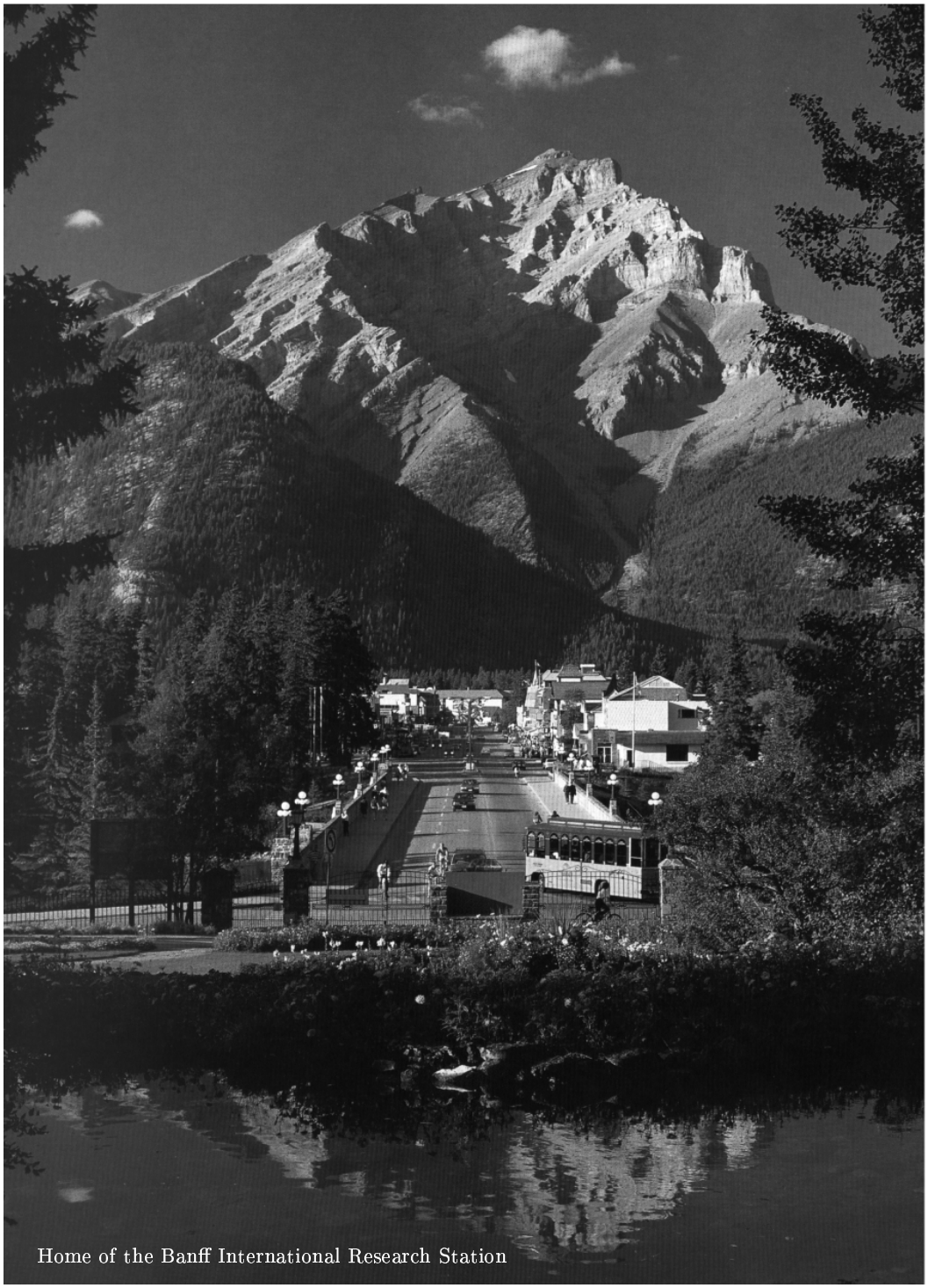
Pacific Institute for the Mathematical Sciences



Home of the Banff International Research Station

Institute Report 2000/2001

The Pacific Institute for the Mathematical Sciences

Our Mission

The Pacific Institute for the Mathematical Sciences (PIMS) was created in 1996 by the community of mathematical scientists in Alberta and British Columbia and in 2000, they were joined in their endeavour by their colleagues in the State of Washington. PIMS is dedicated to:

- Promoting innovation and excellence in research in all areas encompassed by the mathematical sciences;
- Initiating collaborations and strengthening ties between the mathematical scientists in the academic community and those in the industrial, business and government sectors;
- Training highly qualified personnel for academic and industrial employment and creating new opportunities for developing scientists;
- Developing new technologies to support research, communication and training in the mathematical sciences.

Building on the strength and vitality of its programs, PIMS is able to serve the mathematical sciences community as a catalyst in other areas of great importance:

- The communication and Dissemination of mathematical ideas; Public Outreach, Mathematical Education and Training at all school levels;
- The creation of strong mathematical partnerships and links within Canada and organizations in other countries, with a focus on the nations of the Pacific Rim.

Our Community

PIMS is a partnership between the following organizations and people:

- The six participating universities (Simon Fraser U., U. of Alberta, U. of British Columbia, U. of Calgary, U. of Victoria, U. of Washington) and affiliated Institutions (U. of Lethbridge and U. of Northern British Columbia).
- The Government of British Columbia through the Ministry of Competition, Science and Enterprise, The Government of Alberta through the Alberta Ministry of Innovation and Science, and The Government of Canada through the Natural Sciences and Engineering Research Council of Canada.
- Over 350 scientists in its member universities who are actively working towards the Institute's mandate. Their disciplines include pure and applied mathematics, statistics, computer science, physical, chemical and life sciences, medical science, finance, management, and several engineering fields.
- Scientists, practitioners and government researchers using mathematical ideas in dozens of companies across Canada and the U.S.
- A large and rapidly growing group of high school and elementary school teachers and educators in Alberta, British Columbia and Washington State.

From the Chair of the Board

Hugh Morris, FRSC

Hugh Morris, Chair of the PIMS board of directors.

After three years of interaction with a dynamic mathematical science community in Canada, I can proudly say that my association with the PIMS organization continues to be an exhilarating experience. From the very beginning, I was fascinated by the energy, the vitality and the pace that the mathematical scientists of PIMS were putting into their task. This year, I have witnessed the dramatic emergence of PIMS on the international scene where it solidified its stature as one of the most innovative research institutes in the mathematical sciences.

The integration of the University of Washington into the operations of PIMS, and the institute's support for the mathematical community in all of the US Pacific Northwest is unprecedented. The initiation of a Canada-US partnership to launch the Banff International Research Station (BIRS) is an amazing tour de force, especially when it is seen in light of the various partnerships that PIMS has created along the way: First, between the provinces of Alberta and British Columbia, then between western provincial governments and the federal government of Canada, then with the groundbreaking NSF-NSERC partnership and last but not least with the hugely and mutually beneficial PIMS-MSRI partnership. All this is destined to provide a tremendous boost for research in the mathematical sciences all over the world.

This annual report represents a compendium of the various activities and programmes organized and supported by PIMS during its second year of fully-funded operations, together with a glimpse at the planned busy programme ahead. PIMS not only strives to be a world-class research institute in the mathematical sciences, but also to be prominent in the application of mathematics to industry and in mathematics education at all levels.

Through its Industrial Problem Solving Programme and its Industrial Math Training Programme, PIMS has played a key role in bringing mathematical scientists in academia together with their counterparts in the private sector. This year's "Month of Industrial Mathematics at PIMS" with coordinated activities between Vancouver, Victoria, Edmonton, Burnaby and Seattle provided a wealth of new opportunities to Canadian and US graduate students.

This year has also seen a large growth in PIMS involvement in mathematics education. Through such initiatives as the *Women and Mathematics* poster campaign and the *Pi in the Sky* magazine, PIMS is helping educate the youth of Canada on the importance of mathematics in the future of their society.

My warmest congratulations to the director, Dr. Nassif Ghoussoub and to all mathematical scientists of PIMS for their wonderful accomplishments.

Director's Notes

Nassif Ghoussoub, FRSC

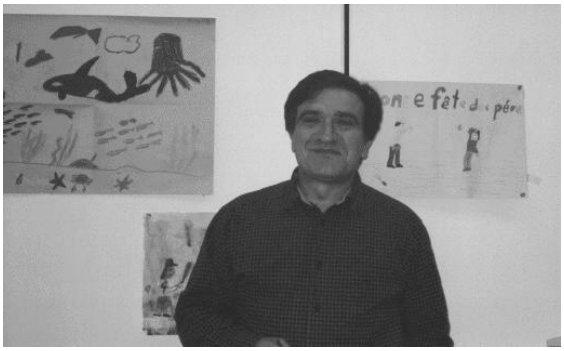
September 2001 marks my fifth year as Director of PIMS. The first three-years were an interim period where, besides the quest for securing funds and sponsorships, the institute's emphasis was on developing a new cohesive and collaborative spirit among the mathematical scientists at its five founding universities as well as on providing a major stimulus for organized research activities in Western Canada.

The institute moved to full operations in 1999/2000, a year that also saw the emergence of PIMS as a leading national institution, thanks to its defining role in conceiving and developing the MITACS Network of Centres of Excellence (Mathematics of Information Technology and Complex Systems), in partnership with its sister institutes in central Canada: the CRM and the Fields Institute. Moreover, PIMS other groundbreaking outreach programs also solidified its reputation as one of the most innovative research institutions in the world.

I am happy to report that this past year 2000/01 has seen PIMS emerge in many ways as a major player on the international scientific scene. The institutes programs kept evolving to optimize the opportunities for our scientists and our national and international partnerships kept multiplying. Here are some of the highlights of an amazing year.

The integration of the mathematical sciences community at the University of Washington, into both the operations and management of PIMS. This unprecedented partnership has provided a formidable boost to the institute's mandate of promoting all aspects of the mathematical sciences. A partnership on such a scale between the 6 major universities in this region builds on already existing substantial links between the scientific communities of Western Canada and the US Pacific Northwest and is destined to open up a whole new era of scientific collaborations between the mathematical communities of the two countries.

The development of the Banff International Research Station (BIRS) in the Canadian Rockies. This unique Canada-US joint venture was developed in partnership with the Berkeley-based Mathematical Science Research Institute (MSRI) and has already received the support of the US National Science Foundation (NSF), of the Alberta Science Research Authority (ASRA) and from NSERC's Major Facilities Access Program. BIRS represents a long awaited North-American counterpart to the highly successful program of the *Mathematisches*



Nassif Ghoussoub, Director of PIMS

Forschungsinstitut Oberwolfach in Germany. We have so far received 118 scientific proposals for the 40 slots available for the BIRS program in 2003, confirming again the extraordinary level of interest and support by the scientific community. More than 1600 mathematical scientists from all over the world are expected to participate in the Station's activities every year.

The leadership of PIMS within the Pacific rim. Faithful to its mandate, the institute pushed ahead with the development of sustained scientific links with several Pacific rim countries. An official cooperative agreement with the Asia Pacific Center for Theoretical Physics (APCTP) in Korea cemented an ongoing partnership on annual joint programs in mathematical physics. PIMS has again represented Canada in the second Pacific Rim Conference in Taipei and will be hosting the third such a conference in 2004. PIMS has again assumed its leadership in the Canada-China Mathematics initiative by organizing its second congress in Vancouver under the watchful and caring eyes of NSERC's President Tom Brzustowski. PIMS will again partner with the NSF, this time in the coordination of a Pan-American Advanced Studies Institute on Inverse Problems (PASI) in Santiago, Chile in 2003.

The development of two Research Facilities. PIMS scientists can now count on the institute's facility at SFU which had been readied just on time to host the 3rd Graduate modeling Camp in May, 2000. The UBC facility of PIMS was already inaugurated on June 15th, 1999. Both facilities include computer labs, office space for PIMS' postdoctoral fellows, visitors and participants in the thematic programmes as well as interdisciplinary space where industrial partners, math educators get together with PIMS' mathematical scientists to discuss, initiate and develop whatever it takes to achieve their common goals.

Lectures by PIMS distinguished scientists and visitors are now available over the internet using on-demand streaming video. PIMS is the first institute in Canada to offer such a service to the world's mathematical community. The lecture by H.S.M. Coxeter on "The Mathematics in the Art of M.C. Escher" and the one by Nobel Laureate Sir Professor Andrew Huxley on the "Hodgkin-Huxley models" during their visits to PIMS are illustrations of what we hope can be seen and appreciated by generations of mathematicians to come.

The implementation of the PIMS Distinguished Chair Programme which supports extended visits by distinguished mathematical scientists to the various PIMS participating universities. So far, the chairs were held by Yuri Matiyasevich (Steklov Institute) during a six week visit to the University of Calgary, by Herbert S. Wilf at the University of Victoria, by S. Donkin at the University of Alberta, by David Brydges at UBC and by Michael Shelley at SFU.

The Month of Industrial Mathematics at PIMS which saw a concentrated and coordinated series of industrially oriented workshops: on *Industrial Fluid Dynamics* in Alberta, on *Inverse problems and imaging* at UBC, on *Computational fuel cells* at SFU, an *Industrial Graduate Modeling Camp* in Victoria followed by the *Industrial Problem Solving Workshop* in Seattle. More than 300 scientists, including 80 graduate students contributed to the success of this groundbreaking programme.

More than fifty companies have so far participated in the PIMS/MITACS Collaborative Industrial Programme sponsoring projects of our researchers with contributions nearing 2 million dollars over the last two years.

Innovative Mathematic Education initiatives starting with a new poster campaign under the theme *Women and Mathematics* which followed last year's highly successful *Mathematics is everywhere* campaign that featured the ever growing importance of Mathematics in modern society. A semi-annual magazine entitled *Pi in the Sky* designed to be a forum for dialogue between academic mathematical scientists, educators, students and the public at large. PIMS has been distributing this magazine across

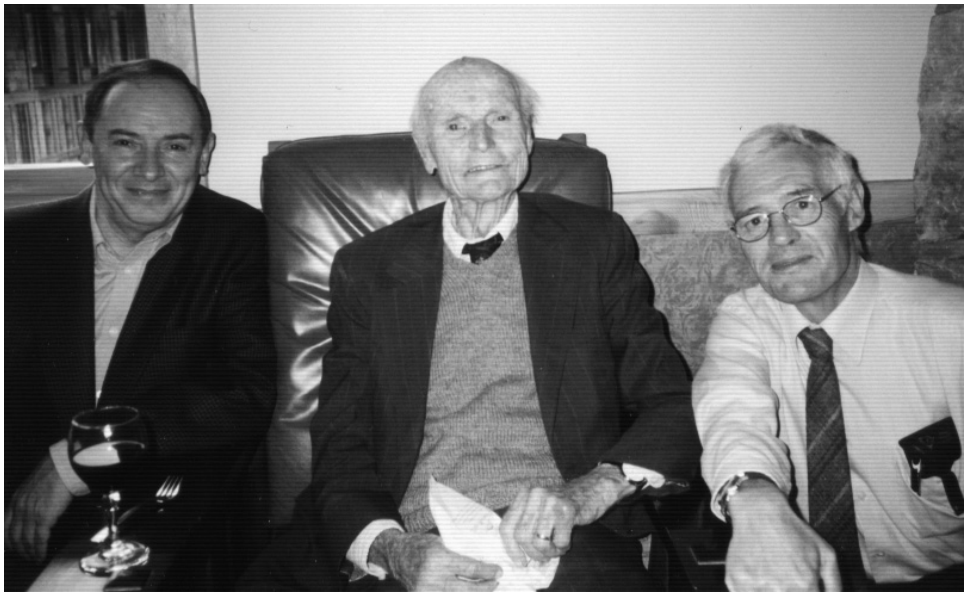
high schools in western Canada and the Pacific Northwest. *Hypatia Street Theater:* A delightful play, sponsored by PIMS and organized around three mathematical skits, was attended by more than 300 people at Frederic Wood theater at UBC. The principal goal of the play was to show mathematics on stage –not just talking about it, but actually doing it– in whatever form the public can take.

The PIMS prizes for mathematical research, education and industrial outreach were awarded for the first time, in an uplifting ceremony on December 12, 2000 to an outstanding group of researchers, applied mathematicians and educators.

On a personal note, I would like to say that the arduous journey of building PIMS wouldn't have been accomplished without the unconditional support and commitment of friends like Arvind Gupta and Ed Perkins. The road to the MITACS network couldn't have been travelled without visionary companions like Don Dawson, Luc Vinet and Steve Halperin. Here again, call it luck, I feel extraordinarily priviledged to be working on BIRS with colleagues like Robert V. Moody and David Eisenbud. With their outstanding scientific credentials, vision, dedication and integrity, the Banff station will soon be ready to be a great new resource for the world's scientific community.

The development of PIMS, MITACS and now BIRS should also be remembered as the culmination of a joint effort by a remarkable group of people who happen to be in leadership positions. Most of them are not mathematical scientists but simply great believers in the role of mathematics, its ramifications and its applications: Senior NSERC and NSF officials (Brzustowski, Lloyd, Menard, Colwell, Eisenstein, Tondeur and others) who are determined to encourage international collaborations in order to multiply the opportunities for their researchers; Senior Alberta officials (Taylor, Church, Palmer, Hill and others) who are totally committed to the R&D effort in their province; Senior administrators in the major Alberta and BC universities (Archer, Smith, Clayman, Taylor, Samarasekera, Peter, Boorman, McBride) who were so instrumental in getting PIMS on its feet, who were so supportive with the MITACS effort and who are now back again actively helping us build the Banff International Research Station.

Finally, I wish to express my warmest congratulations and gratitude to all PIMS mathematical scientists, partners and supporters in Canada, the US and elsewhere who made all this possible.



