Pacific Institute *for the* Mathematical Sciences
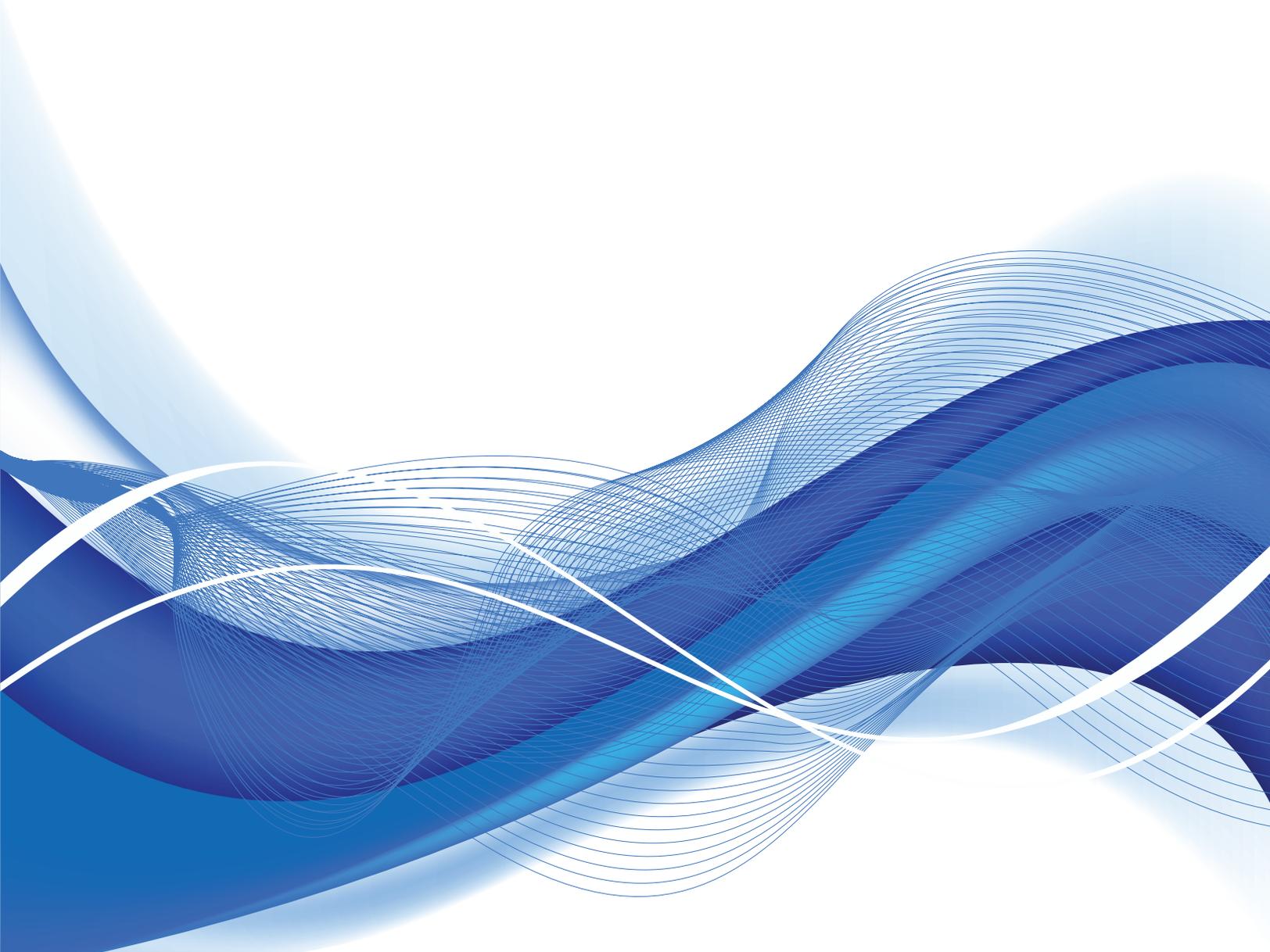
Annual Report *2013*

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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 and the University of Northern British Columbia joined as affiliates. 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 2013

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 International Graduate Training Centre in Mathematical Biology 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 28 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. The CRG on *Geometry and Physics* was launched in April of this year, in November they organized a joint Fields-PIMS workshop on Hodge Theory in String Theory and they have recruited three outstanding postdoctoral fellows. A joint Alberta/BC seminar in geometry and physics has been running since September via videoconferencing, with many distinguished speakers. During May/June 2014 the CRG will organize a major focus period (supported by NSF) with workshops, graduate and undergraduate summer schools, public lectures at UBC, as well as the international String-Math 2014 Conference in Edmonton. The
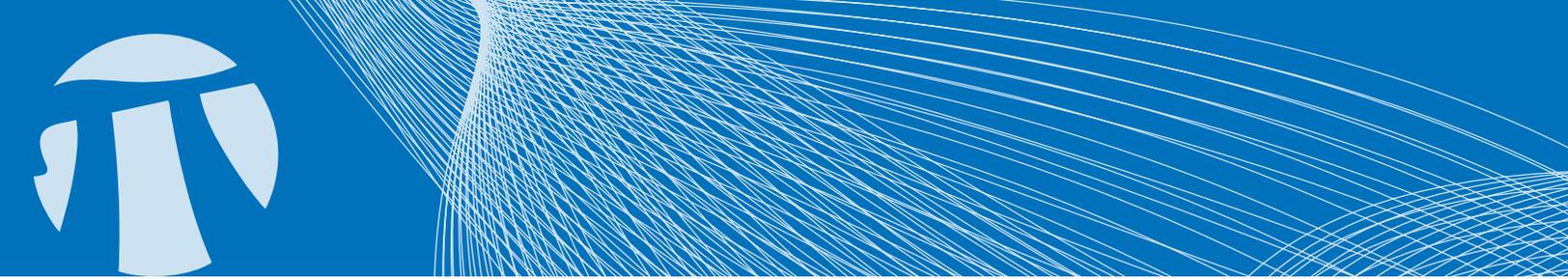
Optimization: Theory, Methods and Applications CRG made a key advance with the introduction of a "normal problem" associated with finding a zero of the sum of two maximally monotone operators; this problem has attractive variational and duality properties. They organized a summer school in Calgary and a highly successful workshop on *Numerical Linear Algebra and Optimization* at UBC. A breakthrough on Kochen-Specker sets came from the *Mathematics of Quantum Information* CRG, which also organized numerous thematic activities at UBC and UC, and the *Algorithmic Theory of Networks* CRG, which got underway at the end of 2012, had its first full slate of activities in 2013. Two new CRGs will get underway in 2014: the first is based at SFU, UBC and US and will focus on *Applied Combinatorics*; the other, on *Applied, Algebraic and Geometric Topology* will involve activities at UBC, UC, UR and UV. They will kick off their activities with a conference in applied topology in May 2014 (jointly organized by PIMS and IMA) followed by the West Coast Algebraic Topology Summer School on *Topological Field Theories* (with significant NSF support).

- In 2013 PIMS organized four *Focus Periods*: a pan-Canadian program on Epidemiology, Ecology and Public Health, an international *Celestial Mechanics* program, and two joint Alberta-British Columbia programs on *Optimization* and *Mathematics of Quantum Computation*. The first two were part of *Mathematics of Planet Earth* – a worldwide thematic effort, and the latter two took place under the auspices of CRGs 22 and 24, respectively.

- Every year PIMS sponsors numerous postdoctoral fellows (PDFs) – 49 in 2013 – 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. One of PIMS' PDFs, C. Warnick of UA, published an article "The Massive wave equation in asymptotically AdS spacetimes" in Comm. Math. Phys., in which he gave the first proof that the Klein-Gordon equation is well posed as an initial-boundary value problem on arbitrary aAdS spacetimes, with a choice of boundary conditions at conformal infinity. Previous works had dealt with specific backgrounds, or general backgrounds but restricted to the simplest choice of boundary condition.

- In 2007, PIMS launched the *International Graduate Training Centre* (IGTC) in *Mathematical Biology*. This program focuses on strategic topics of great current interest such as the mathematical modelling of ecosystems, disease spread and intracellular dynamics. Special fellowships are awarded to students and there are con-ferences and research summits connected to the program. This involves a coordination of resources and ideas from several PIMS sites, emphasizing contact between the student community and the frontiers of scientific research. One of this year's highlights was the IGTC *Summit* in Banff, AB.

- 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, probability and cryptography. This year's offerings included the mathematics behind biological invasions, Hodge Theory, optimization, the physics and mathematics of link homology, algebraic topology and PDE.

- 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 2013 edition (the 17th) of the MMIW, held in Minneapolis, was the third dual effort of PIMS and the Institute for Mathematics and its Applications (IMA). At last year's MMIW in Calgary, six students from 'team 1' worked hard on the project *Touch Sensing, Silhouettes, and "Polygons-of-Uncertainty."* They achieved illuminating results, both theoretically and on the level of simulation, which led them to submit it for publication. It was a group effort: writing the paper, going through revisions, and submitting a full version. Kim Kilgore and Alex Blaessle presented it at the IS&T/SPIE Electronic Imaging 2013 conference in February, and won a prize for their talk. One of the comments that came up in the presentation was "How could they have achieved this in such a short time?" This testifies very well to the ability of having dedicated, focused, and capable group working on one subject for 10 days! In 2013 PIMS further sponsored several conferences on industrial topics such as *Complex Fluids and Flows in Industry and Nature* and *Numerical Methods for Seismic Inverse Problems and Applications*.

- PIMS sponsors conferences and workshops throughout Canada and the world on a wide range of topics. This year's

events took place in California, China, France, México, Newfoundland, Ontario and Quebec, as well as PIMS' 'home' provinces and states, and covered fields such as biophysics, computer science, medicine, physics, and statistics, in addition to almost every area of applied and abstract mathematics. Of particular note were the workshops on *Analysis and PDEs* and *Recent Trends in Stochastic Analysis*, which attracted all-star casts to PIMS.

- This year's speaker in the *Hugh C. Morris Lecture Series was P. Holmes* of Princeton U., who asked "Can We Choose Optimally? The Neural Dynamics of Decisions." Dr. Hugh Morris (1932-2012), former Chair of the PIMS Board of Directors and a longtime friend of the mathematical sciences, generously en-dowed 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 2013 PIMS *Marsden Memorial Lecturer* was P. Constantin of Princeton U. He spoke about mathematical modelling of complex fluids as part of the thematic program on *Complex Fluids and Active Media* hosted by the Isaac Newton Institute at Cambridge U in June. 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.

- A. Wigderson (IAS) and T. Hastie (Stanford) anchored PIMS' Public Lecture Series at UBC this year, giving well-attended talks on *Cryptography: Secrets and Lies, Knowledge and Trust* and *Sparse Linear Models*, respectively. The second lecture was a special event to mark the International Year in Statistics.

