

PIMS Annual Report  
10th Anniversary  
2007-2008

## MISSION STATEMENT

The Pacific Institute for the Mathematical Sciences (PIMS) was founded and is maintained by the five main universities in Western Canada (Simon Fraser University, University of Alberta, University of British Columbia, University of Calgary, and University of Victoria). In 2005 the University of Washington joined this group of Canadian universities, thereby extending PIMS influence into the United States.

PIMS objectives are:

- Promoting research in mathematics;
- Strengthening ties and collaboration between mathematical scientists in the academic community, in the industrial and business sector, and in government;
- Enhancing education and training in mathematical sciences, and broadening communication of mathematical ideas; and
- Creating strong mathematical partnerships and links within Canada and with organizations in other countries, focusing on Pacific Rim nations.

PIMS has a close partnership with the Mathematical Sciences Research Institute (MSRI), and the Mathematics of Information Technology and Complex Systems (MITACS). The Universities of Lethbridge, Northern British Columbia, and Regina are affiliates.

In its ten years of existence, PIMS has developed numerous ways in which to fulfill the objectives set by its founding universities. These include Collaborative Research Groups, various Scientific, Education, and Industrial activities, the Banff International Research Station (BIRS), and Postdoctoral Fellowships. As the Director of PIMS, I am committed to continuing in this direction, as well as exploring other ways in which PIMS can contribute to mathematics, science, and education.

Ivar Ekeland  
PIMS Director

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## Message from the Director



*Ivar Ekeland, PIMS Director*

I will say it one last time: PIMS is a unique organization. Up to now, the standard model for math institutes has been the Princeton one: institutes were supposed to be places that host distinguished visitors and thematic programs: to benefit from them, you have to spend time at the institute. On the contrary, you do not have to go to PIMS: PIMS comes to you. At each of PIMS' seven member universities, there is a PIMS site office, with a PIMS director and an administrative assistant, who together are in charge of organizing PIMS events on site and bringing visitors and post-doctoral fellows to their university.

The PIMS model has weaknesses. First of all, it is unfamiliar, because it is new. We do not yet have the track record of the older institutes, and much of the work we do, such as bringing the mathematical community together across a vast geographical region, goes unnoticed, because people do not expect it. To counter that effect, we must do a better job of promoting ourselves, and explaining to the world who we are and what we do. A second weakness comes from the difficulty of coordinating seven different sites, each of which has to serve its own university, but also the greater mathematical community. This we do through programs that bring together the whole PIMS community, such as the Collaborative Research Groups, our educational programs with the First Nations, and the Industrial Problem-Solving Workshops. This also requires us to find creative ways of weaving to-

gether the administrative staff and processes across the different sites so that they function as a single organization.

The strengths of the PIMS model, on the other hand, are overwhelming. They never were more apparent than on January 22, 2007, where over one hundred scientists from all over the world showed up for the PIMS NSERC site visit. I think all of those who were present that day will remember it. The amount of support we received that day, not only from mathematicians, but also from other scientists, from the universities and from local communities, was incredible. The day ended with a presentation from the CRGs (five minutes each!) which was a real firework, showing mathematics at its best, in terms of eternal quality and relevance to contemporary issues.

This happened because PIMS has been able to unleash and leverage the scientific potential in the various sites. The role of the site directors in this cannot be overstated: it is for them to bring PIMS to their university, by encouraging initiatives across the whole spectrum of mathematics, and bringing to their colleagues' attention the full range of possibilities that is open to them within PIMS: post-doctoral fellowships, individual events, distinguished visitors, CRGs, and our international partnerships. The success of PIMS is largely theirs.

We are happy to see that the success of the PIMS model is attracting ever more scientists and institutions who want to be part of this unique endeavour. It gives me great pleasure of welcoming the University of Regina as a full member, and the Camosun College as the first PIMS Education Associate. I am also proud that PIMS has been recognized by CNRS as an Unité Mixte Internationale, an honour bestowed to only four other mathematical institutes in the world. This opens new avenues for the PIMS community, and is rich in promises for the future.

And yes, I am leaving PIMS: my term as director ends on July 1, 2008. This is not important, because the director is just one of many persons contributing to PIMS, together with the deputy director, the site directors, the Board, and all those staff, scientists, educators, private persons, who are giving part of their time and energy to this unique institution. It has expanded in the past five years, going from five universities to seven, affiliating with the French CNRS, and creating a vast exchange network around Latin America and the Pacific Rim. At this time when so many would have us believe that mankind is breaking down into separate cultures, let us show the world that science can create a vibrant community across five continents.

# Board of Directors

For complete biographies on Board Members please visit [http://new.pims.math.ca/About\\_PIMS/Board\\_of\\_Directors/Current\\_Board\\_Members/](http://new.pims.math.ca/About_PIMS/Board_of_Directors/Current_Board_Members/)

**THE PIMS BOARD OF DIRECTORS IS RESPONSIBLE FOR OVERSIGHT OF ALL ASPECTS OF PIMS. THE BOARD MEMBERSHIP INCLUDES A SENIOR ACADEMIC ADMINISTRATOR FROM EACH OF THE FOUNDING UNIVERSITIES AND REPRESENTATIVES FROM THE BUSINESS, INDUSTRY AND RESOURCE SECTORS AND THE PROFESSIONAL SOCIETIES. A STEERING COMMITTEE IS APPOINTED FROM AMONG THE BOARD MEMBERS TO MONITOR THE DAY-TO-DAY OPERATIONS OF PIMS.**

Brian Russell (Chair)	Vice-President, Veritas DGC Inc., Calgary
Fernando Aguilar	Exec. VP for Can. Land Processing, Can. Land Library, & W. Hemisphere Land Acquisition, CGGV
Lorne Babiuk	Vice-President Research, U.Alberta
Katherine Bergman	Dean of Science, University of Regina
Charmaine Dean	Professor, Burnaby Mountain Research Chair, Dept of Statistics and Actuarial Science, SFU
Dennis Salahub	VP Research & International, UofC, 2003-2004, 2005-2007
Darrell Duffie	Dean Witter Distinguished Professor of Finance, Stanford University (begins July 2008)
Gary Kachanoski	VP Research, Prof of Renewable Resources, UofA, 2002-2007
Ivar Ekeland	Director of PIMS, Canada Research Chair in Mathematical Economics, UBC
Haig Farris	President, Fractal Capital Corp.
Rose Goldstein	Vice-President Research, U.Calgary
John Hepburn	Vice-President Research, UBC
Ron Irving	Interim Dean of the College of Arts and Sciences, U.Washington
Richard Keeler	Assistant Vice-President Research, Professor of Physics, U.Victoria
Mark Lewis	Professor of Mathematics, U.Alberta
Hugh Morris	President and CEO, Padre Resource Management, Delta
Edwin Perkins	Professor of Mathematics, UBC
B. Mario Pinto	Vice-President Research, Professor of Chemistry, SFU
Vaho Rebasso	Chief Technology Officer, IT Services, Boeing Company
Zelda B. Zabinsky	Professor of Industrial Engineering, U.Washington
James V. Kresta	Program Leader for Integrated Decision Support, Syncrude Canada Ltd, 2006-2007
Martin Taylor	VP Research, Prof of Geography, UVic, 1998-2006
Hugh Williams	Professor of Mathematics, UofC, 2004-2006