V. Kac, H. S. M. Coxeter and R. V. Moody at the Banff Centre.

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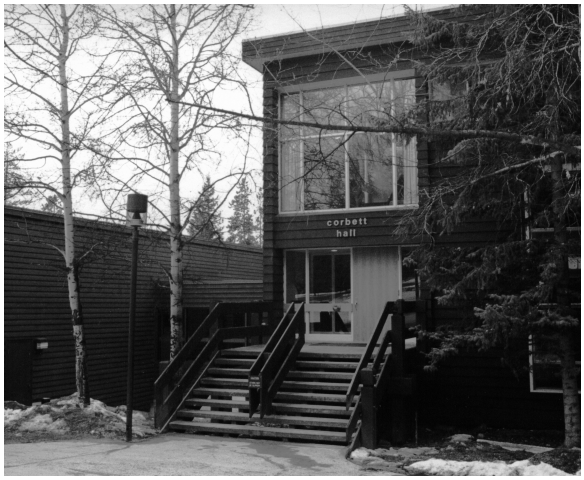
THE BANFF INTERNATIONAL RESEARCH STATION

BIRS Executive committee: David Eisenbud (Director, MSRI), Robert Moody (Scientific Director, BIRS) and Nassif Ghoussoub (Director, PIMS).



Participants will be accommodated in Corbett Hall.

Unique Canada-US Research Facility Launched in Banff, Alberta

New $5M research facility first of its kind in North America

Banff, Alberta - September 24, 2001 - The governments of Alberta, Canada and the United States today announced the establishment of a new international mathematical research facility in Banff, Alberta. The Banff International Research Station for Mathematical Innovation and Discovery (BIRS) will annually host thousands of top international scientists and researchers for intense workshops, collaborative research efforts, and training sessions across the entire spectrum of pure and applied mathematical sciences.

The joint venture is spearheaded in Canada by the Pacific Institute for the Mathematical Sciences (PIMS) and in the US by the Berkeley based Mathematical Sciences Research Institute (MSRI). The facility will also profit from the active participation of the Mathematics of Information Technology and Complex Systems Network of Centres of Excellence (MITACS).

At a ceremony held simultaneously in Washington DC and Banff, Rita Colwell, Director of the National Science Foundation of the United States announced an award of $1.95M, Robert Church, Chair of the Alberta Science Research Authority committed $1.7M and Tom Brzustowski, President of the Natural Sciences and Engineering Research Council of Canada announced an award of $1.5M towards the operation of BIRS from 2003 to 2005. The station will also be supported by the British Columbia Ministry of Competition, Science and Enterprise through its sponsorship of PIMS.

The facility will be housed at the well-known Banff Centre, which has already won acclaim for its programs in music, mountain culture, writing and publishing, visual arts, and its centre for management. BIRS is the first of its kind in North America. Modelled on two similar European facilities, BIRS is expected to enhance research capacity and help develop the careers of young researchers both in North America and around the world. This is the first time that Canada and the US have collaborated on this type of facility.

PIMS was commended by the funding agencies for seizing the opportunity to bring the facility here and for securing wide support for it. NSERC received almost 450 letters of support from researchers in Canada, the US and around the world.

Joint Press Conference for BIRS, Banff, AB and Arlington, VI, September 24, 2001

Remarks of Dr. Rita Colwell, Director US National Science Foundation

Good afternoon, everyone. I am Rita Colwell, director of the U.S. National Science Foundation, and it is a great pleasure to take part in this ceremony – really a "virtual ribbon-cutting" – today.

Our event connects two nations, the United States and Canada, exemplary neighbors who have always cherished peace between each other. In that tradition, today we inaugurate an enterprise that represents the best of the human spirit.

Following the tragic attacks on the United States two weeks ago, this event today lifts our spirits as it symbolizes our joint endeavor to push back the frontiers of knowledge. We have called today's event "Close Parallels"–a mathematical metaphor evoking the steadfast closeness of our nations.

The National Science Foundation supports cutting-edge science and engineering across the range of disciplines. We always strive to integrate research and education, really two faces of the same coin. We invest in the very best of the future, the fundamental research whose ultimate outcome no one can foresee. Mathematical research is an ideal example of such fertile ground for far-reaching investment.

Rita Colwell

Today NSF is very pleased to announce an award to the Mathematical Sciences Research Institute–MSRI. The award of $1.27 million over four years will support United States' participation at the Banff International Research Station for Mathematical Innovation and Discovery. The research station in the Canadian Rockies in Banff will provide a spectacular setting for intensive mathematical research, when it opens in 2003. The station is a project of both our nations, led by the Pacific Institute for the Mathematical Sciences in Vancouver, British Columbia, and MSRI, which I've already mentioned, located in Berkeley, California.

I cannot resist quoting the director of the Pacific Institute, Nassif Ghoussoub; he said that the Banff Centre will enable visitors to "live, eat and breathe mathematics." (I have to say that sounds like a very nourishing diet–talk about "brain food!")

Our NSF contribution joins Canadian support that will be described by our Canadian partners today. The NSF award will help support the travel and living expenses of participants in the research station's programs, especially those from the U.S. I should emphasize that our Canadian colleagues and funding agencies have taken the lead in bringing the Banff center into being. This activity underscores how international cooperation adds up to more than what any nation could accomplish alone.

Every important question of science and engineering is under study by researchers in nations around the world. The mathematical and statistical communities of the United States are at the forefront in engaging their counterparts abroad.

International connections in mathematics are important throughout a career in science. In June of this year, NSF helped to support the International Mathematical Olympiad, a competition that brought talented young people from more than eighty countries to Washington, D.C. for the annual event that was first held in Romania in 1959. It was a rare privilege for us to host the Olympiad in the U.S. However, every year, NSF hosts the U.S. Olympiad team in Washington to honor their achievements.

Our investment in the Banff Center is tangible proof of the vital and growing role of the mathematical sciences in all of science and engineering. I would like to show a few slides now, to illustrate this fundamental importance of mathematics.

E.O. Wilson writes that "...mathematics seems to point arrowlike toward the ultimate goal of objective truth." Indeed, mathematics is the ultimate cross-cutting discipline, the springboard for advances across the board. Mathematics is both a powerful tool for insight and a common language for science. A good example, pictured here, is the fractal, a famous illustration of how inner principles of mathematics enable us to model many natural structures. Cosmologists are beginning to draw an awesome portrait of the structure of the universe–using mathematics as the medium. On the other end of the scale, particle physicists sketch quantum phenomena, again with mathematics as their brush and palette. In the realm of climate, our ability to predict El Niño–the irregular shifts in ocean and atmospheric conditions–is a superb example of where mathematics and computing have brought us. The meeting of mathematics and medicine augurs well for discovery on many fronts. Mathematics and complexity theory, for instance, give insight into the human heart. The top pictures are computer simulations of the electrical activity in a normal heart. Below are abnormal patterns, or fibrillation. Mathematicians are investigating why some patterns of electrical stimulus are better at eliminating fibrillation. Mathematics and biology transform each other. The information science of life edges ever closer to electronic information science. Advances in understanding life may lead to new modes of computing, notably biological computing.

To strengthen the mathematical foundations of science and society, the National Science Foundation has proposed a new priority area. We seek to advance frontiers in three interlinked areas: fundamental mathematical and statistical sciences, interdisciplinary research involving the mathematical sciences, and mathematical sciences education.

I show this final slide as a mathematical metaphor. Fractal sets like we see here can be used to build computer models of clouds, plants, the surface of the sea, even networks of blood vessels. Yet, mathematics also transports us beyond the practical, into the realm of the imagination and art. A coming together of brilliant imaginations for a higher purpose will be a hallmark of the Banff Centre.

We look forward to an inspiring and long-lasting engagement among our mathematical scientists, our Canadian colleagues, and others from around the world, in a superb environment for communication and collaboration.

Remarks of Dr. Tom Brzustowski, President NSERC

Transcribed from the speech of Dr. Brzustowski at the Banff Centre.

Ladies and Gentlemen:

If I may begin, Rita, with a personal request to you. I would ask you on behalf of the entire staff of NSERC, the Natural Sciences and Engineering Research Council of Canada, to convey to our colleagues at the NSF, to the American mathematics community, and to the people of the United States our heartfelt regret and our profound outrage at the event of September 11.

I am very glad, as Nassif has already indicated that he is, that the event today was not postponed or cancelled, because to have postponed it or cancelled it would have given a victory to the terrorists. They might never have known of it, but we would have known.

Let me now move on to the most important thing that I have to do here. I have to read the magic words which make it official, and here they are. The Natural Sciences and Engineering Research Council of Canada is contributing $1.5 million towards the

Tom Brzustowski

operation of BIRS from the year 2003 to the year 2006.

Now, we are here to celebrate a hugely important event. It is hugely important not just for the participating organizations, but for our nations, and for mathematics in the world.

Let me begin by congratulating PIMS, MSRI, and MITACS. (I'll stick with the acronyms, as life is too short to spell them all out.) Let me congratulate these three organizations for their intellectual involvement and their promise to deliver the fruits of this superb international collaboration.

Let me also congratulate the funding partners. Let me congratulate the National Science Foundation of the United States. You heard in the remarks of Dr. Colwell the extensive understanding of the importance of mathematics which has driven their decision. And let me congratulate the Province of Alberta where BIRS is located. This is a province which, in my opinion, really does have its act together when it comes to science and engineering research, and BIRS is yet another illustration of that.

The hallmark of a good idea is that so many people find it obvious once it has been mentioned – obviously! Why not?! You know that Oberwolfach has succeeded for many years. Why not, by way of developing a partnership in research in mathematics in North America, set up something that would be at least as good, and maybe far better? And so it was done – on a fast track and with quick decisions. Something was done that would not have happened, could not have happened, without the vision, the energy, the tenacity, and the leadership of one person, and that of course is Nassif Ghoussoub.

When I think of the many contributions Nassif has made in mathematics, I know they include some quite decent papers on partial differential equations. (I do look at Nature Nassif. I've seen your stuff.) Quite apart from that, his contributions as a leader in organizing mathematical activity in Canada has been extraordinarily important. And now we see the leadership stretching to international collaboration, and we welcome that.

Now I should mention, perhaps for the benefit of our American colleagues rather more than the Canadian colleagues who are already convinced of this, just why this is such an important event. It is the next step in the emergence of Canadian mathematics into the prominence that it deserves. Canadian mathematicians have been good for a very long time. They have been very good, and we have many outstanding individuals, but Canadian mathematics in the corporate sense has been achieving the deserved prominence only very recently. The three institutes now active, CRM, Fields and PIMS, the Network of Centres of Excellence MITACS, are all contributing to that prominence. And today the international partnership that produced BIRS adds to it as well.

But BIRS is also important in another way. It puts the seal of recognition by the funding agencies on the way that mathematicians do research: the face to face contact, the debate of ideas, the closing of dead ends – perhaps in the presence of those who might have contributed to paving them in the first instance, the opportunity for people to change their minds, and the excitement of recognizing a really new development and the ability then to go off with colleagues and immediately talk about it some more. All these aspects of working together in a setting like BIRS are hugely important. Mathematicians assembled in an environment conducive to intellectual creativity will produce a great deal.

Let me finally come to something that I have been saying for quite a little while, and frequently – maybe even weekly. It is more of a matter for generalists thinking about mathematics than it is for mathematicians. I really do believe that mathematics has been the language of high technology. And I also believe that mathematics is becoming the eyes of science, helping scientists in all fields drink from a firehose of data. But for mathematics to function in this way, as the language and as the eyes, and as the many other things that mathematics is yet to become, there is need for continued effort to expand and strengthen the foundations of mathematics – the work of basic research in mathematics.

With that, let me conclude by congratulating one more person, as the focus now shifts from Nassif to Bob Moody. Let me congratulate Bob Moody on becoming the research director of BIRS. I think BIRS is very lucky to have Bob Moody; I think Bob Moody is very lucky to have BIRS. This is a hugely important international effort which will be important for Canadian mathematics, for mathematics in the United States, and ultimately for mathematics in the world. I congratulate all who participated in creating it. I thank our funding partners and I wish everybody success in the years to come.

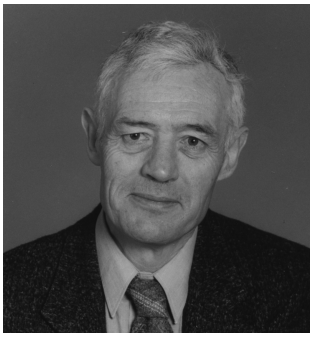
Thank you very much

Overview

The Banff International Research Station (BIRS) is a collaborative Canada-US venture to provide an environment that optimizes opportunities for creative interaction and the exchange of ideas, knowledge, and methods within the mathematical sciences and with related sciences and industry.

The US participation will be led by the Mathematical Sciences Research Institute (Berkeley, CA) while the Canadian effort will be coordinated by the Pacific Institute of the Mathematical Sciences (PIMS) with the participation of the Mathematics of Information Technology and Complex Systems Network of Centers of Excellence (MITACS). BIRS is a truly international venture.

Funding for BIRS has now been secured by the Natural Science and Engineering Research Council of Canada (NSERC), the US National Science Foundation (NSF) and the Alberta Science Research Authority (ASRA).



The first BIRS Scientific Director is **Robert V. Moody** from University of Alberta.

BIRS will pursue an extremely broad program. It will embrace all aspects of the mathematical and statistical sciences, from the most fundamental work on the great problems of algebra, number theory, geometry and analysis to modern pure and applied mathematics, theoretical and applied statistics, financial and industrial mathematics, the mathematics of information technology and computer science, and bio-mathematics.

The initial operation of BIRS will be for forty weeks a year beginning in the Spring of 2003. The main mode will be five-day workshops ("Oberwolfach-Luminy mode"), but there is also provision for two or three-day events suitable for promoting industry-academic collaborations, for "Research in Teams", and for focused research groups to live and to do research together ("Aspen mode") in a non-workshop/non-conference style setting at the BIRS Facility for periods of 2 to 4 weeks.

Applications will be selected on a competitive international basis, by a rotating Scientific Panel of experts from the breadth of the mathematical sciences.

A Long-desired Facility

One of the most successful mathematical institutes in the world is the Mathematisches Forschungsinstitut in Germany. Nestled in the small village of Oberwolfach in the Black Forest, the MFO holds weekly workshops year-round which attract the finest mathematical scientists in the world. France followed suit in the eighties by establishing a similar center at Luminy in southern France. Oberwolfach and Luminy are international treasures, but it is not hard to see that it is the European mathematical community that is the main beneficiary.

It has long been a dream to have a North American counterpart, worthy of the enormous strengths of the mathematical sciences on this continent. This is what the Banff Station will be. The research facilities that BIRS will offer, such as lecture rooms, break-out rooms, high-speed internet connectivity for effective communication and interaction, are also available at universities and institutes, but the Station offers several additional elements. The crucial features that will make the International Research Station a premier place for research and innovation are:

- The quality and timeliness of the programs, guaranteed by the high standard of the Scientific Advisory Board;
- The breadth of coverage of the mathematical sciences and their applications;
- The beautiful and secluded setting;
- The intensity of interaction provided by a facility in which all participants live, work, and eat together;

The Scientific Advisory Board

- Robert V. Moody (Chair), **Lie Theory and Mathematical Physics**, University of Alberta
- James Arthur, **Representation Theory**, University of Toronto
- Jennifer Chayes, **Complexity theory and Statistical Mechanics**, Microsoft Research
- Richard Cleve, **Quantum Computing**, University of Calgary
- Henri Darmon, **Number Theory**, McGill University
- Ken Davidson, **Operator Theory**, University of Waterloo
- David Gross, **Quantum Field Theory and String Theory**, University of California, Santa Barbara
- Peter Guttorp, **Environmental Statistics**, University of Washington
- Craig Huneke, **Algebra**, University of Kansas
- Jacques Hurtubise, **Geometry and Mathematical Physics**, McGill University
- Nancy Kopell, **PDE and Applied Mathematics**, Boston University
- Mark Lewis, **Mathematical Biology and Ecology**, University of Alberta
- László Lovász, **Combinatorial Optimization, algorithms and complexity**, Microsoft Research
- Jitendra Malik, **Computer Vision**, University of California, Berkeley
- Dusa McDuff, **Topology and Symplectic Geometry**, SUNY, Stony Brook
- David Mumford, **Machine and Natural Intelligence**, Brown University
- Robert Myers, **Superstring Theory and Quantum Gravity**, McGill University and Perimeter Institute
- Edwin Perkins, **Probability Theory**, University of British Columbia
- Nicholas Pippenger, **Computer Science**, University of British Columbia
- Ian Putnam, **Dynamics & Operator Algebras**, University of Victoria
- Nancy Reid, **Statistics**, University of Toronto
- Gang Tian, **Geometry**, Massachusetts Institute of Technology
- Robert Tibshirani, **Data Mining and Computational Statistics**, Stanford University
- Margaret Wright, **Algorithmic Optimization**, AT & T Bell labs
- David Eisenbud, Director, MSRI
- Nassif Ghoussoub, Director, PIMS
- Arvind Gupta, Program leader, MITACS

- The ready-made infrastructure which will make it easy to organize smoothly-running meetings and allow the scientific organizers to concentrate on the science.

Vision of the Station

BIRS is to be a center for scientific interaction, a place where promising ideas develop, where lines of thought that appear unrelated converge. The sources of inspiration should come from many sorts of mathematics (Pure, Applied, Computational and Conceptual), different motivations (Intellectually driven or industrially motivated). People interested in similar problems will unite their potentials and join their efforts in order to work on common research projects.

A Model that Complements Institutes' Activities

The new Research Station will complement, not compete with present institutes in Canada and the United States.

The primary mode of operation of these institutes is long (3, 6, or even 12 month) thematic programs with satellite conferences and workshops. This means in-depth years devoted to a relatively small set of topics. In this, they have been wonderfully successful, providing outstanding environments for extended research collaborations, and being the catalysts for major and sustained advances of the fields in question.

In contrast, the Banff Research Station will provide a setting for relatively short but intense, easily organized research and innovation meetings, each year covering a broad range of the mathematical sciences, and capable of responding quickly to new and exciting developments.

A Cost-Effective Research Facility

BIRS will provide a highly cost-effective means of supporting research and training in the mathematical sciences. By securing dedicated space for long term use, and putting into place a trained staff to organize such events, the partners can achieve an economy of scale of large magnitude.

This will allow BIRS to run events for considerably less cost than the typical "hotel plus per diem" costs elsewhere. Such savings and the resources obtained by pooling the resources of several organizations, 2 federal governments and 2 provincial governments (BC and Alberta), allow BIRS to greatly multiply the new opportunities for researchers.

