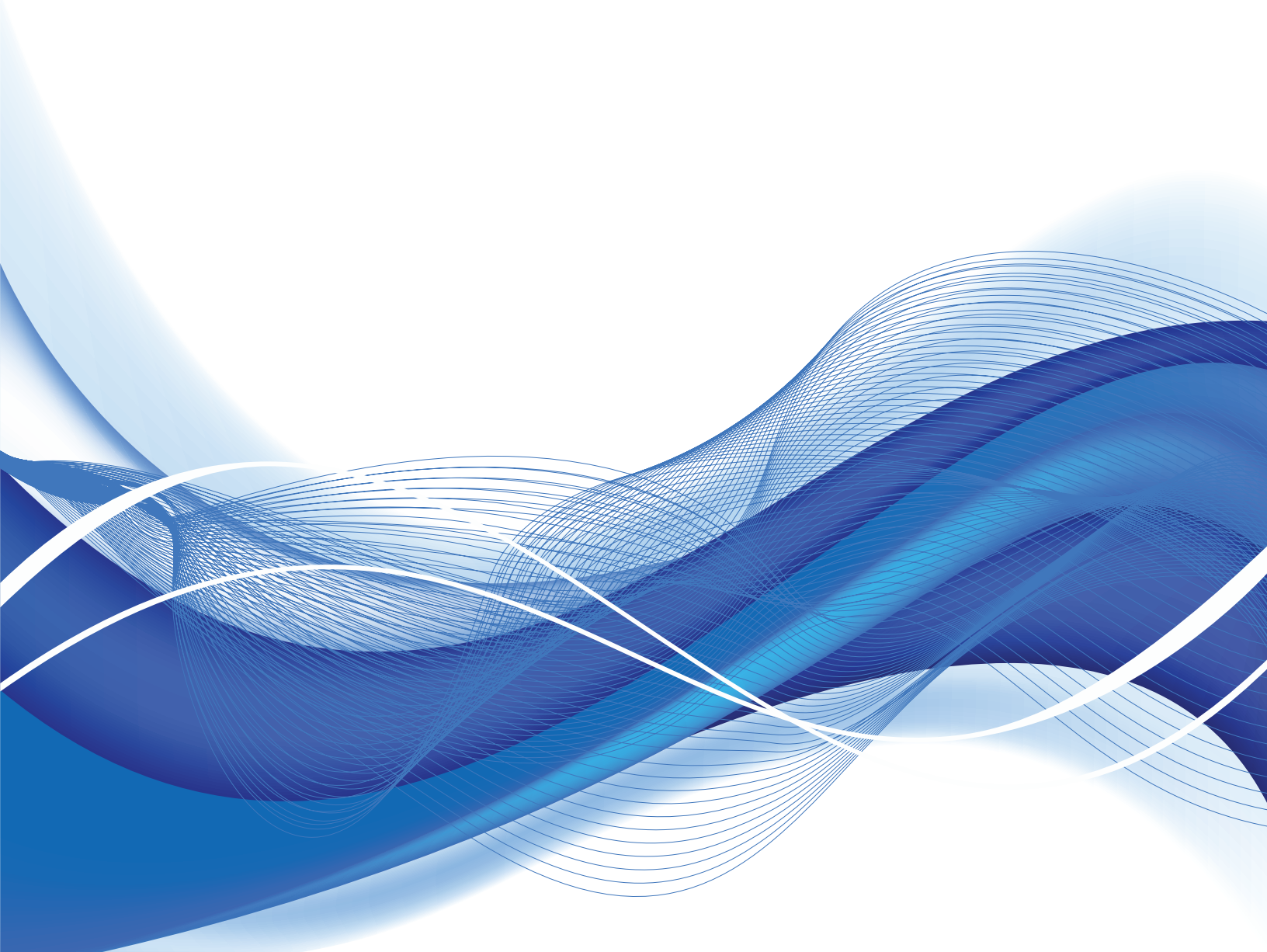
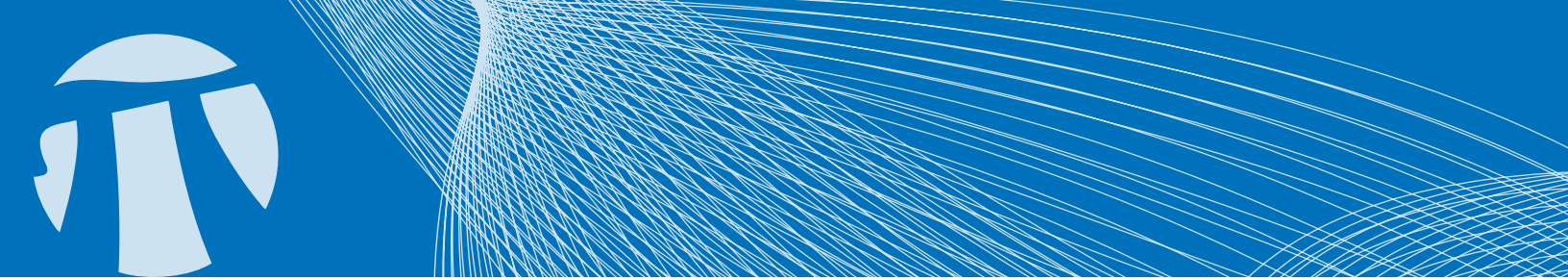


Pacific Institute *for the*  
Mathematical Sciences



**Annual Report 2014**

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# I. PIMS OVERVIEW

## 1. BACKGROUND

The Pacific Institute for the Mathematical Sciences (PIMS) was founded in 1996 by a consortium of five universities in Alberta and British Columbia (the University of Alberta, the University of Calgary, the University of British Columbia, Simon Fraser University and the University of Victoria). Later the University of Washington in the United States, and more recently the Universities of Regina, Saskatchewan, and Lethbridge joined PIMS as full members, and Portland State University in Oregon joined as an affiliate. The mandate of PIMS is to:

- Promote research in and application of the mathematical sciences of the highest international calibre,
- Facilitate the training of highly-qualified personnel at the graduate and postdoctoral levels,
- Enrich public awareness of mathematics through outreach,
- Enhance the mathematical training of teachers and students in K-12, and
- Establish partnerships with similar organizations in other countries, with a particular focus on Latin America and the Pacific Rim.

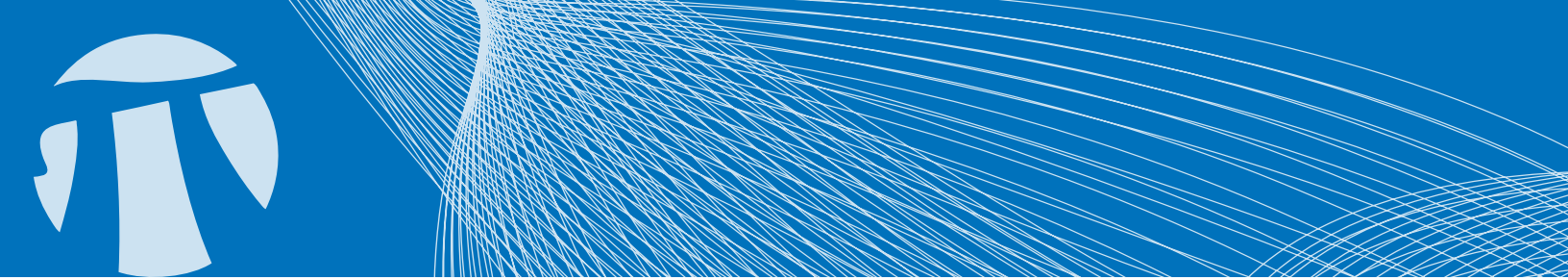
## 2. UNIQUE STRUCTURE OF PIMS

PIMS is unique in several ways, most fundamentally because of its distributed structure. Most institutes organize activities at a central location where international scientists are brought in residence; PIMS, on the other hand, has a site at each of nine major universities in Alberta, British Columbia, Saskatchewan and Washington State. PIMS events and programs are organized at each of these sites and PIMS researchers are distributed throughout the network. PIMS is institutionally bi-national (the University of Washington is a full member, and Portland State University is an affiliate) and it is the only institute of this kind in mathematics. This unique structure projects PIMS beyond the boundaries of Canada, notably towards the Pacific Rim, to allow Canada to benefit from international scientific and economic developments.

## 3. SCIENTIFIC HIGHLIGHTS IN 2014

PIMS has built an international reputation for excellence and has transformed the conditions of mathematical research in Canada. PIMS funds Collaborative Research Groups, Postdoctoral Fellowships, the Postdoctoral Training Centre in Stochastics as well as individual events and focus periods on a competitive basis. The following is a partial list of current scientific achievements:

- The innovative PIMS *Collaborative Research Groups* (CRGs) and their training and focused activities over a multi-year period aim to develop permanent research networks, establishing lasting interdisciplinary links between geographically separate groups of researchers at member universities. PIMS has developed 30 CRGs since its inception, in areas ranging across all the mathematical sciences. This has served as a catalyst for producing mathematical research of the highest quality in Canada and attracting outstanding faculty to PIMS universities. During May-June 2014 the established CRG on *Geometry and Physics* organized a major focus period supported by the U.S. National Science Foundation (NSF) with workshops, graduate and undergraduate summer schools, and public lectures at UBC, as well as the international String-Math 2014 Conference in Edmonton. Two new CRGs got underway in 2014: the first is based at SFU, UBC and US and will focus on *Applied Combinatorics*. It held workshops at SFU and UR in 2014, and is planning a summer school at US in 2015. The other, on *Applied, Algebraic and Geometric Topology* involves activities at UBC, UC, UR and UV.



It kicked off with a conference in algebraic topology in May 2014 followed by the *West Coast Algebraic Topology Summer School* on “Topological Field Theories” (also with significant NSF support). In 2015 two more CRGs will come online: *Applied Partial Differential Equations: Modeling, Analysis, and Computation* and *Explicit Methods for Abelian Varieties*. Finally CRGs on *Algebra* and *Geometric Analysis* are in development for 2016.

- In July 2014 PIMS organized a *Focus Period on The Economics and Mathematics of Systemic Risk*. A number of senior visitors were in residence at PIMS, including I. Ekeland and J. Rochet. There were seminars and other activities during that month, along with a summer school and a workshop. See Section II.1.F for details.
- Every year PIMS sponsors numerous *postdoctoral fellows* (PDFs) – 40 in 2014 – attracting outstanding young scientists who contribute to PIMS research programs, many of whom later become faculty members at leading Canadian universities. They are distributed throughout PIMS sites on a competitive basis. Over the past two years, one of PIMS’ PDFs, T. Zhang at UA has published four papers in *Advances in Mathematics*, *Mathematische Annalen*, the *Duke Mathematical Journal* and the *International Journal of Mathematics*, with two more submitted. He is currently an Asst. Prof. at UA. During the same period S. Madariaga, a PIMS PDF at US, published six articles in well-regarded journals, such as the *Journal of Algebra*, and submitted an additional four.
- In 2007, PIMS launched the very successful *International Graduate Training Centre in Mathematical Biology*. This program has ended; in its place PIMS will inaugurate the *Postdoctoral Training Centre in Stochastics* in 2015.
- PIMS organizes international summer schools to train the new generation of scientists in emerging areas of mathematics and its applications as diverse as seismic imaging, the mathematics of sustainability, string theory, environmetrics, finance, atmospheric modelling and climate change, quantum information, the mathematics behind biological invasions, optimization, link homology and cryptography. This year’s offerings included spatio-temporal modelling (Brazil), topological field theories (UBC), combinatorial algorithms (SFU), probability (UBC) and an undergraduate school on multiple zeta values (SFU).
- PIMS has a lively program in industrial mathematics, and runs *Mathematical Modeling in Industry Workshops* (MMIW) as well as *Industrial Problem Solving Workshops* (IPSW) for students, faculty and industry. The 2014 edition (the 17th) of the MMIW, held in Vancouver, was the fourth dual effort of PIMS and the Institute for Mathematics and its Applications (IMA). In 2014 PIMS further sponsored a *Natural Gas Research Roundtable* at UBC. PIMS also supports medical applications such as *Operations Research and Network Modelling for HIV Treatment and Prevention* and a *Workshop on the Molecular Origins of Protein Misfolding and Neurodegenerative Disease*.
- PIMS sponsors conferences and workshops throughout Canada and the world on a wide range of topics. This year’s events took place in Brazil, India, Ontario, Nova Scotia and Quebec, as well as PIMS’ ‘home’ provinces and states, covering fields such as biomathematics, computer science, genetics, medicine, physics and statistics, in addition to almost every area of applied and abstract mathematics.
- The 2014 *Hugh C. Morris Lecturer* was Fields Medalist C. Villani (U Lyon & Institut H. Poincaré), who explained the “Mathematics of Bats.” Dr. Hugh Morris (1932-2012), former Chair of the PIMS Board of Directors and a long-time friend of the mathematical sciences, generously endowed this yearly lecture series at PIMS. The objective is to attract top mathematical scientists in the world to deliver presentations on current research topics to PIMS universities.
- The 2014 *PIMS Marsden Memorial Lecturer* was M. Desbrun of Caltech. He spoke on “Geometric Discretization for Computational Modeling” at the *IV Iberoamerican Meeting on Geometry, Mechanics and Control* hosted by the Instituto Nacional de Matemática Pura e Aplicada in Rio de Janeiro in April. Jerrold E. Marsden (1942-2010) was a world-renowned Canadian applied mathematician who did extensive research in the areas of geometric mechanics, dynamical systems and control theory.
- S. Gates (U Maryland) headlined PIMS’ Public Lecture Series at UBC this year with a fascinating talk on “From the Adinkras of Supersymmetry to the Music of Arnold Schoenberg.” Gates is a member of President Obama’s Council of Advisors on Science and Technology and recently received the U.S. National Medal of Science.

- Our distinguished colloquia continue to bring first-rate speakers to PIMS; in 2014 these were held at SFU, UBC, UA, UR, UV and UW. Speakers included L. Mahadevan and B. Gross (Harvard), A. Lubotzky (Hebrew U), D. Levermore (U Maryland), R. Caflisch (UCLA), E. Grinspun (Columbia) and C. Camerse (Caltech).
- Each year PIMS awards three prestigious prizes. In 2014 the *CRM-Fields-PIMS Prize* went to N. Kamran of McGill U, and S. Milner of the U. of the Fraser Valley was the recipient of the *PIMS Education Prize*. The PIMS/Canadian Applied and Industrial Mathematics Society (CAIMS) *Early Career Award in Applied Mathematics* recognizes exceptional research in any branch of applied mathematics; the 2014 awardee was G. Wild of the U. of Western Ontario.

## 4. NATIONAL AND INTERNATIONAL COLLABORATIONS

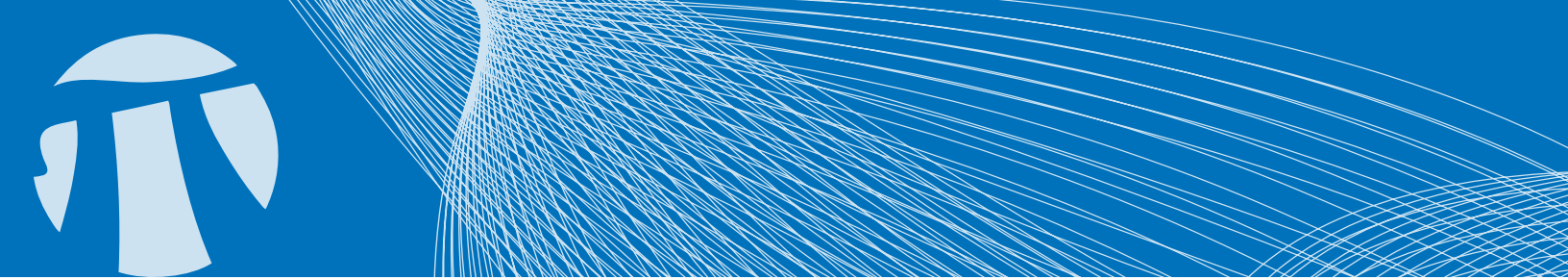
**National:** PIMS has a national mandate to support the mathematical sciences in Canada. To this end, in partnership with the Fields Institute and the Centre de Recherches Mathématiques (CRM), it has created major national programs such as Mprime and the Atlantic Association of Research in the Mathematical Sciences (AARMS). Together with the Mathematical Sciences Research Institute (MSRI) in Berkeley, PIMS created the Banff International Research Station (BIRS), which is now the premier mathematical research station in North America.

PIMS coordinates with AARMS, BIRS, CRM and Fields to support a number of Canadian activities such as meetings of the societies (CAIMS, CMS and SSC), the Séminaire de Mathématiques Supérieures in Montréal and the regularly scheduled Canadian Discrete and Algorithmic Mathematics and CNTA meetings. Recently, we have agreed on a yearly national rotation for the IPSW, which were created by PIMS and then emulated by CRM and Fields. The next PIMS IPSW will be held in 2015 at US. PIMS funding for activities in Atlantic Canada through AARMS is an important link to another region of the country. As part of the Long Range Plan for Mathematical and Statistical Sciences in Canada, PIMS and the other institutes have committed significant resources to support the Canadian Statistical Sciences Institute (CANSSI). Joint activities are underway.