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## Scientific Review Panel

For biographies [http://new.pims.math.ca/About\\_PIMS/Scientific\\_Review\\_Panel/Current\\_SRP\\_Members](http://new.pims.math.ca/About_PIMS/Scientific_Review_Panel/Current_SRP_Members)

**SCIENTIFIC ACTIVITIES OF THE PACIFIC INSTITUTE FOR THE MATHEMATICAL SCIENCES ARE REVIEWED BY AN ARM'S-LENGTH SCIENTIFIC REVIEW PANEL (SRP) OF EXPERTS FROM VARIOUS FIELDS OF THE MATHEMATICAL SCIENCES. THE SRP MEETS ONCE A YEAR TO MAKE RECOMMENDATIONS TO THE BOARD ON THE SELECTION OF UPCOMING SCIENTIFIC ACTIVITIES.**

Ivar Ekeland	Director, PIMS [ex-officio]
Alejandro Adem	Deputy Director, PIMS [ex-officio]
Carl de Boer	Professor Emeritus of Mathematics and Computer Science, University of Wisconsin-Madison
Gunnar Carlsson	Professor of Mathematics, Stanford University
Walter Craig	Professor of Mathematics and Statistics, Canada Research Chair of Mathematical Analysis and its Applications, McMaster University
John Friedlander	Professor of Computer and Mathematical Sciences, University of Toronto at Scarborough
Randy Goebel	Professor of Computer Science, University of Alberta
Richard Kenyon	Professor of Mathematics, Brown University
Bruce Reed	Professor of Computer Science, Canada Research Chair in Graph Theory, McGill University
Nancy Reid	Professor of Statistics, University of Toronto
Bob Russell	Professor of Applied Mathematics, Simon Fraser University
Donald Saari	Professor of Mathematics and of Economics, University of California at Irvine
Barry Sanders	Professor of Quantum Information Science and Director of the Institute for Quantum Information Science, University of Calgary
Gang Tian	Professor of Mathematics, Princeton University
Tatiana Toro	Professor of Mathematics, University of Washington
Efim Zelmanov	Professor of Mathematics, University of California, San Diego



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# PIMS Partnerships (News)

PIMS is pleased to announce a new collaborative agreement with Centro de Investigación y Estudios Avanzados, Cinvestav (Center for Research and Advanced Studies), Mexico. As part of the agreement, PIMS and Cinvestav will collaborate on research projects in the mathematical sciences. The institutes plan to hold joint events and conferences to facilitate the exchange of researchers and knowledge between Canada, the USA, and Mexico.

PIMS holds a place on the world mathematical stage bringing our six member universities and three affiliated university to international collaborations with PRIMA, CNRS, CMM, Cinvestav, and IMUNAM, to name only a few. We look forward to the next 10 years of growth and potential. PRIMA is growing to become a global enterprise for training and research in emergin areas of mathematics. With our international connections, PIMS stands as a gateway between the Pacific Rim, the Americas and Europe, bringing together different mathematical traditions to study global problems.

The first PRIMA event was held in 2006 and there are plans for a PRIMA congress in 2009 to be held in Sydney, Australia. As part of this initiative the Deputy Director and Director of PIMS travelled to China in May 2005, successfully establishing important contacts with several universities there, as well as with the National Natural Science Foundation of China. These exciting developments have made PIMS a leader in international networking among North American mathematical institutes and will surely lead to significant new developments in the near future.

In 2007 PIMS became part of the CNRS Unité Mixte Internationale. CNRS has committed to send to PIMS two or more chargés de recherches or maîtres de conférences. PIMS has also committed to give two post-doctoral fellowships a year to French applicants. As of September 2007, there were two recipients, one at SFU and one at UofA.

This program has just begun, but it shows tremendous success. In the summer of 2008 PIMS UBC will be holding a thematic summer program on “Economics and Finance of Sustainable Development” with the support of CNRS and of the Chaire de Developpement Durable (Polytechnique-EDF-Dauphine). In 2007-08 we had three researchers coming from french on the CNRS agreement. In 2008-09 we are expecting seven such researchers: three at U. Calgary, one at U. of Victoria, and three at UBC. This is only the beginning for PIMS, and I’m sure that when the agreement falls into place and universities recognize the potential, many ambitious projects will arise between PIMS and the French scientific community. PIMS will continue to become a hub between worlds, the Pacific Rim on one side and Europe on the other.

An example of this alliance of world mathematicians is reflected in PIMS new program: International Graduate Training Centres (IGTC). The PIMS IGTC emerged as one of the initiatives in the new PIMS NSERC granting period 2008-2013. It’s goal is to train the next generation of graduate researchers to apply new and traditional mathematics of the major scientific problems of our time. Each IGTC will develop a specialized graduate program at one or several PIMS Universities. The IGTCs will turn PIMS uiversities into international hubs for graduate studies in emerging and strategi areas of mathematics. We expect that within the five-year mandate, the IGTCs will become a world-wide centre of research, learning and training.



# PIMS Postdoctoral Fellows for 2007/08

PIMS HAS CREATED A LARGE NUMBER OF POSTDOCTORAL OPPORTUNITIES FOR YOUNG RESEARCHERS IN THE MATHEMATICAL SCIENCES. THE REGULAR PIMS PDF COMPETITION TAKES PLACE EACH JANUARY. PDFs ASSOCIATED WITH THE COLLABORATIVE RESEARCH GROUP PERIODS OF CONCENTRATION GO THROUGH THE SAME RIGOROUS REVIEW PROCESS. CANDIDATES MUST BE NOMINATED BY A SCIENTIST OR GROUP OF SCIENTISTS AFFILIATED WITH PIMS. FELLOWSHIPS ARE TENABLE AT ANY OF THE CANADIAN MEMBER OR AFFILIATED UNIVERSITIES.