A Place Where Mathematics Will Interact with Other Areas of Culture

The Banff Centre is internationally recognized as a place of high culture. Every year its programs in music and sound, the written, visual and performing arts, leadership and management, and mountain culture draw in many hundreds of artists, students, and intellectual leaders from around the world. The Centre already includes a full-scale television production facility and a unit that focuses on computers in art. The introduction of BIRS, with its stream of incredibly creative and imaginative people, into this rich and fertile environment will provide opportunities for unique synergies. Both the Banff Centre and the BIRS are excited about exploring the possibilities. It is easy to imagine activities around 3D-computer graphics, the mathematics involved in archiving art (the recent destruction in Afghanistan serve to highlight the importance of this), the use of fractals and other mathematical structures in virtual reality, the mathematics in the biology and ecosystems of mountain environments, the inclusion of parts of risk management and complexity in the connection with the management programs, or the study of mathematics in architecture. There are also possibilities for dissemination of mathematical culture to a wider community and the promotion of mathematical/scientific writing for the lay public, both of which are desperately needed to heal the widening gap between the practitioners and the users of modern science and technology.

A Highly Attractive Destination

As a World Heritage Site and a place of immense natural beauty, Banff will provide immediate recognition and high profile to the Research Station, ensuring that it will be an attractive destination for the best researchers from around the world.

Provincial and Industrial Support for Research

BIRS has secured a significant level of financial support from the government of the Province of Alberta, which stands to benefit directly from this new, high-profile research centre within its borders. This support will be both direct, in the forms of a grant for operating costs of the centre, as well as indirect, in the form of funds supplied to the Banff Centre for necessary renovations to accommodate the activities of BIRS. These, as well as the expected support from the industrial partners constitute new resources to support mathematical research and its applications.

Ensuring High Calibre Research

Every year, an international call for proposals will be made, soliciting applications for workshops and organizers from every field of the mathematical sciences and its applications. A call for proposals for the 2003 program year has been made in April 2001 with an October 30, 2001 deadline. The BIRS Scientific Advisory Board will meet early December 2001 to make the final recommendations for the 2003 cycle. Proposals will be accompanied by a summary of the important developments of the field in question and a preliminary list of possible participants.

A subset of some 10 members of the BIRS Scientific Advisory Board will serve as a *Steering Committee*. The Steering Committee is responsible for the Scientific Program of the Station. It will accept the recommendations of the Scientific Advisory Board and will schedule and coordinate the successful proposals.

Modes of Operation

Five-day Workshops

The fundamental mode of BIRS is the Five-day Workshop. These will run from Sunday A.M. through to Thursday P.M. with Saturday night arrival, in order to get a Saturday night stay over on airline flights. Each workshop is devoted to one specific area of high research interest. About 40 expert-participants from around the world are invited to attend. The objective is to exchange the latest advances in the field and to provide an environment which fosters new collaborations and new ideas, and which provides a forum for lively and vigorous discussion for the latest theories and proposals.

The five-day workshop mode will also include industrial case study and problem solving workshops, an extension of the highly successful PIMS events.

Each workshop will have at least two organizers, normally including at least one from a Canadian institution and one from an American institution. They should be internationally respected experts in the area of the workshop, with broad scientific culture and connections. Their job is to form the list of invitations, which must be approved by the Scientific Director, and to run the program during the workshop.

Within the five-day format, two half-workshops may also run side-by-side. This may be especially appropriate for newly emerging fields, for more narrowly focused groups, or to fit in an exciting development.

For workshops in some disciplines where participants cannot easily leave their jobs or laboratories for more than a few days, a two or three-day format will be more suitable.

Two-day Workshops

The normal scheduling of the five-day workshops will leave 2 day periods open (namely Friday and Saturday) that may be used for a variety of special events:

- Special workshops to respond to unexpected new developments or new opportunities.
- Industry/university round table workshops.
- Weekend seminars and mini-conferences.
- Special interactions with other cultural or intellectual activities of the Banff Centre.

Research in Teams

In addition to its on-going workshops, the Station may host teams of two to four researchers for periods of two to four weeks. This *Research in Teams* program will offer individuals from different institutions who are collaborating together, the location and freedom from distraction to concentrate on their research or to finish major projects.

BIRS plans to keep several of its rooms available for the accommodation and activities of such Research in Teams. The RIT program will accept proposals and make decisions on them on a competitive basis through its Scientific Board. We would hope to have 1 or 2 RIT groups working most of the time.

Focused Research Groups

There will be possibilities to have research collaborative groups in residence together for longer stays (Aspen mode) and some with other formats. A typical configuration might be groups of 10 to 15 mathematicians each, up to 8 of them being in residence at BIRS for 2 to 4 weeks. This would provide a good venue for collaborative work for teams of mathematical researchers like those identified and supported by NSF's Focused Research Groups program and NSERC's Collaborative Research Opportunities program.

Summer Schools

BIRS will run some longer events (10-12 days) in the form of (normally summer) schools.

Thematic Summer Schools: These summer schools will continue the tradition already established (at Banff) of starting an Institute's thematic program with a 2-week program at the

Banff Station. The goal is to prepare graduate students, postdoctoral fellows and non-experts for the high level material of the thematic programs.

Graduate Camps: The Station provides an ideal setting for graduate summer camps. These can be introductory to classical topics of mathematics like the upcoming Commutative Algebra program at MSRI or to emerging areas of the mathematical sciences and their applications like MSRI's summer graduate program on Signal Processing or PIMS annual graduate industrial modeling Camps.

Industrial Activities

The Industrial mathematics component will be initially coordinated by the director of the *Mathematics of Information Technology and Complex Systems Network of Centres of Excellence* (MITACS). MITACS is sponsored by a large consortium of companies interested in partnering with Universities and government, and its participation ensures a strong industrial and cross-disciplinary basis.

BIRS will provide the ideal setting for a myriad of industrial activities in the mathematical sciences. While these activities will often follow the same format as the other scientific activities, the focus will be on applied and industrial mathematics with participation from graduate students, postdocs, and academic and industrial scientists.

Training of Highly Qualified Personnel

The sustenance of science and technology depends on capturing the minds and enthusiasm of young people and offering them the training to become future researchers. Both PIMS and MSRI take these responsibilities seriously. For this reason the International Research Station will make opportunities for programs devoted to education in the mathematical sciences.

Summer Mathematics Camps

Both in Canada and the US there are summer mathematics camps for students of junior/senior high schools. Offering a mix of study, training, competition, recreation, and comradeship. These programs promote enthusiasm for the world of sciences and mathematics. BIRS is a good place for such activities (one or two weeks at a time) and the Station will endeavour to attract such events and similar ones from across North America and internationally too (e.g. the International Mathematical Olympiads, and the training camps for them).

Teacher Training

Beyond all else, the elementary school and high school teachers are the ones whom we must rely on for future researchers. The present environment is one in which mathematics/science teachers in the schools need all the help they can get, and professional mathematical scientists must make the effort to engage in the process. The Research Station will cooperate and expand upon the outreach efforts of the institutes and the professional societies towards mathematical education.

Graduate and Senior Undergraduate Summer Camps

There will be special emphasis on graduate and senior undergraduate summer schools. These can be introductory to emerging areas of the mathematical sciences and their applications, or in preparation for the institutes own thematic programs. The Station will offer an ideal setting for these events which are at the core of the mission of each of the partner institutes.

Communication and Dissemination

Not everyone who should be, or would like to be, at the BIRS workshops will be able to be there. In order to disseminate its activities to

the outside world, BIRS will videotape a number of the prominent seminars from each workshop and quickly prepare these materials for remote access via video streaming (accessible from the PIMS and MSRI webpages). A full time IT person, part of whose responsibilities is to manage the videos side of things, will be employed by the Station. In addition, BIRS will keep permanent record of its activities by requesting that each workshop provide a 10-15 page scientific paper that surveys the important developments in the field as represented by the activities and participants of the workshop. These will uniformly edited and appear as yearly bound volumes.

Management Structure of BIRS

The Banff International Research Station will have a **Scientific Director** who is appointed for a renewable 3 years term by the Board of directors of PIMS at the recommendation of the BIRS Executive Committee (see below) after consultation with the sitting members of the Scientific Advisory Board.

The Executive Committee of BIRS

This committee is responsible, and has the ultimate authority, for overseeing and coordinating the whole operation of the Station. It consists of the PIMS Director (Chair), the MSRI Director and the BIRS Scientific Director. The committee will report to the Boards of PIMS (resp., MSRI) through the director of PIMS (resp., MSRI). Its responsibilities are the overall planning of the activities and direction of BIRS, coordinating all aspects of the collaborative effort between the Canadian and US partners, maintaining and finding new funding opportunities for BIRS, as well as coordinating the process of selecting and recommending to the PIMS and MSRI Boards, the membership of the Scientific Advisory Board.

The Scientific Advisory Board and Its Steering Committee

The research and intellectual side of the BIRS program is handled by the **Scientific Advisory Board** of BIRS which is comprised of up to 26 members representing a broad and expert coverage of the Mathematical Sciences. The BIRS Scientific Advisory Board is chaired by the BIRS Scientific Director and will include the directors of PIMS, MSRI and MITACS. It will also have at least 8 members from Canadian institutions and another 8 from US institutions. Appointments are normally for a 3-year term. This board will be responsible for soliciting and ranking proposals for the Station.

The Scientific Advisory Board will have a **Steering Committee**, also chaired by the BIRS Scientific Director, which will make the final selection and schedule the conferences. It will consist of the BIRS Executive Committee as well as seven members of the Scientific Advisory Board. The membership will cover a broad range of expertise as well as the scientific interests of all major users.

Administrative Management of BIRS

The Pacific Institute of the Mathematical Sciences will assume the responsibility for the administrative management of BIRS, including the appointment of a managing director who will oversee day-to-day operation of the Station. The first Managing Director will be Professor Michael Lamoureux of the Department of Mathematics and Statistics at the University of Calgary.

Submissions to BIRS for 2003

118 proposals from all over the world were received by the BIRS Scientific Advisory Board as of October 30, 2001. Only forty of them will be selected for the inaugural year in 2003.

- **Conference on algebraic K-theory**
  Organizers: Eric Friedlander, Dan Grayson, Rick Jardine, Manfred Kolster

- **Noncommutative Geometry**
  Organizers: Joachim Cuntz, George Elliott, Masoud Khalkhali
- **The Geometry, Dynamics and Control of Nonholonomic Mechanics Systems**
  Organizers: Jerrold E. Marsden, Jedrzej Sniatycki
- **POLYTOPES: abstract, convex and computational**
  Organizers: T.Bisztriczky, D. Bremner, E.Schulte
- **Calabi–Yau Varieties and Mirror Symmetry**
  Organizers: Victor Batyrev, Shinobu Hosono, James D. Lewis, Bong H. Lian, S.-T. Yau, Noriko Yui, Don Zagier
- **Point processes–theory and applications**
  Organizers: Peter Guttorp, Bruce Smith
- **Mathematical Epidemiology**
  Organizers: Herbert Hethcote, Pauline van den Driessche
- **Challenges in Symbolic Mathematical Computation**
  Organizers: Wolfram Decker, Keith O. Geddes, Erich Kaltofen
- **Commutative Algebra and Geometry**
  Organizers: Mark Green, Jrgen Herzog, Bernd Sturmfels
- **Statistical mechanics of polymer models**
  Organizers: Christine E. Soteros, De Witt Sumners, Stuart G Whittington
- **Integration on arc spaces, elliptic genus and chiral de Rham complex**
  Organizers: Mikhail Kapranov, Anatoly Libgober, Francois Loeser
- **Functional Differential Equations**
  Organizers: John Mallet-Paret, Hans-Otto Walther, Jianhong Wu
- **Monge-Ampère type equations and applications**
  Organizers: Alice Chang, Pengfei Guan, Paul Yang
- **Topology in and around dimension three**
  Organizers: Steve Boyer, Martin Scharlemann, Abigail Thompson
- **Aperiodic Order: Dynamical Systems, Combinatorics, and Operators**
  Organizers: Michael Baake, David Damanik, Boris Solomyak
- **Stochastic processes in evolutionary and disease genetics**
  Organizers: Ellen Baake, Warren Ewens, Bruce Rannala
- **Applications of Differential Geometry and Group Theory to the Theory of Defective Material Bodies**
  Organizers: Marek Elzanowski, Marcelo Epstein
- **Conformal Geometry**
  Organizers: Thomas Branson , Michael Eastwood, McKenzie Wang
- **Free Probability Theory**
  Organizers: Alexandru Nica, Roland Speicher, Dan Voiculescu
- **Solitons II**
  Organizers: A. S. Goldhaber, R. B. MacKenzie , M. B. Paranjape
- **Stochastic Dynamics of Climate and Geophysical Flows**
  Organizers: Jinqiao Duan, Greg Holloway, Richard Kleeman, Adam Monahan
- **Galois Module Structure**
  Organizers: Ted Chinburg, Manfred Kolster, Alfred Weiss
- **Quadratic forms, algebraic groups, and Galois cohomology**
  Organizers: R.Elman, A.S.Merkurjev, J.Minac, C.Riehm
- **Geometric Evolution Equations**
  Organizers: Bennett Chow, Klaus Ecker, Pengfei Guan, Christine Guenther
- **Scattering and Inverse Scattering**
  Organizers: Richard Froese, Gunther Uhlmann
- **Recent developments in Superstring Theory**
  Organizers: Jim Bryan, Steve Giddings, Mikhail Kapranov, Andreas Karch, Amanda W. Peet, Moshe Rozali, Gordon W. Semenoff, Mark Van Raamsdonk, K. Viswanathan
- **Symmetry and Bifurcation in Biology**
  Organizers: Martin Golubitsky, William F. Langford, Ian Stewart
- **Compact Moduli Spaces**
  Organizers: James Carrell, Brendan Hassett, Sandor Kovacs
- **Interactions between model theory, diophantine geometry and real analytic geometry**
  Organizers: Zoe Chatzidakis, Bradd Hart, Deirdre Haskell, Anand Pillay, Alex Wilkie
- **Explicit Methods in Number Theory**
  Organizers: P. Borwein, H.W. Lenstra Jr., P. Stevenhagen, H. Williams
- **The many aspects of Mahler's measure**
  Organizers: David Boyd, Doug Lind, Fernando Rodriguez Villegas, Christopher Deninger
- **Nonlinear Transport PDEs with Multiple Scales**
  Organizers: Reinhard Illner, Shi Jin, Peter Markowich
- **Mathematics of Non-Relativistic Effective Theories**
  Organizers: A. Czarnecki, U. van Kolck, G. P. Lepage, K. Melnikov
- **Recent advances in algebraic and enumerative combinatorics**

Organizers: Sara Billey, Ian Goulden, Curtis Greene, David Jackson, Richard Stanley

- **Mathematical Biology: From molecules to ecosystems;The legacy of Lee Segel**
  Organizers: Leah Keshet, Simon A. Levin, Mark Lewis
- **Localization Behavior in Reaction-Diffusion Systems and Applications to the Natural Sciences**
  Organizers: A. Bernoff, P. Fife, T. Hillen, M. J. Ward, J. Wei
- **Stochastic partial differential equations**
  Organizers: Martin Barlow, Krzysztof Burdzy, Robert Dalang, Edwin Perkins
- **Current trends in arithmetic geometry and number theory**
  Organizers: Imin Chen, Brian Conrad, Eyal Goren, Adrian Iovita, Chris Skinner, Nike Vatsal
- **Number Theoretic Methods in Harmonic Analysis**
  Organizers: Alex Iosevich, Izabella Laba, Michael T. Lacey
- **Diophantine approximation and analytic number theory**
  Organizers: Michael Bennett, John Friedlander, Andrew Granville, Greg Martin, Cameron Stewart, Trevor Wooley
- **Interaction of Finite Dimensional Algebras with other areas of Mathematics**
  Organizers: Vlastimil Dlab, C.M. Ringel, L.L. Scott
- **Mathematical Models for Biological Invasions**
  Organizers: Mark Lewis, Mark Kot, Pauline van den Driessche
- **The interaction of finite type and Gromov-Witten invariants**
  Organizers: Jim Bryan, David Auckly
- **New Horizons in String Cosmology**
  Organizers: Robert Brandenberger, James Cline, Brian Greene, Paul Steinhardt
- **Perspectives in Differential Geometry**
  Organizers: Richard Schoen, Gang Tian, Jingyi Chen
- **Perspectives on variational methods and their applications**
  Organizers: Nassif Ghoussoub, Paul Rabinowitz
- **Computational Techniques for Moving Interfaces**
  Organizers: Randy LeVeque, Robert D. Russell, Steven Ruuth
- **Nonlinear Dynamics of Optical Communication**
  Organizers: Alan Champneys, Christopher Jones, J. Nathan Kutz, Keith Promislow
- **Computational Fuel Cell Dynamics-II**
  Organizers: John Kenna, Trung Van Nguyen, Keith Promislow, Brian Wetton
- **Matrix factorizations**
  Organizers: Charles R. Johnson, Steve Kirkland, Dale Olesky, Michael Tsatsomeros, Pauline van den Driessche
- **Workshop on Group theory and Numerical Analysis**
  Organizers: A. Iserles, D. Levi, P. Olver, R. Quispel, Pavel Winternitz
- **Valuation Theory and its Applications**
  Organizers: Steven Dale Cutkosky, Franz-Viktor Kuhlmann, Salma Kuhlmann
- **BANFF Credit Risk Conference 2003**
  Organizers: Tom Astebro, Peter Beling, David Hand, Robert Oliver, Lyn Thomas
- **Structural and Probabilistic Approaches to Graph Colouring**
  Organizers: Bruce Reed, Paul Seymour
- **Optimal Transportation and Nonlinear Dynamics**
  Organizers: L. Caffarelli, M.J.P. Cullen, L.C. Evans, M. Feldman, W. Gangbo
- **Combinatorial Hopf Algebras and Problems in Geometry, Representation Theory and Convex Polytopes**
  Organizers: Nantel Bergeron, Louis Billera, Frank Sottile
- **Regularization in Statistics**
  Organizers: Ivan Mizera, Roger Koenker
- **Workshop on Orientation and Shape Analysis**
  Organizers: Fred Bookstein, Theodore Chang, Duncan Murdoch, Christopher Small
- **Workshop on Complex Neumann Estimates and Complex and Cauchy-Riemann Geometries**
  Organizers: John Bland, Yum-Tong Siu
- **Convex Geometric Analysis**
  Organizers: Alexander Koldobsky, Vitali Milman, Nicole Tomczak-Jaegermann
- **A creative writing workshop at BIRS**
  Organizers: Marjorie Senechal, Chandler Davis
- **Functional Integro-Differential and Differential-Algebraic Equations: Numerical Analysis, Simulation and Applications**
  Organizers: H. Brunner, T.L. Herdman, J.A. Burns, E.M. Cliff, J.T. Borggaard, H.T. Banks, M.D. Gunzburger
- **Celestial Mechanics**
  Organizers: Florin Diacu
- **Locally Finite Lie Algebras and Related Topics**
  Organizers: Yuri Bahturin, Georgia Benkart, Ivan Penkov, Helmut Strade, Alexander Zalesskii
- **Applicable Harmonic Analysis**
  Organizers: Rong-Qing Jia, Sherman D. Riemen-