**International:** Part of the PIMS mandate is to establish international partnerships in order to provide mechanisms for Canadian researchers to participate in activities outside Canada and attract visitors from abroad, especially beyond the United States. The establishment of the Centre National de la Recherche Scientifique (CNRS), *Unité Mixte Internationale*, at PIMS (the first in mathematics in North America) has led to year-long visits by 33 researchers from France since 2007, fully funded by CNRS. Similarly the leadership role played by PIMS in establishing the Pacific Rim Mathematical Association (PRIMA) has provided ample opportunities for Canadian exchanges with countries in this huge region; in the past 4 years there have been two PRIMA Congresses, in Sydney and Shanghai. Our partnership with IMA (USA) allows us to provide new opportunities in industrial mathematics for students via the annual MMIW, which are advertised throughout Canada. Our connections with Latin America have led to joint events (Canada-México meetings), as well facilitating the existing North American partnership at BIRS, to the benefit of the entire community.

## 5. ADMINISTRATIVE STRUCTURE AND FUNDING FOR PIMS

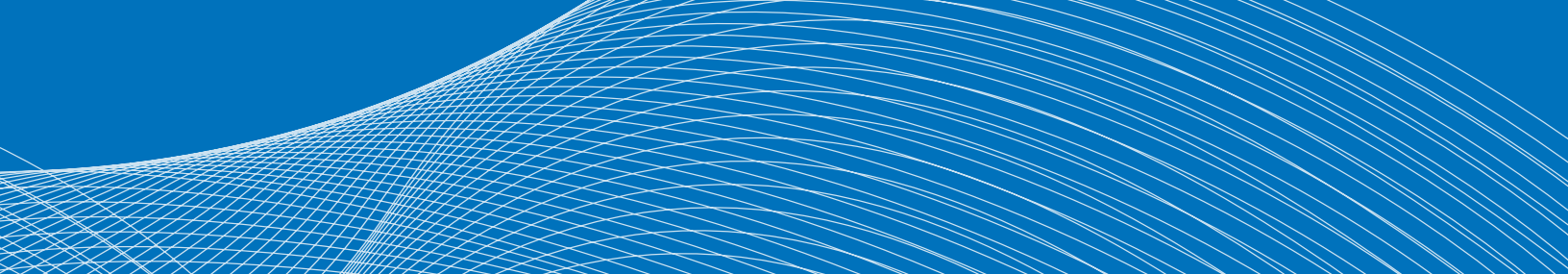
The central office and the Director of PIMS are based at UBC, and each of the other eight universities has a site office and a site director (see [www.pims.math.ca/contact](http://www.pims.math.ca/contact)). The role of the site directors is to look for local opportunities and synergies, while the site offices provide administrative assistance for organizing on-site PIMS activities. The distributed structure has allowed the Institute to support and energize the mathematical sciences across the whole of Western Canada.



The strong presence of PIMS at the university level gives it access to a vast reservoir of scientists from all disciplines. Over the years, PIMS has been able to lower disciplinary barriers and create innovative research teams, making a sustained effort to extend the PIMS community beyond mathematics and statistics departments so as to include scientists in areas such as physics, biology, engineering, informatics, operations research and economics.

In 2014 the day-to-day scientific administration of PIMS was carried out by **Alejandro Adem** (Director), **George Homsy/Martin Barlow** (Deputy Directors) and **Mark J. Gotay** (Assistant Director), all located at PIMS Central at UBC. PIMS operations are overseen by its *Board of Directors*, which includes a senior academic administrator from each of the founding universities and representatives from the business, industry and resource sectors and professional societies. Board members are listed at [www.pims.math.ca/pims-glance/board-directors](http://www.pims.math.ca/pims-glance/board-directors). Scientific events are adjudicated by an independent *Scientific Review Panel* (SRP) composed of internationally renowned mathematical scientists. For biographies of SRP members, see [www.pims.math.ca/pims-glance/scientific-review-panel](http://www.pims.math.ca/pims-glance/scientific-review-panel). PIMS 2014 Site Directors were N. Bruin (SFU), C. Doran (UA), G. Homsy/M. Barlow (UBC), C. Cunningham (UC), A. Akbary (UL), D. Stanley (UR), R. Srinivasan/C. Soteros (US), M. Laca (UV) and P. Hoff/C. Hoffman (UW).

PIMS receives funding from NSERC, its member universities and provincial governments. It also receives contributions from industry and private donors for specific events such as the Hugh C. Morris Lecture Series and Summer Math Camps for Aboriginal Students. Its events are co-sponsored by funding agencies such as the NSF, the U.S. National Security Agency, the U.S. Army, the U.S. National Institute of Standards and Technology, Alberta Advanced Education and Technology (AAET), Alberta Innovates Technology Futures and other Canadian institutes such as AARMS, the Canadian Institute for Advanced Research (CIFAR), the Canadian Institute for Theoretical Astrophysics, CRM, Fields Institute, Mitacs, Mprime, the Pacific Institute for Theoretical Physics (PiTP), the Perimeter Institute and the Winnipeg Institute for Theoretical Physics, by professional societies such as the American Mathematical Society (AMS), American Statistical Association (ASA), Association for Logic Programming, Bernoulli Society, CAIMS, Canadian Association of Physicists, Canadian Institute for Health Research, CMS, Canadian Number Theory Association, the Canadian Society for History and Philosophy of Mathematics, International Association for Cryptologic Research (IACR), International Linear Algebra Society, International Mathematical Union (IMU), Mathematical Association of America (MAA), Society of Actuaries, Society for Industrial and Applied Mathematics (SIAM), Sociedad Matemática Mexicana, Society for Mathematical Biology and Statistical Society of Canada (SSC) and by international partner institutions such as the CNRS, IMA, MSI, PRIMA, the (Kyoto) Research Institute for Mathematical Sciences (RIMS) and Universidad Nacional Autónoma de México. Other partners include Accelerate Okanagan, the ARC Centre of Excellence for Mathematics and Statistics of Complex Systems (Australia), Australian Mathematical Sciences Institute (AMSI), Australian Mathematical Society, Bishop's U, BC Centre for Disease Control, BC Oil and Gas, Beijing Int'l. Center for Mathematical Research, BIRS, Boeing, Boise State U, Brock U, Canadian Institutes for Health Research, Capital One, Center for Analysis and Modeling of Security, Center for Discrete Mathematics and Theoretical Computer Science (DIMACS), Central Michigan U., Centre for Experimental and Constructive Mathematics (CECM), Centre Int. de Mathématiques Pures et Appliquées, Centro de Investigación en Matemáticas (CIMAT), Centro de Modelamiento Matemático, CERTICOM, Chern Institute of Mathematics, Chinese Mathematical Society, CIBC, Clay Mathematics Institute, CRC Press, CryptoWorks, D-Wave Systems, École Fédérale de Lausanne, Elsevier, ENCORA, EPSRC, EQINOCS, Exxon-Mobil, Federal Interlocutor for Métis and Non-status Indians, Fisheries and Oceans Canada, Formosa Tea Café, Foundation Compositio Mathematica, FP Innovations, French National Research Agency (ANR), Global Risk Institute in Financial Services (GRI), Golden Key, Gouvernement de Benin, Grant MacEwan U, Hokkaido U, H.R. MacMillan Space Centre, Imperial Oil, Intellimedia, Institute of Electrical and Electronic Engineers (IEEE), Institut des Hautes Études Scientifiques, Institute for Canadian Urban Research Studies, Institute for Pure and Applied Mathematics, Institute of Industrial Mathematics, Intellimedia, Interdisciplinary Research in the Mathematical and Computational Sciences Centre (IRMACS), International Centre for Theoretical Physics, INTRIQ, Ion Torrent, Isaac Newton Institute (Cambridge), JackTek System Ltd., JMP, J. Templeton Foundation (USA), K.C. Wong Education Foundation (Hong Kong), KLA-Temcor, Korean Institute for Advanced Study, Kyoto U. Global COE Program,



Laboratoire d'excellence Bézat, Luther College, MSRI, MapleSoft, Max Planck-Gesellschaft, Memorial U, Microsoft Research, Miyo Wahkohtowin Educational, Modelling of Complex Social Systems, Mount Royal U, National Institute for Mathematical and Biological Synthesis (NIMBioS), National Natural Science Foundation of China, Nelson Education, North Dakota State U, the Number Theory Foundation, the (U.S.) Office for Naval Research, Okanagan College, Pacific Bioscience, Pearson, the Prairie Network for Research in the Mathematical Sciences (PNRMS), Quantitative Sci. Course Union, Quantum Works, Quest 4D, Reed College, RFEC Americas, Research Network for Statistical Methods for Oceanic & Atmospheric Sciences, SAS, Schlumberger, Science World (Vancouver), SEAMOCS, Seoul U., Shanghai Center for Mathematical Science, Shanghai Jiao Tong U, Shell Canada, Siemens, the Simons Foundation, Springer-Verlag, Stanford U., StataCorp, Statistical and Applied Mathematics Institute (SAMSI), StatOil, Swedish Foundation for Int. Cooperation in Research (STINT), SYREON Corp., TD Bank, Telus Spark, Tourism Edmonton, TU Munich, Tutte Institute, U Abomey Calavi, U Bourgogne, U California (Santa Barbara), U Connecticut, U Colorado-Colorado Springs, U Federal Rio de Janeiro, U Guelph, U Manitoba, U Montréal, U New South Wales, U Oregon, U Waterloo, W.H. Freeman & Co., Western Washington U, Wiley, U Wisconsin and York U.

The PIMS annual budget is approximately \$3.7 million, with roughly 31% of this amount coming from NSERC.

## 6. PIMS EDUCATIONAL AND OUTREACH ACTIVITIES

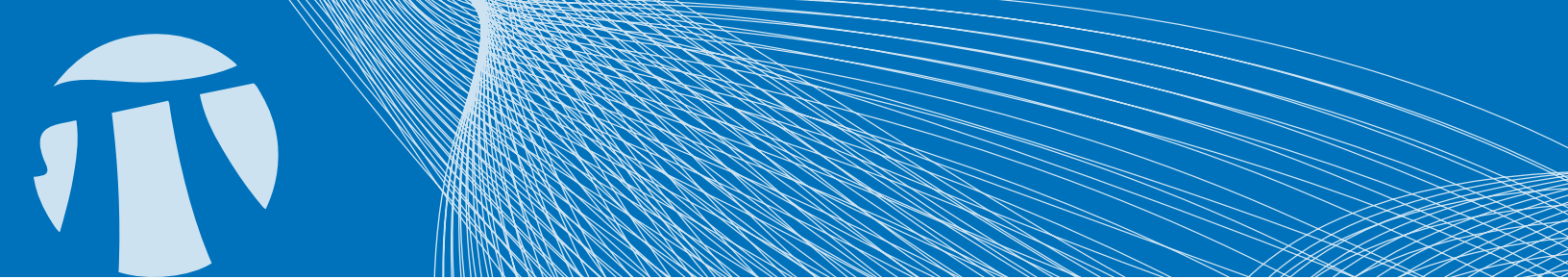
PIMS has a mandate to promote mathematics vigorously in Canada and takes upon itself the mission to help provide the elements for success that are necessary for current and future generations of teachers, scientists and engineers. In addition, the educational programs at PIMS advocate strongly for and find models and activities to facilitate, the participation of people of all backgrounds in mathematics. PIMS is actively involved in promoting mathematical outreach events in schools throughout Western Canada, either directly or through mechanisms such as regional science fairs. These involve students, teachers and parents and seek to convey the excitement of discovery and learning that underlies mathematics and its applications.

PIMS has developed a partnership with First Nations schools in BC that has been supported by the provincial government as well as by private donors. The activities under this program include summer camps for students, teacher training sessions and a coordinated mentoring program where undergraduate students from universities work with local teachers and students to provide support in mathematics.

Colleges and universities within the BC and Alberta post-secondary systems that do not qualify for regular membership in PIMS may become *PIMS Education Associates*. The PIMS educational network allows for the ex-change of successful practices in outreach, teaching and professional development amongst its members. Currently PIMS has 13 educational associates in Alberta and British Columbia.

## 7. PIMS NEWS IN 2014 AND 2015

- G. Homsy retired as PIMS Deputy Director and PIMS-UBC Site Director on July 1. He was replaced on an interim basis by M. Barlow of UBC.
- PIMS announced the appointment of J. Colliander as Deputy Director for a five-year period, starting on July 1, 2015. He will also assume a faculty position in the Department of Mathematics at UBC.
- A. Adem left his position as Director of PIMS on February 1, 2015, to become the CEO of Mitacs. M. Barlow has taken the position of Acting Director.



- On November 14 M. Lamoureux (UC) was appointed PIMS Innovation Coordinator. In this newly established position, he will serve as PIMS' conduit between the academic and industrial sectors, while at the same time interacting with the NSERC Regional Partnerships Program. He will serve as a resource for faculty, students and postdocs seeking industrial connections.
- A. Quas was appointed interim PIMS site director at the University of Victoria for the term January 1, 2014 - June 30, 2015. He took over from M. Laca.
- C. Hoffman was appointed PIMS-UW Site Director replacing P. Hoff. His 3-year term began July 1.
- PIMS has received \$1.2M in funding from the Alberta Government for the next three years. These funds will flow directly to Calgary, Edmonton and Lethbridge.
- This fall PIMS hosted a delegation from CNRS in France as part of the renewal of its status as a Unité Mixte Internationale.
- More information about PIMS can be obtained under "PIMS News/Press" at [www.pims.math.ca](http://www.pims.math.ca) and in the "Year in Review" at [www.pims.math.ca/resources/publications/pims-year-review](http://www.pims.math.ca/resources/publications/pims-year-review).



# II. PIMS CURRENT ACTIVITIES

PIMS efforts are focused in several overlapping directions: scientific, postdoctoral training, and educational. We discuss actual and planned activities as well as accomplishments in these areas below.

## 1. SCIENTIFIC EVENTS

PIMS enables and funds Collaborative Research Groups (CRGs) and their thematic activities and occasional Special Focus Periods. PIMS also sponsors and facilitates stand-alone conferences and workshops, runs summer schools for graduate students, finances lecture and seminar series, and cultivates interactions between academia and industry via various industrial activities. These activities typically take place at PIMS institutions around the Pacific Northwest and Prairie Provinces, but PIMS also has an international presence.

### A. Numbers and Types of Activities

**Collaborative Research Groups:** *Collaborative Research Groups* (CRGs) consist of researchers with a common interest and with a desire to collaborate in developing aspects of their research programs. Groups organize focus periods, including workshops and summer schools as well as seminars, make joint postdoctoral fellowship (PDF) appointments and develop joint graduate training programs. CRGs are designed to promote and support long term, multi-event, multi-site coordinated activities. During its period of operation, typically 3-4 years, a CRG can expect to receive priority access to the full gamut of PIMS resources and benefit from collaborations with other institutes or funding agencies. CRGs will sometimes concentrate their activities in a focused period, but more often their events are spread out over 2-3 years. See [www.pims.math.ca/scientific/collaborative-research-groups](http://www.pims.math.ca/scientific/collaborative-research-groups) for more information.

**Conferences and Workshops:** PIMS organizes and/or funds a variety of meetings around North America and the Pacific Rim each year. These range from small one-day workshops to multi-week conferences involving hundreds of participants. The larger meetings are selected each year on a competitive basis by the SRP. Smaller events are often funded at the discretion of the Director and Deputy Director.

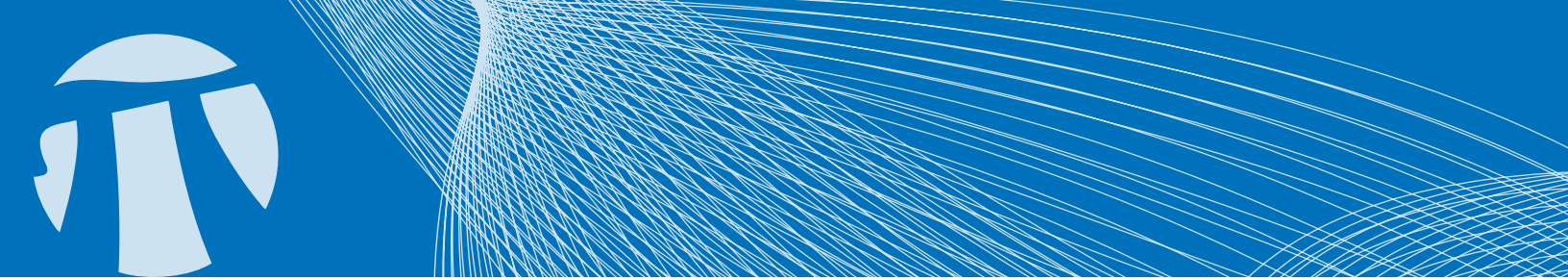
PIMS also hosts or cosponsors several meetings by professional societies such as the CMS, CAIMS, CNTA, IEEE and SSC.

**Summer Schools:** Every year PIMS runs a number of topical summer schools. They are intended to educate graduate students and early career researchers on current developments.

**Focus Periods:** These intensive activities may occur as part of a CRG or on their own depending on current mathematical trends and collaborative prospects. Each covers a specific but substantial area of research of current importance to Canada, with participants ranging from students to world experts in the mathematical sciences. Focus Periods usually take place in the summer and vary in length depending on the discipline. Proposals are evaluated by the PIMS SRP to ensure the highest scientific quality and appropriateness of the subject.