## SIMON FRASER UNIVERSITY

Gabor Kun  
*Constraint Satisfaction Problem, universal algebra, graph theory*: Supervised by: Andrei Bulatov

Arash Rafiey  
*Graph Theory, Computational Biology*:  
Supervised by: Arvind Gupta

Alexander Schoenhuth  
*Markovian Models, Information Theory, Machine Learning, Discrete Math, Gene Expression Analysis, Transcriptional Regulation, Sequence Analysis*  
Supervised by: Martin Ester (SFU)

Eric Fusy: *Combinatorics*:  
Supervised by: Marni Mishna (SFU)

## UNIVERSITY OF ALBERTA

Frederic Hamelin: *Mathematical Biology*  
Supervised by Mark Lewis (UofA)

Viktor Petrov  
*K-Theory, linear algebraic groups, motives*  
Supervised by: Vladimir Chernousov (UofA)

Hadi Salmasian: *Representations of Lie Groups*  
Supervised by Gerald Cliff (UofA)

Teymuraz Tvalavadze: *Lie Theory*  
Arturo Pianzola (UofA)

Radoslaw Adamczak:  
*Geometric and Harmonic Analysis CRG*  
Supervised by Nicole Tomczak-Jaegermann (UofA)

Marton Naszodi:  
*Geometric and Harmonic Analysis CRG*  
Supervised by Nicole Tomczak-Jaegermann (UofA)

## UNIVERSITY OF BRITISH COLUMBIA

Stephane Kirsch: *Partial Differential Equations*  
Supervised by: Antoine Mellet (UBC)

Mathieu Merle: *Probability--Branching models, interacting particle systems and superprocesses*  
Supervised by Ed Perkins (UBC)

Thomas Schmelzer: *Numerical Analysis*  
Supervised by Chen Greif (UBC)

Thomas Seon: *Fluid Mechanics*  
Supervised by Ian Frigaard (UBC)

Guillaume Carazzo: *Fluid Dynamics CRG*  
Supervised by Neil Balmforth (UBC)

Yiping Dou: *Environmetrics CRG*  
Supervised by Jim Zidek (UBC)

Weiyong He:  
*Differential Geometry and Analysis CRG*  
Supervised by Jingyi Chen (UBC), and Ailana Fraser (UBC)

Zuzana Hrdlicková: *Environmetrics CRG*  
Supervised by Sylvia Esterby (UBC)

Gabriel Indurskis: *Topology CRG*  
Supervised by Dale Rolfsen (UBC)

Leobardo Rosales:  
*Differential Geometry and Analysis CRG*  
Jingyi Chen (UBC), and Ailana Fraser (UBC)

## UNIVERSITY OF CALGARY

Solmaz Kolahi: *Data management and the Web*  
Supervised by Denilson Barbosa (U Calgary)

## UNIVERSITY OF LETHBRIDGE

Brandon Fodden: *Number Theory, L-functions*  
Supervised by Amir Akbary (U Lethbridge)

## UNIVERSITY OF VICTORIA

Robert Yuncken:  
*Operator algebras, non-commutative geometry*  
Supervised by Ian Putnam (U Victoria)

Mike Waite: *Climate Modelling CRG*  
Supervised by Boualem Khouider (U Victoria)



# SCIENTIFIC ACTIVITIES

## Collaborative Research Groups

<http://www.pims.math.ca/scientific/collaborative-research-groups>

The PIMS Collaborative Research Groups (CRG) consist of researchers with a common research interest, and with a common desire to collaborate and develop some aspects of their research programmes. Groups may be organizing joint seminars and workshops, making joint PDF appointments, or developing joint graduate training programmes. However, with the resources and organizational structure of PIMS CRGs, they can do considerably more.

The Periods of Concentration (POC) are designed to promote and support longer term, multi-event, multi-site coordinated activities of competitively selected CRGs, in tandem with their national and international collaborators and visitors. Every year, the PIMS Scientific Review Panel selects, on a competitive basis, proposed POCs. The selected areas will be the focus of much of the institute's programme over a one- to two-year period of concentrated activities that will be delivered through the selected CRGs. At any given time, it is expected that between five and eight 8 CRGs will lead the PIMS scientific enterprise. Proposals can vary greatly according to the needs of the particular group and may combine a number of existing PIMS activities. During its period of concentration, a CRG can expect to receive priority for:

- PIMS postdoctoral fellowships
- Pacific Northwest seminar series
- Workshops and conferences at PIMS sites
- Intensive graduate courses
- Distinguished chairs and long-term visitors
- Graduate students exchanges
- Graduate and senior undergraduate schools
- Industrial training camps
- International collaborations

At its Nov. 4, 2006, meeting, the PIMS Scientific Review Panel approved funding for four interlocking CRGs, where the common overarching theme is the mathematics of climate and the environment. In a time of growing concern about climate change, the enhanced development of effective mathematical and statistical methods to model the environment is truly compelling. Our three projects thread together different aspects of this theme, and they complement each other naturally. The potential synergy of the thematic activities is enormous, and the combined impact will establish PIMS as a world-wide leader in this important emerging area of mathematics.

- Mathematical Problems in Climate Modeling: Multi scale Processes in the Tropics (2007-2010)
- Interdisciplinary Research in Geophysical and Complex Fluid Dynamics (2007-2010)
- Environmetrics: Georisk and Climate Change (2007-2010)
- Differential Geometry and Analysis (2007-2010)



# **The Economics and Finance of Climate Risk and Natural Resources (2006-2008)**

*<http://www.pims.math.ca/scientific/collaborative-research-groups/mathematical-finance-2006-2008>*

There is significant research in mathematical economics in Western Canada; however, this research has no supporting network. The goal of this CRG is to promote interdisciplinary co-operations among Canadian experts in Mathematics, finance, economics and econometrics, and to establish an internationally visible network of academic excellence in mathematical economics. To this end, the aim of this CRG is to organize a two-year concentration period on the Economics and Finance of Climate Risk and Natural Resources starting September 2006. As this includes the numerical analysis of equilibrium, Numerical Methods for Partial Differential Equations constitute the fourth focal point of our research.

The analysis of the economic and financial risk associated with climate change has one of the most active and challenging fields of research for mathematicians and economists. However, a unified framework for managing and hedging these risks has not yet been established. Our research project is related to the management of those risks. We focus on three specific topics. The first (Hedging and insurance of climate and energy risk) deals with the issue of pricing and hedging of insurance contracts written on nonfinancial risk factors such as climate phenomena. In the second approach we question how a well established line of research in economic (economic geography) could help in addressing the issues of managing climate risks and natural resources.