schneider, M. Victor Wickerhauser

- **Geometric Optimization Problems**
  Organizers: Stephanie B. Alexander, Maung Min-Oo, John M. Sullivan
- **Quantum Mechanics on the Large Scale**
  Organizers: P.C.E. Stamp, G.A. Sawatzky, A.J. Leggett, T. Havel, S.Popescu, R. Gill
- **Spectral Theory of Ordinary Differential Operators**
  Organizers: P.A. Binding, P. J. Browne, D.B. Hinton, I.W. Knowles
- **Syzygies and Hilbert Functions**
  Organizers: Irena Peeva, Mike Stillman
- **Structured matrices and Fast Algorithms in Mathematics, Computer Science and Engineering**
  Organizers: Peter Lancaster, Vadim Olshevsky, Paul Van Dooren
- **Theory and Numerics of Matrix Eigenvalue Problems**
  Organizers: J. W. Demmel, N. J. Higham, P. Lancaster
- **Resolution of singularities, factorization of Vibrational mappings, and toroidal geometry**
  Organizers: Dan Abramovich, Edward Bierstone, Steven Dale Cutkosky, Kenji Matsuki, Pierre Milman, Jarosław Włodarczyk
- **Analysis and Geometric Measure Theory**
  Organizers: Ana Granados, Herv Pajot, Tatiana Toro
- **Nonlinear dynamics of thin films and fluid interfaces**
  Organizers: A. L. Bertozzi, R. P. Behringer, T. P. Witelski, R. Almgren, M. C. Pugh, M. Shearer
- **Modeling Protein Flexibility and Folding with Rigidity**
  Organizers: Walter Whiteley, Michael F. Thorpe, Leslie A. Kuhn
- **Current trends in representation theory of finite groups**
  Organizers: Jonathan L. Alperin, Michel Broue, Gerald Cliff
- **Differential invariants and invariant differential equations**
  Organizers: Niky Kamran, Peter J. Olver
- **Model Reduction Problems and Matrix Methods**
  Organizers: Gene Golub, Anne Greenbaum, Jim Varah
- **Nonsmooth Analysis in Action - Theory, applications, and computation**
  Organizers: J.M. Borwein, A.S. Lewis, J.V. Burke, P.D. Loewen,
- **The third western Canada workshop on Designs, Codes and Cryptography**
  Organizers: Doug Stinson, Richard A. Mollin, Vladimir Tonchev, Hadi Kharaghani, Wolf Holzmann
- **The Present and Future of Computational Cosmology**
  Organizers: Arif Babul, Julio Navarro, Thomas R. Quinn, Neal Katz
- **The structure of amenable C*-algebras and dynamical systems**
  Organizers: George A. Elliott, Guihua Gong, Eberhard Kirchberg
- **Linbox Template Library Workshop: Exact Black Box Linear Algebra**
  Organizers: Wayne Eberly, B. David Saunders
- **p-adic variation of motives**
  Organizers: Kevin Buzzard, Robert Coleman, Matthew Emerton, Eyal Goren
- **Constraint programming, belief revision, and combinatorial optimization**
  Organizers: Randy Goebel
- **Order, Disorder, and Transport: Recent Advances in Schrodinger Operator Theory**
  Organizers: Richard G. Froese, Peter D. Hislop
- **Numerical Differential Equations: Their Past, Current and Future**
  Organizers: Zhangxin (John) Chen, Jim Douglas, Richard E. Ewing, Yanping Lin, Lawrence Shampine
- **Defects and their Dynamics**
  Organizers: Peter W. Bates, Lia Bronsard, Changfeng Gui
- **Pluripotential Theory, Polynomial Inequalities and Applications**
  Organizers: L. Bos, A. Brudnyi, B.A. Taylor
- **Orthogonal Polynomials; Interdisciplinary Aspects**
  Organizers: Lance Littlejohn, David Sattinger, Jacek Szmigielski
- **Coordinate methods in nonselfadjoint operator algebras**
  Organizers: Allan Donsig, Michael Lamoureux
- **Groupoids and Stacks in Physics and Geometry**
  Organizers: Kai Behrend, Ping Xu
- **Spectral methods and radial basis functions, computation and applications**
  Organizers: Bengt Fornberg, Bernie Shizgal, Manfred Trummer
- **Operator Algebras and Dynamical Systems**
  Organizers: Michael Boyle, Thierry Giordano, Ian Putnam
- **Grand Challenges for Automating Mathematics**
  Organizers: Simon Colton, Robert Holte, Toby Walsh, Hugh Williams
- **Searching with Mobile Agents**

Organizers: Evangelos Kranakis, Nicola Santoro, Danny Krizanc

- **Kaehler Geometry**
  Organizers: E. Calabi, Xiuxiong Chen, McKenzie Wang
- **Quantum Algorithms and Complexity Theory**
  Organizers: Richard Cleve, Umesh Vazirani, John Watrous
- **Galois groups and fundamental groups**
  Organizers: David Harbater, Ernst Kani, Jan Minac, Florian Pop
- **Physical Geometry**
  Organizers: Greg Galloway, Kristin Schleich, Donald M. Witt
- **Image and Video Coding**
  Organizers: Rabab Ward
- **Self-Stabilizing Distributed Systems**
  Organizers: Anish Arora, Faith Fich, Maurice Herlihy, Ted Herman, Lisa Higham
- **Symmetries, Conservation Laws, Integrability in Mathematical Physics**
  Organizers: George Bluman, Wen-Xiu Ma, Stephen C. Anco, Thomas Wolf
- **The Mathematical Foundations of Finance**
  Organizers: Paul Glasserman, Lane P. Hughston, T.R. Hurd, Thaleia Zariphopoulou
- **Topological aspects of real algebraic geometry**
  Organizers: S. Akbulut, G. Mikhalkin, B. Shapiro, F. Sottile, O. Viro
- **Fluid Motion Driven by Immersed Structures: Analysis, Computation, and Applications**
  Organizers: Ricardo Cortez, John Stockie
- **Joint Dynamics**
  Organizers: Douglas Lind, Daniel Rudolph, Klaus Schmidt, Boris Solomyak
- **Computation and dynamics in genetic and metabolic networks**
  Organizers: Leon Glass, John Reinitz, Erik Winfree
- **Problems in Discrete Probability**
  Organizers: Robin Pemantle, Yuval Peres, Peter Winkler
- **Regularity for hypergraphs**
  Organizers: P. Haxell, V. Rodl, J. Skokan, L. Thoma
- **Invariant Manifolds for Stochastic Partial Differential Equations**
  Organizers: Tomas Caraballo, Jinqiao Duan, Kening Lu, Bjorn Schmalfuss
- **Topological orbit equivalence for dynamical systems**
  Organizers: Thierry Giordano, Christian Skau, Ian Putnam
- **Variance of quasi-coherent torsion Cousin complexes**
  Organizers: Joseph Lipman, Suresh Nayak, Pramathanath Sastry
- **Representation theory of linearly compact Lie superalgebras and the Standard Model**
  Organizers: Victor Kac, Alexey Rudakov
- **Local uniformization and resolution of singularities**
  Organizers: Steven Dale Cutkosky, Franz-Viktor Kuhlmann
- **Arithmetic of fundamental groups**
  Organizers: David Harbater, Florian Pop
- **2003 Summer IMO Training Camp**
  Organizers: Bill Sands
- **Topology and Analysis: Complementary approaches to the Baum-Connes and Novikov conjectures**
  Organizers: Nigel Higson, Jerry Kaminker, Shmuel Weinberger

The NSERC site visit team (from left to right): Alan Mackworth (Director, Laboratory for Computational Intelligence, UBC), Arvind Gupta (Director, MITACS), Joe Buhler (Deputy Director, MSRI), Robert Moody (Scientific Director, BIRS), David Gross (Director, ITP), Nassif Ghoussoub (Director, PIMS) and David Eisenbud (Director, MSRI). Missing from photo: Michael Lamoureux (Managing Director, BIRS) and Steve Halperin (Dean of Science, Univ. of Maryland).

PIMS SCIENTIFIC PERSONNEL

PIMS Personnel: 2000/2001

PIMS Main Office

Dr. Nassif Ghoussoub, Director

Dr. Sandy Rutherford, Scientific Executive Officer

Dr. Klaus Hoechsmann, Education Officer

Mrs. Katrina Soh, Assistant to the Director

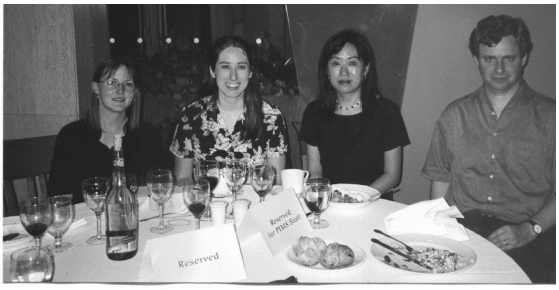
Mr. Shervin Teymouri, Computer Systems Administrator

Mr. Kelly Choo, Website Administrator

Ms. Jacquie Burian, Programme coordinator

Ms. Heather Jenkins, Communications Officer

Ms. Clarina Chan, MITACS Administrator



(from left to right) Heather Jenkins, Jacquie Burian, Katrina Soh and Sandy Rutherford.

PIMS at University of Alberta

Dr. Bryant Moodie, Site Director

Ms. Lina Wang, Executive Assistant

Ms. Martine Bareil, Administrative Assistant

Dr. Ted Lewis, Education Coordinator

Dr. Ruisheng Li, Industrial PDF

Dr. David Lyder, Industrial PDF

Dr. Benjamin Klopsch, PDF

Dr. Matthias Neufang, PDF

Dr. Yoji Yoshii, PDF

Dr. Hongwei Long, Industrial Collaborative Associate

Dr. Wei Sun, Industrial Collaborative

Dr. Long Hongwei, MITACS-PDF

Dr. Sinha Sanjoy, MITACS-PDF Associate

Bryant Moodie, U. Alberta-PIMS Site Director, 1998-2001.

PIMS at Univ. of British Columbia

Dr. Dale Rolfsen, Site Director

Ms. Leslie MacFadden, Administrative Assistant

Dr. Krisztina Vasarhelyi, Education Coordinator

Dr. Siva Athreya, PDF

Dr. Ji-Quang Bao, PDF

Dr. Antal Jarai, PDF

Dr. Luis Lehner, PDF

Dr. Arian Novruzi, PDF

Dr. Sumati Surya, PDF

Dr. Yuqing Wang, PDF

Dr. Bert Wiest, PDF

Dr. Konstantin Zarembo, PDF

Dr. Alexandra Chavez-Ross, Industrial PDF

Dr. Yuri Gusev, MITACS PDF

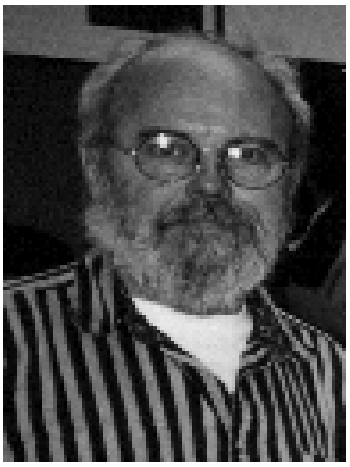
Dr. Simon MacNair, MITACS PDF

Dr. Arian Novruzi, MITACS PDF

Dr. Athan Spiros, MITACS PDF

Dr. Liqing Yan, MITACS PDF

Dr. Xue-Wu Zhang, MITACS PDF



Dale Rolfsen, UBC-PIMS Site Director, 1997-2001.

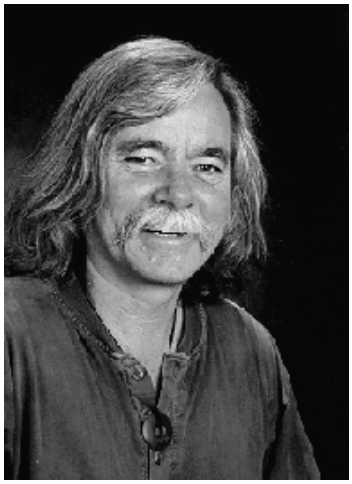
PIMS at University of Calgary

Dr. Michael Lamoureux, Site Director
Mr. Marc Paulhus, Industrial facilitator
Ms. Marian Miles, Administrative Assistant
Dr. Indy Lagu, Education Coordinator
Dr. Mike Powojowski, PDF
Dr. Wai-Shen Cheung, PDF
Dr. Xia Y., MITACS-PDF
Dr. Yao Zhengsheng, MITACS-PDF
Dr. Sadeghi A., MITACS-PDF
Dr. Pen Y., MITACS-PDF
Dr. Gibson Peter, MITACS-PDF

Michael Lamoureux, U. Calgary-PIMS Site Director, 1998-2001.

PIMS at Simon Fraser University

Dr. Bob Russell, Site Director
Ms. Fuyuko Kitazawa, Administrative Assistant
Ms. Andrea Kiefner, PIMS/MITACS Receptionist
Mr. Brent Kearney, Computer Systems Administrator
Dr. Malgorzata Dubiel, Education Coordinator
Dr. Nils Bruin, PDF
Dr. Ricardo Carretero, PDF
Dr. Will Galway, PDF
Dr. Nicolas Robidoux, PDF
Dr. Ladislav Stacho, PDF
Dr. Peter Berg, MITACS PDF
Dr. Radu Bradean, MITACS PDF
Dr. Ronald Ferguson, MITACS PDF
Dr. Ales Janez, PIMS-MITACS PDF
Dr. Cao Jun, MITACS PDF
Dr. Cheb-Terrab Edgardo, MITACS PDF
Dr. Stevens Brett, PIMS-MITACS PDF



Bob Russell, SFU-PIMS Site Director, 2000-01.

PIMS at University of Victoria

Dr. Florin Diacu, Site Director
Mrs. Irena Gavrilova, Admin. Assistant

Dr. David Leeming, Education Coordinator
Mr. Kelly Choo, Web Manager
Dr. Hongtu Zhu, Industrial PDF
Dr. Sam Lightwood, PDF
Dr. Sujin Shin, PDF
Dr. Joachim Stadel, PDF
Dr. Gengsheng Qin, PDF
Dr. Julien Arino, MITACS PDF
Dr. Desharnais Josee, MITACS PDF
Dr. Wenpin Jiao, MITACS PDF

Florin Diacu, U. Victoria-PIMS Site Director, 1998-2001.

PIMS University of Washington

Dr. Tatiana Toro, Site Director
Mrs. Mary Sheetz, Administrative Assistant

Tatiana Toro, U. Washington-PIMS Site Director, 2000-01.

PIMS Distinguished Chairs

PIMS has recently established a program of Distinguished Chairs, which serves to host emminent researchers in the mathematical sciences for extended visits at the PIMS sites. The researchers will have the opportunity to collaborate with colleagues at the PIMS universities and to give a series of lectures on their work.

PIMS Distinguished Chairs for 2000/2001

Yuri Matiyasevich (Steklov Institute of Math)
Site: University of Calagry
February–March, 2000

Herbert S. Wilf (University of Pennsylvania)
Site: University of Victoria
June 2000

Stephen Donkin (University of London)
Site: University of Alberta
July, 2000

David Brydges (University of Virginia)
Site: University of British Columbia
Sept. 1 to Oct. 15, 2000

Yuri Matiyasevich

Yuri Matiyasevich is a distinguished logician and mathematician who is known for his outstanding research in logic, number theory and the theory of computer algorithms. One of his most famous results is the definitive solution to the tenth problem posed by mathematician David Hilbert at the 1900 International Congress of Mathematics,

concerning the solution of certain polynomial equations. This, and related results, are fundamental to basic questions in modern computation on digital computers. Prof. Matiyasevich gave a series of six lectures that were attended to capacity by reserarchers and students in mathematics, statistics, and computer science. These lectures were video-taped, and are available on the web for viewing. Also, lecture notes are being prepared for publication.

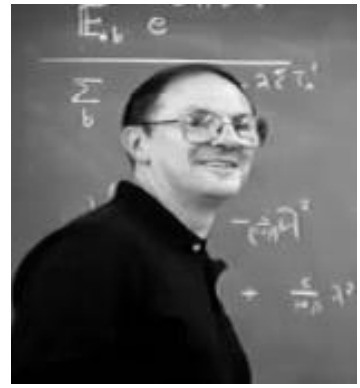
Herbert S. Wilf, Thomas A. Scott Professor of Mathematics at the University of Pennsylvania, is well-known for his research in Combinatorics. He received the Leroy J. Steele Prize of the American Mathematical Society in 1998 (jointly with Doron Zeilberger) for Seminal Contributions to Research.

During his tenure as PIMS Distinguish Chair at the University of Victoria, he gave two series of lectures on Integer Partitions. The first provided a review of the classical theory of integer partitions and the second investigated recent developments in unified machinery for partition bijections.

David Brydges is the Commonwealth Professor at the University of Virginia. He has made numerous significant contributions to mathematical physics in the areas of quantum field theory and statistical mechanics.