- Our distinguished colloquia continue to bring first-rate speakers to PIMS; in 2013 these were held at SFU, UBC, UL, UR, UNBC and UW. Speakers included (among others) B. Reed (McGill), U. Tillman (Oxford), M. Gerritsen (Stanford), Y. Peres (Microsoft), Bela Bollobas (Cambridge), Srinivasa Varadhan (Courant), Simon Levin (Princeton) and Y. Brenier (Ecole Polytechnique).

- Each year PIMS awards three prestigious prizes. In 2013 the *CRM-Fields-PIMS* Prize went to B. Reed of McGill U, and N. Kouzniak of SFU 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 2013 awardee was S. Yuksel of Queen's U.

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 (formerly known as Mathematics of Information Technology and Complex Systems) 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 Superieres in Montréal, and the regularly scheduled CanaDAM and CNTA meetings. Recently, we have agreed on a yearly national rotation for the *Industrial Problem Solving Workshops*, which were created by PIMS and then emulated by CRM and Fields. PIMS funding for activities in Atlantic Canada through AARMS is an important link to another region of the country. In 2013, the three institutes and BIRS sponsored focused programs on epidemiology, ecology and public health, and also celestial mechanics, as part of the *Mathematics of Planet Earth* initiative. 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 recently established Canadian Statistical Sciences Institute (CANSSI). Joint activities are contemplated.

International: Part of the PIMS mandate is to establish international partnerships in order to provide mechanisms
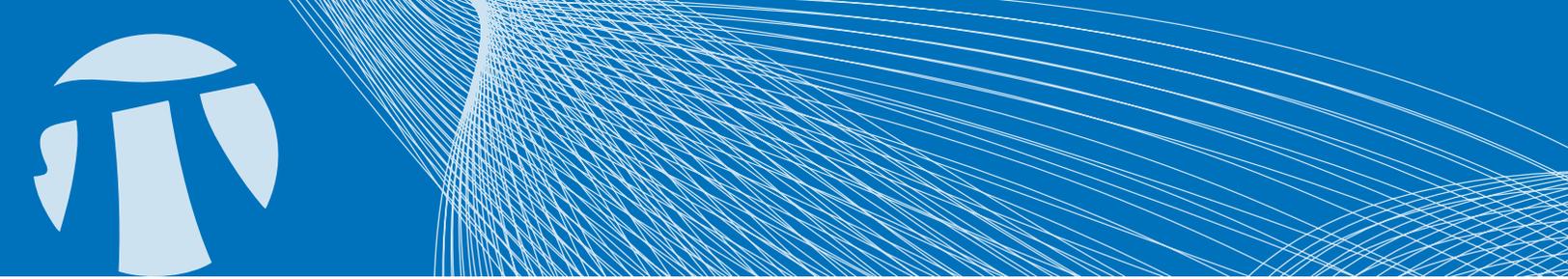
for Canadian researchers to participate in activities outside Canada and attract visitors from abroad, especially beyond the United States. The establishment of the *Centre National de la Recherche Scientifique* (CNRS), Unité Mixte Internationale, at PIMS (the first in mathematics in North America) has led to year-long visits by 28 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 2013, we had about 600 participants at the PRIMA Congress in Shanghai. Our partnership with IMA (USA) allows us to provide new opportunities in industrial mathematics for students via the annual Mathematical Modelling in Industry Workshops, 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*). 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 departments of mathematical sciences across 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.

The day-to-day scientific administration of PIMS is carried out by **Alejandro Adem** (Director), **George Homsy** (Deputy Director) and **Mark J. Gotay** (Assistant Director), who are 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*. Scientific events are adjudicated by an independent *Scientific Review Panel* (SRP) composed of internationally renowned mathematical scientists. For biographies of Panel members, see *www.pims.math.ca/pims-glance/scientific-review-panel*. PIMS 2013 Site Directors were N. Bruin (SFU), C. Doran (UA), G. Homsy (UBC), C. Cunningham (UC), A. Akbary (UL), D. Stanley (UR), R. Srinivasan/C. Soteros (US), M. Laca (UV) and P. Hoff (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 U.S. National Science Foundation (NSF), the U.S. National Security Agency, the U.S. Army, 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, Centre de Recherches Mathématiques (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), SMM, Society for Mathematical Biology (SMB), and Statistical Society of Canada (SSC), and by international partner institutions such as the CNRS, IMA, MSI, PRIMA, Research Institute for Mathematical Sciences (RIMS), and Universidad Nacional Autónoma de México. Other partners

include 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, 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 International de Mathématiques Pures et Appliquées, Centro de Investigación en Matemáticas (CIMAT), Centro de Modeliamiento Matematico, CERTICOM, Chern Institute of Mathematics, Chinese Mathematical Society, CIBC, Clay Mathematics Institute, CRC Press, CryptoWorks, D-Wave Systems, Elsevier, ENCORA, EPSRC, EQINOCS, Federal Interlocutor for Métis and Non-status Indians, Foundation Compositio Mathematica, FP Innovations, French National Research Agency (ANR), Golden Key, Gouvernement de Benin, Grant MacEwan U.,, Hokkaido U.,, H.R. MacMillan Space Centre, 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, 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), Korean Institute for Advanced Study, Kyoto U. Global COE Program, Laboratoire d'excellence Bézat, Luther College, Mathematical Sciences Research Institute (MSRI), MapleSoft, Max Planck-Gesellschaft, Memorial U, Microsoft Research, 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), Quantum Works, Quest 4D, Reed College, RFEC Americas, SAS, Schlumberger, Science World (Vancouver), SEAMOCS, Seoul U., Shell CanadaShanghai Center for Mathematical Science, Shanghai Jiao Tong U., Shell Canada, the Simons Foundation, Springer-Verlag, Stanford U., StataCorp, Statistical and Applied Mathematics Institute (SAMSI), Swedish Foundation for International Cooperation in Research (STINT), SYREON Corp., TD Bank, Telus Spark, Tourism Edmonton, Tutte Institute, U Abomey Calavi, U Bourgogne, U California (Santa Barbara), U Guelph, U Manitoba, U Montréal, U New South Wales, U Oregon, U Waterloo, W.H. Freeman & Co., Wiley and York U.

The PIMS annual budget is approximately $3.43 million, with roughly one-third 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 exchange of successful

practices in outreach, teaching, and professional development amongst its members. Currently PIMS has nine educational associates in Alberta and British Columbia.

7. PIMS NEWS IN 2013

- In July PIMS hosted a special retreat to review existing programs and brainstorm for new initiatives. The resulting ideas and improvements were crystallized in a proposal to NSERC for renewal of PIMS funding for the period 2014-2019. New programs to be supported include a PIMS Postdoctoral Training Center in Stochastics, a National Initiative in Mathematical Biology, the Canadian Statistical Sciences Institute and Grand Challenges in Applied Mathematics.

- CRM, Fields and PIMS are working on a joint Institutes' Innovation Initiative, which aims to develop a platform for innovation in the mathematical sciences in Canada to replace the now defunct Mprime NCE. A special proposal will be submitted to NSERC's Research Partnerships Program

- The Unravelers: Mathematical Snapshots is a bestselling book and exhibition featuring scientists at the Institut des Hautes Études Scientifiques. Together PIMS and IHÉS brought this exhibit to UBC in April. Preceding the Opening Reception, CNRS Director of Research and IHÉS Director J.-P. Bourguignon gave a panoramic overview of The Work of Misha Gromov, a Truly Original Thinker. The French Consul and the Directors of BIRS, CRM, Fields and PIMS were all in attendance.

- Under D. Coombs the PIMS IGTC in Mathematical Biology has flourished, attracting outstanding local and international graduate students, as well as world-class visitors and speakers. In particular the training centre has been extremely successful in fostering student research (with over 90 papers published since 2008, including several in top scientific journals) and career development (centre alumni are moving into excellent positions in academia and elsewhere). The IGTC has been successful in seeking expanded and diversified funding sources which has allowed it to increase student funding and compete for the most exceptional graduate students. §II.2.B contains more reporting on the IGTC. As previously planned, funding for this program will end in 2014. A National Initiative in Mathematical Biology is under development aiming to build on the success of the IGTC.

- The robustness of PIMS educational efforts is reflected by its recent funding successes. In 2013 PIMS was awarded grants from the Royal Bank of Canada, VanCity, the Vancouver Foundation and the Actuarial Foundation of Canada, as well as gifts from generous private donors. The Governments of BC and Saskatchewan awarded special funding for PIMS activities for Aboriginal students and teachers.

- Finally, A. Adem (UBC) began a second five-year term as Director of PIMS on July 1, 2013.

- More information about PIMS can be obtained under "PIMS News/Press" at *www.pims.math.ca* and in "Year in Review" at *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, the International Graduate Training Centre (IGTC) in Mathematical Biology and its training events, and occasional Special Focused 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 focused periods, including workshops and summer schools as well as seminars, make joint postdoctoral fellowship (PDF) appointments, or 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* for more information.

International Graduate Training Centre: Recognizing the importance of mathematics in biology, PIMS created the IGTC in Mathematical Biology in 2007. This has served as the core of a specialized graduate program shared between several PIMS universities. PIMS serves as a catalyst by supporting the program with summits, workshops, and summer schools; bringing international students to them, arranging for distinguished visitors to teach in the program, and awarding fellowships. See *www.pims.math.ca/scientific/graduate-training-igtc.* Funding for this program will end in 2014, but there are plans to have it evolve into a National Initiative in Mathematical Biology, with support from all three institutes.

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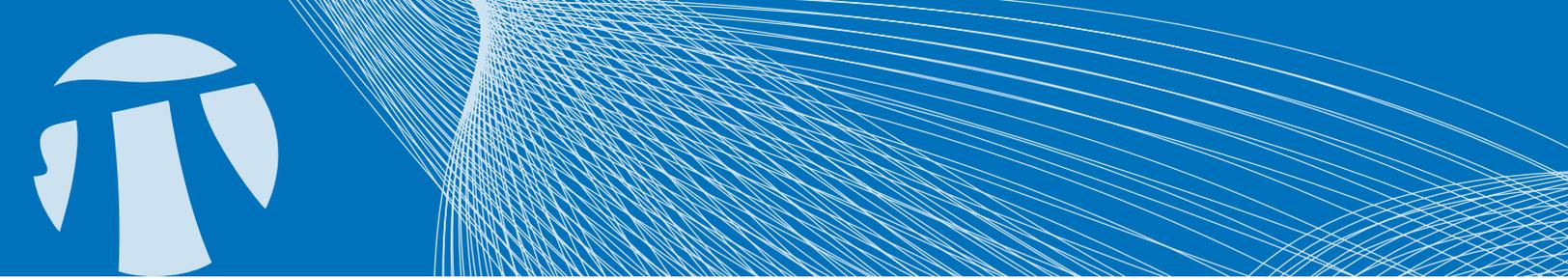
Lecture and Seminar Series: PIMS supports various ongoing seminar series at member universities and industrial centers throughout the year. Some of these are for specialists, while others are geared towards the general public, with the goal of inculcating in the citizenry the importance of mathematical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

Industrial Activities: PIMS also fosters collaborations with industry. *Industrial Problem Solving Workshops* (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 opportunity to host an IPSW will be in 2014.