**Lecture and Seminar Series:** PIMS supports various ongoing seminar series at member universities and industrial centers throughout the year. Some of these are for specialists, while others are geared towards the general public, with the goal of inculcating in the citizenry the importance of mathematical research and its applications.

**Industrial Activities:** PIMS also fosters collaborations with industry. IPSW are based on the Oxford Study Group Model, in which problems of interest to participating industrial companies are posed to the workshop attendees. Participating



graduate students and faculty spend five days working on the problems and the results are published. The advantages for participating students and academics are: (i) the challenge of applying one’s skills to new and relevant problems directly applicable to industry, (ii) the opportunity for continued collaboration with the workshop’s academic and industrial participants and (iii) advancing mathematics by demonstrating to businesses and governments the tangible benefits of supporting the mathematical sciences. The IPSW are held annually, rotating between PIMS, Fields and CRM. PIMS next hosts an IPSW in June, 2015. MMWI enable graduate students from North American universities to learn various aspects of high-level techniques for solving industrial mathematics problems. Since 2010, these camps have been co-organized by PIMS and the IMA and alternate between the two countries; the 2014 MMIW was held in Vancouver.

As well, industrial workshops, short courses, mini-courses, summer schools and seminar series are organized by PIMS researchers, with topics of interest to both industry and academia, which serve to disseminate newly developed mathematical tools that can be of use in industry. For instance, with the sponsorship of Shell Canada Limited, PIMS presents a series of lunch hour lectures at Calgary Place Tower 1. These lectures, given by experts from the PIMS universities, focus on mathematical techniques and applications relevant to the oil and gas industry and demonstrate the utility and beauty of applied mathematics. The talks (5 in 2014) are aimed at a general audience. [www.pims.math.ca/industrial](http://www.pims.math.ca/industrial) has more information.

Activity	2013	2014	2015
Conferences/Workshops	49	34	29
Summer Schools	6	9	5
Collaborative Research Groups	5	5	5
Lecture / Seminar Series	27	28	28
Industrial Activities	5	3	6
Other	16	23	21

**Figure 1:** Numbers of each type of activity supported by PIMS by year.

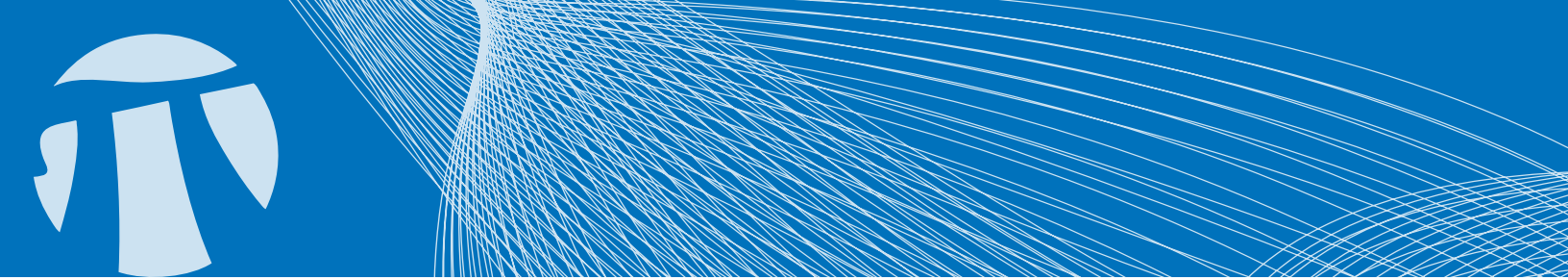
*Note:* The category “Conferences/Workshops” includes CRG events and Focus Period activities. Activities to be co-sponsored by AARMS in 2015 are not all known at this writing; we expect there will be 2-3 of these. PIMS also will be supporting CANSSI activities in 2015; details have not been specified yet. The numbers for 2015 are based on known events at this time.

All activities are listed individually below, along with *selected* highlights, so as to give a taste of what PIMS does. The sheer number of PIMS endeavors precludes us from doing much more than merely mentioning them here; however, details about specific activities can be obtained at [www.pims.math.ca](http://www.pims.math.ca) or by request. Such details typically include lists of organizers and speakers, titles and abstracts of talks, scientific background and summaries, schedules, etc. Because of their importance, more detail is given on the CRGs and PIMS support for AARMS and CANSSI, resp. in Sections II.1 D & E following.

## B. Listing of Activities: 2014

### Conferences and Workshops

1. *Applied Math Workshop*, SFU, January 10-11
2. *The Fourteenth Colloquiumfest*, US, February 28-March 1
  - Presented an overview of the use of fixed point theorems in various areas, in particular the quest of generalizing notions of fractals via iterated function systems.
3. *Frontiers in Biophysics*, SFU, March 15
4. *Joint UBC-SFU Graduate Workshop in Statistics*, SFU, March 16
5. *Mathematics and HIV*, SFU, March 29-30
  - This workshop may have been the first to explicitly focus on combining network modelling and operations research for HIV treatment and prevention.
  - As a result of this workshop SACEMA, (South Africa), the WHO and the epidemiology group at IRMACS (SFU) have initiated a network modelling simulation project to study the dissemination of a HIV testing and treatment program for miners and sex workers in South Africa.
  - Several lectures explored the NependiX network modelling software package developed by the IRMACS group.
6. *Bellingham Algebraic Geometry Seminar*, Western Washington U, April 6
7. *PIMS Analytic RNA Combinatorics Workshop*, SFU, April 15-16
  - This workshop brought together scientists from bioinformatics, mathematics, physics and computer science in an attempt to bridge the gap between the enumeration and asymptotic analysis of models for RNA structure and the design of RNA algorithms.
8. *Alberta Number Theory Days VI*, Banff, April 18-20
  - I. Varma (Princeton) spoke about her recent research with Fields Medalist M. Bhargava, which is related to the latter's ground-breaking work in the geometry of numbers.
9. *Women in Numbers 3*, Banff, April 21-25
  - Participants made significant research progress during the week and a proceedings volume containing original research papers as well as some additional survey papers will be published. Many new networking and mentorship connections were formed.
10. *Alberta Mathematics Dialogue*, UA Augustana Campus, Camrose, AB, May 1-2
  - In total, 92 people attended AMD 2014, from almost every postsecondary mathematics department in Alberta.
  - W. Craig (Fields Institute) gave a fascinating talk on the mathematics associated with vortex filament dynamics.
  - Deep and engaging presentation by P. Gauthier of U Montreal on the Riemann Hypothesis and analytic number theory.
11. *Canadian Human and Statistical Genetics Meeting*, Victoria, May 3-6 \*
12. *TRUe Games*, Thompson Rivers U, May 6-9
  - At least four prominent areas of research have been bolstered due to the collaborations that took



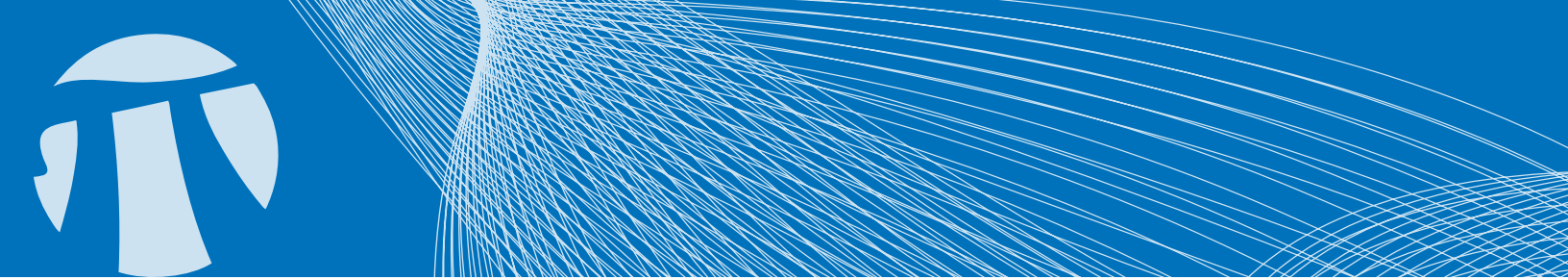
place during the conference: scoring games, limits, hot games and inverse problems.

13. *Western Canada Linear Algebra Meeting 2014*, UR, May 10-11
14. *Symmetry, Methods, Applications and Related Fields in Honor of George Bluman*, UBC, May 13-16
15. *Sharing Mathematics 2014*, Kwantlen Polytechnic U, May 15
  - Educators from B.C. and beyond discussed “Attention-Grabbing (and Mathematically Fruitful) Activities In and *Around the Post-Secondary Classroom.*”
16. *Changing the Culture: Fostering Curiosity*, SFU, May 16
  - Topics discussed included “Why do so many children lose their natural curiosity when they grow into adulthood?” and “Mathematical Habits of Mind.”
17. *Pacific Northwest Number Theory Conference*, SFU, May 17-18
18. *PIMS Undergraduate Workshop on Supersymmetry*, UBC, May 26-30
  - S. Gates (Maryland) presented a series of “very inspiring” lectures for physics and mathematics students.
19. *Algebraic Topology – Methods, Computation and Science 6*, UBC, May 26-30
20. *Geometry and Physics Workshop*, UBC, May 29-31
  - Each of four lecturers explored a topic at the intersection of geometry and physics which was intimately related to supersymmetry: J. Figueroa-O’Farill gave an overall review of supergravity theories, based the presence of special pseudo-Riemannian spinor fields, D. Waldram focused on the new approach to supergravity theories through generalized geometry, R. Donagi explained his paper with Witten on the moduli space of supercurves and C. Brav presented his recent work on shifted symplectic geometry.
21. *11th PIMS Young Researchers Conference in Mathematics and Statistics*, UBC, June 2-4
  - Of special interest was a presentation by M. Folz (Yammer) on “From Mathematician to Data Scientist: My Experiences In Moving From Academia To Industry.”
22. *String Math 2014*, UA, June 9-13
  - The discovery of M24 structure in the refined BPS invariants ... happened at the conference and is now the subject of some intense email exchanges.
23. *Pan-American Advanced Study Institute in Spatio-Temporal Modeling*, Buzios, RJ, Brazil, June 16-26
24. *Combinatorial Applications to Biology, Chemistry and Physics*, US, June 21-22
25. *Mathematics at the Frontier of Developmental Biology*, UBC, July 2-4
  - The workshop facilitated networking between mathematical modelers and experimental biologists and introduced trainees in PIMS in-stitutions to this emerging area of applied math.
26. *Workshop on Algebraic Design Theory and Hadamard Matrices*, UL, July 8-11
  - Physicist K. Zyczkowski explored the connection between quantum information and Hadamard matrices.
  - B. Schmidt’s lecture on Lander’s conjecture included powerful tools from number theory and imaginative approaches. Consequently he was able to rule out about 95% of the known cases in the Barker sequence conjecture, one of the important conjectures in the workshop’s area.
27. *Summer Conference and Workshop on the Molecular Origins of Protein Misfolding and Neurodegenerative Disease*, Vancouver, July 27-30

- Several reports at the meeting had significant implications and actual or potential impact. For example, the dominance of nucleation or branching processes in the proliferation of misfolded protein aggregate point towards the possibility of upregulation of chaperones as a possible therapy for amyloidosis-related disease.
- 28. *The Economics and Mathematics of Systemic Risk Workshop*, UBC, July 28-30
- 29. *2014 Symposium on Mathematics and Computation*, SFU, August 6
- 30. *Integrability and Exact Solvability as Avatars of Symmetry*, CRM, August 25-29
  - Celebrated the 60th birthday of L. Vinet, focusing on symmetries, groups, algebras and their representation theory.
- 31. *West Coast Optimization Meeting*, SFU-Surrey, September 20-21
- 32. *Pacific Northwest Numerical Analysis Seminar*, PSU, October 18
- 33. *Joint UBC-SFU Graduate Workshop in Statistics*, SFU-Vancouver, October 18
- 34. *Workshop on Kinetic theory*, UV, November 14-15

## Summer Schools

1. *String Math Summer School*, UBC, June 2-6
  - Five senior researchers (Zaslow, Pantev, Costello, Neitzke and Szendroi) in the general area of geometry and physics each gave a series of four lectures aimed at postdocs and senior graduate students.
2. *PIMS Summer School in Probability*, UBC, June 2-27
  - The school consisted of two 4-week courses by E. Mossel (“Influences and Noise Stability in Product Space”) and A. Nachmias (“Random Walks and Random Fractals”) and three 3-hour minicourses.
3. *Seminaire de Mathématiques Supérieures-2014*, CRM-U Montréal, June 23-July 4
  - This was the first summer school to focus on the new approach to arithmetic geometry that has been led by M. Bhargava and resulting in several extraordinary results, including that almost two-thirds of elliptic curves satisfy the Birch-Swinnerton-Dyer conjectures.
4. *West Coast Topology Summer School*, UBC, July 7-11
  - D. Freed’s commentary on the presentations was universally appreciated.
5. *PIMS-SFU Undergraduate Summer School on Multiple Zeta Values*, SFU, July 7-August 1
  - Students were exposed to some research level mathematics beginning with only a second year undergraduate background. The students, spontaneously in many cases, explored different aspects of the topic on their own and many were surprised how much they were able to understand.
6. *The Economics and Mathematics of Systemic Risk and the Financial Networks*, UBC, July 21-25
7. *AARMS Summer School*, Dalhousie U, July 21-August 15 \*°
8. *Two Weeks at Waterloo, a Summer School for Women in Math*, U Waterloo, August 10-23°
  - Two mini-courses were offered, “Kakeya sets, or, a handbook of parallel parking and “Algorithmic learning theory.”
  - Tours were made to meet with female mathematicians in industry at IBM, Sun Life and Maplesoft. The students also visited the Fields Institute.
9. *Summer School in Randomized Techniques for Combinatorial Algorithms*, SFU, August 18-22



### Collaborative Research Groups†

1. CRG 24 – *Optimization: Theory, Algorithms and Applications*, 2012-2014
2. CRG 25 – *Algorithmic Theory of Networks*, 2012-2014
3. CRG 26 – *Geometry and Physics*, 2013-2016
4. CRG 27 – *Applied Combinatorics*, 2014-2017
5. CRG 28 – *Applied, Algebraic and Geometric Topology*, 2014-2018

### Focus Periods

1. *Geometry and Physics*, UA & UBC, May-June
2. *The Economics and Mathematics of Systemic Risk*, UBC, July

### Lecture and Seminar Series

1. *UW-PIMS Colloquium*, UW
2. *Seminar Series on Analysis Of Genetic Data*, UC
3. *PIMS/UBC Distinguished Colloquium Series*, UBC
4. *PIMS Distinguished Lecture Series*, UR, January 4-March 2015
5. *The AMI Seminar Series*, UA, April 2013-March 2017
6. *Niven Lecture*, UBC, May 26
  - B. Poonen (MIT) discussed “Undecidability in Number Theory.”
7. *PIMS-UAlberta Distinguished Lecture Series*, UA
  - R. de la Llave (Georgia Tech) spoke on “Geometric Mechanics for Arnol’d Diffusion.”
8. *The PIMS Marsden Memorial Lecture*, Instituto Nacional de Matemática Pura e Aplicada, Rio de Janeiro, Brazil, April 7
9. *Applied Mathematics Seminar*, US, September 2014-June 2015
10. *The CORE Seminar Series*, UW, October 2014-June 2015
11. *CS Distinguished Colloquium Series*, UBC, September 2014-June 2016
12. *Lethbridge Number Theory and Combinatorics Seminar*, UL, September 2013-August 2015
  - O. Ramaré (Lille 1) explained the relationship between combinatorial and analytic methods in number theory, D. Fiorelli (Michigan) that between zeta function theory and random matrix theory and E. Naslund (Princeton) presented his work on the additive combinatorics of Roth’s theorem in the primes.
13. *Calgary Mathematics & Philosophy Lecture*, UC, October 2014
14. *PIMS/CSC Distinguished Lecture Series*, SFU, September 2012-August 2015
15. *Discrete Math Seminar*, SFU, August 2013-August 2014
16. *PIMS-UBC Statistics Constance van Eden Lecture*
  - R. Tibshirani (Stanford) talked about a new significance test for ‘the lasso.’
17. *Distinguished Public Lecture Series in Mathematical Biology*, US
18. *SCAIM Seminar Series*, UBC, September 2011-December 2014

- This covered topics ranging from “UrtheCast: Changing the way we look at the Earth” to “Critical Phenomena in Gravitational Col-lapse of Einstein-Vlasov System.”
- 19. *PIMS-UW Distinguished Colloquia in Statistics*, UW, April 21
  - Luke Born (Harvard) explained what happens when “Basketball Meets Big Data.”
- 20. *IAM-PIMS Distinguished Colloquium Series*, UBC, September 2013-June 2015
- 21. *CRM-Fields-PIMS Prize Lecture*, UBC, April 7
  - N. Kamran discussed “General Relativity, Differential Geometry and Differential Equations; Stories From a Successful Menage-a-trois.”
- 22. *Hugh C. Morris Distinguished Lecture*, UV, November 14
- 23. *PIMS Mathematical Biology Seminars*, UBC
- 24. *PIMS Public Lecture Series*, UBC
- 25. *R&L Guy Public Lecture Series*, UC, September 18
  - F. Doolittle of First Nations U spoke about the rich and extensive mathematical traditions of the Western Hemisphere prior to Euro-pean contact.
- 26. *PIMS Public Lecture and French Scholars Lecture Series*, UBC
  - P. Dehornoy from U Caen spoke about “Set Theory: The Last 50 Years.”
- 27. *COCANA Seminar Series*, UBC-O
- 28. *Geometry and Physics Seminar Series*, UA

### Distinguished Visitors

1. O. Ramaré, UL, February 20-March 13
2. Y. Neseřtil, UBC/SFU, February 20-March 10
3. F. Kamareddine, UL, April 1-April 1, 2015
4. M. Nebel, SFU, April 6-20
5. I. Dell’Ambrogio, UR, April 15-May 15
6. D. Bryant, SFU, April 20-May 31
7. M. Boyle, UBC, May 15-August 15
8. T. Johnson, UV, June 1-30
  - As a result of this visit, T. Johnson has initiated a collaboration between the Mathematics and Psychology Departments at UV and the Biostatistics Department at U Michigan on developing a neuro-imaging meta-analysis for examining differences for spatial cognition in familiar versus recently learned spatial environments.