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## **Mathematical Modelling and Computation in Biology (2006-2008)**

*<http://www.pims.math.ca/scientific/collaborative-research-groups/mathematical-modeling-2006-2008>*

The primary focus of this CRG is mathematical modelling driven by biological applications. The goal is to promote research and cooperation both within specific research areas and across different areas of applications. This CRG proposed three themes, focuses on the interests of the team members as well as emergent opportunities for research at the mathematics-biology interface. In keeping with the interdisciplinary nature of the rapidly developing field of Mathematical Biology and the specific areas listed above, this CRG provides avenues for interaction between theoretical, clinical and experimental researchers, something not always feasible in the context of large discipline-focused national and international society meetings. In addition, and arguably fundamentally important to the continuation of this valuable trend of cross fertilization, it will give young mathematicians (undergraduate and graduate students, postdoctoral fellows) an opportunity to interact with theoreticians involved in experimental collaborations as well as with experimentalists themselves. This kind of interaction is a crucial step in interdisciplinary career development, one that is rarely available to students due to the departmentally focused nature of most educational training programs.

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## **GEOMETRIC AND HARMONIC ANALYSIS (2006-2008)**

*<http://www.pims.math.ca/scientific/collaborative-research-groups/geometric-and-harmonic-analysis-2006-2008>*

Geometric functional analysis is concerned with geometric and linear properties and structure of finite- and infinite-dimensional Banach spaces and their unit balls. An asymptotic point of view is based upon expressing such properties in terms of various quantitative invariants whose limiting behavior is investigated when the dimension or a number of other relevant free parameters tends to infinity. Abstract harmonic analysis relates to the studies of Banach algebras of spaces of measures or functions associated to (unitary representations of) a locally compact group involving powerful tools from group representations, geometry of Banach space, operator algebras and operator space theory. Two locally compact groups are isomorphic if and only if certain associated Banach algebras (i.e., Fourier algebras or the group algebra) are isometrically isomorphic. Consequently, the study of various Banach algebras and their geometric properties reveals deep structural properties of the underlying group.



# **CRG in Environmetrics: Georisk and Climate Change (2007-2010)**

*<http://www.pims.math.ca/scientific/collaborative-research-groups/environmetrics-2007-2010>*

The eventual goal of this CRG is to develop a multisite, distributed environmetrics research centre. The main research themes are statistical and deterministic models in georisk analysis, modeling space-time fields, agroclimate risk analysis, environmental quality assessment (with emphasis on water and linkages to agriculture and species at risk), and modeling changes in the diversity and structure of forests as a consequence of climate change. This project will enable the strong statistics community in the Pacific Northwest to address important environmental questions where deterministic and statistical models are critically important. It will be based at UW, UBC and SFU.

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# **CRG in Mathematical Problems in Climate Modeling: Multiscale Processes in the Tropics (2007-2010)**

*<http://www.pims.math.ca/scientific/collaborative-research-groups/climate-modelling-2007-2010>*

This CRG will be a multidisciplinary effort bringing together mathematicians and earth/ocean scientists to understand some of the many outstanding problems in climate modeling and numerical weather prediction. Particular emphasis will be placed on multiscale processes in the tropics, to bridge the gap between idealized models and the general circulation models used by government forecasters. One of the main objectives is to provide a venue for mathematicians and atmospheric scientists to interact, as well as to train young researchers in a fully interdisciplinary setting. It is based at UVic, the Canadian Centre for Climate Modeling and Analysis (CCCMA), SFU, UA and UBC.

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# **CRG in Interdisciplinary Research in Geophysical and Complex Fluid Dynamics (2007- 2010)**

*<http://www.pims.math.ca/scientific/collaborative-research-groups/geophysical-and-complex-fluid-dynamics-2007-2009>*

The primary focus of this CRG is the mathematical modeling of complex and classic geophysical fluid dynamics, which are key elements in many geophysical phenomena such as volcanic eruptions, mud slides and avalanches. Bringing sophisticated mathematical and computational elements to bear on these problems is the main motivation for this project, which will involve geophysicists as well as applied mathematicians. Particular emphasis will be on complex geophysical fluids, multiphase flow in volcanic systems, waves in geophysical fluids, and particle-driven. It is based at UA, UBC and SFU.



# Conferences

*for a detailed list of all lecturers and seminars go to <http://www.pims.math.ca/scientific/scientific-lecture>*

## **GRAD STUDENT WORKING GROUPS ON STOCHASTIC MODELING IN INFECTIOUS DISEASE**

University of British Columbia

April 30 - May 1s, 2007

Grad students from across North America will meet for one month in order to work on stochastic modeling in a number of aspects of infectious disease modeling. Following some introductory lectures, students will divide into teams and work on projects. Students will dedicate the entire month to working with their project groups.

## **STATISTICAL DISTRIBUTIONS AND MODELS: ASSESSMENT AND APPLICATIONS**

Simon Fraser University

April 19-20, 2007

<http://www.stat.sfu.ca/assessment/>

## **SYMPOSIUM ON KINETIC EQUATIONS AND METHODS**

University of Victoria

April 27-28, 2007

A conference in honour of the 10th anniversary of the founding of the Pacific Institute for the Mathematical Sciences. World leaders from diverse branches of kinetic theory gathered for an intense two-day workshop at the University of Victoria in April, 2007.

## **MATHEMATICS AND THE ENVIRONMENT: ENERGY RISK, ENVIRONMENTAL UNCERTAINTY AND PUBLIC DECISION MAKING**

BIRS Banff, Alberta

May 8 - 13, 2007

This workshop brought together economics, mathematics and social scientists to discuss recent progress in the modeling and managing climate and weather related risk factors. It attracted about 20 graduate students and postdoctoral fellows and about 20 senior scientists. Possible topics include risk sharing and risk transfer; equilibrium in incomplete markets; numerical methods for backward stochastic differential equations; public decision making in the presence of environmental uncertainties; economic impacts of global climate change; stochastic climate models; markets for greenhouse gas emission credits. This workshop was accompanied by a summer school.

[http://www.pims.math.ca/birs/birspages.php?task=displayevent&event\\_id=07ss081](http://www.pims.math.ca/birs/birspages.php?task=displayevent&event_id=07ss081)

## **SUMMER SCHOOL ON COMBINATORIAL MODELS IN GEOMETRY AND TOPOLOGY OF FLAG MANIFOLDS**

University of Regina

June 5 - 15, 2007

The main objective of the school was to provide an interactive environment where interested people (graduate students, postdocs, young researchers) can learn results and understand techniques concerning various aspects of flag manifolds. The subject was an interplay between differential geometry, algebraic geometry, Lie theory, and combinatorics, and the school will focus on combinatorial models and algorithms which have been developed in connection with the study of various geometric and topological aspects of flag manifolds.