During his visit he delivered four lectures about his recent work on applying rigorous renormalization group methods to the four-dimensional self-avoiding walk problem. The motivating problem was to determine the end-to-end distance of a very long self-avoiding walk on a four-dimensional cubic lattice as a function of the number of steps, n. It is conjectured that the end-to-end distance is a constant times $n^{\frac{1}{2}} \log^{\frac{1}{8}} n$. In the talks, this conjecture was used as pedagogical device to relate some of the standard machinery used in theoretical physics to ideas that are familiar and attractive to mathematicians.

Herbert S. Wilf poses in front of his plane, in which he flew to Victoria with his wife Ruth Wilf. On the left is Brendan McKay (Australian National University).



David Brydges

In the first lecture, *Self Avoiding Walk and Differential Forms*, Prof. Brydges reviewed the continuous time simple random walk on a finite lattice. He demonstrated how the self-avoiding walk problem can in principle be solved as an extension of "Laplace's Method" that has been developed by physicists. The second lecture, *Mehler's Formula and the Renormalization Group,* introduced an improved method for evaluating the integrals introduced in lecture one using a generalization of "Mehler's Formula." This generalization is known as the "Renormalization Group" in the mathematical physics and theoretical physics literature. The third lecture, *Hierarchical Lattices and the Renormalization Group Revisited,* introduced an approximation of the original "Hierarchical Lattice." The main advantage of this is that implementation of the Renormalization Group method becomes much simpler. The log corrections in the four-dimensional end-to-end distance formula was also explained in the context of the Hierarchical Approximation. The final lecture, *Analysis with the Renormalization Group and Outlook,* investigated how the remainder after perturbation theory can be controlled for hierarchical lattices.

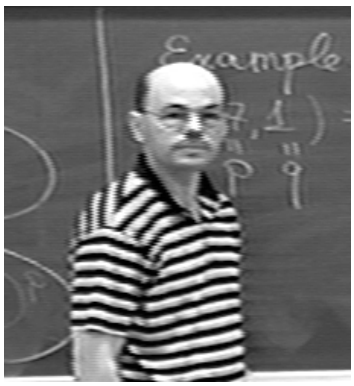
PIMS Distinguished Chairs for 2001/2002

Vladimir Turaev (CNRS Strasbourg VI)
Site: University of Calagry
July–August, 2001

Gang Tian (MIT)
Site: University of British Columbia
August 2001

Michael Shelly (Courant Institute)
Site: Simon Fraser University
October 2001

Vladimir Turaev (Research Director, CNRS IV, Strasbourg) was the PIMS Distinguished Chair at the University of Calgary for the months of July and August 2001 where he gave a series of 6 lectures on *Torsion Invariants of 3-manifolds.*



Vladimir Turaev

Turaev has made several seminal contributions to quantum invariants of 3-manifolds and topological quantum field theory. His recent research has been motivated by the development of topological quantum field theory by Edward Witten in 1988. Witten used the Feynman path integral in his construction, even though there is no rigorous mathematical justification for the path integral in this context. Following the publication of Witten's work, Turaev and Reshetikhin proved that a system of topological invariants of 3-manifolds could be developed using the representation theory of quantum groups. In their work they exploited a relationship between the representation theory of quantum groups and solutions of the Yang-Baxter equation of statistical mechanics. This allowed them to use the theory of representations of the quantum group $U_q(sl_2(\mathbb{C}))$ to define invariants of 3-manifolds. They then went on to give a rigorous construction of a topological quantum field theory in dimension 3.

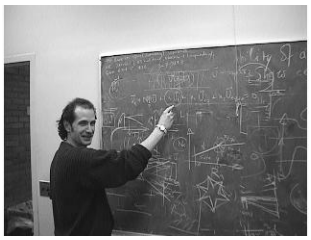
Professor Turaev's work has led to many advances in mathematics and physics. In particular, an understanding of the topological and geometric nature of quantum invariants is viewed by many to be essential for the deveopment of a quantum theory of gravity.

PIMS looked forward to hosting **Gang Tian** as PIMS Distinguished Chair at UBC during the month of August, 2001. Professor Tian is the Simons Professor of Mathematics at MIT. While at UBC, he will lecture on *Recent Progress in Complex Geometry.* He gave 4 lectures in the Geometric PDEs seesion of the PDE Thematic Programme and he also lectured the Canada-China congress.

Tian's research covers such diverse areas as differential geometry, algebraic geometry, geometric analysis and partial differential equations. He has made fundamental contributions in each of these areas. In particular, he is well known for his work on the question of existence and obstructions for Kähler-Einstein metrics on complex manifolds with positive first Chern class, for his proof that the qantum cohomolgy ring is associative (joint with Y. Ruan) and for his work on higher dimensional gauge theory.

Gang Tian

Tian received the 19th Alan Waterman Award from the National Science Foundation in 1994, the Oswald Veblen Prize in 1996 and was an Alfred P. Sloan Research Fellow from 1991–93.



Mike Shelley

Michael Shelly is Professor of Mathematics and Neural Science at the Courant Institute and Co-Director of the Applied Mathematical Laboratory at NYU. He will be giving a series of lectures as a PIMS Distinguished Chair in the month of October at SFU.

PIMS PDFs for 2001/2002 Academic Year

The selection in the 2001/2002 competition was made by Gordon Slade (chair, UBC), Pauline van den Driessche (University of Victoria), Richard Lockhart (SFU), Robert Moody (University of Alberta), Nick Pippenger (UBC) and Rex Westbrook (University of Calgary).

1. **Yuqing Wang**: mathematical biology.
   Supervised by Robert Miura (Math, UBC) and Yue-Xian Li (Math, UBC).
2. **Luis Lehner**: general relativity, numerical relativity and quantum gravity
   Supervised by Bill Unruh (Physics, UBC) and Matt Choptuik (Physics, UBC).
3. **Antal Jarai**: mathematical physics (percolation theory)
   Supervised by Gordon Slade (Math, UBC).
4. **Kazuyuki Furuuchi**: theoretical physics (string theory)
   Supervised by Gordon Semenoff (Physics,UBC).
5. **Joachim Stadel**: numerical astrophysics
   Supervised by Julio Navarro (Physics, UVic) and Arif Babul (Physics, UVic).
6. **Inhyeop Yi**: dynamical systems and operator algebras
   Supervised by Ian Putnam (Math, University of Victoria).
7. **Nils Bruin**: number theory and arithmetic algebraic geometry
   Supervised by Peter Borwein (Math, SFU), David Boyd (Math, UBC), Imen Chen (Math, SFU), Rajiv Gupta (Math, UBC) and Nike Vastal (Math, UBC).
8. **William Galway**: computational number theory
   Supervised by Jonathan Borwein (Math, SFU), Peter Borwein (Math, SFU), Imin Chen (Math, SFU), Stephen Choi (Math, SFU) and Petr Lisonek (Math, SFU).
9. **Sumati Surya**: quantum gravity
   Supervised by Kristin Schleich (Physics, UBC), Don Page (Physics, University of Alberta) and E. Woolgar (Math, UA).
10. **Matthias Neufang**: functional analysis, harmonic analysis and operator algebras
    Supervised by Volker Runde (Math, University of Alberta).
11. **Wen Chen**: signal and image processing
    Supervised by Bin Han (Math, University of Alberta) and Rong-Qing Jia (Math, University of Alberta).
12. **Roman Vershynin**: geometric functional analysis
    Supervised by Nicole Tomczak-Jaegermann (Math, University of Alberta).
13. **Christina Cobbold**: mathematical biology. Supervised by Mark Lewis (Math and Biological Sciences, University of Alberta).
14. **Luigi Santocanale**: computer science and category theory
    Supervised by Robin Cockett (Computer Science, University of Calgary).
15. **Peter Hoyer**: algorithmics, data structures, complexity theory and quantum computing
    Supervised by Richard Cleve (Computer Science, University of Calgary).
16. **Jorgen Rasmussen**: conformal field theory and Kac-Moody algebras
    Supervised by Mark Walton (Physics, University of Lethbridge).

PIMS Industrial PDFs for 2001/2002 Academic Year

The following projects have been supported in 2001/2002.

1. **Denis L. Westphalen**
   Industrial Partner: Hyprotech Ltd.
   Sponsors: Brent Young (Chemical and Petroleum Eng., U. Calgary)
   Project: Design of heat exchanger networks for optimal controllability
2. **Abdul Hannan Chowdhury**
   Industrial Partner: Nortel Networks/StatCaR
   Sponsors: Rita Aggarwala (Math, U. Calgary)
   Project: Analysis of Censored Data for Reliability Improvement under Highly Fractionated Experiments
3. **David Burggraff**
   Industrial Partner: Galdos Systems
   Sponsor: Dennis Sjerve (UBC)
   Project:
4. **Steven Wang**
   Industrial Partner: Insightful
   Sponsors: Ruben Zamar and Raymond Ng (UBC)
   Project: Data mining and robust statistics

I. THEMATIC PROGRAMMES

Gang Tian (MIT), Clifford Taubes (Harvard), Rick Schoen (Stanford) and Jingyi Chen (UBC) the minicourse lecturers for the **Workshop on Geometric PDE**.

Jack Edmonds and Adrian Bondy discuss with participants in the **Workshop on Colourings and Homomorphisms**.

Theme 2000 (A): Graph Theory & Combinatorial Optimization

Mathematically, a **graph** consists only of a set of "vertices" and a set of pairs of vertices that are "joined" by "edges". Physical examples abound. For example, the vertices can be communication centres and the edges can represent direct connections between pairs, or the vertices can be the atoms of a molecule, and the edges can be chemical bonds. Although graphs are extremely basic objects, the subject of Graph Theory, which the studies the theoretical structure of graphs and the algorithmic exploitation of such structure, is a deep and active part of mathematics. There are also important applications and strong connections to other parts of mathematics and computer science.

Combinatorial Optimization is the mathematics of finding the best among some collection of discrete structures. An example would be to find the graph with some connectivity property and having the smallest number of edges, or to find the best route through a given graph. Again, this subject is both mathematically interesting and rich with applications.

Organizing Committee:

Brian Alspach (SFU)
Luis Goddyn (SFU)
Arvind Gupta (SFU)
Pavol Hell (SFU)
Valerie King (U. Victoria)
David Kirkpatrick (UBC)
Frank Ruskey (U. Victoria)

Programme

Computational Graph Theory and Combinatorics,
University of Victoria, May 6–8, 1999

Algorithms and Data Structures,
SFU Harbour Centre, August 11–14, 1999

11th Canadian Conference on Computational Geometry,
UBC, August 15–18, 1999

Dynamic Graph Problems,
U. Victoria, June 5–9, 2000

Graph Decompositions,
PIMS-SFU, June 19–30, 2000

Flows, Cycles, and Orientations,
PIMS-SFU, July 3–14, 2000

Graph Colourings and Homomorphisms,
PIMS-SFU, July 17–28, 2000

This was a joint programme of the Fields Institute and the Pacific Institute for the Mathematical Sciences for a special year on graph theory and combinatorial optimization, taking place over the period June 1999 to August 2000. Lead-off workshops started at PIMS in the summer of 1999. September through May activities shifted to Fields, to eventually return to PIMS for the June through August, 2000 period. The fall term concentrated on combinatorial optimization, and the remaining period concentrated on graph theory and related topics.

Lead-off Events:

PIMS first sponsored a pre-thematic workshop on Computational Graph Theory and Combinatorics at the University of Victoria in May, 1999. The lead-off event for the joint thematic year was the Workshop on Algorithms and Data Structures (WADS), held at the SFU harbour Centre in August, 1999. Immediately following WADS was the Canadian Conference on Computational Geometry (CCCG), which took place at UBC in late August. Here are the events held in 2000.

Dynamic Graph Problems, Univ. of Victoria, June 5–9, 2000

Organizers: Monika Henzinger (Google Inc.) and Valerie King (Computer Science, University of Victoria)

For any graph problem, one may ask: If a graph instance undergoes an on-line sequence of updates, can one make use of previous computation to recompute the solution after each update more quickly? The study of dynamic graph problems has recently undergone some dramatic developments. The goal of this workshop is to bring together experts on various topics in the area with interested students and researchers, to discuss the current state of the field, identify promising directions for research, and do some problem-solving. Topics include: proving lower bounds, problems in computational geometry, new and old problems for undirected and for directed graphs, problems on trees, and applications to networks, data bases and programming languages.

Main lecturers:

Bob Tarjan (Princeton and Intertrust): *Parametric and Kinetic Heaps,*

Stephen Alstrup (IT University of Copenhagen): *Trees* and *Improved Algorithms for Finding Level Ancestors in Dynamic Trees,*

Faith Fich (University of Toronto): *Lower Bounds for Dynamic Graph Problems,*

David Eppstein (Univ. of California, Irvine): *Computational Geometry,*

Leo Guibas (Stanford University): *Kinetic Data Structures,*

Pino Italiano (Univ. degli Studi di Roma): *Fully Dynamic Transitive Closure: Breaking Through the $O(n^2)$ barrier,*

Roded Sharan (Tel Aviv University): *A Fully Dynamic Algorithm for Proper Interval Graph Recognition,*

Mikkel Thorup (AT & T Research): *2-Edge and Biconnectivity (Including Applications in Matching Theory), Tree Packing and General Dynamic Edge Connectivity* and *Applications to the Internet.*

Participants in the **PIMS Workshop on Dynamic Graph Problems** head to sea.

Graph Decompositions, PIMS-SFU, June 19–30, 2000

Organizing Committee: Brian Alspach, Chair, (U. Regina), Reinhard Diestel (U. Hamburg), Herbert Fleischner (Austrian Academy of Science), Ron Gould (Emory U.), Chris Rodger (Auburn U.)

The workshop consisted of a series of invited instructional lectures whose purpose was to survey the current status of a variety of important graph decomposition problems. Graph decompositions is a topic at the heart of graph theory. Decomposition problems have a long history, have spawned large areas of research, and continue to be studied by many people inside and outside of graph theory. Steiner triple systems were introduced early in the nineteenth century. When viewed as decompositions of complete graphs into complete graphs of order 3, their generalization leads to the well studied field of design theory. When viewed as decompositions of complete graphs into 3-cycles, their generalization leads to a wide range of problems dealing with decomposition of complete graphs into cycles.

Vertex coloring is a topic that was introduced in the middle of the nineteenth century, has generated considerable research over the years and has important scheduling applications. It corresponds to a particular kind of vertex decomposition of a graph. Edge coloring problems also have scheduling applications and have been studied extensively. They correspond to decompositions of graphs into 1-factors.

The preceding topics are still actively studied along with many new areas of investigation. G. Ringel's conjecture that K_{2n+1} can be decomposed into any fixed tree of size n directly led to the notion of a graceful labelling of a tree. That in turn spawned the very active area of graph labellings. The cycle double cover conjecture has attracted a lot of attention over the last twenty years. Isomorphic factorizations, orthogonal factorizations and ascending subgraph decompositions are other areas in which there are many unsolved problems and considerable research activity.

The format of the workshop was informal with invited talks dovetailed with working sessions. The purpose was to provide the opportunity for a group of approximately 40 researchers and graduate students from around the world to work together to gain a better understanding of widely accepted problems in the area. The workshop consisted of problem-solving sessions, tutorials designed for the non-expert, and a series of invited instructional lectures, the purpose of which was to survey the current status of a variety of important graph decomposition problems, and more specifically, edge decomposition problems.

Main lecturers:

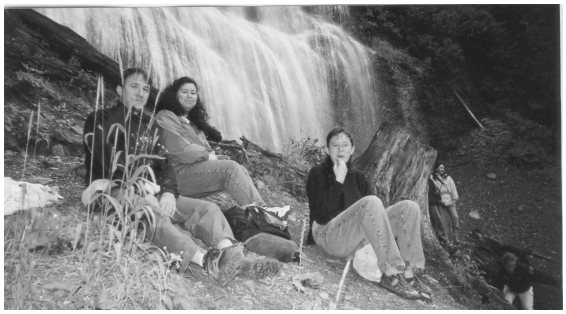
Darryn Bryant (Univ. Queensland)
Edward Dobson (Mississippi State)
Mark Ellingham (Vanderbilt)
Herbert Fleischner (Austrian Academy of Science)
Ron Gould (Emory U.)
Hans-Dietrich Gronau (U. Rostock)
Jiuqiang Liu (Eastern Michigan U.)
Chris Rodger (Auburn U.)
Mateja Sajna (Capilano College)

Flows, Cycles, and Orientations, PIMS-SFU, July 3–14, 2000

Organizer: Luis Goddyn (SFU)

This workshop presented an opportunity for participants to identify and work collaboratively on current problems in graph/matroid theory which broadly fall into the above three categories. Topics were concerned with algorithmic, polyhedral, algebraic, probabilistic, or extremal aspects, and involved embeddings, flow/colouring theory, circuit/bond covers, matroids and connectivity.

The format of the workshop consisted of two formal talks per day, interspersed with periods during which the participants engaged in informal discussions.



Enrique Garcia (U. of Ohio), Laura Chavez (SFU), and Cindy Loten (SFU), graduate student participants in the **Workshop on Flows Cycles and Orientations,** relax on an outing to Bridal Veil Falls.

Main lecturers:

Matt DeVos (Princeton): *I. Antiflows* and *II. Flow Choosability,*

Bertrand Guenin (Univ. of Waterloo): *Even Cycle Matroids,*

Petr Hlineny (Fields Institute): *Crossing Numbers,*

Kathie Cameron (Wilfred Laurier): *Parity of Nodes,*

Winfred Hochstäettler (Köln): *Dirac condition for Matroids,*

Mohamed Kobeissi (Univ. J. Fourier): *Cycles in Hypercubes,*

Sean McGuinness (Univ. of Umeå): *CDC for oddness four,*

Deryk Osthus (Humboldt Univ.): *Thomassen's conjecture,*

Riste Skrekovski (Univ. of Ljubljana): *Nowhere Zero Flows,*

Miki Tarsi (Tel-Aviv University): *Cycles and Flows,*

Dirk Vertigan (Lousisiana State Univ.): *Matroids,*

Doug West (Univ. of Illinois): *Alon-Tarsi on Hypergraphs,*

C.-Q. Zhang (W. Virginia Univ.): *Flows and Covers,*

Xuding Zhu (Nat. Sun Yat-sen Univ.): *Range of Flow Numbers.*

Graph Colourings and Homomorphisms, PIMS-SFU, July 17–28, 2000

Organizing Committee: Pavol Hell (Chair, SFU), Jing Huang (UVic), Rick Brewster (Capilano College), Gena Hahn (Montreal)

Graph colourings are at the core of graph theory. Starting from the famous four colour conjecture, now theorem, all the way to applications in scheduling, graph theory developed along with the study of colourings. From both theoretical and algorithmic perspective, colourings have always played a central role.