### Industrial Activities

1. *PIMS/Shell Lunchbox Lecture Series*, Calgary, ongoing.
2. *Mathematical Modeling in Industry Workshop 18*, UBC, August 6-16
  - Groups of students worked under the mentorship of industrial scientists on projects including: prediction under uncertainties, microcalorimeter spectroscopy, vibroseis seismic recordings and diffraction by photomasks.

- 
3. *Natural Gas Research Roundtable*, UBC, November 13-14

## Other

PIMS provided administrative, financial and/or travel support for a number of activities and organizations, including:

1. *2014 Math Institutes Open House, Baltimore*, January 15
2. *Cascade Topology Seminar*, Oregon State U, April 19-20
3. *West Coast Optimization Meeting*, Oregon State U, May 2-3
4. *Cementing Fluid Mechanics Progress Meeting*, UBC, May 22-23
5. *Statistical Society of Canada Annual Meeting*, UT, May 25-28
6. *CMS Summer Meeting, Winnipeg*, June 6-9
7. *CAIMS Annual Meeting, Saskatoon*, June 22-26
8. *Software Carpentry Bootcamp: Basic Software Skills Training for Researchers in the Mathematical and Statistical Sciences*, Saskatoon, June 24
9. *Annual Meeting of Alberta Statisticians*, UA, October 18
10. *PIMS Job Forum*, UBC, October 24
11. *Northwest Probability Seminar*, Redmond, WA, October 25
  - Alexander E Holroyd (Microsoft Research) addressed a particularly simple formulation of the question: Do local constraints demand global coordination? The quest to answer this has led to the discovery of a beautiful yet mysterious new stochastic process that seem-ingly has no right to exist, while overturning the conventional thinking on a fundamental 49-year old question.
  - The Birnbaum Lecturer was S. Varadhan of NYU, winner of the Abel Prize.
12. *Cascade Topology Seminar*, Banff, November 7-9
  - Reviewed the latest developments in topological data analysis and homotopy-type theory.
13. *CMS Winter Meeting*, December 6-9
14. *PIMS IISER Pune Mathematical Biology Conference*, Pune, India, December 8-15
15. *American Women in Mathematics Mentor Network*

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° Circled events are co-sponsored with and organized by AARMS.

\* Starred events are co-sponsored with and organized by CANSSI.

† Although they have formally ended, certain CRGs still had several active PDFs in 2014.

## C. Listing of Planned Activities: 2015

### Conferences and Workshops

1. *Joint Graduate Student Workshop in Statistics*, SFU-Vancouver, February 28
2. *Frontiers in Biophysics*, UBC, March 14
3. *Bellingham Algebraic Geometry Seminar*, Western Washington U, April 4
4. *Statistical Inference for Large Scale Data*, SFU, April 20-24
5. *BC Combinatorics Day*, UVIC, April 25



6. *Cascade Topology Seminar*, UV, April 25-26
7. *Geometry of the Central Path*, UC, May
8. *Geometry and Lie Theory*, UA, May 16-17
9. *Big Data in Environmental Science*, UBC, May 11-15
10. *PIMS Young Researchers Conference in Mathematics and Statistics*, UC, May 27-29
11. *2015 Canadian Discrete and Algorithmic Mathematics and Conference*, US, June 1-4
12. *Western International Workshop on Harmonic Analysis and PDE*, UBC, June 10-12
13. *Theory Canada 10*, UC, June 11-14
14. *Alberta Number Theory Days 7*, Banff, June 12-14
15. *Connections in Discrete Mathematics Conference*, SFU, June 15-19
16. *Geometric and Computational Spectral Theory*, UBC, June 15-26
17. *2015 Canadian Undergraduate Math Conference*, UA, June 17-21
18. *CMS Regional Math Camp*, UC, June 28-July 6
19. *PIMS Symposium on the Geometry and Topology of Manifolds*, UBC, June 29-July 10
20. *Canadian Undergraduate Computer Science Conference 2015*, UBC-O, July 8-11
21. *Joint MSI-PIMS Workshop on Conformal Field Theory and Related Topics*, Australian Nat. U, Canberra, July 13-17
22. *Prairie Discrete Math Workshop 2015*, Summer
23. *Graduate Workshop on Target Benefits*, UT, August 5
24. *Combinatorial Constructions in Topology*, UR, August 17-21
25. *Applied Topology and High-Dimensional Data Analysis*, August 17-28
26. *Joint Graduate Student Workshop in Statistics*, SFU-Vancouver, Fall
27. *Mathematics of Sea Ice*, SFU-Vancouver, September 24-26
28. *Pacific Northwest Numerical Analysis Seminar*, WWU, October 17
29. *Combinatorial Potlatch*, UBC, November 1

### Summer Schools

1. *PIMS-US Graduate Summer School: Applied Combinatorics*, US, May 18-29
2. *PIMS-SFU Undergraduate Summer School on Rigorous Computing*, SFU, June 7-27
3. *Geometric and Computational Spectral Theory*, CRM, June 15-26
4. *CRM-PIMS Summer School in Probability*, McGill U & U Montreal, June 15-July 11
5. *AARMS-PIMS Summer School in Differential Equations and Numerical Analysis*, Dalhousie U, July 6-31\*

### Collaborative Research Groups

1. CRG 26 – *Geometry and Physics*, 2013-2016
2. CRG 27 – *Applied Combinatorics*, 2014-2017
3. CRG 28 – *Applied, Algebraic and Geometric Topology*, 2014-2018
4. CRG 29 – *Applied Partial Differential Equations: Modeling, Analysis and Computation*, 2015-2018

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5. CRG 30 – *Explicit Methods for Abelian Varieties*, 2015-2018

#### Focus Periods

1. *Applied, Algebraic and Geometric Topology*

#### Lecture and Seminar Series

1. *UW-PIMS Colloquium*, UW
2. *PIMS/UBC Distinguished Colloquium Series*, UBC
3. *Spectral Graph Theory*, UC
4. *PIMS Distinguished Lecture Series*, UR
5. *The AMI Seminar Series*, UA
6. *Niven Lecture*, UBC
7. *PIMS-UAlberta Distinguished Lecture Series*, UA
8. *The PIMS Marsden Memorial Lecture*, EPFL, Lausanne, Switzerland, June 10
9. *Applied Mathematics Seminar*, US
10. *The CORE Seminar Series*, UW
11. *PIMS-UV Distinguished Lecture Series*
12. *CS Distinguished Colloquium Series*, UBC
13. *Lethbridge Number Theory and Combinatorics Seminar*, UL
14. *Calgary Mathematics & Philosophy Lectures*, UC
15. *PIMS/CSC Distinguished Lecture Series*, SFU
16. *Discrete Math Seminar*, SFU
17. *PIMS-UBC Statistics Constance van Eden Lecture*, UBC
18. *Distinguished Public Lecture Series in Mathematical Biology*, US
19. *SCAIM Seminar Series*, UBC
20. *PIMS-UW Distinguished Colloquia in Statistics*, UW
21. *IAM-PIMS Distinguished Colloquium Series*, UBC
22. *CRM-Fields-PIMS Prize Lecture*, K. Behrend, UBC, March 27
23. *Hugh C. Morris Distinguished Lecture*, UV
24. *PIMS Mathematical Biology Seminars*, UBC
25. *PIMS Public Lecture Series*, UBC
26. *R&L Guy Public Lecture Series*, UC
27. *COCANA Seminar Series*, UBC-O
28. *Geometry and Physics Seminar Series*, UA

#### Industrial Activities

1. *PIMS/Shell Lunchbox Lecture Series*, Calgary
2. *PIMS Industrial Problem Solving Workshop*, Saskatoon, June 15-19

3. *Conference on Mathematical and Computational Issues in the Geosciences*, Stanford, June 29-July 2
4. *Mathematical Models and Algorithms for the Evolution of Genome Structure*, SFU, July 1-31
5. *Mathematical Modelling in Industry Workshop*, IMA, August 5-14
6. *Mathematical Models and Algorithms for the Evolution of Genome Structure*, SFU, July 1-31

### Distinguished Visitors

1. P. Thieullen, UV, January 3-February 3
2. M. Singer, SFU, January 25-February 7
3. C. J. Budd, SFU and UBC, February 1- June 30
4. M. Henning, UV, March 8-21
5. E. Knobloch, UA, March 25-29
6. F. Pappalardi, UL, April 1-30
7. S. Komarova, SFU and UBC, September
8. C. Mathieu, UV, July 20-August 20
9. S. Siksek, SFU and UBC, September 7-20
10. E. Tannier, SFU, July 1-31

### Other

PIMS will provide administrative, financial and/or travel support for a number of activities and organizations, including:

1. *Statistical Society of Canada Annual Meeting*
2. *CMS Summer Meeting*
3. *CAIMS Annual Meeting*
4. *Symposium on Models for HIV Epidemiology*, UBC, September
5. *Northwest Probability Seminar*, Microsoft, Redmond, WA, Fall
6. *CMS Winter Meeting*, December 4-7
7. *PIMS Diff. Geom./Math. Phys./PDE Seminars*, UBC
8. *PIMS Probability Seminar*, UBC
9. *PIMS Topology Seminar*, UBC
10. *PIMS Discrete Mathematics Seminar*, UBC
11. *American Women in Mathematics Mentor Network*

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<sup>o</sup> Circled events are co-sponsored with and organized by AARMS.

\* Starred events are co-sponsored with and organized by CANSSI.



## D. CRG Status Reports

PIMS had five active CRGs in 2014; below we briefly summarize current and upcoming activities and list their PDFs. New CRGs on *Applied Combinatorics* and *Applied, Algebraic and Geometric Topology* got underway in 2014. PIMS is currently developing new CRGs for following years.

### CRG 24: Optimization: Theory, Algorithms and Applications (2012-2015)

**Leaders:** *Heinz H. Bauschke (UBC-O), Michael Friedlander (UBC), Y. Zinchenko (UC).*

#### 2014 Activities:

- *West Coast Optimization Meeting*, UW, Spring.
- *West Coast Optimization Meeting*, SFU–Surrey, Fall 2014.
- *COCANA Seminars*

#### 2015 Activities (Planned):

- *Workshop on the Geometry of the Central Path*, UC, May.
- *COCANA Seminars*
- This CRG will end in 2015.

**Visitors:** G. Carlier, U Paris-Dauphine, France, November; D. Noll, U Toulouse, January–February; J. Pang Chin How, National U Singapore, May; R. Mifflin, Washington State U, July; C. Ryan, U Chicago, January 2014; C. Sagastizabal & M. Solodov, IMPA, Brazil, July; D. Schuurmans, UA, April; J. Cruz, U Goias, Brazil, August 15, 2013 – January, 2015

**Students & PDFs:** Sedi Bartz (PIMS PDF, UBC-O); Ima Rahmanian (UBC-O); Minh Dao (NSERC Accelerator PDF, UBC-O); Ting Kei Pong (PIMS PDF, July 2013 – present); and 18 PhD and MSc students at UBC-O, UA and UBC.

#### Highlights:

- A new norm, the so-called stadium norm, was introduced and its proximal mapping computed. This opens the door for the optimization (rather than the mere feasibility) of road design optimization problems where earthwork cost is minimized.
- The study of the so-called p-norm cones culminated in construction of the previously unknown optimal (polynomial size) approximation scheme that in theory allows one to efficiently solve linear optimization problems posed over such cones using the very well-developed machinery of linear programming.
- A noteworthy mention goes to the COCANA web-cast optimization seminars, which are hosted by the UBC-O optimization group and run roughly bi-weekly.

### CRG 25: Algorithmic Theory of Networks (2012-2015)

**Leaders:** F. Ergun & P. Berenbrink (SFU), V. King (UV)

#### 2014 Activities:

- *Summer School on Randomized Techniques for Combinatorial Algorithms*, SFU, Summer.

#### 2015 Activities (Planned):

- *Workshop on Big Data in Networks and Distributed Systems*, SFU, Spring
- Seminar Series at SFU, UV, UC

- This CRG is winding down in 2015.

**Visitors :** G. Giakkoupis (INRIA, Rennes), UC, March

**PDFs:** P. Kling , A. Megrabian

**Highlights:**

The focus has been on algorithms for large dynamic graphs with the goal of fast update times, sublinear storage and, in distributed networks, with low communication costs. 2014 saw two break-throughs: (1) Byzantine agreement can be performed in polynomial expected time in the full information model (no cryptography or assumption of private channels needed) and (2)  $n$  nodes of an arbitrary network with  $m$  edges can determine a broadcast tree and broadcast over a network in  $n$  polylog  $n$  bits of communications, beating the “folklore” lower bound of  $m$ .

**CRG 26: Geometry and Physics (2013-2016)**

**Leaders:** Chuck Doran (UA), Jim Bryan (UBC) and Kai Behrend (UBC)

**PIMS Faculty:** Vincent Bouchard, Thomas Creutzig, David Favero, Terry Gannon (UA)

**2014 Activities:**

- *The Geometry and Physics Seminar Series*, UA & UBC
- *Undergraduate Supersymmetry Summer School*, UBC, May 26-31
- *Geometry and Physics Workshop*, UBC, May 29-31
- *Special Lecture, Jim Gates (U Maryland)*, May 29
- *String-Math Summer School*, UBC, June 2-6
- *String-Math Conference*, UA, June 9-13

**2015 Activities (Planned):**

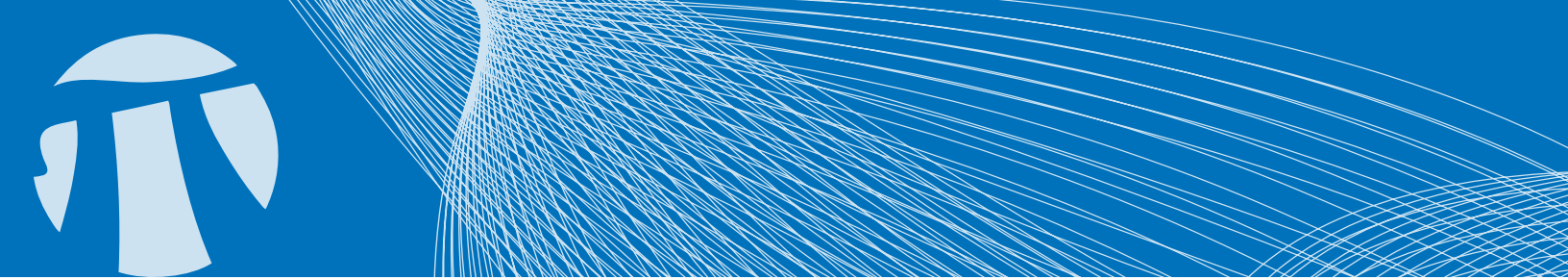
- *The Geometry and Physics Seminar Series*, UA & UBC
- *The Mathematics of Conformal Field Theory*, Canberra, July 13-17
- *TSIM Workshop on K-Theory and Physics*, Sanya, November 9-13

**Visitors:** A. Malmendier (Utah State U), January-June 2014; P. Overholser (Leuven), January-June 2014

**PDFs:** Callum Quigley (UA), Alan Thompson (UA), Martijn Kool (UBC)

**Highlights:**

- The pair of lectures by D. Gaiotto (Perimeter) and G. Moore (Rutgers) at String-Math 2014 on their work with E. Witten (IAS) on BPS webs.
- The lecture by S.-T. Yau on “Period Integrals, Counting Curves and Mirror Symmetry” at the SMC 2014 satellite workshop on *Calabi-Yau Manifolds and their Moduli*.
- Another important SMC 2014 satellite workshop on was on *Quantum Curves and Quantum Knot Invariants*.
- Thematic courses by CRG faculty: Doran’s graduate topics class on “Calabi-Yau Geometry” during winter 2014 and Bouchard’s reading course in Enumerative geometry and string theory during Fall 2014 for undergraduate and graduate students, both at UA.
- The public lecture by J. Gates (UMD/Perimeter) entitled “The ABEGHHK’tH Revolution,” which described in personal and accessible terms both the background for the search for the Higgs boson and the significance of its discovery.