## **2007 STATISTICS CANADA ANNUAL MEETING IN ST. JOHN'S**

University of British Columbia

June 10 - 13, 2007

[http://www.ssc.ca/2007/index\\_e.html](http://www.ssc.ca/2007/index_e.html)

## **SYNCHRONOUS RHYTHMS IN THE BRAIN**

University of British Columbia

June 18-20, 2007

The meeting took place over a 3 day period, with four or five 45-minute talks per day, and plenty of time for discussion and interaction. The local participants (organizers and their students) did not speak but presented their work at a poster session during the meeting). Topics covered by invited speakers: Hormonal rhythms generated by synchronized endocrine neurons; The origin of respiratory rhythm; Synchrony and epileptic seizure-like activities; Mathematics and simulation of physiologically realistic neural networks; Synchrony in neural networks and dynamical systems; Measurement and interpretation of neural synchronization in animals; Measurement and interpretation of neural synchrony. This workshop was part of the activities of the CRG in Mathematical Modeling and Computation in Biology.

## **FIRST NORTH AMERICAN REGIONAL TIES MEETING**

University of Washington

June 19-21, 2007

The first North American regional meeting took place in Seattle. Ninety participants listened to a variety of speakers geared towards the conference theme of "Climate Change and its Environmental Effects: monitoring, measuring and predicting." Throughout the program there were contributed sessions on Inference for mechanistic and stochastic models; Spatial methods; Methods in ecology; Forest Fires, remote sensing and stochastic models, and Climate. Another meeting is potential planned for sometime in 2009. <http://www.stat.washington.edu/peter/TIES%20NA07.html>



### **CONFERENCE ON APPLIED INVERSE PROBLEMS 2007**

University of British Columbia  
June 25-29, 2007

The series of AIP Conferences aim to provide a primary international forum for academic and industrial researchers working on all aspects of inverse problems, such as mathematical modelling, functional analytic methods, computational approaches, numerical algorithms etc. The success of the first conference in Montecatini in 2001 with more than 150 participants and several parallel sessions led to the proposal to have this Conference every two years, alternating between North or South America and Europe or a site outside the western hemisphere. A second equally successful conference was thus held in Lake Arrowhead, California in 2003 and finally a third was held in Cirencester in the UK Cotswold region from June 26th to 30th in 2005. The fourth will be held in Vancouver from June 25th to 29th in 2007. Each AIP Conference will follow the pattern of a number of invited talks from international experts and a set of minisymposia on topical themes. The venues will be chosen to encourage the maximum interaction between all participants.

### **MECHANICAL BEHAVIOR OF GLASSY MATERIALS**

University of British Columbia  
July 21-23, 2007

<http://pitp.physics.ubc.ca/confs/glass07/>

This workshop is part of the PITP collaborative research network on "Complex Systems", bringing together experimentalists and theorists trying to elucidate the non-equilibrium behaviour of such disordered materials. Some of the main themes of the conference were:

- New ideas for understanding the glass transition.  
Quantum glasses vs classical glasses
- Formation and importance of dynamical heterogeneities
- Extensions of equilibrium stat. mech concepts to glassy dynamics: effective temperatures and related concepts
- Mechanical behaviour of amorphous solids: Hysteresis, Aging, Shear localization. The low-T limiting behaviour
- Structural glasses vs spin glasses
- Glassy physics in biological systems  
(single molecule, networks)

### **16TH DISCRETE SIMULATION OF FLUID DYNAMICS: MICRO, NANO AND MULTISCALE PHYSICS FOR EMERGING TECHNOLOGIES**

University of Calgary  
July 23-28, 2007

<http://nanotech.ucalgary.ca/dsfd2007/>

Topics covered at the DSFD series of meetings included lattice gas automata, the lattice Boltzmann equation, dissipative particle dynamics, smoothed-particle hydrodynamics, direct simulation Monte Carlo, stochastic rotation dynamics, molecular dynamics, and hybrid methods.

### **PIMS ALGEBRA SUMMER SCHOOL**

University of Alberta  
July 30 - August 9, 2007

This Summer School was part of the activities of the CRG in Algebraic Geometry, Cohomology and Representation Theory.

### **SUMMER SCHOOL TROPICAL MULTISCALE CONVECTIVE SYSTEMS: THEORY, MODELING, AND OBSERVATIONS**

University of Victoria  
July 30 - August 3, 2007

This event was a 3-day summer school (Monday, Tuesday, Wednesday) followed by a 2-day workshop (Thursday, Friday). The aim was to bring university researchers in applied math, physics, or meteorology departments working in the area of tropical meteorology together with government lab scientists working on operational weather and climate forecast models to foster interactions between the two communities.

### **SUMMER SCHOOL ON PARTICLE PHYSICS, COSMOLOGY AND STRINGS**

University of British Columbia  
August 8-19, 2007

The Summer School on Particle Physics, Cosmology and Strings was the 5th in an ongoing series offered by Perimeter Institute and PIMS. The summer school was targeted at 40 advanced graduate students in high energy physics with interests in at least one of the research areas of particle physics, cosmology and/or string theory.

### **INTERNATIONAL CONFERENCE OF THEORETICAL AND NUMERICAL FLUID MECHANICS III**

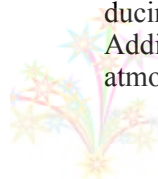
University of British Columbia  
August 13-17, 2007

The International Conference of Theoretical and Numerical Fluid Mechanics III was held in honor of Professors Giovanni Paolo Galdi and Rolf Rannacher, in celebration of their sixtieth birthdays. Reflecting their interests, it was an interdisciplinary meeting within the general field of mathematical and computational fluid dynamics, devoted mainly to Newtonian and non-Newtonian viscous flow. There were lectures on turbulence, blood flow, sedimentation, fluid structure interaction, flow control, and the dynamical systems perspective, as well as key issues of the Navier-Stokes theory.

### **CANADIAN SUMMER SCHOOL ON COMMUNICATIONS AND INFORMATION THEORY 2007**

University of Alberta  
August 20-23, 2007

The summer school consisted of invited talks from leading experts in the areas of Communications and Information theory. The talks were self-contained and aimed at introducing graduate students and researchers to new areas in. Additionally, the summer school will provide a stimulating atmosphere to learn, present, discuss and exchange ideas.