Mathematical Modelling in Industry Workshops (MMIW) 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 2013 MMIW was held in Minneapolis.

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 2013) are aimed at a general audience. *www.pims.math.ca/industrial* has more information.

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

Activity	2012	2013	2014
Conferences/Workshops	39	49	32
Summer Schools	9	6	12
Collaborative Research Groups	6	5	6
Lecture and Seminar Series	24	27	26
Industrial Activities	4	5	3
Other	20	16	20

Note: The category "Conferences/Workshops" includes CRG events, Focus Period activities as well as IGTC events. Activities to be co-sponsored by AARMS in 2014 are not known at this writing. We expect there will be 3-4 of these that we have listed under "Other." PIMS will be supporting CANSSI activities in 2014; details have not been specified yet. The numbers for 2014 are based on known events at this time.

All activities are listed individually below, along with *selected* highlights, as well as an expanded summary of a showcase event, 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* 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, PIMS support for AARMS and the IGTC in §§II.1.D&E and II.2.B following.

B. Listing of Activities: 2013

Conferences and Workshops

1. *Frontiers in Biophysics, UBC, March 2.*
   - ➢ Keynote speaker C. Wolgemouth asked how do biochemistry and biophysics conspire to drive a single cell's motion? How do single cell crawling and cell-cell interactions lead to the complex bulk migration that is observed during wound healing and cancer metastasis?

2. *Second Seminar on Dispersive PDEs,* UV, March 9.

3. *UBC/SFU Graduate Student Workshops in Statistics,* SFU-Vancouver, March 16.

4. *Bellingham Algebraic Geometry Seminar,* WWU, April 6.

5. *North-South Dialogue in Math,* UC, May 2-3.
   - ➢ Plenary lectures were given by R. Piccinini (Dalhousie U) on "Fibrations" and T. Hillen (UA) on "Mathematical Modelling of Cancer."

6. *2013 Prairie Discrete Mathematics Workshop,* Thompson Rivers U, May 3-4.
   - ➢ B. Sands (UC) entertained an audience of over 80 high school students with illustrations of how contest problems have led to genuine research problems.

7. *Spring West Coast Optimization Meeting,* UW, May 4.

8. *3rd Pacific Northwest Theory Day,* UV, May 4-5.

9. *East Coast Combinatorics Conference 2013,* MUN Corner Brook, May 8-10. º

10. *Alberta Number Theory Days 2013,* Banff, May 11-12.
    - ➢ Noam Elkies discussed conjectures on discriminants and conductors of elliptic curves, including Hall's conjecture and the ABC conjecture.

11. *Cascade Topology Seminar,* PSU, May 18-19.
    - ➢ Each of the seven talks represented significant progress in various areas of algebraic and geometric topology along with algebraic K-theory, ranging from knot and three manifold theory, to Andre-Quillen homology theory, and to the solution to the Arf-Kervaire invariant problem.

12. *10th Annual PIMS Young Researchers Conference in Mathematics and Statistics,* UA, May 21-24.
    - ➢ The conference highlight was the lecture on "Moonshine" By T. Gannon.

13. *International Workshop on Perspectives on High Dimensional Data Analysis, III,* UBC, May 23-25.
    - ➢ Discussions centered on experimental design for high-dimensional data collection, algorithmic problems in protein folding, and regularization methods.

14. *Inaugural SSC Student Conference,* UA, May 25.
    - ➢ This student-led conference focused on professional skill development, careers in industry and academia, and research presentations. J. Rosenthal of the Department of Statistics of U Toronto, a leading Canadian researcher, teacher, author, and an engaging speaker, gave the keynote address.

15. *PIMS/CWOS/CGU/CRWA Math of Planet Earth Joint Meeting,* US, May 26-30.*
    - ➢ The theme of the congress was "Bridging Environmental Science, Policy and Resource Management."

16. *Pacific Northwest Number Theory Conference,* UW, June 1-2.

17. *S. Gross lectured on the number 4959866698915122609810424451 2918.*

18. *Automata Theory and Symbolic Dynamics,* UBC, June 3-7.
    - ➤ The focus was on the role of computation theory in symbolic dynamics. This is a major recent devel-opment, which has generated breakthrough results and raised new questions in multi-dimensional symbolic dynamics. One outstanding problem was solved by a graduate student shortly after the workshop; this student is now developing a new and intriguing body of theory based on his solution.

19. *CANADAM 2013,* St. John's, NL, June 10-13.°
    - ➤ Talks by R. Sedgewick (Princeton) on "The Lasting Legacy of Philippe Flajolet" and B. Sudakov (UCLA) on "Induced Matchings, Arithmetic Progressions and Communication" were very well received.
    - ➤ There was a one-hour popular lecture on "Opt Art" (art constructed with the assistance of optimization techniques) given by R. Boscch of Oberlin College.

20. *Women Optimize in the West,* UC, June 13-14.

21. *Recent Advances in Hodge Theory: Period Domains, Algebraic Cycles, and Arithmetic, UBC, June 14-20.*
    - ➤ This workshop brought together leading scholars to study the conjectures of Hodge, Bloch and Beilinson on algebraic cycles in Hodge theory.

22. *Canadian Quantum Information Students' Conference,* UC, June 24-28.

23. *PRIMA 2013,* Shanghai Jiaotong U, June 24-28.
    - ➤ This year's PRIMA Congress was very successful; the attendance was over 580, with participants from all over the Pacific Rim, including China, Japan, Korea, Vietnam, Australia, New Zealand, Singapore, Chile, Colombia, Hong Kong, Taiwan, Mexico, the USA and Canada.
    - ➤ There were two entertaining public lectures. The first was by Cedric Villani (recent Fields medallist), entitled "Of Triangles, Gas, Prices and Men"; the second one was delivered by Ronald Graham on "Computers and Mathematics: Problems and Prospects".

24. *Rolfsenfest: Low dimensional Topology, Knots, and Orderable Groups,* Luminy, France, July 1-5.

25. *Quantum Information and Foundations of Quantum Mechanics,* UBC, July 2-5.

26. *Analysis and PDEs: A Conference in Honour of the 60th Birthday of Nassif Ghoussoub,* UBC, July 7-12.
    - ➤ Several breakthrough results were presented, opening new directions of research: these include Y. Brenier's result concerning volume-preserving diffusion process related to fluid mechanics, A. Figalli's stability result concerning convex hulls, F. Lin's results on geometric measures and topology of nodal sets, V. Milman's results on new structures on log-concave functions, and C.-S. Lin's results on mean-field equations combining PDE and number theory.

27. *Analytic Spaces and Their Operators,* MUN, July 9-12. °

28. *Recent Trends in Stochastic Analysis,* UBC, July 22-26.

29. *Celestial, Molecular, and Atomic Dynamics (CEMAD-2013),* UV, July 29-August 2.*
    - ➤ New connections between the motion of particles in celestial, molecular, and atomic dynamical systems were uncovered and explored.

30. *Mathematical Congress of the Americas,* Guanajuato, México, August 5-9.
    - ➤ PIMS support enabled 21 young Canadian researchers to attend this conference.

31. *2013 Symposium on Mathematics and Computation,* SFU, August 7.

32. *Workshop on Numerical Linear Algebra and Optimization,* UBC, August 8-10.
    - ➤ Sessions were devoted to non-smooth analysis with eigenvalue optimization and applications in mind, problems in control theory relevant to eigenvalue optimization, and Krylov subspace methods, which

constitute indispensable numerical ingredients for optimization algorithms.

33. *Selected Areas in Cryptography (SAC),* SFU, August 14-16.
34. *Workshop on Curves and Applications,* UC, August 19-21.
    ➢ This project-driven workshop focused on constructing curves with special properties, arithmetic infra-structure and implementation in SAGE, and applications including cryptography.
35. *Workshop on Applied Harmonic Analysis,* UC, August 26-30.
36. *West Coast Algebraic Topology Summer School 2013,* U Oregon, September 6-8.
37. *Fall West Coast Optimization Meeting,* UV, October 4-5.
38. *Joint UBC/SFU Graduate Student Workshops in Statistics,* SFU-Vancouver, October 5.
39. *The 35th Annual Meeting of Alberta Statisticians,* UC, October 5.
40. *Pacific Northwest Probability Seminar,* UW, October 19-20.
    ➢ P. Fitzsimmons (UCSD) delivered the annual Birnbaum Lecture on "The Stationary Process Associated with an Excessive Measure of a Markov Process; Applications Old and New."
41. *Bellingham Algebraic Geometry Seminar,* Western Washington U, October 20.
42. *Cascade Topology Seminar,* UW, November 2-3.
43. *Workshop on Hodge Theory in String Theory,* Fields, November 18-22.
    ➢ This workshop surveyed and explored the interaction between Hodge theory and physics in the understanding of Calabi-Yau varieties. Lecturers included Claire Voisin and David Morrison.
44. *Combinatorial Potlatch, UV, November 23.*

Summer Schools

1. *Summer School on Mathematics Behind Biological Invasions, UA, May 27-June 14.*
2. *Recent Advances in Hodge Theory: Period Domains, Algebraic Cycles, and Arithmetic*, UBC, June 10-13.
3. *Summer School on Optimization*, UC, June 14-28.
4. *Canadian Summer School on Quantum Information 2013*, UC June 17-21.
5. *Seminaire de Mathématiques Superieures-2013*, CRM-U Montréal, June 24-July 5.
6. The subject was on the Physics and Mathematics of Link Homology.
7. *AARMS Summer School, MUN*, July 15-August 9. °*
8. Courses were given on Mathematical Methods to Gain Biological Insights and Mathematical Modeling in Developmental Biology and Medicine.

Collaborative Research Groups†

1. CRG 22 - *Mathematics of Quantum Information,* 2010-2013.
2. CRG 23 - *Applied and Computational Harmonic Analysis,* 2011-2014.
3. CRG 24 – *Optimization: Theory, Algorithms and Applications*, 2012-2015.
4. CRG 25 – *Algorithmic Theory of Networks*, 2012-2015.
5. CRG 26 – *Geometry and Physics*, 2013-2016.

Focus Periods

1. *Celestial Mechanics*, January 1-November 30.*

2. *Models and Methods in Epidemiology, Ecology and Public Health*, January 1-September 30.*
3. *Optimization*, part of CRG 24, Summer.
4. *Quantum Information*, part of CRG 22, Summer.