Nowhere-zero flows were introduced by Tutte as an extension of chromatic number. Indeed a flow is the matroidal dual of a graph colouring. Many well-known graph colouring problems, such as the Four Colour Theorem, extend naturally to problems about flows. There are several outstanding problems about flows, such as Tutte's conjecture that every graph has flow number at most five. Circuit covers were introduced in 1979 when Seymour proposed the still-unsolved Circuit Double Cover Conjecture. This conjecture is closely related to the topic of Surface Embeddings of graphs. Relating these three areas together will be the focus of part of this workshop.

Recently, the theory of colourings has benefited from an introduction of algebraic techniques, through the vehicle of list homomorphisms. At the same time, generalizations of colourings, especially graph homomorphisms, have also enjoyed much popularity. List homomorphisms, like list colourings, exhibit certain properties that can be exploited in the design of efficient algorithms. Both list colourings and list homomorphisms owe a historical debt to constraint satisfaction problems (which in fact are more general than both these concepts), studied in artificial intelligence. In fact some of the AI techniques have only recently been rediscovered by graph theorists. Finally, any of these concepts lead naturally to practical applications in timetabling and scheduling.

The workshop attracted over 70 participants and consisted of a series of invited instructional lectures, addressed to graduate students, and highlighting recent developments in graph colourings and their generalizations, including circular and oriented colourings, and, more generally, graph homomorphisms. Algorithmic, combinatorial, and algebraic issues were also discussed, as well as applications in, and

connections to, constraint satisfaction problems, scheduling, etc. Generous amounts of time were reserved for informal talks and unstructured discussions. Graduate students found the environment very stimulating.

Main lecturers:

Michael Albertson (Smith College): *Extending graph colorings,*

Noga Alon (Tel Aviv Univ.): *Acyclic coloring, strong coloring, list coloring and graph embedding,*

Adrian Bondy (U. Claude Bernard): *Colourings and orientations of graphs,* Graham

Brightwell (London Sch. of Econ.): *Dismantlability,*

Karen Collins (Wesleyan): *Applications of the No-homomorphism lemma,*

Jerrold Griggs (U. South Carolina): *Channel Assigments with Distance Conditions,*

Joan Hutchinson (Macalester College): *A 3-color theorem for some graph evenly embedded on orientable surfaces,*

Tommy Jensen (U. of Hamburg): *25 Pretty colouring problems,*

Bojan Mohar (U. of Ljubljana): *Some topological methods in graph coloring theory,*

Jarik Nesetrild (Charles U., Prague): *Extension properties and universality of the coloring poset,*

Andre Raspaud (U. Bordeaux I): *Homomorphisms and Oriented Coloring,*

Bruce Reed (CNRS, U. Paris VI): *Graph colouring via the probabilistic method,*

Norbert Sauer (U. of Calgary): *The homomorphism lattice of graphs,*

Claude Tardif (U. of Regina): *Cones over a graph,*

Peter Winkler (Bell Labs): *Random homomorphisms,*

Xuding Zhu (Nat. Sun Yat-sen U., Taiwan): *Circular perfect graphs.*

Many of the lectures in the above workshops are available by streaming video files available over the internet, along with scans of the speaker's slides. They appear on the webpage **www.pims.math.ca/video**.

Theme 2000 (B): Algebra and Related Areas

Group Theory plays a central role in just about all the branches of mathematics and continue to be a very active area of research. We are now witnessing the culmination of a 3 directional attack on the Burnside problems. The first consists of the geometric methods of Ol'Shanskii in producing finitely generated groups of finite exponent that are infinite. The second is the positive solution of the restricted Burnside Problem for residually finite groups by Zelmanov, and the third is the p-adic analytic methods in dealing with questions of linearity of residually finite groups by Lubotzky and Mann. There are also the remarkable advances made by Shalev, Lubotzky, and others on pro-finite groups and results of Segal and others for residually finite solvable groups.

Representation theory continues to be fundamental importance in mathematics and other sciences. There has been much recent progress, especially, on the representation theory of finite groups of Lie type, which ties together the Lie theory and group theory themes of the programme. Modular representation theory is also an area of considerable activity.

Programme Organizers:

Bruce Allison (U. Alberta)
Gerald Cliff (U. Alberta)
Robert Moody (U. Alberta)
Arturo Pianzola (U. Alberta)
Akbar Rhemtulla (U. Alberta)
M. Schlottman (U. Alberta)
Mazi Shirvani (U. Alberta)
Alfred Weiss (U. Alberta)

Programme

Lie School,
U. Alberta, June 19–23, 2000

Lie Workshop,
U. Alberta, June 26–30, 2000

Groups School,
U. Alberta, June 26–30, 2000

Groups Workshop,
U. Alberta, July 3–7, 2000

Aperiodic School,
U. Alberta, July 3–7, 2000

Aperiodic Workshop,
U. Alberta, July 10–14, 2000

The Summer School/Workshop concentrated on three areas: groups and their representations, Lie theory, and the mathematics of aperiodic order. As its name suggests, it did incorporate both an instructional and research components in each of the three broad areas.

Each area was featured for a two week period and had lecturers of international stature. The first week was devoted to a series of introductory lectures, aimed at giving the students an introduction to the subject in question. The second week was dedicated to the workshop/conference which ran at a research level and which involved additional researchers and students.

The School was open to graduate students, recent Ph.D.'s, and advanced honours students. Financial support was available to support selected participants. Students were expected to participate in the teaching part of each of the three areas.

The main speakers stayed for the full 2 weeks of activity of their area. Trips to Jasper were scheduled for each of the 3 internal weekends, and the accommodation there was planned so as to allow the groups to continue their scientific interactions.

Lie Theory Component, U. Alberta, June 19–30, 2000

Canada has a strong representation in the algebraic side of Lie theory. The timing of this event was particularly favorable because during the fall of 2000, the Fields Institute was holding a semester on infinite dimensional Lie theory. The intention was to use the minicourses of this conference to prepare the students for the Fields' activities.

Mini-course Lecturers at the School:

A. Pianzola (U. Alberta): *Lie Algebras*

S. Donkin (U. London): *Algebraic Groups.*

Main speakers at the Workshop:

G. Benkart (University of Wisconsin)
N. Bergeron (York University)
S. Berman, (University of Saskatchewan)
Y. Billig (University of New Brunswick)
A. Broer (Univerité de Montréal)
C. Dong (Univ. of California, Santa Cruz)
S. Donkin (Queen Mary & Westfield College, London)
Y. Gao, (York University)
M. Gaberdiel (Cambridge University)
T. Gannon (University of Alberta)
Y.-Z. Huang (Rutgers University)
O. Mathieu (IRMA, Strasbourg)
K.-H. Neeb (Technische Universität Darmstadt)
E. Neher (University of Ottawa)
C. Schweigert (Université Paris VI)
O. Smirnov (Randolph-Macon)

Stephen Berman (U. Saskatchewan) who spoke at the **Lie Workshop**.

Group Theory Component, U. Alberta, June 16 – July 7, 2000

Groups play a central role in just about all the branches of mathematics and continue to be a very active area of research.

At present we have the culmination of a three directional attack on the Burnside problems. The first consists of the geometric methods of Ol'Shanskii in producing finitely generated groups of finite exponent that are infinite (a vast improvement of Adian's construction which is one of the technically most difficult piece of a 300+ page work). The second is the positive solution of the restricted Burnside Problem for residually finite groups by Zelmanov, and the third is the p-adic analytic methods in dealing with questions of linearity of residually finite groups by Alex Lubotzky and Avinoam Mann. There are also the remarkable advances made by Aner Shalev, Lubotzky, and others on pro-finite groups and results of Dan Segal and others for residually finite solvable groups.

Representation theory continues of fundamental importance in mathematics and other sciences. There has been much recent progress, especially, on the representation theory of finite groups of Lie type, which ties together the Lie theory and group theory themes of the programme. Modular representation theory is also an area of considerable activity.

The conference presented an excellent opportunity to get a broad picture of these manifold activities as told by the masters themselves to our graduate students and fresh Ph.D's. All main lectures were of the "colloquium" nature, reserving the afternoon sessions for specialized talks that were meant for the experts.

Mini-course lecturers in the School:

Michel Broué (Univ. de Paris VII): *Representations of Groups of Lie Type*

Peter Kropholler (Queen Mary & Westfield College, London): *Cohomological Methods*

Dan Segal (Oxford): *Residually finite groups*

Aner Shalev (Hebrew University, Jerusalem): *Profinite and p-adic analytic groups.*

Main speakers at the Workshop:

Michel Broué (Université Paris VII)
Steve Gersten (University of Utah)
Rod Gow (Dublin City University)
Peter Kropholler (Univ. of London)
A. Lubotzky (Hebrew University, Jerusalem)
A. Yu. Ol'shanskii (Moscow State University)
Geoffrey Robinson (University of Birmingham)
Dan Segal (Oxford University)
Aner Shalev (Hebrew University, Jerusalem)
Alex Turull (University of Florida)

Aperiodic Component, U. Alberta, July 3–14, 2000

Aperiodic order, as its name suggests, refers to the mathematical study of systems, typically in Euclidean spaces, that are highly ordered but are lacking in periodic translational symmetry. Stemming from the recent discoveries of such objects in mathematics (e.g. Penrose tilings) and physics (aperiodic crystals) the subject has blossomed into a new area of mathematics that cuts across many boundaries and has many fascinating possibilies for future research.

The course aimed to provide the students with the background to understand the main ideas being used at present in the development of the mathematics of aperiodic order. One of the appealing aspects of this subject is the way in which it draws together a number of diverse subdisciplines of mathematics: discrete geometry, algebra, analysis, and measure theory and topological dynamics. For this reason the instructional part was given by three speakers. The goal was to give the students a reasonable feel for main ideas and to provide sufficient background and lots of pointers so that they may pursue it more deeply later on.

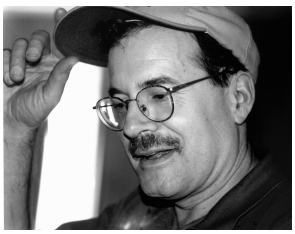
The conference/workshop part of the programme, which occured in the second week, focused on the most recent developments.

Mini-course Lecturers in the School:

M. Baake (Universität Tübingen): *Introduction to aperiodic order, tilings, and diffraction*

J. Lagarias (AT&T Labs), *Discrete geometry and aperiodic point sets*

B. Solomyak (University of Washington): *Dynamical systems and aperiodic order.*



Jeff Lagarias (AT&T Research Labs), mini-course lecturer at the **Aperiodic School** and speaker at the **Aperiodic Workshop**.

Main speakers at the Workshop:

Jean-Paul Allouche (CNRS, Orsay)
Michael Baake (Universität Tübingen)
Jean-Pierre Gazeau (Université Paris VII)
Uwe Grimm (Technische Universität Chemnitz)
Petra Gummelt (Universität Greifswald)
Jeff Lagarias (AT&T Labs)
Boris Solomyak (University of Washington)

Theme 2001 (A): Nonlinear Partial Differential Equations

Partial Differential Equations appear in the study of problems in material science, mathematical physics, fluid dynamics, Riemannian geometry, and many other related areas.

Differential Geometry has been a great source of problems and inspirational ideas for PDEs. Recent developments deal with harmonic maps, prescribed curvature problems, Monge-Ampère equations, Kahler-Einstein manifolds, Seiberg-Witten invariants and their connections to Gromov's invariants in Symplectic Geometry.

Concentration phenomena have been discovered in many different parts of science. Mathematically, they appear as vortices in Ginzburg-Landau equations, as spike-layers in biological diffusions, or as bubbles in geometrical problems occur.

Phase transitions often appear in material sciences problems such as the formation and evolution of grain boundaries in alloys, vortex states in superconducting materials, flame propogation, etc... The related equations include the Cahn-Hilliard equations, Allen-Cahn equations and again the Ginzburg-Landau equations.

The emphasized methods **(Variational and Viscosity solutions)** are very active areas of research, quite relevant to other areas of mathematics (Geometry, Topology, Analysis, Applied mathematics) with many applications in other disciplines (Physics, Chemistry, Biology, Economics and Engineering).

Programme Committee:

Jingyi Chen (UBC)
Michael Crandall (UC Santa Barbara)
Maria J. Esteban (U. Paris-Dauphine)
Nassif Ghoussoub (UBC)
Changfeng Gui (UBC)
Pierre-Louis Lions (U. Paris-Dauphine)
Wei-Ming Ni (U. Minnesota)
Paul Rabinowitz (U. Wisconsin)
Panagiotis Souganidis (U. Texas, Austin)

Programme

Viscosity Methods in Partial Differential Equations,
PIMS-UBC, July 2–10, 2001

Phase Transitions,
PIMS-UBC, July 11–18, 2001

Concentration Phenomena and Vortex Dynamics,
PIMS-UBC, July 19–27, 2001

Variational Methods and their Applications,
PIMS-UBC, July 30–August 07, 2001

Geometric PDEs,
PIMS-UBC, August 8–17, 2001

More than 500 researchers from 15 countries participated in the PIMS Thematic Programme on Nonlinear PDE, which was held at PIMS-UBC from July 2 to August 18. The programme dealt with several interrelated topics originating in finance, physics, chemistry, biology and material sciences, as well as in geometry. The common feature of these topics is the interplay between nonlinear, geometric and dynamic components of partial differential equations. The focal point of each workshop was a series of minicourses given by some of the best world experts in the field.

There was an emphasis on: Viscosity methods in partial differential equations, Phase Transitions, Concentration Phenomena and Vortex Dynamics, Variational methods in partial differential equations as well as Geometric PDEs. There were also several related events happening at PIMS during the summer of 2001: a workshop on *Theoretical and Numerical Fluid Mechanics*, organized by Giovanni P. Galdi (Pittsburgh), John Heywood (UBC), Rolf Rannacher (Heidelberg) and the *Second Canada-China Mathematics Congress* which had an important component in Geometry and PDEs. It was a highly successful plan to capitalize on this large gathering of expertise in Western Canada so as to create a favourable atmosphere for graduate training and collaborative research.

The program consisted of five consecutive workshops. The overlap between them was substantial enough and many participants were involved with several events. Each workshop had at least three mini-courses of up to four hours each. These ran in the morning and targetted mainly graduate students, postdocs and all non-specialists who were interested in learning new active directions of research. In addition, about 25 one-hour lecturers were selected and invited for each workshop by the program committee.

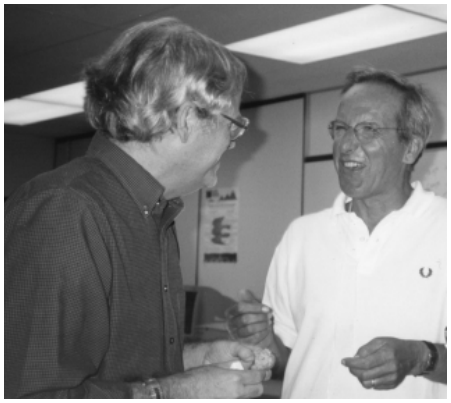
Viscosity Methods in Partial Differential Equations, PIMS-UBC, July 2–10, 2001

Organizers: P. L. Lions (Paris), M. Crandall (Santa Barbara), P. Souganidis (Maddison-Austin)

This workshop focused on the theory of viscosity solutions of differential equations and its applications. Viscosity solutions are the correct class of weak solutions of fully nonlinear first and second order, possibly degenerate partial differential equations. As such they provide the tools which are necessary for the analysis and further understanding of such equations. Some of the problems in this general context are:

- the theory of fully non-linear stochastic PDEs;
- boundary value problems with non-standard boundary conditions for fully non linear elliptic PDEs;
- equations with singular coefficients and/or non standard growth conditions;
- various questions regarding the Stefan problems, which are related to the motion of moving interfaces with velocity depending upon the interface, positions, direction, curvature, gradient difference of the temperature, etc;
- the studies of ray theory for multiphase geometrical optics and of generalized characteristics which connect the theory of viscosity solutions to contact and symplectic geometry;
- regularity problems for nonlinear second order elliptic equations and free boundary problems.

There was also an emphasis on the applications of the theory to Phase transition, Combustion, Control theory, Mathematical Finance, and Image Processing.



Craig Evans (Berkeley) and Italo Capuzzo-Dolcetta (Università di Roma "La Sapienza") during the **Viscosity Methods Workshop**.