## **CRG 27: Applied Combinatorics (2014-2017)**

**Leaders:** M. Mishna (SFU), A. Rechnitzer (UBC), C. Soteros (US) and K. Yeats (SFU)

### **PIMS Faculty:**

- SFU: C. Chauve, L. Yen
- US: M. Atapour, M. Szafron, R. Bowles
- UBC: O. Angel, S. van Willigenberg

### **2014 Activities:**

- *SFU Discrete Math Seminar*
- *UBC Discrete Math Seminar*
- *Local organization of CanaDAM*
- *PIMS Analytic RNA Combinatorics Workshop (PARC)*, SFU, April 15-16
- *Combinatorial Applications to Biology, Chemistry and Physics*, Saskatoon, June 21-22
- *Polymer Models and Combinatorics, SLAM meeting on Discrete Mathematics*, Minneapolis, June

### **2015 Activities (Planned):**

- *Undergraduate Supersymmetry Summer School*, UBC, May 26-31.
- *Geometry and Physics Workshop*, UBC, May 29 - 31, 2014
- *Special Lecture, Jim Gates (U Maryland)*, May 29, 2014.
- *String-Math Summer School*, UBC, June 2 - 6, 2014
- *String-Math Conference*, UA, June 9 - 13, 2014

### **PIMS/CNRS Visitors and Distinguished PIMS Visitors:**

- Y. LeBorgne (Bordeaux), SFU, 2013-2104
- Y. Ponty (Polytechnique), SFU, fall 2014-onwards
- E. Fusy (Polytechnique), SFU and UBC
- Distinguished PIMS Visitor M. Nebel, SFU, April
- Distinguished PIMS Visitor S Whittington, US, November 10-13

**Students & PDFs:** J. Lumbroso (SFU), 2013-2014; J. Courtiel (SFU, PIMS Postdoc), 2014; N. Beaton (US, PIMS Postdoc); 2 Ph.D., 15 others.

### **Highlights:**

- Extended recent work of Johnson, Mishna & Yeats on asymptotic properties of lattice paths, creating the first efficient uniform random generation model capable of generating walks of length almost 20,000 steps for models under constraints for which no other standard model could apply.
- Used lattice polygon models to answer questions about DNA topology.
- Found a new apparent graph theoretic invariant for Feynman integrals coming from a permanent modulo 3 calculation.
- Built a formal mathematical framework to evaluate the “goodness” of combinatorial models that arise in evolutionary genomics.
- One of the main successes of the CRG in the past months has been to draw top quality international researchers to Vancouver and Saskatoon, leading to the development of some strong collaborations.

## CRG 28: Applied, Algebraic and Geometric Topology (2014-2018)

**Leaders:** K. Bauer (UC), R. Budney (UV), J. Palmieri (UW), A. Pettet (UBC), D. Rolfsen (UBC), D. Sinha (U Oregon), D. Stanley (UR).

**PIMS Faculty:** A. Adem (UBC), R. Cockett (UC, computer science), R. Zach (UC, philosophy), P. Zvengrowski (UC), B. Botvinnik (U Oregon), J. Palmieri (UW)

### 2014 Activities:

- *Algebraic Topology: Methods, Computation & Science 6 (ATMCS6)*, UBC, May 26-30
- *West Coast Algebraic Topology Summer School*, UBC, July 7-12
- *UV Topology Seminar*
- *PIMS-UBC Topology Seminar*

### 2015 Activities (Planned):

- *Cascade Topology Seminar*, UV, April 25-26
- *PIMS Symposium on Geometry and Topology of Manifolds*, UBC, June 29-July 10
- *Combinatorial Constructions in Topology*, UR, August 17-21
- *PIMS Workshop on Applied Topology and High-Dimensional Data Analysis*, UV, August 24-28

**Students & PDFs:** M. Cheng (UBC), B. Williams (UBC), H. Ruping (UBC), T. Pinsky (UBC), R. Koytcheff (UV), S. Sarkar (UR), 8 Ph.D. students.

### Highlights:

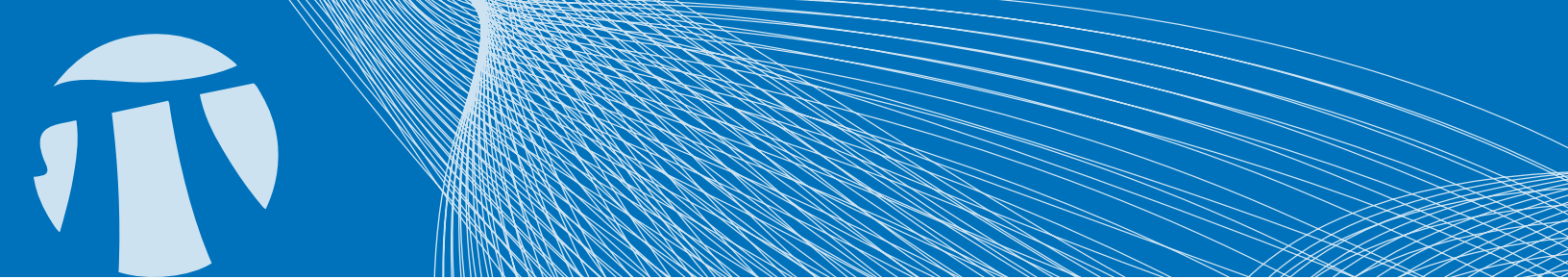
- An old problem of Kervaire's on the difference between the fundamental groups of co-dimension two knot exteriors in  $S^3$ ,  $S^4$  and  $S^5$  has been partially resolved. A new knot group in dimension 4 was discovered.
- A recently discovered filtration of BU has led to new generalized cohomology theories, in particular a notion of commutative K-theory represented geometrically by transitionally commutative vector bundles.
- The team leaders have applied for approximately \$87,500 USD from NSF, UR and Fields to support additional activities of the CRG. The NSF funds have already been awarded.

## E. Focus Periods

**Systemic Risk and Financial Networks, July 2014:** Financial markets are not physical systems. The rules they operate 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 modeled 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 program studied the way the markets generate and propagate risk and what kind of regulation can mitigate it.

This focus period was organized by: A. Adem (UBC), R. Carmona (Princeton U), I. Ekeland (U Paris Dauphine) and G. Papanicolaou (Stanford U). Activities included a summer school which was held July 21-25 and a workshop which took place on July 28-30. Both were held at UBC. A number of senior visitors were in residence at PIMS during July 2014, including I. Ekeland and J. Rochet. There were seminars and other activities during that month as well.

The summer school comprised six courses of 3 lectures each. The lecturers, economists, finance academics and mathematicians, were of the highest calibre and leaders in their respective fields of expertise. Their 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). They also covered the analysis of the complex networks underpinning the system of financial transactions and the impact of regulatory constraints like clearing and capital requirement (Cont, Glasserman). Finally, investor behavior and the over the counter markets were given a sound mathematical foundation in game theoretic frameworks (Duffie). The attendance was a patchwork of PhD students and young researchers representing the fields of economics and applied mathematics in approximately the same proportions. The constant exchanges between speakers and audience were made the event lively and entertaining.

The workshop picked up where the school let off: 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 gave a different tone to the interactions between the speakers and the audience. While cutting edge mathematical analyses 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 some of the aftermaths of the crisis including regulatory interventions.

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

**Geometry and Physics, May-June 2014:** Pure mathematics and fundamental physics, historic partners for centuries, grew apart during the first half of the 20th century. This changed with the emergence of gauge theory in particle physics and, still more strikingly, the string-theoretic approach to quantum gravity. In the 21st century thus far, many of the great insights into geometry have come from physical models formulated in geometric terms.

During the summer of 2014, the PIMS Focus Period on Geometry and Physics brought hundreds of the world's best researchers in geometry and physics to Western Canada to continue to develop this rich interface. Details about focus period activities can be found in the CRG 26 Status Report, in Section II.1.D above.

## F. AARMS & CANSSI Reports

As part of a national mandate, PIMS supports mathematical activities in the Maritime Provinces in conjunction with the Atlantic Association of Research in the Mathematical Sciences (AARMS). Together they co-sponsored the following activities in 2014; PIMS' financial contribution to each activity is listed in parentheses:

1. *AARMS Summer School*, Dalhousie U, July 21-August 15: Every summer highly regarded faculty from around the world deliver graduate courses in the mathematical sciences. In 2014 the courses given were "Gröbner Bases in Commutative Algebra," "Homological Conjectures in Commutative Algebra," "Statistical Learning with Big Data" and "Spatial Statistics." (\$22,700)
2. *Two Weeks at Waterloo – A Summer School for Women in Math*, U Waterloo, August 10-23: The purpose of this workshop was to encourage and inspire outstanding female undergraduate mathematics students to continue their studies in mathematics and to consider graduate work in mathematics. Two mini-courses were offered, "Kekeya Sets, or, a Handbook of Parallel Parking," taught by M. Pramanik (UBC) and "Algorithmic Learning Theory," taught by J. Reimann (U San Francisco). As part of the courses, the students worked in small groups on a research project. Each course also had a female graduate student act as a TA and mentor for the students. (\$1,800)
3. *AARMS* administrator salary. (\$7,500)

As well, PIMS supports statistical activities throughout Canada through the Canadian Statistical Sciences Institute

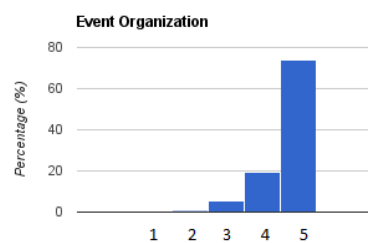
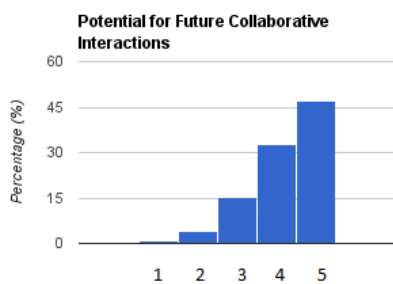
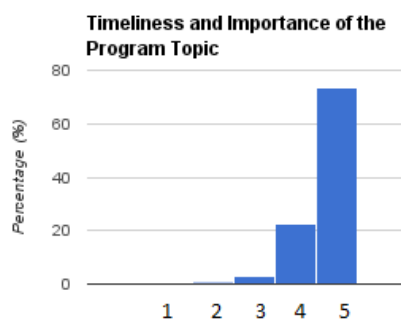
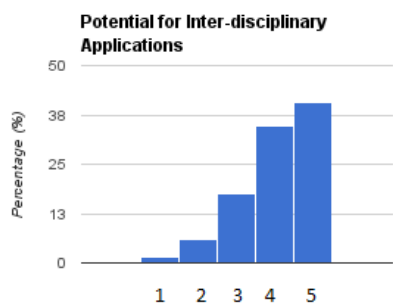
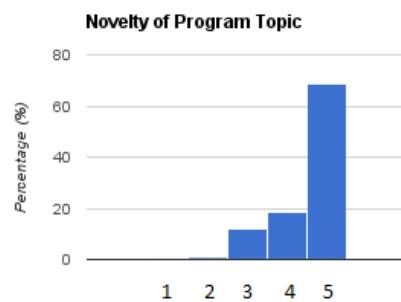
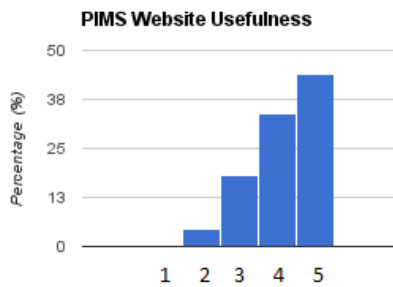


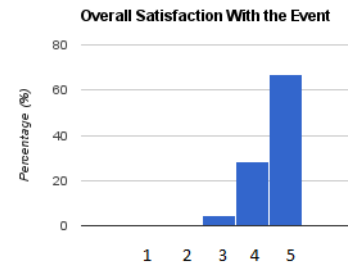
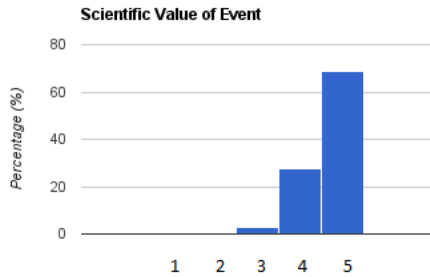
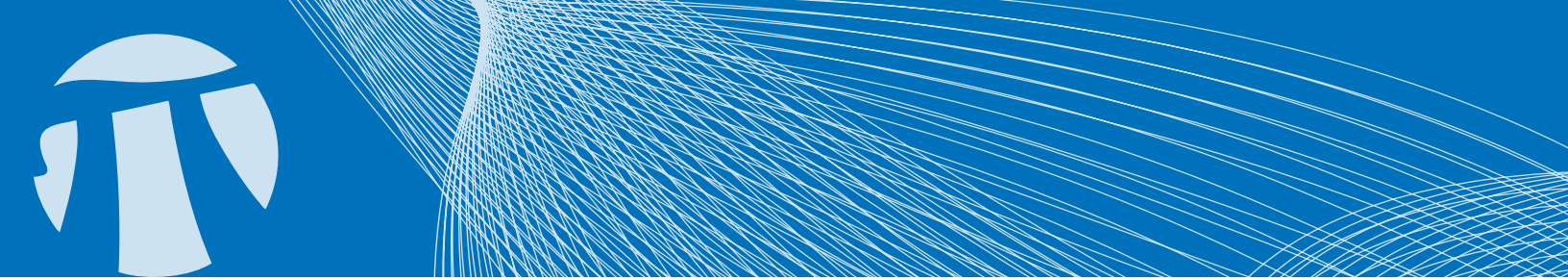
(CANSSI). In 2014 these included:

4. *Canadian Human and Statistical Genetics Meeting*, May 3-6, Victoria. (\$9,681)
5. *AARMS Summer School*, July 21-Aug 18, 2014, Dalhousie U. See 1. above under AARMS. (\$22,700)
6. *Scientific coordinator* (\$22,674), Postdoc (\$9,022) & Research assistant (\$6,641) salaries.

## G. Evaluation of PIMS Activities

In 2010 PIMS began collecting evaluations of all its scientific events of at least three days duration. Participants are asked to fill in an online survey rating various aspects of their events; approximately 287 responded in 2014. The results were passed on to event organizers and scrutinized at PIMS Central. Below are charts summarizing responses to questions of particular interest to PIMS; here “1” represents the worst score (very dissatisfied/low/poor) and “5” the best score (very satisfied/high/excellent):





The results were broadly similar to those in previous years.

Individual comments regarding PIMS' events included:

- “It has been a long time since I have been at such a pleasant, well-organized and scientifically significant event. The scheduling, social events, chances for interactions were spectacular. Speakers were exceptional.”
- “There were many excellent talks, but as a highlight I would mention the useful scientific discussions with some colleagues, which helped me to make progress in some mathematical problems I was stuck with for some time and also the potential for future collaborations.”
- “As a whole the workshop helped me realize that I indeed want to be an industrial mathematician.”
- “All the organization by the PIMS staff was perfect and it was wonderful to be in the new building.”
- “It was a wonderful workshop with great importance to my research and career. I can only be grateful for PIMS for the support.”
- “This conference was incredibly helpful to me. I made many new contacts and discussed my research with lots of people - I am pretty sure that one of these discussions will lead to a postdoc opportunity.”
- “This is one of my favorite scientific events because of the quality and originality of the works presented and the very productive interactions with other participants.”
- “This is one of the best organized conferences in which I participated and I am looking forward for the next edition. Ran smoothly and excellently despite a major natural disaster!”
- “This is the best academic workshop I have attended in the past 5 years, both in the technical and social settings. Thank you.”
- “It was an honor to be asked to speak and a real pleasure to hear such good mathematicians talk about their work. There were really exceptional talks by many people, broad overviews that could only come from the top people of the field. These mathematicians are really good.”
- “Many of the talks were fantastic and I attended every single one which is a first in 30 years of conference attendance.”
- “[It] was a terrific conference. It is a rare event when I'm sad to leave a conference, but I wasn't ready to go home.”
- “... engaging and well-organized. The courses were intensive and useful. ... Overall the school was fantastic and it was quite apparent that the organizers put a lot of effort into making the event a huge success.”
- “This summer program has been a terrific experience mathematically. Both of the main courses were very well taught and had very interesting subject matter. I had many interesting conversations with students, post docs and professors, some of which led directly to progress in my research. I started working on a new project with one of the students I met here and we plan to continue collaborating in the future. I learned about several areas that are very appealing to work on in the future. Also, it's been a really fun few weeks--Vancouver is beautiful and the hikes and other activities have been great.”
- “Personally, [the highlight] was spending 2 hours talking with two people who I had not met before and setting in motion international collaborations.”
- “The organizers... have done a fantastic and outstanding job!! I rate this one of the best conferences in our field.”
- “The conference brought together a remarkable group of mathematical scientists, with applications to a wonderful variety of applied problems. It was extremely well organized in every way. PIMS can feel very pleased -- it deserved support, it received strong support and the result was a success for applied mathematics.”
- “I had several important conversations with important researchers in my field ... who expanded my thinking... I could not ask for more!”
- “The scientific content of the conference was excellent - interesting topics, good speakers, great interdisciplinary talks.”