Lecture and Seminar Series

1. *UW-PIMS Colloquium*, U Washington, ongoing.
2. *Seminar Series on Analysis Of Genetic Data*, UC, May 1-December 31.
3. *PIMS/UBC Distinguished Colloquium Series*, UBC, ongoing.
4. *PIMS Distinguished Lecture Series*, UR, ongoing.
5. *The AMI Seminar Series*, UA, ongoing.
6. *Niven Lecture*, UBC, May 27.
7. *The PIMS Marsden Memorial Lecture*, the Isaac Newton Institute, Cambridge, England, June 10.
8. *Applied Mathematics Seminar*, US, ongoing.
9. *CS Distinguished Colloquium Series*, UBC, ongoing.
10. *Lethbridge Number Theory and Combinatorics Seminar*, UL, ongoing.
11. *Lectures on the occasion of the year of Mathematics of Planet Earth and the International Year of Statistics*, UNBC, October 1, 2012- April 3, 2013.*
12. *PIMS Voyageur Colloquium*, U Calgary, ongoing through March.
13. *Anabelian Geometry and Arithmetic Geometry*, UL, UBC, UC, October 1, 2012- October 1, 2013.
14. *PIMS/CSC Distinguished Lecture Series*, SFU, ongoing.
15. *SFU Discrete Math Seminar*, SFU, ongoing.
16. *SCIAM Seminar Series*, UBC, ongoing.
17. *PIMS-UW Distinguished Colloquia in Statistics*, Fall 2013.
18. *IAM-PIMS Distinguished Colloquium Series*, UBC.
19. *CRM-Fields-PIMS Prize Lecture*, SFU, July 18.
20. *Hugh C. Morris Distinguished Lecture*, November 1.
21. *PIMS Mathematical Biology Seminars*, UBC, ongoing.
22. *MathAcrossCampus Colloquium Series*, UW, ongoing.
23. *Quantum Information Seminar Series*, U Calgary, ongoing through March, 2014.
24. *PIMS Public Lecture Series*, UBC, ongoing.
25. *R&L Guy Public Lecture Series*, UC, ongoing through 2013.
26. *COCANA Seminar Series*, UBC-O, ongoing.
27. *Geometry and Physics Seminar Series*, UA, Fall onwards.

International Graduate Training Centre in Mathematical Biology

1. *Summer School on Mathematics Behind Biological Invasions,* UA, May 27-June 14.
2. *IGCT Summit,* Banff, AB, November 8-10.
   ➢ This summit focused on Career Transitions and Development in Math Biology.

Industrial Activities

1. *PIMS/Shell Lunchbox Lecture Series*, Calgary, ongoing.
2. *Disease Dynamics 2013: Immunization, a True Multi-scale Problem*, UBC, January 17-19.*
   - Covered mathematical modeling of diseases at all scales (epidemic, host, cell, genome) but with a focus on immunization and other control measures.
3. *Recent Developments in Numerical Methods for Seismic Inverse Problems and Applications*, UC, July 16-18.
   - Participants agreed that seismic inversion is a promising technique in exploration geophysics and is worthy of increasing investment.
4. *Complex Fluids and Flows in Industry and Nature II*, UBC, July 24-26.
   - For many the highlight was the special session in honour of the 70th Birthday of G.M. Homsy, which attracted talks from: E. Shaqfeh (Stanford), T. Ward (Iowa), E. Meiburg (UCSB), K. Breuer (Brown) and P. Grassia (Manchester).
5. *Mathematical Modeling in Industry Workshop 17*, IMA, August 7-16.
   - Groups of students worked under the mentorship of industrial scientists on projects including: sweep MRI, visually significant QR codes, shear band formation in metallic glasses, and electrochemical storage devices.

Other

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

1. *Mathematical Institutes Open House & Mathematics of Planet Earth 2013 US Launch*, San Diego, January 9.*
2. *UBC Shale Gas and LNG Industry Symposium*, UBC, February 22.
3. *Luncheon for Women Graduate Students in Mathematics and Statistics*, UBC, March 15.
4. *The Unravelers: Mathematical Snapshots*, UBC, April 5-19.
   - Through revealing photographs and accompanying text, this exhibit offered an enchanting and beautiful glimpse into the inner life of the Institut des Hautes Études Scientifiques (IHÉS).
5. *PIMS Distinguished Lecturer Frits Beukers*, SFU, April 28-May 10.
   - Prof. Beukers presented two comprehensive lectures on "Hypergeometric Functions, from Euler to Gel'fand."
6. *CANSSI Annual Meeting*, UA, May 25.
7. *Statistical Society of Canada Annual Meeting*, UA, May 26-29.
8. *CMS Summer Meeting*, Halifax, June 4-7.
9. *CAIMS Annual Meeting*, Québec City, June 16-20.
10. *5th Conference on Reversible Computation*, UV, July 4-5.
11. *Canadian Undergraduate Mathematics Conference (CUMC)*, U Montreal, July 10-14.
12. *PIMS Distinguished Lecturer Ivar Ekeland*, UBC, July 15 and 17.*
    - This two-part lecture investigated how our idea of the world has influenced the development of mathematics. The first part described the situation up to the twentieth century, and the second one followed up to the present time and discussed the global challenges humanity and the planet are facing today.
13. *MSI: Music, Film and Mathematics Together*, Banff, AB, August 10-17.
    - This residency at the Banff Centre will enable artists and mathematicians to complete post-production on a documentary exploring how to present complex mathematical concepts in different forms.
14. *MAGE - Methods and Algorithms for Genome Evolution*, Eastern Twps, QC, August 23-26.
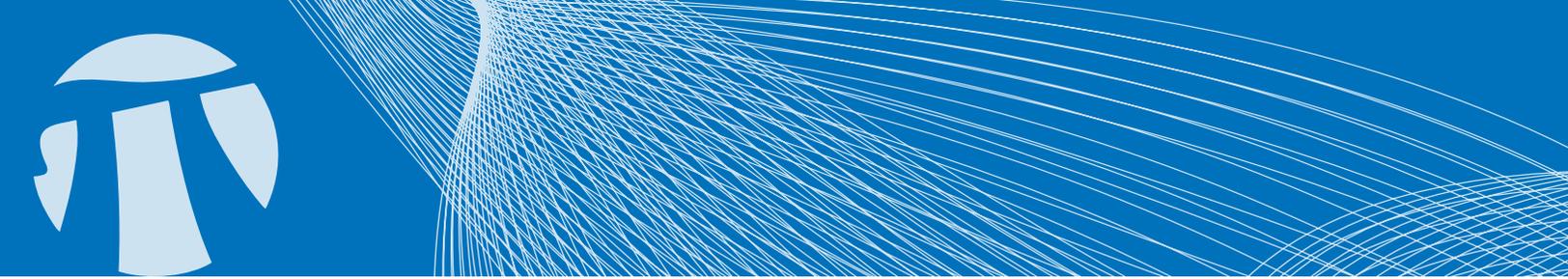
> ➤ This conference celebrated D. Sankoff's 50th anniversary of research.

15. *CMS Winter Meeting*, December 6-9.
16. *American Women in Mathematics* Mentor Network.

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* Starred events are part of *The Mathematics of Planet Earth 2013 Program.*

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

† Although they have formally ended, CRGs 19 on *Partial Differential Equations* and 21 on *L-functions and Number Theory* still had several active PDFs in 2013.

C. Listing of Planned Activities: 2014

Conferences and Workshops

1. *Frontiers in Biophysics*, UBC, March 2.
2. *Second Seminar on Dispersive PDEs,* UV, March 9.
3. *Women in Numbers 3*, Banff, January 1-6
4. *Pacific Northwest Geometry Seminar*, Stanford U, February 8-9
5. *The Fourteenth Colloquiumfest*, US, February 28-March 1
6. *Alberta Number Theory Days*, Banff, April 19-27
7. *Bellingham Algebraic Geometry Seminar*, Western Washington U, October 20.
8. *Cascade Topology Seminar*, Banff, May/June
9. *Geometry and Physics Workshop*, UBC, May 29-31
10. *Alberta Mathematics Dialogue*, Banff, May 1-2
11. *TRUe Games*, Thompson Rivers U, May 6-9
12. *Western Canada Linear Algebra Meeting 2014*, UR, May 10-11
13. *Symmetry, Methods, Applications, and Related Fields in Honor of George Bluman*, UBC, May 13-16
14. *Changing the Culture*, SFU, May 16.
15. *Pacific Northwest Number Theory Conference*, SFU, May 17-18.
16. *Algebraic Topology – Methods, Computation, and Science 6*, UBC, May 26-30
17. *Geometry and Physics Workshop*, UBC, May 29-31
18. *Calabi-Yau Manifolds and Moduli*, UA, June
19. *11th PIMS Young Researchers Conference in Mathematics and Statistics*, UBC, June 2-5
20. *String Math Conference*, UA, June 9-13
21. *Combinatorial Applications to Biology, Chemistry, and Physics*, US, June 21-27
22. *Mathematics at the Frontier of Developmental Biology*, UBC, July 2-4
23. *Workshop on Algebraic Design Theory and Hadamard Matrices*, UL, July 8-11
24. *Pan-American Advanced Study Institute in Spatio-Temporal Modeling*, Buzios, RJ, Brazil, July 14-25
25. *The Economics and Mathematics of Systemic Risk Workshop*, UBC, July 28-30
26. *Summer Conference and Workshop on the Molecular Origins of Protein Misfolding and Neurodegenerative Disease*, Vancouver, July 30-August 2.

27. *Integrability and Exact Solvability as Avatars of Symmetry*, CRM, August 25-30
28. *Pacific Northwest Probability Seminar*, Microsoft, October
29. *Bellingham Algebraic Geometry Seminar*, Western Washington U, Fall.
30. *Cascade Topology Seminar*, UBC, October
31. *Workshop on Big Data in Networks and Distributed Systems*, SFU, October 7-8
32. *PIMS IISER Pune Mathematical Biology Conference*, IISER-Pune, India, December

Summer Schools

1. *Software Carpentry Bootcamps: Basic Software Skills Training and Researchers in the Mathematical and Statistical Sciences,* various PIMS Sites, May – August
2. *Undergraduate Supersymmetry Summer School,* UBC, May 26-31.
3. *PIMS Summer School in Probability,* UBC, June 2-27
4. *String Math Summer School,* UBC, June 2-6
5. *Seminaire de Mathématiques Superieures-2014,* CRM-U Montréal, June 23-July 4
6. *PIMS- SFU Undergraduate Summer School on Multiple Zeta Values,* SFU, July 7 – August 1
7. *West Coast Topology Summer School,* UBC, July 7-11
8. *Fields-PIMS Summer School in Operator Algebras,* U Ottawa, July 7-18
9. *The Economics and Mathematics of Systematic Risk and the Financial Networks,* UBC, July 21-25
10. *AARMS Summer School,* MUN, July-August
11. *Two Weeks at Waterloo, a Summer School for Women in Math,* U Waterloo, August 10-23
12. *Summer School in Randomized Techniques for Combinatorial Algorithms,* SFU, August 18-22

Collaborative Research Groups

1. CRG 23 – *Applied and Computational Harmonic Analysis*, 2011-2014.
2. CRG 24 – *Optimization: Theory, Algorithms and Applications*, 2012-2015
3. CRG 25 – *Algorithmic Theory of Networks*, 2012-2015
4. CRG 26 – *Geometry and Physics*, 2013-2016
5. CRG 27 – *Applied Combinatorics*, 2014-2017
6. CRG 28 – *Applied, Algebraic, and Geometric Topology*, 2014-2018

Focus Periods

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

Lecture and Seminar Series

1. *MathAcrossCampus Colloquium Series*, UW, ongoing
2. *SFU Discrete Math Seminar,* SFU, ongoing until April
3. *PIMS/CSC Distinguished Lecture Series*, ongoing
4. *PIMS-AMI Seminar Series*, ongoing

