysis
2015 - 2018	Applied PDEs: Modeling, Analysis, and Computation
2015 - 2018	Explicit Methods for Abelian Varieties
2014 - 2017	Applied Combinatorics
2014 - 2018	Applied, Algebraic and Geometric Topology
2013 - 2016	Geometry and Physics

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