- “For me the highlight was the range of new problems and ideas -- exceptional.”
- “Very nice and friendly scientific environment, which connects young researcher[s] and helps[s] them to learn from each other and col-laborate.”
- “I appreciate from the bottom of my heart the opportunity... to attend... As a graduate student my goal was to learn the concepts... But [the] instructors have taken us to another level... having received hands-on experience on applying them to real data sets...”
- “The organizers put together a truly brilliant program that gave the participants a broad and varied look at many topics in the field. A truly wonderful week.”
- “I’m writing to thank you \*so much\* for making the amazing NLO workshop possible. I was blown away by everything.”
- “A well-organized conference which attracted several big names in the field and which was of considerable instructional value to the many graduate students and which stimulated a good deal of research.”
- “Spectacular survey ... outlining a number of interesting research directions that will help my PhD student.”
- “Unexpected interactions between several distinct areas of mathematics.”
- “The set-up of the workshop was excellent. 4 days was the perfect length of time... Also, all of the speakers were great and the organizers were approachable and friendly. Overall, an excellent workshop.”
- “A great experience as the first experience for an undergraduate student can be.”
- “...it helped expand my horizons and understand the mathematical community. I was intimidated but thoroughly enjoyed the experience! It was great...”
- “Underscored how mathematics is a foundation upon which technological breakthroughs are enabled.”
- “The meeting was terrific. I found the scientific content to be top-notch with an appropriate range of related topics. The time available to discuss the science as a group ... was unique among the meetings I normally attend ... an important initiative for the advancement of science. ... It would be very exciting to build on this.”
- “The workshop has exceeded my expectations. The program was carefully thought out, balanced current results with some back-ground material and was of exceptionally high level altogether. A mixture of current results and recent work were reported which in-formed me and broadened my understanding of the current state of the field. I returned home inspired by the great mathematics I have learned.”
- “... the diversity of the problems was a real bonus for me. High resolution photon measurement, to airplane design, to iron furnaces, to seismic imaging. All very diverse, yet making important use of mathematics.”
- “The workshop was really excellent, with a focus that was narrow enough to provide real opportunities for research synergy but broad enough that one was not seeing ‘the same people, one always sees.’”
- “My first PIMS event and a great one overall. I look forward to others!”
- “Making us sit down and make posters was a brilliant way to force us to reflect on our knowledge. This was also a wonderful way to meet other students...”
- “The talks were wonderful and thought provoking. I am still working on some problems I learned at the meeting.”
- “...was very well organized and was an absolute pleasure to attend.”
- “An unforgettable experience.”
- “I found the event both fascinating and informative. The presenters were able to cover a variety of topics... The lectures were clear and concise. Furthermore, the labs showcased the theory nicely and the instructors were approachable and helpful throughout the week. The funding made a big difference for myself as well as other students as without it I don’t think the week could have been as outstanding as it was. Overall it was an excellent experience and I am motivated to apply for future PIMS events...”
- “The most valuable aspect was getting to do group collaboration and to see what working for a company is like. It helped give me clearer direction for the future.”
- “It is so hard for mathematicians and physicists to communicate. This effort is to be commended.”
- “...the quality of the talks was, in general, very high. What’s more, [this conference] is attracting many international participants while still highlighting Canadian involvement in the community.”
- “Perhaps it’s cliché, but this will be one of the defining moments in my life, probably. It was an amazing conference, in a wonderful locale, with stellar organization and featuring amazing talks by both students and professors.”
- “...the summer school was a huge success. The event surpassed my expectations on all accounts.”

## H. Demographics

Here we provide some demographics of participants in PIMS scientific events and programs. For all PIMS-sponsored or co-sponsored conferences/workshops, summer schools, IGTC, industrial and selected educational and ‘other’ activities, we:

1. Summarize the total number of attendees and the number of attendee-days.
2. Sort the attendees into academics, educators, industrial scientists, and others. We further sort academics into professors, postdoctoral fellows, graduate students, undergrads and others, and broadly classify them by field.
3. List the number of males/females.
4. Classify the attendees as to whether they belong to Canadian institutions, other North American institutions, or institutions located elsewhere. As well, we break down the Canadian participants by province.

In what follows, data from the two previous years are placed in brackets.

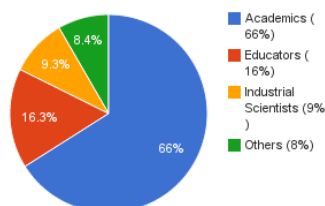
During the 2014 [2013/2012] reporting period, PIMS helped to support 89 [96/81] scientific activities of the types listed above. We have data on 72 activities – a substantial 81% return rate (Compare the 62% response rate for the Math and Physical Sciences Directorate of NSF in 2011). Of these,

- The total number of attendees: 6,733 [8,125/5,472]
- Attendee-days spent at PIMS activities: 23,380 [25,113/17,611]
- Average attendees/activity: 76 [92/75]
- Average attendee-days/activity: 263 [285/241]
- Average activity duration (days): 3.2 [3.3/3.9]

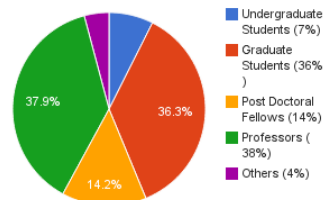
Of all identifiable attendees,

- 66% [60/88]% were academics, of which:
  - 38% [37/34]% were professors,
  - 14% [9/9]% were PDFs,
  - 36% [48/45]% were graduate students,
  - 7% [4/10]% were undergraduate students and
  - 4% [1/2]% were other academics.
- 16% [1/2]% were educators,
- 9% [4/4]% were industrial and
- 8% [34/6]% were others (this includes programs aimed at secondary and elementary school students)

**Attendee Demographics**

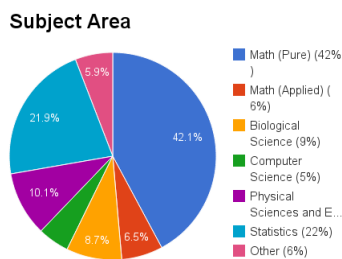


**Academic Attendee Demographics**

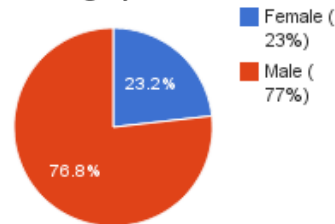


Many respondents also supplied their fields of expertise. They consisted of:

- 42% pure mathematicians
- 6% applied mathematicians
- 9% biological scientists
- 5% computer scientists
- 10% physical sciences and engineering
- 22% statisticians
- 6% others.



**Attendee Gender Demographics**



Of those attendees who stated their gender,

- 77% [76/72]% were male and
- 23% [24/28]% female.

Also,

- 70% [72/83]% were from Canadian institutions, of which:
  - 63% [50/61]% were from British Columbia,
  - 23% [16/15]% were from Alberta,
  - 2% [1/2]% were from Saskatchewan,
  - 0.5% [1/1]% were from Manitoba,
- 11% [17/18]% were from Ontario and Quebec and
- 0.5% [3/3]% were from the Atlantic Provinces.
- 21% [13/9]% were from **other North American institutions** and
- 9% [15/8]% were from **elsewhere**.

We have also computed the geographical distribution of PIMS events and programs, including Lecture & Seminar Series, during 2014. Of the activities with well-defined geographic locations,

- 92% [85/88]% were held in **Canada**, of which:
  - 56% [60/54]% were held in British Columbia,
  - 20% [23/26]% were held in Alberta,
  - 10% [4/8]% were held in Saskatchewan,
  - 1% [4/3]% were held in the Atlantic Provinces,
  - 8% [9/8]% were held in Quebec, Ontario and Manitoba,
- 10% [10/12]% were held in the **United States** (seven events in Washington and two in Oregon) and
- 3% [5/1]% were held **elsewhere**.

Of course, some programs such as CRGs are spread over several provinces and states.



## I. Publications

PIMS CRG activities, PDFs and CNRS researchers produced almost 220 publications in 2014. Over the years, many of these appeared in top journals, such as the *Ann. Math.*, *SIAM J. Math. Anal.*, *Math. Proc. Cambridge Phil. Soc.*, *J. Algebra*, *Commun. Pure Appl. Anal.*, *Phys. Rev.*, *Quart. J. Math.*, *Acta Arith.*, *Adv. Appl. Math.*, *Int. J. Math.*, *J. Amer. Chem. Soc.*, *Compositio Math.*, *J. Comp. Anal.*, *Commun. Math. Sci.*, *SIAM J. Num. Anal.*, *Trans. A.M.S.*, *Int. Math. Res. Not.*, *Comm. Math. Phys.*, *J. Funct. Anal.*, *Nature*, *Math. Annalen*, *J. Math. Bio.*, *J. Geom. Anal.*, *Amer. Naturalist*, *Indiana U. Math. J.*, *Arch. Rational Mechanics Anal.*, *Inventiones Mathematicae*, *Ramanujan J.*, *Commun. PDE*, *Biophys. Adv. Math.*, *J. Proc. Nat. Acad. Sci. (USA)* and the *Duke Math. J.* A list is at: [www.pims.math.ca/resources/publications/pims-scientific-publication-lists](http://www.pims.math.ca/resources/publications/pims-scientific-publication-lists).

## 2. TRAINING OF HIGHLY QUALIFIED PERSONNEL (HQP)

### A. Postdoctoral Fellows & CNRS/PIMS Scientists

PIMS has created a large number of postdoctoral opportunities for young researchers in the mathematical sciences. The regular PIMS Postdoctoral Fellow competition takes place each January. Postdoctoral candidates from institutions in France are eligible for CNRS/PIMS fellowships. In addition, there are several PIMS-supported PDFs that are associated with CRGs and/or Focus Periods; these go through the same rigorous review process. Candidates must be nominated by a scientist or group of scientists affiliated with PIMS. The two-year fellowships are tenable at any one of the member or affiliated universities.

In 2014 (2013) PIMS supported 40 (49) PDFs. They were distributed as follows: SFU – 3, UA – 9, UBC – 8, UBC-O – 2, UC – 4, UL – 2, UR – 2, US – 4, UV – 2 and UW – 4. For a list of all PDF appointments, see [www.pims.math.ca/scientific/postdoctoral/postdoctoral-fellowships](http://www.pims.math.ca/scientific/postdoctoral/postdoctoral-fellowships).

PIMS PDFs are closely mentored by sponsoring faculty at PIMS host institutions. In the case of CRG and Special Focused Period PDFs, they are inducted into appropriate research groups. PIMS Central also monitors PDF progress, and follows up on PDFs after their tenures have ended. All PDFs are given exit interviews and fill out anonymous surveys that are used to assess and improve programs. The average ratings terminal 2013 (2012) PDFs gave to selected questions are listed below (1 = worst score, 5 = best score).

PDF SURVEY	Score
How well were you mentored in your department?	4.4 (4.3)
How suited to your academic interests was your department?	4.0 (4.1)
How suited to your academic interests was your mentor?	4.2 (4.5)
How was the intellectual life in your department?	3.8 (4.2)
How well were you looked after (in a practical sense) in your department?	4.4 (4.5)
Were there opportunities for collaborative interactions?	3.8 (3.9)
Amount of travel support:	3.0 (3.3)
Do you feel that your PIMS PDF has prepared you for your professional career?	4.4 (4.3)
Overall satisfaction with your postdoctoral experience:	4.5 (4.4)

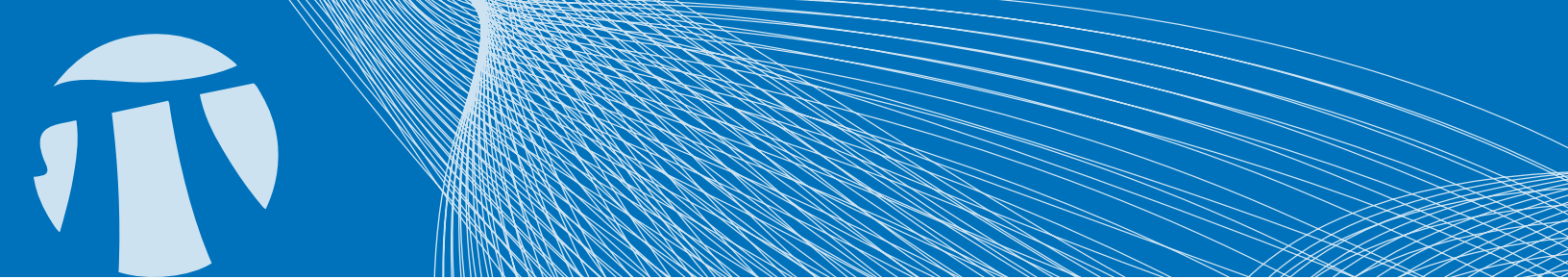
PDFs move on professionally to a range of positions and activities at top places, including: Johns Hopkins U, City U Hong Kong, McGill U, Haverford College, Lancaster U (England), U Paul Cézanne (Aix-Marseille, France), Champlain College (QC), UCLA, Max Planck Institute for Informatics (Saarbrücken, Germany), UW, Hong Kong U of Science and Technology (China), US, U Algarve (Faro, Portugal), U Waterloo, U Chile (Santiago, Chile), U Massachusetts (Boston), UC, Brno U of Technology (Czech Republic), U Manitoba, U B. Pascal de Clermont-Ferrand (France), Oakland U, U Ottawa, Harvard U, Indian Institute of Science Education and Research (Kolkata, India), McMaster U, U Frankfurt (Germany), Nova Southeastern U, U Utrecht, Rice U, Atomic Energy Canada, Ltd., Western Washington U, U Newcastle (Australia), Columbia U, INRIA Bordeaux Sud Ouest & Rennes (France), Princeton U, Nat. Acad. Sci. (Ukraine), U Toronto, École normale supérieure (Paris), U California (Berkeley), U Karlova v Praze (Prague, Czech Republic), U Kentucky, Laboratoire Écologie et Sciences Phytosanitaires (Rennes, France), Purdue U, SAP AG (Walldorf, Germany), Zhejiang Sci-Tech U (China), MSRI, Victoria U (Wellington, NZ), U Gottingen (Germany), UA, MSRI, U Warsaw (Poland), École Polytechnique (Palaiseau, France), U London (UK), University of Zurich, U N. Carolina (Chapel Hill), Institut Joseph Fourier (Grenoble, France), Carnegie-Mellon U, Austrian Acad. Sci., Munich American Reassurance Company (WA), Institute for Advanced Study, CNRS (Montpellier, France), UBC, Max Planck Institute for Mathematics (Bonn, Germany), U Oregon, Ben-Gurion U, UR, École Polytechnique Federal Lausanne (Switzerland), U Mississippi, Moscow State U (Russia), Southern Illinois U, Hausdorff Ctr. (Bonn, Germany), D-Wave Systems, Hong Kong Polytechnic U and Cambridge U.

At UBC, the PIMS PDFs are looked after intellectually, professionally and socially. As well, PIMS Central holds yearly one-day workshops on professional development topics such as Information Session on Grant Opportunities and Postdoc / Grad Student Job Forum and the PIMS workshops include discussions on “Postdoctoral life in different kinds of institutions – research, teaching and industrial.” PIMS also hosts various social activities so as to reduce postdoc isolation and promote formation of long-term friendships and contacts.

#### Some verbatim comments from PDF exit interviews:

- “My overall impression of the PIMS Postdoctoral Fellowship program is very good. The straight-forward nature of the application process, the freedom of choice of research areas and the number of fellowships available annually ranks it, in my opinion, as the best of those offered by the mathematical research institutes in Canada...”
- “My postdoctoral research is a departure - and an evolution, I think - from my doctoral thesis.”
- “I was very happy with my supervisor and have managed to make research connections outside of the department... On the whole, the department has been very welcoming.”
- “Working with members of the university was a joyful experience. I learned a lot and had a wonderful time both at work and social life. I consider this opportunity as a great help to advance my career.”
- “My PIMS post-doc has provided me with the opportunity to gain research experience and to make connections in an area outside of my PhD work. This will certainly help in my future research work.”
- “I did receive a \$1000 travel supplement and this was a great bonus. I greatly enjoyed my time in the Department. I got along very well with my mentor, was well taken care of and made friends with many of the faculty, students and the few other post-docs in the department. I learnt a lot during my stay and I would certainly have done this again.”
- “At first I felt social isolation. This was one of the issues PIMS worked on and I must say that things changed for the better. I recommend that the social activities keep running.”
- “I learned new mathematics and became a more mature and independent mathematician. I am grateful to PIMS for this wonderful opportunity.”
- “I have to say that overall I had a very good opportunity to collaborate with the people here at PIMS.”
- “... the staff at PIMS made the experience a most enjoyable one.”

PIMS also hosts more senior researchers from France as part of its cooperative agreement with the CNRS. In 2014 N. Billerey (UBC, U. B. Pascal - Clermont-Ferrand II), S. Le Coz (UBC, U. Toulouse), Y. Ponty (SFU, LIX- École Polytechnique - Palaiseau), G. Charlier (UV, Ceremade-Dauphine) and E. Fusy (UBC, LIX- École Polytechnique - Palaiseau) took part in this program.



In addition to PDFs and PIMS/CNRS scientists, PIMS sites host many long- and short-term visitors: over 180 in 2014 alone. They came from around the world, including Japan, China, Korea, New Zealand, Chile, Brazil, Europe and of course North America.