5. *PIMS Applied Mathematics Seminar Series*, US, ongoing
6. *Lethbridge Number Theory and Combinatorics Seminar*, UL, ongoing
7. *Marsden Memorial Lecture*, ongoing
8. *IAM-PIMS Distinguished Colloquium Series*, UBC, ongoing
9. *PIMS-UW Distinguished Colloquia in Statistcs*, ongoing
10. *CRM-Fields-PIMS Prize Lecture*, Niky Kamran (McGill), UBC, April 7
11. *COCANA Seminar Series*, UBC-O, ongoing.
12. *Geometry and Physics Seminar Series*, UA, ongoing.
13. *Niven Lecture Series*, ongoing.
14. *Special Lecture*, Jim Gates (U Maryland), UBC, May 29.
15. *Hugh C Morris Distinguished Lecture Series*, ongoing
16. *UW-PIMS Colloquium*, ongoing
17. *PIMS Mathematical Biology Seminars*, ongoing
18. *CS Distinguished Colloquium Series*, UBC, ongoing
19. *SCAIM Seminar Series*, UBC, ongoing
20. PIMS Public Lecture Series, ongoing
21. *PIMS Distinguished Lecture Series*, UR, ongoing
22. *PIMS/UBC CS Distinguished Colloquium Series*, UBC, ongoing until April
23. *PIMS Diff Geom/Math Phys/PDE Seminars*, UBC, ongoing
24. *PIMS Probability Seminar*, UBC, ongoing
25. *PIMS Topology Seminar*, UBC, ongoing
26. *PIMS Discrete Mathematics Seminar*, UBC, ongoing

Industrial Activities

1. *Financial Industry Panel on Systemic Risk*, UBC, July 30
2. *Mathematical Modeling in Industry Workshop*, UBC, August 5-15
3. *PIMS/Shell Lunchbox Lecture Series*, Calgary, ongoing

Other

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

1. *Distinguished Visitor O. Ramaré*, UL, February 20 – March 13
2. *PIMS Distinguished Visitor Y. Nesetril*, UBC/SFU, February 20 – March 10
3. *Distinguished Visitor F. Beukers*, ongoing
4. *Distinguished Public Lectures in Mathematical Biology*, US, April 1, 2014 – March 30, 2015
5. *Distinguished Visitor F. Kamareddine*, UL, April 1, 2014 – April 1, 2015
6. *Distinguished Visitor M. Nebel*, SFU, April 6-20
7. *Distinguished Visitor I. dell'Ambrogio*, UR, April 15 – May 15
8. *Distinguished Visitor D. Bryant*, SFU, April 20 – May 31
9. *ELMACON*, UBC, 3 May

10. *Distinguished Visitor M. Boyle*, UBC, May 15 – August 15
11. *Changing the Culture*, SFU, May 16.
12. *Distinguished Visitor T. Johnson*, UV, June 1-30
13. *CAIMS Annual Meeting*, Saskatoon, June 22-26
14. *International Congress for the Psychology of Mathematics Education (PME)*, Vancouver, July 15-20
15. *Summer School on Population Data*, UBC, Summer.
16. *Distinguished Visitor Singer*, SFU, October 5-19
17. *CANSSI Annual Meeting*
18. *2014 CMS Summer Meeting*
19. *SSC 2014 Meeting*
20. *2014 CMS Winter Meeting*

D. CRG Status Reports

PIMS had five active CRGs in 2013; below we briefly summarize current and upcoming activities and list their PDFs. In 2013, PIMS inaugurated CRG #26 on *Geometry and Physics*, and new CRGs on *Applied Combinatorics* and *Applied, Algebraic and Geometric Topology* will kick-off in 2014. PIMS is currently considering letters of intent for new CRGs in following years.

CRG 22: The Mathematics of Quantum Information (2010–2014)

Leaders: Barry Sanders (UC), Robert Raussendorf (UBC), Petr Lisonek (SFU), Aram Harrow (UW).

2013 Activities:
- *13th Canadian Summer School on Quantum Information 2013,* UC, June 17 - 21, 2013
- *Canadian Quantum Information Students' Conference,* UC, June 24 - 28, 2013
- *Workshop on Quantum Information and Foundations of Quantum Mechanics,* UBC, July 2 - 5, 2013

Future Activities: This CRG will end March 31, 2014.

PDFs: R. Dridi (UC), V. Gheorghiu (UC), N. Lovett (UC), V. Singh (SFU), C. Trail (UC), Y. Wang (UC).

Highlights:
- In 2013, P. Lisonek at SFU found the simplest possible Kochen-Specker set for the fre-quently studied case when the Kochen-Specker proof is based on a set of rays satisfying a particular parity condition, while under fairly general assumptions for measurement-based quantum computation, UBC researchers showed that a Kochen-Specker proof serving as quantum computation is contextual whenever it computes a non-linear Boolean function with 'high' probability of success.
- At UC, the Sanders group devised an efficient autonomous classical algorithm for simulating accurately a single-qubit channel efficiently with respect to the simulation error tolerance, and this surprisingly simple circuit is immediately implementable experimentally.

CRG 23: Applied and Computational Harmonic Analysis (2011-2014)

Leaders: Bin Han (UA), Rong-Qing Jia (UA), Elena Braverman (UC), Ozgur Yilmaz (UBC).

2013 Activities:

- *Alberta-British Columbia Seminar in Harmonic Analysis,* UC, August 26 - 30.
- *PIMS-BIRS Workshop: Recent Progress on Applied and Computational Harmonic Analysis,* Banff, August 30 - September 1.

Future Activities: This CRG will end March 31, 2014.

Visitors : Xiaosheng Zhuang (City University of Hong Kong), Alexandra Rodkina (U West Indies), J.L. Guermond (Texas A&M U), B. Sendov (Institute of Mathematics, Bulgarian Academy of Sciences).

PDFs: E. Au-Yeung (UBC, 2011-2013), K. Wang (UA, 2012-2013).

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

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

2013 Activities:
- *West Coast Optimization Meeting,* Spring.
- *WOW – Women Optimize in the West,* UC, June 13-14
- *Summer School on Optimization,* UC, June 14-28
- *Workshop on Numerical Linear Algebra and Optimization,* August 8-10.
- *West Coast Optimization Meeting,* Fall.

Future Activities (Planned):
- *West Coast Optimization Meeting,* Spring 2014.
- *West Coast Optimization Meeting,* SFU–Surrey, Fall 2014.

Visitors: D. Noll (U Paul Sabatier, Toulouse) will be a CNRS/PIMS visitor to UBC-O in 2014.

PDFs: N. Krislock (UBC, 2012-13), T.K. Pong (UBC, 2013-2014), N. Tran (UBC-O; 2013-2014).

Highlights:
- This CRG has developed the notion of a "normal problem" associated with finding a zero of the sum of two maximally monotone operators is introduced. If the original problem admits solutions, then the normal problem returns this same set of solutions. The normal problem may yield solutions when the original problem does not admit any; furthermore, it has attractive variational and duality properties.
- The first series of computational validation of the newly proposed moment-based relaxation of the DVH constraints for radiotherapy treatment confirmed the expectations that this is indeed a viable computational approach.

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

Leaders: Funda Ergun & Petra Berenbrink (SFU), Valerie King (UV).

2013 Activities:
- *Workshop on Network Theory,* UV, May, 2013.
- *Related Activity: Workshop on Communication Complexity,* Banff, August 24-29, 2014.

Future Activities (Planned):
- *Workshop on Big Data in Networks and Distributed Systems,* SFU Summer 2014.
- *Summer School on Randomized Techniques for Combinatorial Algorithms,* SFU, Summer 2014.

Visitor: Morteza Monemizadeh (Karlsruhe I. T., April 5-May 30, 2013).

Students & PDFs: Zahed Rahmati (UV), Erfan Sadeqi Azer (SFU), Hoda Akbari (SFU).

Highlights: CRG leader Valerie King (UV) won the Best Paper Award at SODA 2013 for "Dynamic Graph Connectivity in Polylogarithmic Worst Case Time" with B. Kapron and B. Mountjoy.

CRG 26: Geometry and Physics (2013-2016)

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

- *2013 Activities:*
- *The Geometry and Physics Seminar Series,* UA & UBC, Fall 2013 onwards
- *Concentrated Graduate Course on Hodge Theory in String Theory,* Fields Institute, November 11-15.
- *Workshop on Hodge Theory in String Theory, The Fields Institute,* November 18-22.

    Future 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

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

    Highlight: Thus far the CRG has focused on the study of moduli spaces of Calabi–Yau varieties and their compactifications from the perspective of period maps, with applications to various string dualities.
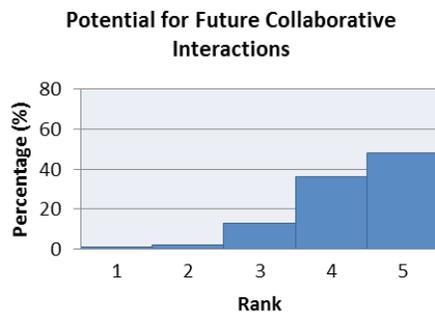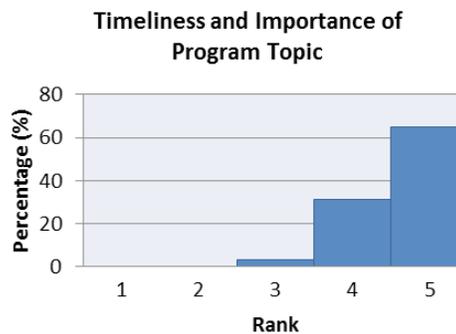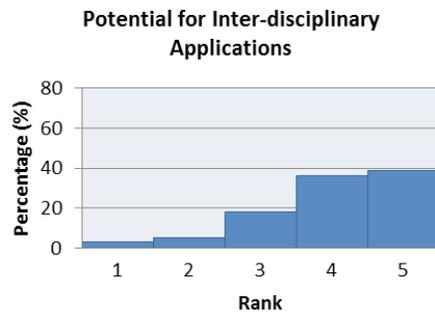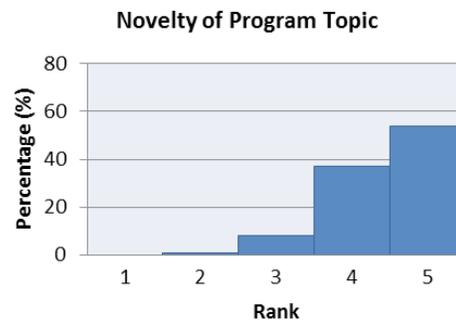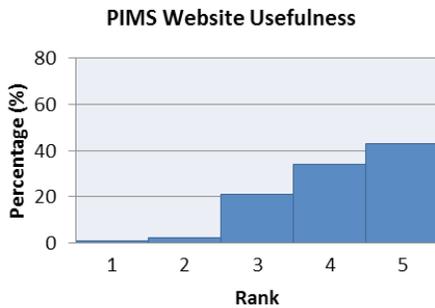
E. AARMS Report