Mini-course Lecturers:

Xavier Cabré (Universitat Politecnica de Catalunya) 2 lectures on *Nonconvex Fully Nonlinear Elliptic Equations: $C^{2,\alpha}$ Regularity for some Bellman-Isaacs Equations.*

Craig Evans (Berkeley): 2 lectures on *Hamilton-Jacobi Equations and Dynamical Systems.*

Robert Jensen (Loyola): 2 lectures on *Variational Problems in L^∞.*

Panagiotis Souganidis (Austin): 2 lectures on *Fully Nonlinear Stochastic PDEs.*

Andrzej Swiech (Georgia Tech): 5 lectures on *Viscosity Solutions in Infinite Dimensional Spaces and Optimal Control of PDEs.*

Thaleia Zariphopoulou (Austin): 2 lectures on *Viscosity Solutions in Finance.*

Main Speakers:

Maurizio Falcone (Università di Roma "La Sapienza"): *Semi-Lagrangian schemes for Hamilton Jacobi equations*

Pierpaolo Soravia (Università di Padova): *Uniqueness for degenerate elliptic equations with discontinuous coefficients*

Martino Bardi (Università di Padova): *Ergodicity, singular perturbations, and homogenization in the HJB equations of stochastic control*

Petri Juutinen (University of Jyväskylä): *The infinity eigenvalue problem*

Anne Bourlioux (University of Montreal): *Effective Hamiltonians for numerical turbulent combustion*

Espen Jakobsen (Norweigan University of Science and Technology): *Convergence rate for Approximation Schemes for Hamilton-Jacobi-Bellman equations*

Hitoshi Ishii (Tokyo Metropolitan University): *A model of the wearing process of a non-convex stone*

Fabiana Leoni (Universita Di Roma): *Diffusion generated motions in codimension > 1*

Elisabeth Rouy (Université de Tours): *Some applications of the theory of viscosity solutions to the problem of reflected stochastic differential equations*

Alexander Vladimirsky (UC Berkeley): *Ordered upwind methods for static PDEs*

Agnes Tourin (University of Toronto): *Approximation schemes for Hamilton-Jacobi equations*

Adam Oberman (University of Chicago): *Level set motion by growth, advection & mean curvature & reaction-diffusion advection equations*

I. Capuzzo Dolcetta (Università di Roma "La Sapienza"): *On Hopf - Lax formulas for Hamilton-Jacobi equations*

Mariko Arisawa (Tohoku University): *Long time averaged reflection force and homogenizations of oscillating Neumann type boundary conditions*

Shigeaki Koike (Saitama University): *On the limit of minimizers of variational problems*

Dejan Slepcev (University of Texas at Austin): *Approximation schemes for front propagation with nonlocal velocities*

Juan J. Manfredi (University of Pittsburgh): *The Subelliptic Maximum Principle*

Zhongdan Huan (Beijing Normal University): *On Removable Boundaries*

Michael Crandall (University of California, Santa Barbara): *Another way to say harmonic*

Phase Transitions, PIMS-UBC, July 11–18, 2001

Organizers: Nassif Ghoussoub (PIMS & UBC) and Changfeng Gui (UBC)

This workshop focused on problems in phase transition such as formation and evolution of grain boundaries in alloys, vortex states in superconducting materials, etc. The related equations include Cahn-Hilliard equations, Allen-Cahn equations, Ginzburg-Landau equations, and others.

Mini-course Lecturers:

Henri Berestycki (Université Paris VI): 4 lectures on *Propagation of fronts in excitable media*

David Kinderlehrer (Carnegie Mellon University): 4 lectures on *Topics in metastability and phase changes*

Main Speakers:

Yuxi Zheng (Indiana University, Bloomington): *The Semi-Classical Limit of Schrodinger-Poisson to Vlasov-Poisson Equations*

Hongming Yin (Washington State University): *A free boundary problem arising in microwave heating processes*

Xavier Cabré (Universitat Politecnica de Catalunya): *A conjecture of De Giorgi on symmetry for elliptic equations in R^n "*

Reiner Schaetzle (ETH Zentrum): *Quadratic tilt-excess decay and strong maximum principle for varifolds*

Masayasu Mimura (Hiroshima University): *Annihilation and Reflection of Travelling Spots in Reaction-Diffusion*

Maurizio Falcone (Università di Roma "La Sapienza"): *Large Time-Step Schemes for Front Propagation*

Jacob Rubinstein (Technion): *Phase transitions in quantum wires*

Gieri Simonett (Vanderbilt University): *On the Stefan problem with surface tension*

Nicholas Alikakos (University of Tennessee Knoxville): *Motion By Surface Tension In Curved Ambient Space*

Peter Sternberg (Indiana University, Bloomington): *Existence and Non-existence Results for Permanent Currents in Superconductivity*

Daniel Phillips (Purdue University): *Thermal effects in superconductivity*

Pablo Padilla (Institute of Investigations in Mathematics, Applied and in Systems (IIMAS)): *Global geometric properties of solutions in a phase transition model*

Jian-Jun Xu (McGill University): *Dynamics of Dendritic growth in solidification—global stability and limiting state selection*

Masaharu Taniguchi (Tokyo Institute of Technology): *Instability of planar traveling fronts in bistable reaction-diffusion systems*

Xiaofeng Ren (Utah State University): *Energy Equilibria of the Copolymer Problem*

Francois Hamel (Université Paris VI): *Speed of propagation of fronts for rection-diffusion equations in periodic and general domains*

Yoshi Tonegawa (Hokkaido University): *Singular perturbation problem with a variable mean curvature field*

Changfeng Gui (University of British Columbia): *About the De Giorgi conjecture in dimensions 4 and 5*

Michelle Schatzman (Université Claude Bernard Lyon 1): *Asymmetric layers and solutions of elliptic systems in full space*

Junping Shi (College of William and Mary): *Saddle solutions of semilinear elliptic equations*

Alberto Farina (Université de Picardie Jules Verne): *Phase Transition and Symmetry*

Danielle Hilhorst (Université Paris-Sud): *Singular limit of a reaction-diffusion system with resource-consumer interaction*

Yuan-Wei Qi (Hong Kong University of Science and Technology): *Global self-similarity and Renormalization Group of a thermal-diffusive combustion system with critical nonlinearity*

Yasumasa Nishiura (Hokkaido University): *Dynamics of interfaces for domain growth problems*

Xuefeng Wang (Tulane University): *Metastability and Stability of Patterns for a Convolution Model for Phase Transitions*

Concentration Phenomena and Vortex Dynamics, PIMS-UBC, July 19–27, 2001

Organizers: Changfeng Gui (UBC) and Wei-Ming Ni (Minnesota)

Concentration phenomena have been discovered in many different areas. Mathematically they appear in the form of vortices in Ginzburg-Landau equations and of spike-layers in biological diffusions, etc. This workshop dealt with the up-to-date advances in these phenomena and the variatonal methods involved. Related equations include Ginzburg-Landau equations, nonlinear Schrodinger equations, Gierer-Meinhardt systems, and others.

Changfeng Gui (UBC), Fang Hua Lin (Courant), Michael Struwe (ETH) and Wei-Ming Ni (Minnesota), the minicourse lecturers for the **Concentration Phenomena and Vortex Dynamics Workshop**.

Mini-course Lecturers:

Michael Struwe (ETH Zurich): 4 lectures on *Concentration problems in two dimensions*

Wei-Ming Ni (University of Minnesota): 2 lectures on*Diffusions, cross-diffusions, and their steady states*

Changfeng Gui (University of British Columbia), 2 lectures on *Diffusions, cross-diffusions, and their steady states*

Fang-Hua Lin (Courant Institute): 4 lectures on *Vortex Dynamics of Ginsburg-Landau and Related Equations.*

Main Speakers:

Robert Jerrard (University of Illinois at Urbana-Champaign): *Vortex filament dynamics for the Gross-Pitaevsky equation*

Yuan Lou (Ohio State University): *A Semilinear Parabolic System for Migration and Selection in Population Genetics*

Yung-Sze Choi (University of Connecticut): *On the blowup of heat flow for conformal 3-harmonic maps*

Henry Warchall (National Science Foundation USA): *Spectrally stable encapsulated-vortex solutions of nonlinear Schrodinger equations (with Robert L. Pego Department of Mathematics University of Maryland)*

Norman Dancer (University of Sydney): *Peak solutions on annular regions and non-degeneracy conditions*

Amandine Aftalion (Université Paris VI): *Vortex energy and vortex bending in Bose Einstein condensates*

Dongho Chae (Seoul National University): *Nontopological Chern-Simons vortices-statics and evolutions*

Jun Cheng Wei (Chinese University of Hong Kong): *Multiple Clusters Generated By Reaction-Diffusion Systems*

Izumi Takagi (Tohoku University): *Remarks on the stability of single-spike patterns in annuli*

Hirokazu Ninomiya (University of Minnesota): *Reaction-diffusion approximation to cross diffusion systems*

Sylvia Serfaty (École Normale Supérieure de Cachan): *Vortices in the static Ginzburg-Landau equations of superconductivity*

Xingbin Pan (National University Singapore): *Concentration Phenomena of Ginzburg-Landau System and Surface Superconductivity*

Fang Hua Lin (Courant Institute): *Vortex dynamics of Ginsburg-Landau and related equations*

Changfeng Gui (University of British Columbia): *Diffusions, cross-diffusions, and their steady states*

Eiji Yanagida (Tohoku University): *Stability analysis for reaction-diffusions systems with gradient/skew-gradient structure*

Matthias Winter (Universitaet Stuttgart): *Concentrated solutions for the two-dimensional Gierer-Meinhardt system*

Patricio Felmer (Universidad de Chile): *Semi-classical limit for the one dimensional Nonlinear Schrodinger Equation*

Masaharu Taniguchi (Tokyo Institute of Technology): *Instability of planar traveling waves in bistable reaction-diffusion systems*

Joseph McKenna (University of Connecticut)

Jack Xin (University of Texas at Austin): *Focusing PDEs and their Applications in Optics and Speech Processing*

Stanley Alama (McMaster University): *Vortices in the Lawrence-Doniach Model of Layered Superconductors in a Parallel Field*

Salome Martinez (University of Minnesota): *Cross-Diffusion for 3x3 competitive systems*

Shoji Yotsutani (Ryokoku University): *Limiting equations for a cross-diffusion system*

Patricia Bauman (Purdue University): *Results on a Ginzburg-Landau Model including Pinning of Vortices*

Vieri Benci (Università degli Studi di Pisa): *Concentration phenomena and solitary waves*

Michael Ward (University of British Columbia): *The Dynamics of Spikes for the Gierer-Meinhardt Model (joint work with David Iron UBC grad student, Juncheng Wei Chinese Univ. of Hong Kong)*

Zheng Chao Han (Rutgers University):

Dmitry Golovaty (University of Akron): *On uniqueness of vector-valued minimizers of the Ginzburg-Landau functional in annular domains*

Gabriella Tarantello (Università Roma II): *On Liouville type equations with singular data*

Variational Methods and their Applications in PDEs, Hamiltonian Systems & Mathematical Physics, PIMS-UBC, July 30 – Aug. 7, 2001

Organizers: Maria J. Esteban (Paris), Nassif Ghoussoub (UBC), Paul Rabinowitz (Wisconsin)

This session dealt with modern variational methods which have been at the core of mathematics for a long time, yet still experiencing major development: Various infinite dimensional extensions of Morse theory, new "gluing" techniques and useful duality methods. Variational methods have had enormous new applications in the study of problems in phase transition, Hamitonian systems, pattern formation, fluid dynamics, Riemannian geometry, etc., as they are used to answer questions about existence, multiplicity, location, asymptotics, concentration, etc.

Mini-course Lecturers:

Maria Esteban (Université Paris IX): 4 lectures on *Variational problems related to operators with gaps and applications in relativistic quantum mechanics*

Eric Séré (Université Paris IX): 4 lectures on *Variational problems in relativistic quantum mechanics: Dirac-Fock equations*

Yann Brenier (Paris): 4 lectures on *Variational problems related to fluid and plasma modelling.*

Main Speakers:

Vieri Benci (Università degli studi du Pisa): *Variational principles for Lorentz invariant field equations*

Jedrzej Sniatycki (University of Calgary): *Structure of a space of solutions for Yang-Mills equations and its quantization*

Robert McCann (University of Toronto): *Optimal Transportation - from Monge and Kantorovich to Beckmann and Beyond: Uniqueness and Transport Density*

Kazunaga Tanaka (Waseda University): *An elementary method for construction of complex solutions in 1-dimensional singular perturbation problems*

Zhi-Qiang Wang (Utah State University): *On weighted Sobolev inequalities and related PDEs*

Patricio Felmer (Universidad de Chile): *Peaks and Multipeaks for Nonlinear Schrodinger equation: A Variational Appproach*

Nassif Ghoussoub (Pacific Institute for the Mathematical Sciences): *On De Giorgi's conjecture in dimensions 4 and 5*

Ugo Bessi (Universita degli studi Roma III):

Gero Friesecke (Oxford University): *2D Curvature functionals as Gamma-limits of 3D non-linear elasticity theory*

Yiming Long (Nankai University): *Closed characteristics on convex and star-shaped hypersurfaces in R^{2n}*

Bernhard Ruf (Università degli studi di Milano): *On a result by Carleson-Chang concerning the Trudinger-Moser inequality*

Pietro Majer (Università di Parma):

Sergey Bolotin (University of Wisconsin–Madison): *Variational methods for connecting orbits of Hamiltonian systems*

Claude Le Bris (CERMICS, École Nationale des ponts et chaussées), *On the ground state energy of systems composed of infinitely many particles*

Susanna Terracini (Politecnico di Milano), *Nehari's method and systems with large interaction*

Pietro Montecchiari (Università degli studi di Ancona), *Multiplicity of entire solutions for non autonomous Allen-Cahn type equations*

Vittorio Coti Zelati (Università di Napoli), *Chaotic behavior for rapidly oscillating Hamiltonian systems*

Gabriella Tarantello (Universit̓a Roma II), *Elliptic problems in vortex theory*

Eric Paturel (Université Paris IX).

Louis Jeanjean (Université de Franche Comté), *An asymptotically linear problem on R^N autonomous at infinity*

Chao-Nien Chen (National Changhua University of Education)

Boris Buffoni (École Polytechnique Fédérale de Lausanne), *Interfaces between homogeneous configurations for elastic cylinders of infinite length*

Patrick Bernard (École Normale Superieure)

Paul Rabinowitz (University of Wisconsin–Madison)

Geometric PDEs, PIMS-UBC, August 8–17, 2001

Organizers: Gang Tian (MIT) and Jingyi Chen (UBC)

This workshop focused on PDE problems arising from geometry particularly in the study of Kahler-Einstein manifolds, minimal surfaces, scalar curvature, harmonic maps, and other phenomena.

Mini-course Lecturers:

Cliff Taubes (Harvard University), 4 lectures on *Pseudoholomorphic geometry as a tool to study smoothe 4-dimensional manifolds*

Richard Schoen (Stanford University), 4 lectures on *Geometric Variational Problems*

Gang Tian (Massachusetts Institute of Technology), 4 lectures on *Recent progress in complex geometry*

Main Speakers:

George Daskalopoulos (Brown University), *The Yang-Mills flow in higher dimensions*

Pengfei Guan (McMaster University), *Hessian equations in classical and conformal geometry*

Nicholas Kapouleas (Brown University), *Singular perturbation constructions for minimal surfaces in the Sphere*

Jiaping Wang (University of Minnesota) *Counting harmonic functions and massive sets*

McKenzie Wang (McMaster University)

Daniel Pollack (University of Washington), *Gluing and wormholes for the Einstein constraint equations*

Jose Escobar (Cornell University), *New results on conformal deformation of metrics*

Robert Gulliver (University of Minnesota), *Embedded Minimal Surfaces and Total Curvature of Curves in a Manifold*

Jim Bryan (University of British Columbia), *Curves in Calabi-Yau 3-folds, Gromov-Witten invariants, and BPS states of M2-branes*

Jeff Cheeger (Courant Institute), *L_2-bounds on curvature and rectifiability of singular sets*

Jiayu Li (Chinese Academy of Sciences)

Ignasi Mundet i Riera (Universidad Autonoma de Madrid), *Hamiltonian Gromov-Witten invariants*

Peter Li (University of California, Irvine), *Duality of local and global estimates for elliptic PDEs*

Yong Geun Oh (Korea Institute for Advanced Study, currently visiting University of Wisconsin–Madison), *Holomorphic volume preserving maps and special Lagrangian submanifolds*

Richard Wentworth (University of California, Irvine)

Emmanuel Hebey (Université de Cergy-Pontoise), *Sharp Sobolev-Poincaré inequalities on Riemannian manifolds*

Bo Guan (University of Tennessee), *A Minkowski Problem for Convex Hypersurface*

Tom Ilmanen (ETH Zentrum), *Minimal surfaces and mean curvature flows with L^2 curvature bounds*

Bill Minicozzi (Johns Hopkins University), *Embedded Minimal Surfaces*

Jingyi Chen (University of British Columbia), *Quaternionic maps between hyperkahler manfolds.*

Theme 2001 (B): Theoretical, Numerical and Industrial Fluid Dynamics

The mathematical **theory of waves** has a wide spectrum of cross-disciplinary applications. In geophysical contexts waves are a primary method by which energy is transported in fluids and they are thus responsible for global circulation of the atmosphere, the oceans and the earth's mantle. In biological contexts, waves are used in the study of haemodynamic neural networks and respiratory flows. Waves are also studied for their use in remote sensing and have been exploited to map our atmosphere from space, to explore and see the deep oceans and to detect biological disease by non-invasive methods.

The equations that describe the most fundamental behavior of a fluid were derived by Euler in 1755. They are the equations of conservation of momentum and conservation of mass of a fluid that is incompressible, has constant density and is inviscid. The initial boundary value problem for the **Euler equations** is surprising difficult and it is perhaps the most challenging of all problems in PDE that arises directly from physics. Incorporation of the effects of viscosity (for friction) leads to the **Navier-Stokes equations**. The fundamental open questions are all related to the issues of the formation of singularities in finite time.

Programme Organizers:

Giovanni P. Galdi (Pittsburgh)
John Heywood (UBC)
Rolf Rannacher (Heidelberg)
Bruce Sutherland (U. Alberta)
Andrew Bush (U. Alberta)
T. Bryant Moodie (U. Alberta)

Workshops:

3rd Annual PIMS Summer School in Industrial Fluid Dynamics,
U. Alberta, June 4–8, 2001

Wave Phenomena III: Waves in fluids from the microscopic to the planetary scale,
U. Alberta, June 11–15, 2001

Workshop on Theoretical and Numerical Fluid Mechanics,
Vancouver, August 20–25, 2001

Participants in the Summer School.

3rd PIMS Summer School in Industrial Fluid Dynamics, University of Alberta, May 27 – June 8, 2001

Organizers: B. R. Sutherland and T. B. Moodie (U. Alberta)

This summer school offered an enriched learning environment in which the theoretical, experimental and computational aspects of fluid dynamics are synthesized. Participants attended a comprehensive series of lectures, and were given hands-on experience performing and analyzing experiments in the Environmental and Industrial Fluid Dynamics Laboratory. In addition, they ran numerical simulations using research-level codes. Topics included fluid dynamics fundamentals, industrial and environmental flows, geophysical fluid dynamics, turbulence modeling and computational fluid dynamics.