## **THE 19TH CANADIAN CONFERENCE ON COMPUTATIONAL GEOMETRY**

University of British Columbia  
August 20-22, 2007

CCCG focused on the computational aspects of geometric problems. Computational Geometry applies to all fields that touch geometric computing. Application areas included computer graphics and animation, computer vision, CAD/CAM, GIS, pattern recognition, wireless communication, robotics, urban planning, graph drawing, or statistical analysis to name just a few. CCCG was intended to be a forum, accessible to a broad variety of researchers in the area. The intended audience for this conference included graduate and undergraduate students, researchers in the area and members of industry that work in areas requiring the use of intensive geometric computation.

## **WORKSHOP ON THE CYCLE DOUBLE COVER CONJECTURE**

University of British Columbia  
August 22-31, 2007

The Cycle Double Cover Conjecture (CDC) was proposed independently by P.D. Seymour (1979) and G. Szekeres (1973). The conjecture is easy to state: "For finite every 2-connected graph, there is a list of cycles (polygons) such that every edge of the graph is an edge of exactly two cycles in the list." The workshop included some formal presentations with the purpose of bringing the participants up to date on techniques and recent results. Long collaborative working periods took the majority of the working time.

## **INTUITIVE GEOMETRY WORKSHOP AND INTUITIVE GEOMETRY DAY**

University of Calgary  
August 31-September 3, 2007

This two-day workshop was organized to provide an opportunity to share research findings in the interconnected fields represented in Intuitive Geometry. This workshop was also part of a series of Intuitive Geometry conferences first organized in 1975 in Tihany, Hungary. This workshop was the sixth in the series. The workshop was a direct continuation of the Intuitive Geometry BIRS workshop. Its main purpose was to provide an extension to the BIRS event. Subjects of the talks covered a broad spectrum of general convexity, iterative geometric processes, the theory of packing and covering both in Euclidean and hyperbolic spaces, and polytopal approximation of convex bodies.

## **THE 29TH ANNUAL ALBERTA STATISTICIANS' MEETING**

University of Calgary  
October 20-21, 2007

This meeting served many purposes. It allowed faculty and graduate students at different universities in Alberta to interact and discuss their research. It afforded statisticians working to discuss their problems with academic researchers. Additional, it afforded graduate students an opportunity to present their work and themselves to possible future employers.

## **FALL 2007 JOINT UBC/SFU GRADUATE STUDENT WORKSHOP**

Simon Fraser University  
November 2-3, 2007

Various speakers presented talks on Statistical Research in a Collaborative Environment, Median Loss Analysis, Statistical Monitoring of Clinical Trials with Multivariate Response or Multiple Arms using Repeated Confidence Bands to name a few. For complete details go to <http://www.stat.sfu.ca/~mtpratol/ubcsfufall2007.html>

## **QUANTUM INFORMATION AND MANY BODY PHYSICS WORKSHOP**

University of British Columbia  
December 1-3, 2007

Both quantum information theory and many-body physics deal essentially with the complex quantum correlations arising between a large number of sub-units. It is inevitable that important new insights have come with the pooling of ideas between the two fields, as well as very new kinds of experimental investigation of many-body systems. The present workshop concentrated on the various themes, see website: <http://pitp.physics.ubc.ca/confs/qinfo-mbody/index.html>

## **DATA-DRIVEN & PHYSICALLY-BASED MODELS FOR CHARACTERIZATION OF PROCESSES IN HYDROLOGY, HYDRAULICS, OCEANOGRAPHY & CLIMATE CHANGE**

National University of Singapore  
January 1-26, 2008

The 3-week program consisted of a full week of seminars/lectures, and two weeks of workshops and research discussions aimed at developing research collaboration. Three main topics were covered in the program. They were: "Development of a fully integrated data driven and physical-based models for water resources management"; "Dynamic and Statistical Downscaling on Climate Change Study"; "Nonlinear Wave Dynamics and Tsunami Modeling"

## **FIRST CANADA-MEXICO STATISTICS MEETING**

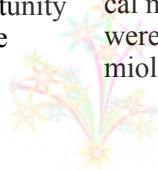
University of British Columbia  
February 22-23, 2008

For details of this conference please visit: <http://www.cimat.mx/Eventos/canada-mexico-SM/>

## **PIMS MATHEMATICAL BIOLOGY SUMMER WORKSHOPS**

University of Alberta  
March 6 - 16, 2008

The aim of this workshop was to introduce students to mathematical modelling and analysis applied to real biological systems via: Lectures and exercises that introduce students to various techniques of mathematical modelling of biological systems; A self-guided tutorial, that teaches students computational techniques to simulate mathematical models and relate them to real biological data; Projects were chosen from a wide variety of topics, including epidemiology, population biology, cell biology, and physiology.



# PIMS Industrial Activities

<http://www.pims.math.ca/industrial/all-events>

**Industrial Problem Solving Workshops** are based on the Oxford Study Group Model, in which problems of relevant and current interest to participating industrial companies are posed to the workshop participants, by experts from those various industrial companies. 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:

- The challenge of applying one's skills to new and relevant problems directly applicable to industry.
- The opportunity for continued collaboration with the workshop's academic and industrial participants.
- Helping PIMS and mathematics by demonstrating to businesses and governments the tangible benefits of supporting the mathematical sciences.

**PIMS Graduate Industrial Mathematics Modeling Camps** have graduate students from Canadian universities attend to learn various aspects of high-level techniques for solving industrial mathematics problems. The camp prepares them for the PIMS Industrial Problem Solving Workshop (IPSW), which follows the GIMMC.

**Industrial workshops, mini-courses and summer schools** are organized by PIMS researchers, with topics of interest to both industry and academia serve to disseminate newly developed mathematical tools that can be of use in industry.

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## EVENTS

### **11TH PIMS INDUSTRIAL PROBLEM SOLVING WORKSHOP**

University of Alberta

June 11-15, 2007

Connecting Industry to Solutions

[http://www.pims.math.ca/files/IPSW\\_11\\_brochure.pdf](http://www.pims.math.ca/files/IPSW_11_brochure.pdf)

### **PIMS-CINVESTAV MATHEMATICS OF OIL EXPLORATION WORKSHOP**

University of British Columbia

October 18-20, 2007

The workshop consisted of ten 40-minute lectures by distinguished mathematical scientists and researchers in oil exploration as well as sessions for discussion of problems and future collaborations. It was an excellent opportunity to bring together experts from academia and industry in the US, Canada and Mexico. <http://www.math.cinvestav.mx>

### **9TH PIMS GRADUATE INDUSTRIAL MATHEMATICS MODELLING CAMP**

Simon Fraser University

March 21-25, 2008

The Graduate Industrial Mathematics Modelling Camp was designed to give graduate students in the Mathematical Sciences an opportunity to learn techniques of mathematical modeling under the supervision and guidance of experts in the field. The workshop was a preparation for the following IPSW 10 at the Simon Fraser University, and financial support for graduate students is contingent upon their attending both events.