As part of a national mandate, PIMS has been supporting 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 2013; PIMS' financial contribution to each event is listed in parentheses:
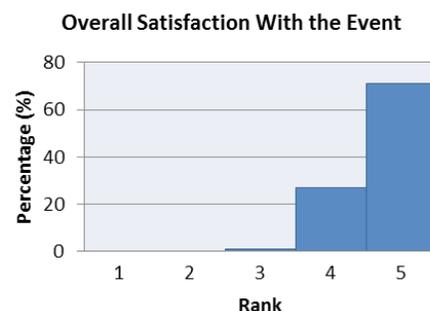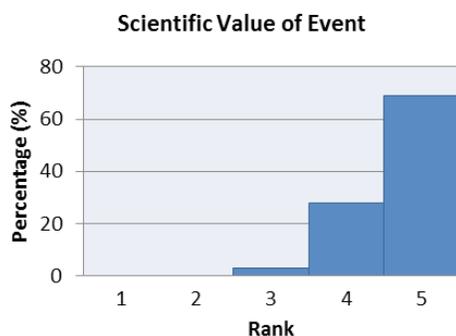
- *AARMS Summer School*, MUN, July 15 - August 9: Every summer highly regarded faculty from around the world deliver graduate courses in the mathematical sciences. In 2013 as part of the MPE theme, we offered a course in Mathematical Methods to Gain Biological Insights, delivered by O. Diekmann (U Utrecht), and a course in Mathematical Modeling in Developmental Biology and Medicine, delivered by P. Maini (Oxford U). ($9,750).
- *Analytic Spaces and Their Operators*, MUN, July 9-12: This event included 13 invited talks representing recent developments ranging aspects of analytic spaces, studies of some special function-theoretic operators up to the study of moduli spaces of holomorphic bundles as well as convex geometry. Altogether 31 participants enrolled in this event from China, the USA, Spain, Finland, and across Canada. ($2,000)
- *East Coast Combinatorics Conference 2013* (May 8-10, MUN, Corner Brook) This conference is designed to attract regional mathematicians, computer scientists, and graduate students interested in various aspects of discrete mathematics. C. Colbourn, a researcher with over 400 publications in discrete mathematics and computer science, spoke on "F-Vectors of Pure Complexes and Pure Multicomplexes of Rank Three," which outlined his recent work to solve some open questions arising from questions in commutative algebra. K. Mynhardt, an expert in the area of graph domination, gave a survey talk on the topic of "Broadcast Domination in Graphs," which in particular discussed recent connections to the multipacking number in graphs. ($2,000)
- PIMS also partially supported one PDF at MUN – Ryan Tifenbach ($8750).

F. 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 366 responded in 2013. 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):

PIMS Website Usefulness

Novelty of Program Topic

Potential for Inter-disciplinary Applications

Timeliness and Importance of Program Topic

Potential for Future Collaborative Interactions

Event Organization

Scientific Value of Event

Overall Satisfaction With the Event

The results were broadly similar to those in 2012, except for a substantial uptick in the usefulness of PIMS' website.

Individual comments regarding PIMS' events included:

➢ "I think that PIMS is entirely on the right track in its efforts. Program choices are good."

➢ "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."

➢ "Great conference. One of the best I have attended."

➢ "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."

➢ "The plenary talks were uniformly good in quality, and I appreciated that the organizers chose speakers who made an effort to aim their talk at a wider audience."

➢ "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 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."

➢ "I felt I do not like to leave at the end." [*sic*]

➢ "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."

- "An amazing conference … above and beyond."
- "I had several important conversations with important researchers in my field … who expanded my thinking… I could not ask for more!"
- "This is certainly one of the most impressive and high quality conferences that I have been [to] in the past couple of year[s]. The organizers had done excellent work making it very smooth and enjoyable. Most importantly, the quality of the talks is very high."
- "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 collaborate."
- "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."
- "Outstanding mathematicians in general… Extremely excellent!"
- "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."
- "Attending … has been very rewarding. It will certainly help in scientific collaboration."
- "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 workshop has exceeded my expectations. The program was carefully thought out, balanced current results with some background material and was of exceptionally high level altogether. A mixture of current results and recent work were reported which informed me and broadened my understanding of the current state of the field. I returned home inspired by the great mathematics I have learned."
- "It was also great to get problems to work on and company to work with."
- "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.'"
- "This conference was a model of organization. … The program was excellent as well."
- "The talks were wonderful and thought provoking. I am still working on some problems I learned at the meeting."
- "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."
- "…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."
- "… the level of work and diversity was impressive."
- "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."

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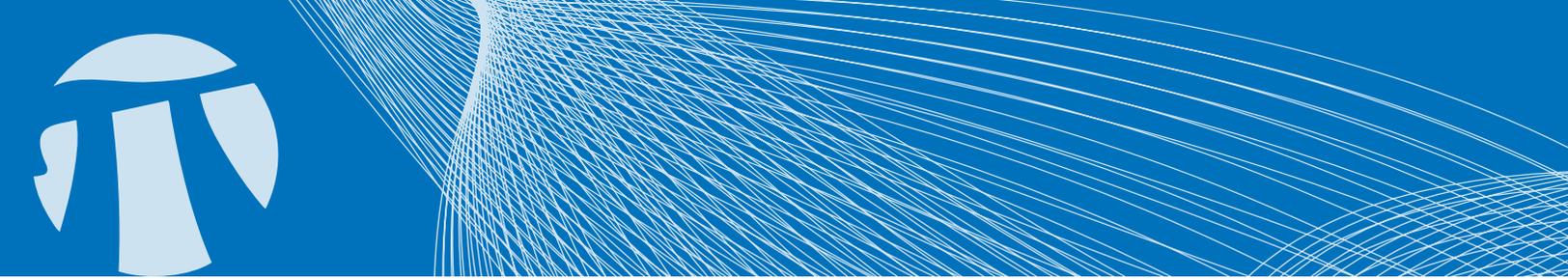
In what follows, data from the two previous years are placed in brackets.

During the 2013 [2012/2011] reporting period, PIMS helped to support 96 [81/74] scientific activities of the types listed above. We have data on 88 activities – a remarkable 92% return rate (Compare to the 62% response rate for the Math and Physical Sciences Directorate of NSF in 2011). Of these,

- The total number of attendees: 8,125 [5,472/4,166]
- Attendee-days spent at PIMS activities: 25,113 [17,611/15,573]
- Average attendees/activity: 92 [75/60]
- Average attendee-days/activity: 285 [241/254]
- Average activity duration (days):   3.3 [3.9/3.7]

Of all identifiable attendees,
- 60% [88/83]% were academics, of which:
  - 37% [34/38]% were professors,
  - 9% [9/10]% were PDFs,
  - 48% [45/43]% were graduate students,
  - 4% [10/4]% were undergraduate students, and
  - 1% [2/5]% were other academics.
- 1% [2/5]% were educators,
- 4% [4/11]% were industrial, and
- 34% [6/1]% were others (this includes programs aimed at secondary and elementary school students).

Attendee Demographics

Academics (60%)
Educators (1%)
Industrial Scientists (4%)
Others (34%)

34.2%
60.4%
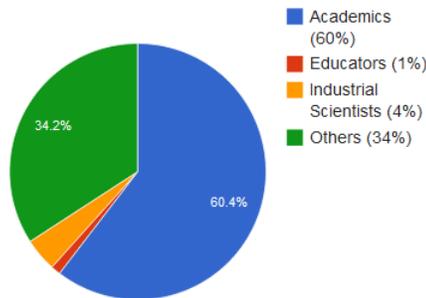
Academic Attendee Demographics

Undergraduate Students (4%)
Graduate Students (48%)
Post Doctoral Fellows (9%)
Professors (37%)
Others (1%)

36.8%
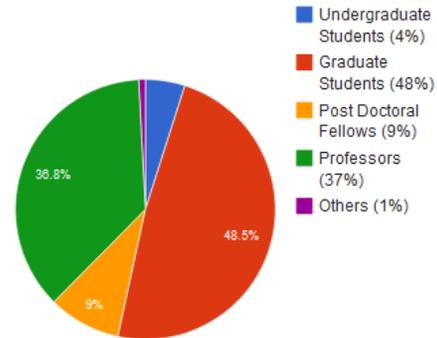48.5%
9%

Some respondents also supplied their fields of expertise. They consisted of:
- 32% pure mathematicians
- 10% applied mathematicians
- 6% biological scientists
- 6% computer scientists
- 13% physical sciences and engineering
- 31% statisticians
- 2% others.

Subject Area

Math (Pure) (32%)
Math (Applied) (10%)
Biological Science (6%)
Computer Science (6%)
Physical Sciences and Engineering (13%)
Statistics (31%)
Other (2%)

31.2%
32.1%
13.4%
6.2%
9.8%
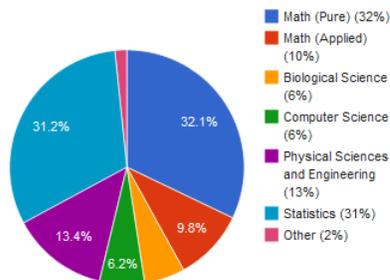
Attendee Gender Demographics

Female (24%)
Male (76%)

23.7%
76.3%
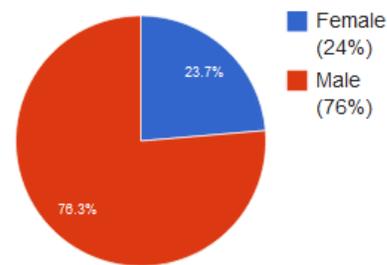
Of those attendees who stated their gender,
- 76% [72/76]% were male, and
- 24% [28/24]% were female.

Also,
- 72% [83/66]% were from **Canadian** institutions, of which:
  - 50% [61/41]% were from British Columbia,
  - 16% [15/35]% were from Alberta,
  - 1% [2/4]% were from Saskatchewan,
  - 1% [1/1]% were from Manitoba,
  - 17% [18/10]% were from Ontario and Quebec, and
  - 3% [3/9]% were from the Atlantic Provinces.

- 13% [9/18]% were from **other North American** institutions, and
- 15% [8/16]% were from elsewhere.

We have also computed the geographical distribution of PIMS events and programs, including Lecture & Seminar Series, during 2012. Of the activities with well-defined geographic locations,

- 85% [88/86]% were held in **Canada**, of which:
  - 60% [54/66]% were held in British Columbia,
  - 23% [26/26]% were held in Alberta,
  - 4% [8/6]% were held in Saskatchewan,
  - 4% [3/5]% were held in the Atlantic Provinces,
  - 9% [8/4]] were held in Quebec and Ontario,
- 10% [12/13]% were held in the **United States** (7 events in Washington, 2 in California and 1 each in Idaho and Oregon), and
- 5% [1/2]% was held **overseas**.