## B. PIMS Postdoctoral Training Centre in Stochastics

Probability theory has become an increasingly important part of both pure and applied mathematics in the last two decades. The stochastic calculus, developed by Kiyoshi Ito in the 1950s, is one of the key tools in mathematical finance. Statistical physics has brought new problems to probability theory and these are now recognised as being as hard and deep as any in mathematics. Models in statistical physics are formulated via random local interactions and the key question is how these microscopic interactions affect the macroscopic behaviour of the system and in particular its scaling close to a critical point. The Schramm-Loewner evolution (SLE), discovered in 1999 by Lawler, Schramm and Werner, introduced exciting new probabilistic techniques to the theory of two-dimensional statistical physics. These and other developments have been marked by the award of several Fields medals.

In 2015 PIMS will launch the *Postdoctoral Training Centre in Stochastics* (PTCS), headed by E. Perkins (UBC). 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 PTCS to train an outstanding cadre of postdoctoral fellows in probability theory. The program has already attracted \$550,000 in NSF funds for our University of Washington 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 as well as with groups in Microsoft Research and Eastern Canada and support visits by distinguished visitors.

## 3. EDUCATIONAL

### A. K-12 Educational Activities:

PIMS is dedicated to increasing public awareness of the importance of mathematics in the world around us. PIMS encourages young people to see that mathematics is a subject that opens doors to more than just careers in science. Many different and exciting fields in industry are eager to recruit people that are well prepared in this subject. From its inception, PIMS has supported a series of educational initiatives for the K-12 level, including:

- Organization of interesting, fun and challenging math events for children of all ages.
- Facilitation of access to information (newsletters, workshops, conferences, special publications, etc.) about math education matters to parents, teachers and university faculty.
- Coordination of workshops to create communication links between parents, mathematicians and educators.
- Publishing *Pi in the Sky*, a math magazine for high school students.
- Holding workshops to improve teachers' math and teaching skills.
- Hosting the annual *Changing the Culture* conferences for schoolteachers.
- Sponsoring regional and Canada-wide *Science Fairs*.



## 1. General

**Math Mania:** This is a popular alternative math education event that has been presented in elementary and (more recently) middle schools in Western Canada for many years. All age levels are welcome, although it is particularly suited to students in grades 4-7. Math Mania presents a variety of interactive demonstrations, puzzles, games and art. These activities are designed to demonstrate to students – and their parents – fun ways of learning both math and computer science concepts. On average over two hundred students, parents and teachers participate in Math Mania events. In 2014 Math Manias were held in the remote communities of Port Renfrew and Sooke on Vancouver Island, as well as around the greater Victoria area, the Lower Mainland and Saskatoon. Further details are available at [www.pims.math.ca/educational/math-mania](http://www.pims.math.ca/educational/math-mania).

One BC school principal wrote: “... a great evening! You don’t know how much this means to our students and parents. I heard so many positive comments from parents and it was amazing how thrilled they were that we were doing this for the kids. Many of them had never looked at math as being very fun or exciting.. Hopefully this will inspire them to take a real interest in math and develop a greater appreciation for its application to everyday life.”

**SNAP Math Fairs:** PIMS sponsors these non-traditional **S**tudent-centered, **N**on-competitive, **A**ll-inclusive, and **P**roblem-based math fairs based in Alberta. The purpose of a SNAP math fair is to provide a meaningful problem-solving experience for all students. Several SNAP fairs were held in Okanagan and the Lower Mainland this past year. Visit [www.mathfair.com](http://www.mathfair.com) for more information.

**Changing the Culture:** This is a yearly one-day meeting organized and sponsored by PIMS, bringing together mathematicians, mathematics educators and school teachers from all levels to work together towards improving the teaching of mathematics. This year’s conference attracted 123 participants and discussed “Fostering Curiosity.”

**ELMACON:** The **E**lementary **M**athematics **C**ontest is a yearly event held at UBC (and in 2011 at UV) and is open to students in Grades 5 to 7 from Lower Mainland schools and Victoria-area schools. ELMACON gives them the chance to experience mathematics as an exciting sport. This PIMS-sponsored event attracted about 280 participants in 2014.

**UBC/PIMS Math Workshops:** These workshops in Lower Mainland schools aim to excite Grade 6-12 students about mathematics by exposing them to interesting and challenging problems and interesting mathematics personalities. In the case of Grade 12 students, careers and university programs in the mathematical sciences are also discussed. The workshops are conducted by faculty and student volunteers from the UBC Mathematics Department and are coordinated by the PIMS-BC Education Coordinator. Over 90 workshops are conducted each year.

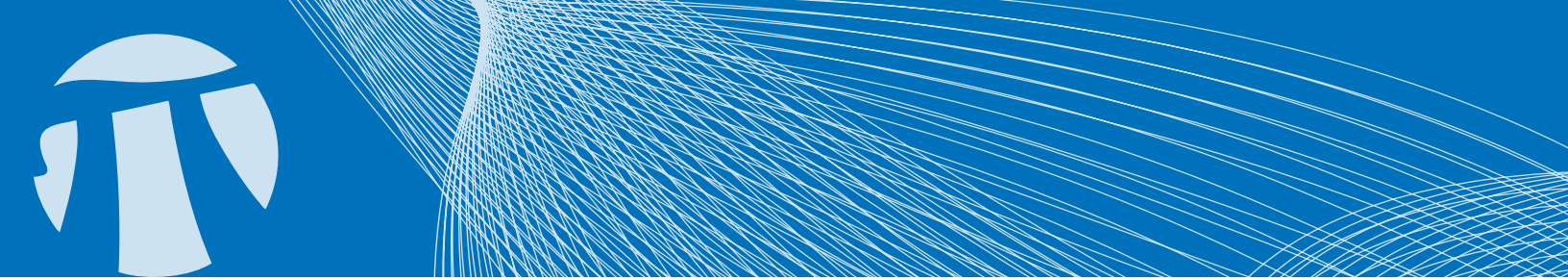
**Teacher Workshops:** A variety of workshops, designed to help elementary school teachers build their math skills for the classroom, are supported by our institution. Fifteen workshops to teach problem solving were held all around the province. Eleven additional workshops to support the teaching of JUMP math were held at PIMS-UBC and around the province..

**Math On the Move:** This is a mobile version of the UR Math Camp that was initiated in 2003. With support from PIMS, two UR faculty and four math education students deliver inquiry-based mathematical activities to high school students in rural Saskatchewan.

At UL, weekly problem-solving sessions for high school students called **Fun with Math** were instituted the 2012-2013 academic year.

**Pi in the Sky:** The widely distributed (estimated circulation is 2,500) high school level periodical produced by PIMS for students in Canada and the United States, aims to establish direct contact with teachers and students, to involve high school students in mathematical activities, as well as to promote careers in mathematical sciences. Go to [www.pims.math.ca/resources/publications/pi-sky](http://www.pims.math.ca/resources/publications/pi-sky) for current and back issues.

**Math Central:** Beginning its 19th year, Math Central ([www.mathcentral.uregina.ca](http://www.mathcentral.uregina.ca)) continues to be a successful tool for



teachers. The site currently gets in excess of eight million hits per month from approximately 30,000 visitors per day. Math Central attracts answer submissions from keen mathematicians from all over the world including Italy, Romania, Turkey and Indonesia. It contains a number of services including the Resource Room, a facility where mathematics educators can store and retrieve resources on mathematics and the teaching thereof; Quandaries and Queries, a mathematics question and answer service; Math Beyond School which is a response to the question often asked by students, “When will I ever use this?”; Mathematics with a Human Face which profiles mathematicians and their careers and more. The site is maintained by PIMS Education Coordinator Harley Weston and faculty and students in the Mathematics and Statistics and Mathematics Education Departments of UR.

In addition, PIMS supports the **Alberta High School Mathematics Competition**, **Math Circles Coaching Program**, the **Vancouver Free Math Mentorship Program**, the **BC Math Challengers**, the **Forever Annual Math Exhibition**, **Jump for Math**, the **Math Kangaroo Contest**, **Science Fairs** in Vancouver and Calgary and the **No Homework Club**, along with other local initiatives.

## 2. Aboriginal/First Nations

PIMS has shown its leadership in bringing together various people, resources and institutions in working together towards the improvement of aboriginal mathematics education. In particular, under the auspices of the First Nations Education Steering Committee (FNESC), PIMS has developed a partnership with First Nations schools in British Columbia, which has received funding from private donors, Vancouver City, the Vancouver Foundation, the Kinder Foundation as well as provincial and federal agencies. In 2014 special funding for these programs was received from the Governments of British Columbia and Saskatchewan. Activities under this program include:

**Teacher training/math development sessions:** During the summer, mathematicians and educators provide lessons for teachers to help them assimilate teaching material for their mathematics courses. Sessions have been held in Kamloops, Lytton, Barriere, Port Alberni, Vernon and Merritt. Partner schools in the interior of British Columbia include: Stein Valley Nlakapamux School in Lytton, Neqweyqwelsten School in Barriere, First Nations elementary and secondary schools in Bella Bella, First Nations elementary school in Port Alberni, Lower Nicola Band School in Merritt, Haisla Community School in Kitimat, Seabird Island Indian Band School in Agassiz, the Gitanyou, Kispiox, Holly Smith and Anspayaxw Schools in Smithers and Houston, the Wilpe School in Gitwangak and the Xit’olacw Community School in Mount Currie.

**A coordinated mentorship program** where undergraduate students from universities work with local teachers and students to provide support in mathematics.

**Assistance in choosing and implementing mathematics curricula** at First Nations Schools, where the PIMS BC Education Coordinator serves as a permanent resource for teachers and administrators.

**Math summer camps**, which PIMS has organized in Kamloops, Lytton, Merritt and Mount Currie for the past five years. More than 150 children have attended these camps. This summer, 30 First Nations students in grades 10-12 attended the five week long *Emerging Aboriginal Scholars* summer camp jointly run by PIMS and the UBC First Nations House of Learning. As part of this camp, students took math and English classes each morning and three afternoons per week each student took part in an internship program that placed them with university-affiliated faculty and staff. Other afternoons were spent meeting with members of the aboriginal community who are successfully working in various fields. In 2014, 25 students attended the first SFU Academic Summer Camp for Aboriginal Students at the SFU, Burnaby campus. The main goal of this camp was to help Aboriginal students in grades 8-11 to accelerate in math and English, however, the camp also included a variety of interdisciplinary activities, including science sessions, visits to computer labs and the Surrey campus, archery lessons, and a tour of Burnaby Mountain with an SFU earth scientist. Support from the Royal Bank of Canada has extended the reach of these camps in rural BC.

### Academic Highlights:

Four of the students who attended Emerging Aboriginal Scholars camps and the Mentorship Program graduated from high school and were accepted to UBC.

From 2007 to 2014, scholarships were provided to more than 70 students attending Britannia, Templeton and Windermere high schools. Money for the scholarships was provided by private donors, the government of British Columbia and the Federal Government.

Out of these 70 students:

- 4 graduated with calculus
- 9 graduated with principles of Math 12
- 7 graduated with principles of Math 11
- 14 graduated with principles of Math 10

Currently:

- 4 students are taking pre-calculus 12
- 4 students are taking pre-calculus 11
- 9 students are taking pre-calculus 10

Our programs have helped students move from the lower level math courses into the high academic math courses according to their grade.

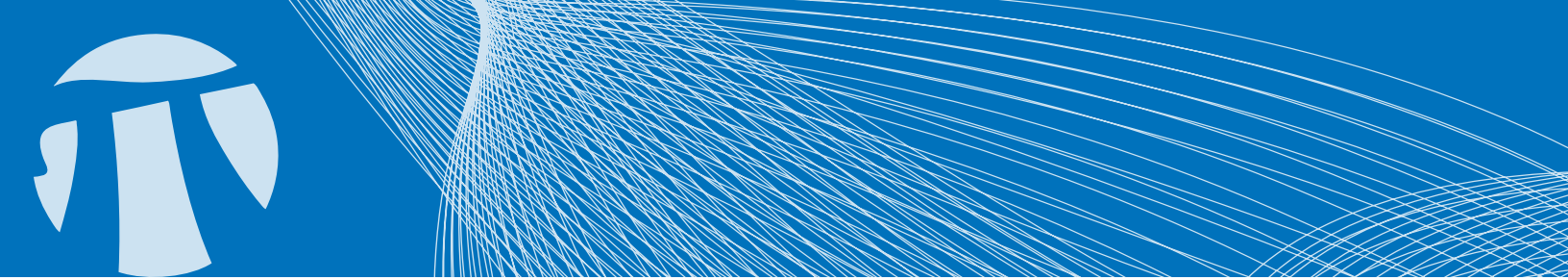
**Providing in-depth assessment** of the mathematical skills for students at our partner schools, measuring the impact of their programs and suggesting adjustments along the way. FNEESC has commissioned an assessment tool from PIMS to evaluate third grade students in First Nation schools.

**School partnerships:** During the last seven years, PIMS has developed a partnership with the Britannia, Templeton, Windermere and Point Grey secondary schools and the MacDonald elementary school in Vancouver, which have large numbers of aboriginal students. In recent summers PIMS organized a math summer camp for a group of these students. Together with the math department at UBC, PIMS has been coordinating mentorship programs at several elementary schools in Vancouver. PIMS is also coordinating a scholarship program to support the most needy of their aboriginal students. This program has been funded both by the federal government and private donors.

In Saskatchewan, PIMS supports the Aboriginal Perspectives web site [www.AboriginalPerspectives.uregina.ca](http://www.AboriginalPerspectives.uregina.ca), which serves as a means for delivering lesson ideas with an Aboriginal focus to K-12 teachers. Support from PIMS has been used to help hire the students who write the lessons and facilitate the workshops. PIMS also partially funds the ongoing *Aboriginal Perspectives Workshop*. S. Stavrou, PIMS' outreach coordinator at US, is working in seven schools in Saskatoon, engaging students in hands-on math activities that includes content from the curriculum and First Nations perspectives.

## B. Post-Secondary Educational Activities

Colleges and universities wishing to enjoy an affiliation with PIMS (but not otherwise eligible for regular PIMS membership) may engage as *PIMS Education Associates*. Membership is for a period of three years and is renewable. Members are entitled to apply for PIMS funding to engage in appropriate education, outreach and professional development activities in their region. Examples of approved activities are the support of a guest speaker, support for a regional math competition



and for the purchase of mathematical models and demonstration materials for use in the classroom. Currently nine colleges in BC and four in Alberta are PIMS Education Associates: Okanagan College (BC), U of the Fraser Valley (BC), Langara College (BC), Red Deer College (AB), Thompson Rivers U (BC), Concordia College (AB), Douglas College (BC), Grant McEwan U (AB), Mount Royal U (AB) and joining in 2014, Capilano U, Selkirk College, College of the Rockies and Vancouver Island U. PIMS hopes to enroll still more Education Associates in 2015.

PIMS directly sponsors high-level undergraduate activities such as the *Canadian Undergraduate Math Conference*, the *PIMS Undergraduate Workshop on Supersymmetry* and the *PIMS-SFU Undergraduate Summer School on Multiple Zeta Values* and sponsors ongoing series of public lectures such as the *PIMS Public Lecture Series* at UBC and the *R&L Guy Public Lecture* at UC. In addition, PIMS provides travel support for Canadian students to attend various educational activities, e.g., the joint *PIMS-IMA Mathematical Modeling in Industry Workshop*. As well, PIMS uses its facilities for teaching; in 2014 PIMS-UBC hosted two algebraic topology courses, a course in algebraic geometry, numerous seminar series and streamed a video-conferenced seminar series.

PIMS sponsors the annual *Alberta Colleges Mathematics Conference*, which provides a forum for a discussion of issues relating to mathematical education at all levels throughout the conference. This year it was held at UA-Augustana in Camrose. Another worthwhile educational event PIMS supported was the 2014 *International Group for the Psychology of Mathematics Education Annual Conference* in Vancouver.

Every year the *PIMS Education Prize* is awarded to an outstanding mathematical educator in Alberta, British Columbia, Saskatchewan or Washington State. A cash award is attached to the prize, which has considerable prestige and receives widespread publicity in the mathematical community and beyond. See [www.pims.math.ca/pims-glance/prizes-awards](http://www.pims.math.ca/pims-glance/prizes-awards) for details about past prizewinners.

# III. MECHANISMS OF ACCESS TO PIMS

## 1. COMMUNICATIONS PLAN

This plan identifies communication objectives, key messages, identifies stakeholders and sets out the strategies and tools that will be used.

### Objectives and communication priorities:

- Build a consistent communications framework to raise the profile of PIMS in the global scientific community.
- Demonstrate to existing and potential new sponsors and the global scientific community that PIMS has given thought and priority to communicating with them, with the view that we are here to stay.
- Place education as a top priority in terms of gathering funding, program organization and awareness-raising.
- Build the PIMS community through regular, consistent and targeted formal and informal communications.