## LECTURES/SEMINARS

Julie Pietrzak (Technische Universiteit Delft): Insights into the Indian Ocean Tsunami from GPS, Altimeters and Tide Gauges: April 27, 2007 (Calgary Place Tower)

Joern Davidsen (UofC): Scaling, universality and spatio-temporal clustering in seismicity and rock fracture phenomena: Oct. 4, 2007: UofC

Michael Lamoureux (UofC): Compressive Sampling: Nov. 22, 2007: (Calgary Place Tower)

Vassil Dimitrov (UofC): Computer Arithmetic & Cryptography: Dec. 4, 2007: (Calgary Place Tower)

David W. Eaton (UofC): Some Mathematical Aspects of Earthquake Research: Feb. 26, 2008: (Calgary Place Tower)

Elise Fear (UofC): Breast Cancer Detection with Microwave Imaging: Mar. 25, 2008: (Calgary Place Tower)



# International Graduate Training Centre

<http://www.pims.math.ca/scientific/igtc>

The Pacific Institute for the Mathematical Sciences is creating International Graduate Training Centers (IGTCs) in strategically chosen areas of mathematics. Each of these centres will develop a specialized graduate programme at one or several PIMS universities. The programme will be developed in conjunction with PIMS scholars in relevant fields, and may include courses taken in other universities, as well as topical PIMS summer schools.

PIMS serves as a catalyst, by:

- \* identifying the appropriate areas of mathematics based on their strategic importance and PIMS' relative strength
- \* supporting the programme with summer schools, and bringing to them international students
- \* arranging for distinguished visitors from partner institutions to teach in the programme
- \* awarding graduate fellowships to the programme

After five years of operation, PIMS financial support to each IGTC will be reviewed, to enable new IGTCs to be opened in other strategic areas.

Each IGTC will turn the PIMS universities into an international hub for graduate studies in emerging and strategic areas of mathematics. Each of them will be supported by, and operate closely with, strong research groups, so that students and researchers from around the world who want to learn and explore these new mathematics will come to the IGTC. It is expected that at the end of five years, a successful IGTC will have become a worldwide centre of research, learning and training in its area.

The IGTC graduate training elements can include annual research summits, summer courses, new term-time courses, seminars, graduate student exchanges and graduate fellowships, and international visitors.

Faculty are encouraged to participate in the IGTC programme. In particular IGTC fellows' supervisors are expected to be actively engaged in helping to develop the IGTC programme so as to enhance the PIMS universities training capacity. Contributions from the supervisor can take the form of seminars, courses, mini-courses, workshops and related activities. The IGTC will help faculty ensure the accessibility of activities within the IGTC programme, including advertising, assisting with transfer credits, and providing travel funds as necessary.

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## EVENTS

### **INTERNATIONAL GRADUATE TRAINING CENTRE IN MATHEMATICAL BIOLOGY - FIRST GRADUATE RESEARCH SUMMIT**

University of British Columbia  
Sept. 28 - 30, 2007

The IGTC is a new PIMS initiative to develop and enhance graduate training opportunities in the Pacific Northwest. As part of this Math-Biology IGTC, the Graduate Research Summit will provide an opportunity for graduate students, post-docs and interested faculty in the field of Mathematical Biology to gather and present their research.

### **PIMS MATHEMATICAL BIOLOGY SUMMER WORKSHOPS**

University of Alberta  
Mar. 6-16, 2008

The aim of this workshop was to introduce students to mathematical modelling and analysis applied to real biological systems. Students were introduced to various techniques of mathematical modelling. Typically, participants have completed two to three years of undergraduate study in mathematics or a similar quantitative science.





# PIMS Education

<http://www.pims.math.ca/education/educational-outreach>

The Pacific Institute for the Mathematical Sciences (PIMS) sponsors and coordinates a wide assortment of educational activities for the K-12 level, as well as undergraduate, graduate students, women and minorities. PIMS is dedicated to increasing public awareness of the importance of mathematics in the world around us. We want 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. PIMS believes that training the next generation of mathematical scientists and promoting diversity within mathematics cannot begin too early: The PIMS Graduate Industrial Math Modeling Camps (GIMMC) train graduate students in industrial problem solving; PIMS organizes a variety of Summer Schools for undergraduates as well as for graduate students; PIMS offers opportunities for postdoctoral fellowships and graduate industrial fellowships; PIMS Programmes for Women and Minorities; Annual workshop "Connecting Women in Mathematics Across Canada" (CWIMAC) is jointly organized by PIMS and the Committee for Women in Mathematics of the Canadian Mathematical Society; Through a variety of contacts with people of First Nations, we are looking for different activities to enhance math learning in the community; PIMS Programmes for K-12 Students: Organization of interesting, fun and challenging math events for children of all ages; Facilitation of access to information about math education matters to parents, teachers and university faculty. (Newsletters, workshops, conferences, special publications, etc.); Coordination of workshops to create links of communication between parents, teachers, mathematicians and math-educators.

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## First Nations Outreach Programs

<http://www.pims.math.ca/education>

PIMS sponsored several First Nation educational events during 2007-2008. Summer camps, teacher training programs and mentorship programs were held in various locations throughout British Columbia. PIMS sponsored several successful summer camps at Sk'elep School of Excellence in Kamloops; Stein Valley Nkaklapamux, Lytton; Lower Nicola Band School, Merit; Xit'olacw Community School, Mount Currie; and the first summer camp for children in Vancouver was held at the PIMS Office at UBC. Five students from Britannia Secondary School participated in this summer camp.

Teacher training programs in mathematics and science was held at Stein Valley Nlaklapamux, Lytton and at the First

Nations Elementary School, Port Alberni. PIMS sponsored Science World Staff to come to the schools and train teachers in science.

A math homework club and mentorship program was held at the Sk'elep School of Excellence in Kamloops. The mentorship program involved students from Thompson River University assisting teachers at Sk'elep School of Excellence. Students from the University of BC mentored students at Britannia Secondary School in East Vancouver.

Two workshops were held during the FNSA Conference at PIMS UBC office in April 2007 and a meeting between elders, teachers and mathematicians took place at Banff Centre in December 2007.