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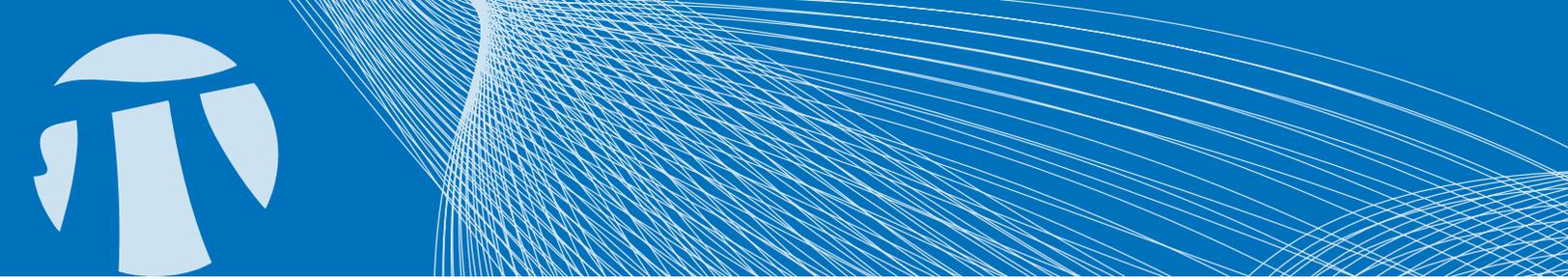
H. Publications

PIMS CRG activities, PDFs and CNRS Researchers produced almost 270 publications in 2013, many of which were 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., 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. 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.*

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 (PDF) 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 Collaborative Research Groups and/or Special Focused 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 2012 PIMS supported 47 PDFs, and 49 in 2013. They were distributed as follows: MUN-1. SFU-3, UA-11, UBC-11, UC-1, UL-1, UR-1, US-3, UV-3, and UW-2. Below we list the 2013 PDFs and their university affiliations:

Akhunov, Timur (UC)
Biasse, Jean-François (UC)
Chan, Kenneth (UW)
Giladi, Ohad (UA)
Hubicka, Jan (UC)
King, Andrew (SFU)
Koytcheff, Robin (UV)
Madariaga, Sara (US)
Nasserasr, Shahla (UR)
Parks, James W.A. (UL)
Potts, Jonathan (UA)
Sarkar, Soumen (UR)
Singh, Vijaykumar (SFU)
Tran, Nghia T.A (UBC-O)
Wiedemann, Emil (UBC)
Youssef, Pierre (UA)
Zubov, Vladimir (UC)

Au-Yeung, Enrico (UBC)
Buckingham, Paul (UA)
Felix, Adam Tyler (UL)
Gurel-Gurevich, Ori (UBC)
Hulshof, Tim (UBC)
Kitagawa, Jun (UBC)
Krislock, Nathan (UBC)
Marks, Christopher (UA)
Oluwaseun, Sharomi (US)
Phan, Hung Minh (UV)
Quigley, Callum (UA)
Shen, Yi (UA)
Tiefenbach, Ryan (MUN)
Wang, Kun (UA)
Wilcox, Stewart (UA)
Zhang, Tong (UA)

Berget, Andrew (UW)
Ce, Bian (UC)
Gheorghiu, Vlad (UC)
Hamilton, Ryan (UC)
Huruguen, Matieu (UBC)
Kool, Martijn (UBC)
Lundell, Benjamin (UW)
M. Nenna, Vanessa (UC)
Pal, Koushik (US)
Pong, Ting Kei (UBC)
Roe, David (UC)
Saumard, Adrien (UW)
Trail, Collin (UC)
Warnick, Claude (UA)
Wu, Hehui (SFU)
Zhong, Changlong (UA)

For a complete list of PDF appointments over the years, see *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
1	How well were you mentored in your department?	4.3 (4.3)
2	How suited to your academic interests was your department?	4.1 (4.0)
3	How suited to your academic interests was your mentor?	4.5 (4.4)
4	How was the intellectual life in your department?	4.2 (4.3)
5	How well were you looked after (in a practical sense) in your department?	4.5 (4.4)
6	Were there opportunities for collaborative interactions?	3.9 (3.6)
7	Amount of travel support:	3.3 (3.7)
8	Do you feel that your PIMS PDF has prepared you for your professional career?	4.3 (4.1)
9	Overall satisfaction with your postdoctoral experience:	4.4 (4.6)

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. Blaise Pascal de Clermont-Ferrand (France), U. Ottawa, Harvard U, Indian Institute of Science Education and Research (Kolkata, India), McMaster U., U. Frankfurt (Germany), Nova Southeastern U., Rice U., Atomic Energy Canada, Ltd., Google, Laboratoire de Probabilité et Modèles Aléatoires (Paris), 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 (Renne, France), Purdue U., SAP AG (Walldorf, Germany, 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 University, UR, Moscow State U. (Russia), Southern Illinois U., D-Wave Systems and Cambridge U.

At UBC, the PIMS Assistant Director is responsible for ensuring that the PIMS PDFS are looked after intellectually, professionally, and socially. As well, PIMS Central holds one-day workshops on professional development topics such as *Information Session on Grant Opportunities* and *Postdoc/Grad Student Job Forum*, and the PIMS Workshop on Automorphic Forms included a discussion on "Postdoctoral life in different kinds of institutions – research, teaching and industrial." The Assistant Director 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."

➢ "The PIMS PDF has been a great experience."

➢ "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 with my mentor very well, 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 the 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 2013 F. Robert (UBC, U. Lorraine), P. Castillon (UBC, U. Montpellier 2), N. Boussaid (UV, Lab. Math. de Besançon), Y. LeBorgne (SFU, U Bordeaux 1), Yann Ponty (SFU, Ecole Polytechnique), D .Noll (UBC-O, U Paul Sabatier, Toulouse) and F. Havet

(SFU, U Nice-Sophia Antipolis) took part in this program.

In addition to PDFs and PIMS/CNRS scientists, PIMS sites host many long- and short-term visitors: over 115 in 2013 alone. These included several UBC mathematics postdocs, a BC Oil and Gas postdoc, and a graduate student in applied mathematics from the Consejo Superior de Investigaciones Científicas in Madrid.

B. IGTC in Mathematical Biology Report

Although life sciences and mathematics have historically been separate, the application of mathematical and statistical methods to solving scientific problems in the life sciences and systems biology is now experiencing dramatic success. To meet the need to train new researchers in this area, PIMS established an IGTC in 2007 in the area of mathematical biology. This IGTC was designed to develop distributed training by building, in particular, on graduate programs in mathematical biology at PIMS universities. The IGTC counted 26 faculty from PIMS universities along with dozens of yearly visitors.

The key component of the IGTC was its Fellowships, which were awarded to graduate students at Canadian PIMS member or affiliate universities. These Fellowships were generously funded in part by Mprime, which provided $100,000 for the period September, 2011 to August, 2013. There were 6 students with fellowships for 2011-13 and there are currently 4 for 2012-14. During the lifetime of the program, IGTC students have been located at UA, UBC, UC, UV and SFU. The number of applicants increased every year from 2008-2012, allowing us to raise the quality of students obtaining IGTC fellowships. Based on feedback from the IGTC Evaluation Committee, the current level of excellence of IGTC students compares favorably to those of NSERC scholarship applicants. Recent IGTC students have been successful, obtaining positions as a junior faculty member in Pathology at Oxford U, an Asst. Professor at St. Francis Xavier U, a postdoctoral Science Teaching and Learning Fellow at UBC, and as a scientist for Alberta Environment. Most students are in graduate programs, such as those at MIT, Berkeley, and the PIMS universities.

Students supported by fellowships as of Sept 1, 2013 are: Amanda Swan (UA), Stilianos Louca (UBC), Alejandra Herrera (UBC), Ashok Rajaraman (SFU), Alexander Blaessle (UBC-O) and Susan Fassnacht (UBC). We also congratulate the graduating IGTC students for 2013: Oksana Chkrebitii (SFU), Bernard Konrad (UBC), Cory Simon (UBC), Jia Gou (UBC-O) and Silogini Thanarajah (SFU).

The IGTC was a major participant in the Mathematics of Planet Earth thematic year, through the pan-Canadian program "Models and Methods in Ecology, Epidemiology and Public Health". The centre supported the conference "Immunization - a true multi-scale problem" (January 17-19, UBC) and the major IGTC summer school "Mathematics Behind Biological Invasions" (May 27-June 14, UA). Both events featured leading biological and mathematical scientists from around the world. As well, it supported the UBC-SFU workshop on *Frontiers in Biophysics* on March 2.

As previously noted, funding for this program will end in 2014. A National Initiative in Mathematical Biology is under development aiming to build on the success of the IGTC.

Further information about the IGTC is at *www.pims.math.ca/scientific/graduate-training-igtc/mathematical-biology*, and a recent assessment of the program as well as a list of IGTC publication can be obtained by clicking on *www.pims.math.ca/files/IGTCreport2011.pdf* and *www.pims.math.ca/files/IGTC_Publications-_2008-_2012_0.pdf* respectively.

Feedback on the IGTC includes the following verbatim comments:

➢ "I am at a smaller campus, UBC Okanagan, and therefore there is not access to many professors in the field of mathematical biology. Thus, the opportunities that I have had from the IGTC program have shaped my PhD education."

➢ "My decision to enroll for grad studies at the U of A was influenced by the fact that the U of A is a part of PIMS and hence participates in the IGTC program. I had read about the IGTC program and realized it would provide me with great opportunities for learning and networking. So far, in fact, it has given me the opportunity to attend the grad summit where I met colleagues from other universities and during which I learnt a lot about math bio."

- ➤ "The IGTC was an excellent way to meet students from across western Canada working on problems in mathematical biology. Without it, I may never have discovered those working on similar projects - even in my back yard! … Thanks to the IGTC, I have learned of a group of students and profs in mathematics at UVic working on interesting models in biology, and have collaborated with them during time I have spent on the coast of British Columbia for field work…"
- ➤ "IGTC Funding and workshops were of great assistance to my research and to writing my master's thesis. In particular, these enabled me to pursue research and to communicate and share ideas with others in the same field, or in related fields of mathematical biology."
- ➤ "The summer schools and workshops organized by the IGTC have been a great opportunity to stay at the forefront of current research, and have given me plenty of new ideas and perspectives."
- ➤ "The IGTC has opened up so many opportunities for me to attend courses, conferences, and the IGTC summit. Without the IGTC I would not have met my current supervisors and not known the work that they do – I have no idea where I'd be!"
- ➤ "It was wonderful to be part of this research community. IGTC made me feel that my work was acknowledged and valued, and also put my research into prospective [sic] as I could relate it to work of others."
- ➤ "The program has a large impact on the students here at UVic, which has a relatively small math biology program. It enables the students to have an enriched program, to make excellent connections, and to enhance their research interests. The program is just up and running, and is beginning to reach its full potential."
- ➤ "[This event] was an amazing success with excellent student posters, talks, discussions and group presentations. The students are well-informed, eager to learn, and have lots of good ideas and energy. Thank you PIMS!"
- ➤ "On the how-to-find-a-research-topic: I love how you experiment with these ideas, and how you really want students to take something useful away."
- ➤ "[Highlights were] Meeting with other students and getting to hear about research happening at other universities. The PIMS IGTC in Math Bio has been amazing for connecting me to other math biologists in Pacific Canada. "

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 of greater Victoria and the Lower Mainland since 1997. 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. This year *Math Manias* were held in the remote communities of Tahsis, Port Renfrew, and Sooke on Vancouver Island, as well as around the greater Victoria area and the Lower Mainland. Further details are available at *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 areas this past year. Visit *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 about 120 participants, and discussed the question: What are we prepping our students for?