### Key messages:

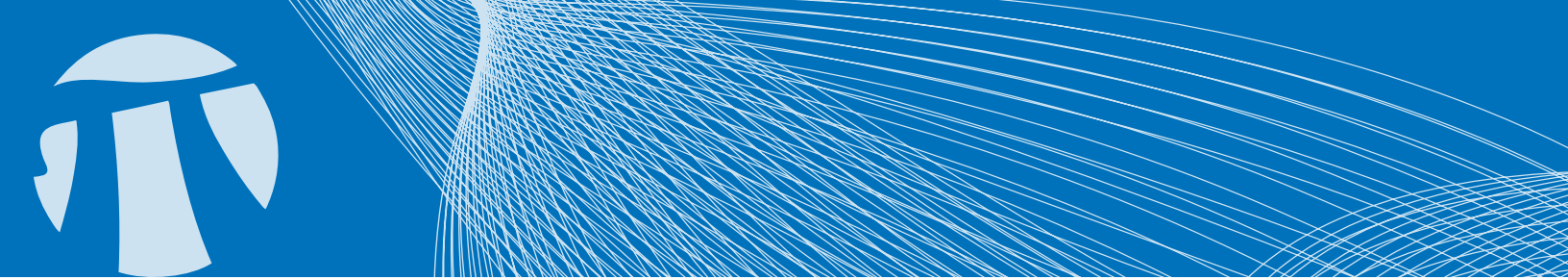
- PIMS is a leading mathematical institute in North America, with worldwide influence on research and industry. PIMS has established innovative programs which have had a transformative impact on the mathematical sciences and the training of HQP.
- The PIMS community is inclusive; from K-12 to research faculty. PIMS' distributed structure throughout the Pacific Northwest enables all who are engaged to do so locally, while still benefitting from all of PIMS' resources.
- PIMS is nurturing the pipeline of younger generations in Western Canada, including those with First Nations backgrounds. PIMS promotes numeracy as an integral part of development and learning.

### Strategies:

- Create consistency, clarity and regularity of communications.
- Respond to the needs of stakeholders as to how they would like to receive information.
- Add a more human touch, include photos, personal stories and testimonials.
- Become more proactive and opportunistic in promoting PIMS to stakeholders.
- Increase internal and external community building opportunities.

### Tools:

- Websites and electronic
  - **PIMS website** The PIMS website ([www.pims.math.ca](http://www.pims.math.ca)) offers easy global access to information on all PIMS activities, recent news and resources. One feature is the PIMS News/Press section that is highlighted on the home page; stakeholders can easily access the most current and noteworthy happenings at PIMS via this section, be they award notices, media coverage, funding announcements or site appointment updates.
  - **Mathtube.org** A dedicated site that will eventually archive all of PIMS written, video and audio media. [mathtube.org](http://mathtube.org) was created to meet the increasing demand to see footage of past PIMS lectures. It provides global exposure to PIMS events and gives those who attend our events the chance to review and those who don't, a chance to see what they've missed. This resource also gives added value to conference organizers and participants, as well as a forum to see world-class speakers from all areas



of the mathematical sciences. These materials are an important resource and include contributions from some of the world's most distinguished contemporary mathematicians. [mathtube.org](http://mathtube.org) is for those interested and engaged in the mathematical sciences; whether one is a student, a researcher, an industry professional or a mathematics teacher, [mathtube.org](http://mathtube.org) includes useful content that will help advance one in their field.

- **PIMS Connection, monthly e-newsletter**, was introduced in 2011. This brief email includes URL links to event updates and news items. Its circulation is over 3500. In 2014, PIMS switched from a purely text-based format, to one that used an online resource (Mailchimp), which allows us to utilize a more brand-savvy digital template and track the number of opens and link clicks.
- **Social Media** in 2012, PIMS began using Twitter and Facebook allowing us to connect with and provide all of our updates and news to the PIMS community. These posts are far more frequent than to any other of our communications vehicles and cover a range of content from event photo highlights, notices of publication availability, weekly event updates and more. (The same content is provided on both Twitter and Facebook.)

#### ▪ **Hardcopy publications**

- **Year in Review** is a booklet designed to summarize the range of PIMS activities. The 2009–2014 Years in Review can be downloaded from [www.pims.math.ca/resources/publications/pims-year-review](http://www.pims.math.ca/resources/publications/pims-year-review).
- **PIMS Newsletter** is produced twice yearly. It contains reports on the recent activities at PIMS, announcements of upcoming scientific, industrial and educational events, accolades and breakthroughs within the PIMS community; and upcoming opportunities and how to apply. The latest issue can be found at [www.pims.math.ca/resources/publications/pims-newsletter](http://www.pims.math.ca/resources/publications/pims-newsletter). It has a circulation of 800 hardcopy issues. The latest issue (October 2014) was also sent out via Mailchimp in electronic format to a list of over 1,000 recipients.
- **Pi in the Sky** is primarily aimed at high-school students and teachers, with the main goal of providing a cultural landscape for mathematics. It has a natural extension to junior high school students and undergraduates, with articles that put curriculum topics in a different context. *Pi in the Sky* accepts material on any subject related to mathematics and its applications, including: articles, problems, cartoons, statements, jokes, etc. *Pi in the Sky* is produced once a year and mailed to various institutes and private subscriptions throughout Canada and the world, (estimated circulation is 2,500) and can be downloaded from the PIMS website: [www.pims.math.ca/resources/publications/pi-sky](http://www.pims.math.ca/resources/publications/pi-sky).

#### ▪ **Other**

- **Advertising** PIMS-funded events and opportunities are advertised both electronically and in print. We advertise through websites and publications at institutions such as AMS, CMS, IMS, Mprime and SIAM and by offering custom-designed event posters that are distributed to the major mathematical departments and institutes in Canada and the US, as well as an annual poster highlighting all of PIMS main events for the year, which is distributed to over 200 of the top scientific institutions worldwide.
- **Reports** Conference proceedings, abstracts, lecture notes, websites and final event reports are all made available for download from the PIMS website in .pdf or .html format. (See [www.pims.math.ca](http://www.pims.math.ca)). Conference materials are attached to the corresponding event, which are listed chronologically and are searchable by keyword for ease of access. PIMS also produces an annual report that is sent to sponsors, administrators at PIMS-affiliated universities, representatives from the business, industry and resource sectors as well as the major professional societies. Past annual reports (1997-2011) can be viewed at [www.pims.math.ca/resources/publications/annual-reports](http://www.pims.math.ca/resources/publications/annual-reports).

## 2. AUDIO/VIDEO FACILITIES

PIMS makes extensive use of technology to allow our event coordinators to work efficiently with remote collaborators and event participants. In 2014 we have had a significant increase in the use of our videoconferencing facilities for a variety of events.

**Seminars and Lectures** We continue to offer our seminars to remote participants utilizing different technologies to lower the barrier to participation as much as possible. We operate a traditional h.323-based hardware videoconferencing system along with a variety of software solutions such as Skype and BlueJeans.

- In the winter term of 2014 we participated in the COCANA seminar series (Centre for Optimization, Convex Analysis and Non-smooth Analysis) as part of the PIMS CRG in Optimization.
- The CRG on Geometry and Physics includes an ongoing seminar series, which includes participants at UA and UBC.
- As the UBC-Vancouver WestGrid/Compute-Canada collaboration node, PIMS-UBC participates in the WestGrid and Coast-to-Coast seminar series. The latter includes participants from throughout Canada and the 2014 series on *Technology for Aging Well* was enthusiastically attended at UBC. We are also the host site for all of the speakers for the upcoming series on *The Power of Linked Administrative Health Data for Population Health Research: Robust Data and Progressive Data Analytics*. These seminars bring PIMS researchers into contact with researchers from areas outside of PIMS' traditional scope.

### Academic Courses

- The PIMS-UBC Education Coordinator (M. Alvarez), taught a course in elementary math education to students participating in the NITEP program (UBC's Indigenous Teacher Education Program). These students took part in the course from the remote village of Bella Bella, BC.
- W. Welch of UBC taught an academic course in *Computer Simulations* for Statistics to students at SFU and Acadia U. This course was interactive and included student presentations and lectures from those sites to UBC.
- A topical course in *Shimura Varieties* by P. Walls was shared with UC to allow students at PIMS-UBC to take advantage of a visit to Calgary by one of the experts in this field.

**Other Uses** As in previous years our facilities were used to allow researchers to take care of academic duties such as participating in thesis defenses or academic job interviews. This year, some of the key operational meetings of PIMS also utilized collaborative technology.

- The PIMS-UBC education coordinator gave a video conferenced presentation to the Actuarial Foundation of Canada and was successful in securing funding for a program of workshops for teacher training with a focus on aboriginal teachers.
- The PIMS director was able to fulfill PIMS duties as a Unité Mixte Internationale of the CNRS.
- As part of the PIMS mandate in helping to establish CANSSI (the Canadian Statistical Sciences Institute), our videoconferencing facilities were used in collaboration with the UBC's bridging facility to organize and distribute a webinar on funding opportunities.



## IV. ACTIVITIES TO KEEP ABREAST OF SCIENTIFIC ADVANCES

The Scientific Review Panel is responsible for the scientific leadership at PIMS. Through their continuing efforts, PIMS keeps abreast of activities in the mathematical community and seeks to develop programs in new areas. The process that the SRP follows can be briefly described as follows:

1. Identify research topics,
2. Discuss at length the value, impact and feasibility of running scientific activities in these areas at the annual SRP meeting and through email discussion,
3. Serve as liaisons between experts in a particular area and the PIMS Director and Deputy Director thus providing crucial scientific expertise,
4. Once an important theme has been identified, the SRP will work with potential organizers to develop a proposal that encompasses the required depth and breadth to ensure a high quality event of international calibre.

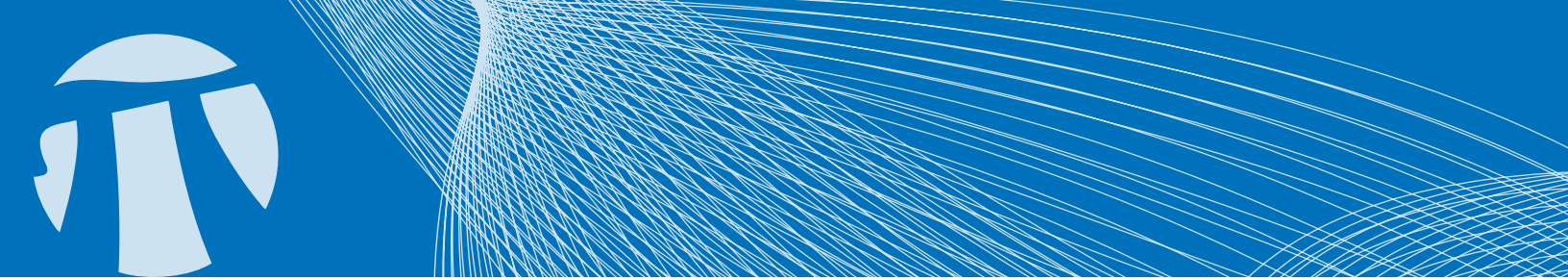
Aside from the role played by the SRP, the PIMS Directors regularly attend research conferences and meetings of professional societies and consult with leading experts to obtain/solicit information on recent advances in the mathematical sciences. This also involves establishing regular channels of communication with the PIMS community and encouraging researchers to use PIMS as a platform for the development of their ideas. In addition, through a systematic scanning of web-based literature (such as preprints on the arXiv) and announcements of scientific breakthroughs in bulletin boards and journals, PIMS maintains a pro-active involvement in learning about and enhancing the impact of new developments.



# IV. FINANCIAL REPORTS

## PIMS CTRMS NSERC Activity Report January 1 to December 31 2014

	Use of the resource (i.e. PIMS) Paid from ALL revenue sources January 1 to December 31 2014	Planned use of MRS funds January 1 to March 31 2015	Planned use of MRS funds April 1 2015 - March 31 2016
<b>Resource Expenditures</b>			
1) Salaries & Benefits	273,640	0	0
a) Administrative Staff	154,421	0	0
b) Directors & Site Directors Teaching Releases/Stipends	170,884	45,300	75,000
c) Scientific Support Personnel	572,352	143,100	525,000
d) Postdoctoral Fellows (inc. CRG PDFs)	17,679	0	0
e) Technical/Professional Assistants (inc. Education)	22,781	0	0
f) IGTC students			
2) Equipment or Facility	16,095	0	0
a) Purchase or Rental	29,911	0	0
b) Operation and Maintenance Costs			
3) Materials & Supplies	6,185	0	0
a) Refreshments	21,278	0	0
b) Office Supplies			
c) Meetings/Collaborations/Staff Travel			
4) PIMS Meetings (SRP, PDF, Board, Admin, Exec)	51,405	0	0
a) PIMS Meetings (SRP, PDF, Board, Admin, Exec)	16,155	0	0
b) Staff/PDF Travel	69,959	0	0
c) Director Research Support and Scientific Consultation			
5) Dissemination Costs	22,695	0	0
a) Publication Costs	4,864	0	0
b) Advertising & Networking			
6) Scientific Activities (inc. CRGs and IGTC)	283,525	17,000	104,500
a) Conferences/Symposia	142,548	0	45,000
b) Summer Schools	221,905	25,000	106,000
c) Workshops/Seminars/Colloquia (inc. MMIW)	32,205	8,000	27,000
d) Distinguished Visitors/Chairs/Speakers	190,707	0	0
7) Education Initiatives			
8) AARMS Activities	7,500	0	50,000
a) Honoraria for lecturers at AARMS Summer School	13,200	0	
b) Accommodation for AARMS Summer School	7,500	0	
c) Administrative Staff	1,800	0	
d) Two Weeks at Waterloo			
9) CANSSI	9,681	0	228,000
a) Canadian Human Statistical Genetics	22,674	10,500.00	
b) Scientific Coordinator	9,022	10,000.00	
c) Postdoctoral Fellow	6,641	4,500.00	
d) Research Assistant			
<b>TOTAL EXPENDITURES</b>	<b>2,399,212</b>	<b>263,400</b>	<b>1,160,500</b>



**Resource Revenues (collected during the period January 1 to December 31 2014)**

a)	User Fees (Registration Fees collected)	55,166
b)	Contributions from Partner Universities	
	UBC	294,718
	Simon Fraser University	80,000
	University of Alberta	77,700
	University of Calgary	67,710
	University of Victoria	66,600
	University of Saskatchewan	50,000
	University of Regina	35,000
	University of Washington	11,934
	University of Lethbridge	35,000
	Portland State University	4,280
c)	Contributions from MITACS/Mprime/NSF	
	Mprime for MMIW 2014	20,000
	Mitacs Industrial Innovation	50,000
	NSF (U Wisconsin) for Super Symmetry	5,593
	NSF (U Waterloo) for GAP 2014	506
	NSF (U Washington) for SSPROB	20,819
	NSF (U Oregon) for WCATSS	16,929
	NSF (U Connecticut) for Analysis and PDE	8,673
d)	Private Donations	98,521
e)	Other Contributions	
	Perimeter Institute for GAP 2014	2,000
	Sauder School of Business for Systemic Risk	5,000
	Global Risk Institute for Systemic Risk	5,000
	Clay Mathematics Institute for SSPROB	6,329
	Dept of Math & Statistics at U Regina	585
	Equity Enhancement Fund/TLEF for Education	12,000
	City of Edmonton for Korea Intl Math Competition	5,807
	Vancouver Foundation for Education	20,000
	BC Oil and Gas Commission	80,000
	UBC Math Dept	53,758
	Other Miscellaneous	47,944
f)	NSERC Industrial Innovation Grant	182,000
g)	NSERC CTRMS Grant	1,150,000
h)	Carried Forward from December 31 2013	1,167,444
	<b>TOTAL REVENUES (January 1 to December 31 2014)</b>	<b>3,737,016</b>
	Revenue less Expenses	1,337,804

## GLOSSARY OF ACRONYMS

<b>PIMS</b>	Pacific Institute for the Mathematical Sciences
<b>AARMS</b>	Atlantic Association of Research in the Mathematical Sciences
<b>AMS</b>	American Mathematical Society
<b>BIRS</b>	Banff International Research Station
<b>CAIMS</b>	Canadian Applied and Industrial Mathematics Society
<b>CANSI</b>	Canadian Statistical Sciences Institute
<b>CMS</b>	Canadian Mathematical Society
<b>CNRS</b>	Centre National de la Recherche Scientifique
<b>CNTA</b>	Canadian Number Theory Association
<b>CRG</b>	Collaborative Research Group
<b>CRM</b>	Centre de Recherches Mathématiques
<b>IMA</b>	Institute for Mathematics and its Applications
<b>IPSW</b>	Industrial Problem Solving Workshop
<b>Mitacs</b>	Mathematics of Information Technology and Complex Systems
<b>MMIW</b>	Mathematical Modeling in Industry Workshops
<b>MSI</b>	Mathematical Sciences Institute
<b>MSRI</b>	Mathematical Sciences Research Institute
<b>NSERC</b>	National Sciences and Engineering Research Council
<b>PDF</b>	Postdoctoral Fellow
<b>PNRMS</b>	Prairie Network for Research in the Mathematical Sciences
<b>PRIMA</b>	Pacific Rim Mathematical Association
<b>PSU</b>	Portland State University
<b>PTCS</b>	PIMS Postdoctoral Training Centre in Stochastics
<b>SFU</b>	Simon Fraser University
<b>SFU-V</b>	Simon Fraser University-Vancouver
<b>SIAM</b>	Society for Industrial and Applied Mathematics
<b>SRP</b>	Scientific Review Panel
<b>SSC</b>	Statistical Society of Canada
<b>UA</b>	University of Alberta
<b>UBC</b>	University of British Columbia
<b>UBC-O</b>	University of British Columbia–Okanagan
<b>UC</b>	University of Calgary
<b>UL</b>	University of Lethbridge
<b>UR</b>	University of Regina
<b>US</b>	University of Saskatchewan
<b>UV</b>	University of Victoria
<b>UW</b>	University of Washington
<b>WWU</b>	Western Washington University