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## Educational Activities

<http://www.pims.math.ca/education/all-events>

### 2007 ALBERTA NORTH-SOUTH DIALOGUE ON MATHEMATICS & 2007 ALBERTA COLLEGE TEACHERS

#### CONFERENCE

University of Alberta  
May 3-5, 2007

### 9TH ANNUAL PIMS ELEMENTARY GRADES MATH CONTEST, ELMACON 2007

University of British Columbia  
May 5, 2007

### PIMS EDUCATION DAY

University of British Columbia  
June 8-9, 2007

### SFU MATH CAMPS

Simon Fraser University  
July 3-6, 2007

### INTERNATIONAL GRADUATE INSTITUTE ON MODELING ENVIRONMENTAL SPACE-TIME PROCESSES

University of Washington  
July 9-14, 2007

### THE CEDAR DAY CAMP

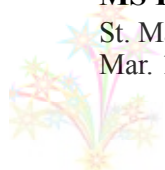
University of British Columbia  
July 23 - August 4, 2007  
<http://www.cedar.science.ubc.ca/index.php>

### A TASTE OF PI

Simon Fraser University  
March 8, 2008  
<http://www.math.sfu.ca/atasteofpi/>

### MS INFINITY CONFERENCE

St. Margarets Girls School, Victoria BC  
Mar. 10-11, 2008



# Publications

## PIMS NEWSLETTER

PIMS produces a twice-yearly magazine for distribution within the PIMS community, across Canada, and around the world. The magazine contains:

- \* Scientific articles contributed by mathematical scientists, including PIMS Distinguished Chair lecturers.
- \* Announcements of upcoming scientific, industrial and education events.
- \* Reports on the recent activities of PIMS
- \* Information on upcoming PIMS, BIRS and MITACS opportunities and how to apply.
- \* Results of recent reviews and competitions.

### VOL 11(1), SPRING 2008

<http://media.pims.math.ca/newsletter/2008/newsletter.11.1.pdf>



## PI IN THE SKY

All issues of *Pi in the Sky* can be downloaded for free from the Pi in the Sky web page. Significant funding for *Pi in the Sky* is provided by Alberta Innovation and Science.

*Pi in the Sky* is primarily aimed at high-school students and teachers, with the main goal of providing a cultural context/landscape for mathematics. It has a natural extension to junior high school students and undergraduates, and articles may also put curriculum topics in a different perspective.

*Pi in the Sky* accepts materials on any subject related to mathematics or its applications, including articles, problems, cartoons, statements, jokes, etc. Copyright of material submitted to the publisher and accepted for publication remains with the author, with the understanding that the publisher may reproduce it without royalty in print, electronic, and other forms. Submissions are subject to editorial review and revision. *Pi in the Sky* is mailed to various institutes and private subscriptions throughout Canada and the world. Individuals may request a copy of *Pi in the Sky* magazine by sending their mailing address to [pi@pims.math.ca](mailto:pi@pims.math.ca).

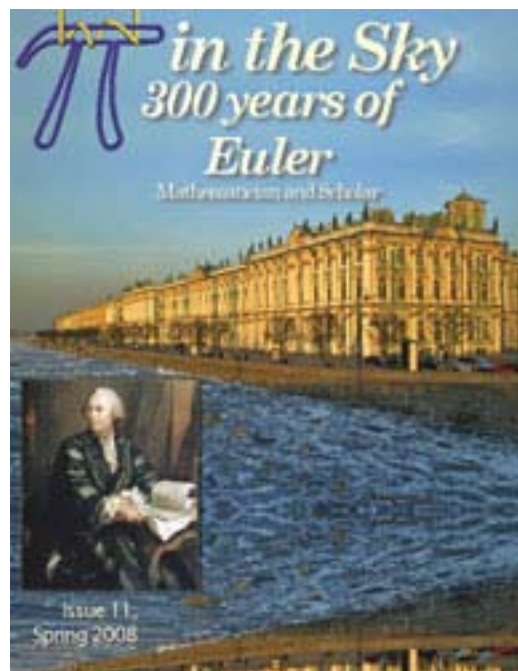
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[www.pims.math.ca/pi](http://www.pims.math.ca/pi)



# Financial Reports

**PIMS Total Income: April 1, 2007, to March 31, 2008**

Revenue	Budget	Actual	Variance
NSERC	1,023,100	1,023,100	0
Partner Contributions	566,385	608,521	42,136
Alberta AE & T	401,000	401,000	0
UBC - NCE	129,000	127,805	(1,195)
SFU - NCE	42,500	42,500	0
Infrastructure	0	41,797	41,797
Donation	11,500	16,700	5,200
BC Government for First Nations	130,000	130,000	0
Portland State University	2,000	1,863	(137)
Ian Frigaard - Industrial grant	70,000	70,000	0
Carrell Clay Institute grant	20,000	20,000	0
Alberta Sustainable Resource Development	75,000	75,000	0
BC Government (NPCDS project)	20,000	20,000	0
Conference Registration	0	45,651	45,651
Anticipated funds (other sources)	0	109,413	109,413
BC Government IGTC Fellowships	0	60,000	60,000
Carryforward from Mar 31 07 FY0607	1,558,052	1,558,052	0
<b>Total Revenue</b>	<b>\$4,048,537</b>	<b>\$4,351,401</b>	<b>\$302,864</b>

Expenses	Budget	Actual	Variance
<b>Total Operating Expenses</b>	<b>\$588,665</b>	<b>\$645,583</b>	<b>\$56,918</b>
<b>Total Industrial Expenses</b>	<b>\$180,738</b>	<b>\$154,979</b>	<b>(\$25,759)</b>
<b>Total Scientific Expenses</b>	<b>\$1,642,830</b>	<b>\$1,914,093</b>	<b>\$271,263</b>
<b>Total Education Expenses</b>	<b>\$214,405</b>	<b>\$187,956</b>	<b>(\$26,449)</b>
<b>Total Exec/Board Expenses</b>	<b>\$196,750</b>	<b>\$186,507</b>	<b>(\$10,243)</b>
<b>Total External Expenses</b>	<b>\$185,000</b>	<b>\$185,000</b>	<b>\$0</b>

<b>Total Expenses</b>	<b>\$3,008,388</b>	<b>\$3,274,118</b>	<b>\$265,730</b>
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<b>Closing Balance Mar 31 2008</b>	<b>\$1,040,149</b>	<b>\$1,077,283</b>	<b>\$37,134</b>
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**BACK COVER**