ELMACON: The **El**ementary **Ma**thematics **Con**test 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 attracts close to 350 participants.

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. Ten 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 this 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* for current and back issues.

Lesson Studies for Teachers: Lesson Study is a form of professional development in which teachers jointly plan, implement, observe, analyze, and refine actual classroom lessons called "research lessons", and then revise and report on the results so that other teachers can benefit. For the last three years PIMS has been offering series of workshops closely modelled on the highly successful Lesson Studies conducted by the Galileo Educational Network of Calgary. Teachers meet six Saturdays a year to develop lessons on a variety of mathematical concepts.

Math Central: Beginning its 18th year, Math Central (*www.mathcentral.uregina.ca*) continues to be a successful tool for teachers.

The site currently gets in excess of 5 million hits per month from approximately 450,000 visitors. Math Central attracts answer submissions from keen mathematicians from all over the world including Italy, Romania, Turkey and Indonesia. The site is maintained by PIMS Education Coordinator Harley Weston and faculty and students in the Mathematics and Statistics and Mathematics Education Departments of the University of Regina.

In addition, PIMS supports the **Math Circles Coaching Program**, the **Vancouver Free Math Mentorship Program**, the **BC Math Challengers**, the **Forever Annual Math Exhibition**, J**ump for Math**, the **Math Kangaroo Contest** 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 2013 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: Sk'elep School of Excellence in Kamloops, Lelawagila Primary School in Kingcome Inlet, Stein Valley Nlakapamux School in Lytton, Neqweyqwelsten School in Barriere, Bonaparte School north of Lytton, First Nations elementary and secondary schools in Bella Bella, First Nations elementary school in Port Alberni (Vancouver Island), 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, 27 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, and 21 students participated in the transitional summer camp for students entering high school. As part of these camps, students took math and English classes each morning and three afternoons per week they attended an internship program which placed each student with university-affiliated faculty and staff. Other afternoons were spent meeting with members of the aboriginal community who are successfully working in various fields. Support from the Royal Bank of Canada has extended the reach of these camps in rural BC.

Academic Highlights:

Two of the students who attended Emerging Aboriginal Scholars camps and the Mentorship Program graduated from high school and were accepted to UBC. One plans to major in math.

From 2007 to 2013, scholarships were provided to more than 60 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 60 students:

- 3 graduated with calculus
- 7 graduated with principles of Math 12
- 7 graduated with principles of Math 11
- 13 graduated with principles of Math 10

Currently:

- 5 students are taking pre-calculus 12
- 6 students are taking pre-calculus 11
- 6 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. FNESC has commissioned an assessment tool from PIMS to evaluate third grade students in First Nation schools.

School partnerships: During the last six 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*, 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*.

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 5 colleges in BC and 4 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 U. College (AB), Douglas College (BC), Grant McEwan U. (AB), and Mount Royal U. (AB). PIMS hopes to enroll more Education Associates in 2014.

PIMS directly sponsors sponsors high-level undergraduate activities such as *The Statistical Society of Canada Student Conference*, and sponsors ongoing series of public lectures such as the *MathAcrossCampus* program at UW. 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 2013 PIMS-UBC hosted an algebraic topology course, 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 UC. The featured speaker was R. James Milgram of Stanford U., who gave a withering summary of "K-12 Educational Practices in the U.S. and their Consequences."

Every year the PIMS Education Prize is awarded to outstanding mathematical educators 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* 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.
- Build the PIMS community through regular, consistent and targeted formal and informal communications.
- Place education as a top priority in terms of gathering funding, program organization and awareness-raising.

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*) offers easy global access to information on all PIMS activities, recent news and resources. One feature is the Research Impacts section on "PIMS at a Glance" page that shows results from PIMS researchers.
  - **Mathtube.org** A dedicated site that will eventually archive all of PIMS written, video and audio media. mathtube.org was created to meet the increasing demand of requests 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 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 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 4000.

➤ **Social Media** in 2012, PIMS began using Twitter and Facebook allowing us to connect with and provide all of our updates and news to our community more frequently and through a single channel (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 2009–2013 Years in Review can be downloaded from 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*. It has a circulation of 800.

➤ **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*.

▪ **Other**

➤ **Advertising** PIMS-funded events and opportunities are advertised both electronically and in print. We advertise through websites and publications at institutions such as Mprime, IMS, CMS, SIAM and AMS, and by offering custom-designed event posters that are 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*). 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*.

2. AUDIO/VIDEO FACILITIES

PIMS event coordinators are offered a wide range of audio-visual services to facilitate the global nature of collaborative scientific work. Following PIMS/UBC's move to the new Earth Sciences Building (which included a significant modernization of our existing video-conferencing infrastructure) we are actively engaged with UBC's Media Group to provide an *automated* video capture and publishing service for our event participants. This facility would upgrade existing

equipment in the lecture theaters of the Earth Sciences Building, and would provide participants with a simple mechanism to live stream and permanently archive their contributions. This would add significant value to our existing event program and would be used as widely as possible for PIMS events.

We continue to operate distributed seminar series and lectures among PIMS sites, including the Geometry and Physics Seminar Series (part of the CRG in Geometry and Physics) and the COCANA Seminar series (part of the CRG in Optimization). In the summer of 2014 we are expecting to run a summer school with researchers in Population Data; this summer school will host lecturers at UBC and will bring together participants from UV, UBC-O, SFU and UNBC. In addition, we have expanded our use of the BlueJeans software system. This system allows remote participants to take part in our events without the need for specific videoconferencing hardware. A browser plugin allows people to join meetings with minimal difficulty. For example, in the past year we have used BlueJeans to allow PIMS researchers to participate in a seminar series hosted by the Mathematical Biosciences Institute at Ohio State U.

PIMS/UBC continues to participate in the Compute Canada *Coast-to-Coast* and *WestGrid* seminar series. These seminars bring together up to 30 remote sites throughout Canada for events every two weeks. The *Coast-to-Coast* series highlights applications of high performance computing and technology for a different theme each term (the theme for spring 2014 is "Technology for Aging Well"). The *WestGrid* seminar series is tutorial based and focuses on the more practical aspects of applying technological resources and high performance computing to research problems. Together with other Compute Canada events, these seminars help to raise awareness of PIMS among new groups and departments at UBC while also providing valuable training to PIMS researchers.

Our facilities continue to be used by researchers to fulfill their academic responsibilities while at PIMS. Examples include participation in the thesis examination of a PhD candidate in Carleton U. and PIMS PDFs interviewing for faculty positions at remote institutions as far away as the Netherlands. PIMS online educational forum utilizes video-conferencing to bring together all the PIMS education coordinators from BC, Alberta and Saskatchewan in meetings to examine successful math educational programs and techniques and to plan new ones. We plan to continue this event as well as to provide distributed teacher training workshops as part of our education program.

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.

PIMS MRS NSERC Activity Report January 1 to December 31 2013

Resource Expenditures	Use of the resource (i.e. PIMS) Paid from ALL revenue sources January 1 to December 31 2013	Planned use of MRS funds January 1 to March 31 2014	Planned use of MRS funds April 1 2014 - March 31 2015
1) Salaries & Benefits			
a) Administrative Staff	257,593	0	0
b) Directors & Site Directors Teaching Releases/Stipends	148,799	0	0
c) Scientific Support Personnel	179,392	44,850	75,000
d) Postdoctoral Fellows (inc. CRG PDFs)	573,042	143,300	455,000
e) Technical/Professional Assistants (inc. Education)	27,956	0	0
f) IGTC students	79,787	20,000	15,000
2) Equipment or Facility			
a) Purchase or Rental	8,850	0	0
b) Operation and Maintenance Costs	29,403	0	0
3) Materials & Supplies			
a) Refreshments	7,963	0	0
b) Office Supplies	21,037	0	0
4) Meetings/Collaborations/Staff Travel			
a) PIMS Meetings (SRP, PDF, Board, Admin, Exec)	49,377	0	0
b) Staff/PDF Travel	4,527	0	0
c) Director Research Support and Scientific Consultation	68,619	0	0
5) Dissemination Costs			
a) Publication Costs	22,452	0	0
b) Advertising & Networking	1,288	0	0
6) Scientific Activities (inc. CRGs and IGTC)			
a) Conferences/Symposia	431,780	20,000	250,000
b) Summer Schools	137,235	0	200,000
c) Workshops/Seminars/Colloquia (inc. MMIW)	303,785	35,000	234,000
d) Distinguished Visitors/Chairs/Speakers	72,597	18,200	100,000
7) Education Initiatives	295,954	0	0
8) AARMS Activities			
a) Postdoctoral Fellowship	8,750		40,000
b) Honoraria for lecturers at AARMS Summer School	9,750		
c) Administrative Staff	7,500		
d) Analytic Spaces and Their Operators	2,000		
e) East Coast Combinatorics Conference 2013	2,000		
9) CANSSI	2,066	0	131,000
TOTAL EXPENDITURES	**2,753,502**	**281,350**	**1,500,000**

Resource Revenues *(collected during the period January 1 to December 31 2013)*

a)	User Fees (Registration Fees collected)	40,937
b)	Contributions from Partner Universities	
	UBC	260,186
	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	11,163
	University of Lethbridge	35,000
	Portland State University	4,133
	UNBC	5,000
c)	Contributions from MITACS/Mprime/NSF	
	Mitacs - Disease Dynamics	1,250
	NSF - Hodge Theory	14,570
	Mitacs - Analysis and PDE	25,000
d)	Private Donations	34,543
e)	Other Contributions	
	BC & Saskatchewan Govt for Education	200,000
	Vancity/RBC for Education	39,500
	Actuarial Foundation of Canada	15,000
	Arvind Gupta grant for Stochastic Analysis	10,000
	Education Associates	3,500
	Equity Enhancement Fund/TLEF for Education	39,000
	FIELDS support for Analysis and PDE	5,000
	Foundation Compositio Mathematica for Hodge Theory	9,268
	Vancouver Foundation for Education	20,000
	Bud Homsy grant for Complex Fluids and Flows	33,500
	BC Oil and Gas Commission	20,000
	Brian Marcus grant for Automata Theory	5,000
	CRM for Automata Theory & Analysis and PDE	10,000
	UBC Math Dept	54,360
	Other Miscellaneous	81,898
f)	AAET Grant	400,000
g)	NSERC Grant	1,100,000
h)	Carried Forward from December 31 2012	939,486
TOTAL REVENUES (January 1 to December 31 2013)		**3,794,304**
	Revenue less Expenses	1,040,802

GLOSSARY OF ACRONYMS

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