This year's summer school was particularly rewarding for the students since it was held in conjunction with the PIMS Thematic Programme on Wave Phenomena and Fluid Dynamics. Special invited speakers were T. G. Shepherd (U. Toronto) who spoke on *The Fluid Dynamics of the Middle Atmosphere* and H. J. S. Fernando (Arizona State) who spoke on *Turbulence and Mixing in Stably Stratified Fluid Layers.*

Core Lecturers from U. Alberta

John C. Bowman, *Turbulence Modelling*;
Andrew B. G. Bush, *Climate Modelling*;
Peter Minev, *Computational Fluid Dynamics*;
T. Bryant Moodie, *Wave Theory*;
Bruce R. Sutherland, *Stratified Flows* and
Gordon E. Swaters, *Physical Oceanography.*

Wave Phenomena III: Waves in fluids from the microscopic to the planetary scale, University of Alberta, Edmonton, June 11–15, 2001

Conference Organisers: T. B. Moodie, Andrew Bush, Bruce Sutherland, Gordon Swaters (U. Alberta)

Bruce Sutherland & John Bowman having a break.

The wave concept links together such diverse disciplines as geophysics, oceanography, meteorology, astrophysics, physiology, and biology. In geophysical contexts, waves are a primary method by which energy is transported in fluids and they are thus responsible for global circulation of the atmosphere, the oceans, and the earth's mantle. In biological contexts, waves are used in the study of haemodynamics, neural networks, and respiratory flows. Waves are also studied intensively for their use in remote sensing and have been exploited to map our atmosphere from space, to explore and see the deep oceans, and to detect disease by non-invasive methods. The enormous range of spatial scales spanned by waves is indicative of their relevance to many disciplines.

The previous two Wave Phenomena meetings were also successful and focused on wave propagation phenomena in a wide spectrum of applications. For the third Wave Phenomena Meeting, we chose to focus on the fluid medium for wave transmission. We did this first because of the general importance of the subject at this time with its relation to world climate change and our concerns with this change and second in order to better mesh with the topics of the **3rd PIMS Summer School in Fluid Dynamics**, which immediately preceded the conference.

Waves III was attended by 145 delegates from Canada, Mexico, USA, Turkey, Ghana, France, Germany, The Netherlands, Scotland, Italy, India, Denmark, China, Japan, Sweden, New Zealand, Taiwan, Australia, and Russia.

There were a total of 23 plenary talks that were given in the morning session each day. These were then followed by the contributed talks that were held in 5 parallel sessions during the afternoons.

The opening address was given by **Dick Peter** (Dean of Science, University of Alberta) who emphasized the important role that has been played in the mathematics community by The Pacific Institute for the Mathematical Sciences and how meetings of this calibre would not be possible without the support of PIMS.

Plenary Speakers:

Carlo Cercignani (Poli. di Milano) *On the Structure of Infinitely Strong Shock Waves*

Jerry L. Bona (Univ. of Texas at Austin) *Nearshore Zone Dynamics and Beach Protection*

David Benney *Some Evolution Equations for Selective Disturbances in Hydrodynamics*

Colin Rogers (Univ. of New South Wales) *Intrinsic Geometry in Soliton Theory: Hydodynamic and Magnetohydrostatic Connections*

Michael S. Longuet-Higgins (Univ. of California, San Diego)*Dynamics of Standing Surface Waves: a Review*

S. George Philander (Princeton Univ.)*How El Nino Changes when Climate Changes*

Andrew J. Majda (Courant Institute)*Convectively Coupled Tropical Waves*

Michael E. McIntyre (Univ. of Cambridge)*The Pseudomomentum Rule Revisited: Wave-Mean Interaction*

Melvin E. Stern (Florida State Univ.)*Internal Waves Amplified by Salt Fingers*

J.A. Whitehead (Woods Hole Oceanographic Inst.) *Upstream and Downstream Adjustment of Controlled Hydraulic Flows*

P.L. Sachdev (Indian Inst. of Science, Bangalore)*Asymptotic Behavior of Some Nonlinear Partial Differential Equations*

Peter G. Baines (CSIRO, Australia)*Dynamics of the Antarctic Circumpolar Wave*

H.J.S. Fernando (Arizona State Univ.)*Turbulence and Mixing in Stably Stratified Fluid Layers*

Roger Grimshaw (Monash Univ.)*Coupled Korteweg-de Vries Equations; Solitary Wave Interactions Growth and Saturation*

Richard S. Lindzen (MIT)*What Limits Linear Growth?*

Peter B. Rhines (Univ. of Washington) *Teaching Waves in the GFD Lab*

R.T. Pierrehumbert (Univ. of Chicago) *Martian Baroclinic Amplitude Internal Solitary Waves in the Slope-shelf Area*

A. Newell (Univ. of Warwick) *Wave Turbulence and Intermittency*

James C. McWilliams, Lee Paul Graves, Michael T. Montgomery (Univ. of California, Los Angeles) *A Formal Theory for Vortex Rossby Waves and Vortex Evolution: Natural Selection of Anticyclones at F*

W.R. Peltier (Univ. of Toronto) *Breaking Waves and Mixing in Stratified Flows*

Robert M. Miura, Jennifer Enns-Tuttan, Yuquing Wang (UBC) *Waves in the Brain*

Theodore G. Shepherd (Univ. of Toronto) *Wave-vortex Interactions and Implications for Mixing in the Middle Atmosphere*

Interested readers may view a complete list of speakers together with their abstracts, contact information, and pictures on the website **waves3.math.ualberta.ca**.

Workshop on Theoretical and Numerical Fluid Mechanics Vancouver, August 20–25, 2001

Organizers: Giovanni P. Galdi (Pittsburgh), John Heywood (UBC, chairman), Rolf Rannacher (Heidelberg)

The meeting brought together leading researchers from several areas of fluid dynamics to share recent developments, discuss their significance, and bring into focus new directions and problems. The topics considered shared a unifying theme, in that their theoretical starting points are in the mathematical theory of the Navier-Stokes equations. Specifically, the focus was on: Nonlinear Fluids, Turbulence, Viscous Compressible Flow, Classical Navier-Stokes Problems, and Numerical Methods for these various types of problems.

Another focus was to bring to attention interesting problems for numerical computation. Presently, we have achieved the capability to compute two and three dimensional incompressible Navier-Stokes flow in complicated geometries, provided that the complexity of the solution (its range of scales) does not exceed the limitations of our hardware. The aim was to promote the extension of current numerical meth-

ods to problems for compressible and nonlinear fluids, and also to the modeling of turbulent flow. Also, with improved computational ability, many classical Navier-Stokes problems have become suggestive of interesting situations for numerical computation. Many of these raise interesting questions concerning artificial boundary conditions, for the restriction of idealized problems to bounded computational domains. Other problems for numerical computation involve questions of stability and bifurcation, and of attractors, and of the statistical properties of attractors, and of the energy dissipation in different regions of the spectrum.

Finally, the meeting brought Canadian and American research in mathematical fluid dynamics into better contact with European and Japanese research.

Main Speakers:

Pironneau, Olivier (U. of Montpellier II and of Paris VI, France) *Optimal Shape Design with Turbulent flows*

Hughes, Thomas J.R. (Stanford U., USA) *Large eddy simulation and the variational multiscale method*

Masuda, Kyuya (Meiji U., Japan) *Equations in Fluid Mechanics and analyticity*

Mahalov, Alex (Arizona State U., USA) *3D Navier-Stokes and Euler Equations with Initial Data Characterized by Uniformly Large Vorticity*

Neustupa, Jiri (Charles U., Prague, Czech Republic) *Conditions for Local Regularity of a Weak Solution to the Navier-Stokes Equations*

Choe, Hi Jun (KAIST, Korea) *On the regularity criterion of Navier-Stokes equations*

Turek, Stefan (U. of Dortmund, Germany) *On the next generation of CFD Tools*

Kevlahan, Nicholas (McMaster U., Canada) *An adaptive wavelet method for fluid-structure interaction*

Rautmann, Reimund (U. of Paderborn, Germany) *Navier-Stokes Approximations in Interpolation Spaces*

Matsumura, Akitaka (Osaka U., Japan) *Inflow problems for a one-dimensional isentropic model system of compressible viscous gas*

Hoff, David (U. of Indiana, USA) *Dynamics of Singularity Surfaces for Multidimensional, Compressible Navier-Stokes Flows*

Pileckas, Konstantin (Vilnius U., Lithuania) *Asymptotics of Solutions to Navier-Stokes Equations in a Three- Dimensional Layer*

Kroener, Dietmar (U. of Freiburg, Germany) *Transparent boundary conditions for compressible flows*

Novotny, Antonin (U. of Toulon, France) *Navier-Stokes equations when the density is not square integrable*

Bause, Markus (U. of Erlangen, Germany) *Approximation schemes for stationary compressible viscous flow*

Nagata, Wayne (U. of British Columbia, Canada) *Bifurcations on spheres and hemispheres: convection in planets and branching of plant tips*

Bermejo, Rodolfo (Universidad Complutense de Madrid, Spain) *A numerical study of the attractor of 2D Navier-Stokes equations applied to Ocean dynamics*

Morrison, Philip (U. of Texas, Austin, USA) *Transport by chaotic advection with nontwist Hamiltonian flows and symplectic maps of the plane*

Amann, Herbert (Institute for Mathematics, U. of Zrich, Switzerland) *Navier-Stokes equations in spaces of low regularity*

Beale, Thomas J. (Duke U., USA) *Computational Methods for Singular and Nearly Singular Integrals in Incompressible Fluid Flow*

Straskraba, Ivan (Mathematical Institute, Czech Academy of Sciences, Czech Republic) *A brief summary of global properties of solutions to the compressible Navier-Stokes equations*

Jindrich Necas (Charles U. Institute of Mathematics, Prague, Czech Republic) *Global Analysis for fluids with pressure dependent viscosities*

Frigaard, Ian (U. of British Columbia, Canada) *Stability problems in parallel shear flows of visco-plastic fluids*

Schonbek, Maria (U. of California at Santa Cruz, USA) *On zero mass solutions of viscous conservation laws*

Shibata, Yoshihiro (Waseda U., Japan) *Stokes resolvent problem with Neumann type boundary condition*

Wiegner, Michael (Institute of Technology at Aachen, Germany) *The Stokes Semigroup on an Infinite Layer*

Sawada, Okihiro (Hokkaido U., Japan) *Global existence of two-dimensionl Navier-Stokes flow with nondecaying initial velocity*

Galdi, Giovanni P. (U. of Pittsburgh, USA) *Sedimentation of Symmetric Particles in Newtonian and Viscoelastic Liquids: A Mathematical Analysis with Applications*

Glowinski, Roland (U. of Houston, USA) *On the motion of pendula in incompressible viscous fluids: A numerical approach*

Finn, Robert (Stanford U., USA) *Six remarkable properties of capillary surfaces*

Padula, Mariarosaria (U. of Ferrara, Italy) *Stability of an isolated fluid drop rotating with finite angular velocity*

Heine, Claus (Institute of Technology at Aachen, Germany) *A Numerical Method for Shape and Stability of the Rotating Drop*

Siegel, David (U. of Waterloo, Canada) *Equilibrium Configurations For A Floating Drop*

Farwig, Reinhard (Institute of Technology at Darmstadt, Germany) *Maximal Regularity of the Stokes Operator in an Infinite Cylinder*

Guenther, Ronald (Oregon State U., USA) *Hydrodynamic Forces and Torques on Submerged Rigid Bodies - Steady Flow*

Avrin, Joel (U. of North Carolina at Charlotte, USA) *A Large-Frequency One Point Attractor Theory for the incompressible Navier-Stokes Equation on Bounded Domains*

Rannacher, Rolf (U. of Heidelberg, Germany) *Adaptive discretization in optimal control of flows*

Illner, Reinhard (U. of Victoria, Canada) *Diffusive equilibria in granular flow*

Fujita, Hiroshi (Tokai U., Tokyo) *Nonlinear Semigroup Theory and Nonstationary Stokes Flows under Boundary Conditions of Friction Type*

Sauer, Niko (U. of Pretoria, South Africa) *A model for boundary permeation*

Bowman, John (U. of Alberta, Canada) *A Statistical Description of Two and Three-Dimensional Turbulence*

Tran, Chuong (U. of Alberta, Canada) *Constraints on the spectral distribution of energy and enstrophy dissipation in forced two-dimensional turbulence*

Theme 2002 (A): Asymptotic Geometric Analysis

Asymptotic Geometric Analysis is concerned with the geometric and linear properties of finite-dimensional convex bodies, especially with the asymptotics of various quantitative parameters as the dimension of the underlying space tends to infinity. The techniques here combine geometric, analytic, probabilistic and combinatorial methods. The main directions of study are:

- *Convex Geometric Analysis* including problems from Classical Convexity and Isomorphic Geometry.
- *Asymtotic Combinatorics* including questions in Complexity Theory and Computational Geometry.
- Certain aspects of *Statistical Physics* that deals with "Threshold" and "Phase Transition" phenomena.

The main probabilistic tools used are deviation inequalities and the concept of concentration of measure phenomenon, which in fact is, an isomorphic form of isoperimetric type inequalities. Measure Transport methods and related PDEs have provided new and powerful *Geometric Inequalities* of Brunn-Minkowski and Brascamp-Lieb type as well as novel approaches to Log-Sobolev and Talagrand-type inequalities. The subject is also connected with *quantized functional analysis* via important estimates for the distribution of eigenvalues and norms of random matrices, as well as with some aspects of free and quantum information theories, operator spaces and non-commutative L_p spaces.

Scientific Committee:

Vitali Milman (co-chair, Tel Aviv)
Nicole Tomczak-Jaegermann (co-chair, U. Alberta)
Nassif Ghoussoub (PIMS and UBC)
Robert McCann (U. Toronto)
Gideon Schechtman (Weismann Inst.)
Gilles Pisier (U. of Paris VI and Texas A&M)

Programme:

Advanced Graduate Camp
PIMS-UBC, June 15–30, 2002

Conference on Convexity and asymptotic theory of normed spaces
PIMS-UBC, July 1–5, 2002

Concentration period on Measure Transportation and Geometric Inequalities
PIMS-UBC, July 8–12, 2002

Workshop on Phenomena of large dimensions
PIMS-UBC, July 14-20, 2002

Focused Research Groups on Random Methods and High Dimensional Systems
PIMS-UBC, July 21–August 5, 2002

Workshop on Non-commutative Phenomena and Random Matrices
PIMS-UBC, August 6–9, 2002

Workshop on Banach Spaces
PIMS-UBC, August 12–15, 2002

Programme Summary and Schedule:

The goal of this thematic program is to bring together some areas of Mathematics and Computer Science which are dealing with asymtotic behavior of different parameters when the dimension, or a number of other relevant free parameters, increases to infinity . The main directions of this subject of study are Convex Geometric Analysis (Asymptotic Theory of convex bodies and Normed spaces), some problems of Discrete Mathematics (one may call it Asymptotic Combinatorics) including problems of Complexity Theory, and some problems of Statistical Physics. Closely connected are also some directions in Probability and in PDE, including non linear PDEs arising from problems in Convex Analysis and Geometric Inequalities. The main activity will concentrate around Convex Geometric Analysis, but understood in a very broad sense, as the intent is to involve a large number of main people of other related fields.

The intent is to bring together senior experts and young researchers, postdocs and advanced Ph.D. students, with an emphasis on a major participation from the young generation.

Advanced Graduate Camp PIMS-UBC, June 15–30, 2002

Organizers: Vitali Milman (Tel Aviv) and Nicole Tomczak-Jaegermann (U. Alberta).

Lectures on subjects connected with the whole program directed to young participants, advanced Ph.D. students and PDFs.

Conference on Convexity and asymptotic theory of normed spaces PIMS-UBC, July 1–5, 2002

Organizers: Erwin Lutwak (Warsaw) and Alain Pajor (Marne-La-Vallée).

Topics include classical convexity, Radon transform and Fourier methods in convexity, asymptotic theory of high dimensional convex bodies, geometric functional inequalities and probabilistic methods in convexity, isoperimetric-type inequalities.

Concentration period on Measure Transportation and Geometric Inequalities PIMS-UBC, July 8–12, 2002

Organizer: Robert McCann (U. Toronto).

This concentration period will focus on transportation of measure methods and their applications, concentration of measure phenomenon, geometric functional inequalities (Brascamp-Lieb, Sobolev, entropy, Cramer-Crao, etc), "isomorphic" form of geometric inequalities and probabilistic methods.

Workshop on Phenomena of large dimensions PIMS-UBC, July 14–20, 2002

Organizers: Vitali Milman (Tel Aviv), Michael Krivilevich, Laszlo Lovasz (Microsoft Research) and Leonid Pastur (U. Paris VII).

Topics include different phenomena observed in complexity theory, asymptotic combinatorics, asymptotic convexity, statistical physics and other theories of very high parametric families (or large dimensional spaces).

Focused Research Groups on Random Methods and High Dimensional Systems PIMS-UBC, July 21–August 5, 2002

Organizers: Vitali Milman (Tel Aviv) and Nicole Tomczak-Jaegermann (U. Alberta).

Topics include the asymtotic behavior of different parameters when the dimension, or a number of other relevant free parameters, increases to infinity. The main direction is the study of the asymptotic theory of convex bodies and normed spaces as well as their applications to combinatorics and phase transition phenomena.

Workshop on Non-commutative Phenomena and Random Matrices PIMS-UBC, August 6–9, 2002

Organizers: Gilles Pisier (U. Paris VI and Texas A & M) and Stanislaw Szarek (U. Paris VI and Case Western Reserve).

Topics include the distribution of eigenvalues of random matrices, norms of such matrices, some aspects of free and quantum information theories, applications in many fields, quantized functional analysis and operator spaces and non-commutative L_p spaces.

Workshop on Banach Spaces PIMS-UBC, August 12–15, 2002

Organizers: Bill Johnson (Texas A & M and Ted Odell (U. Texas, Austin).

This workshop will focus on the asymptotic theory of Banach spaces and other applications of local theory to the geometry of infinite dimensional Banach spaces.

Theme 2002 (B): Selected Topics in Mathematical and Industrial Statistics

Statistical models became, in the late 20th century extremely complex and high dimensional. One goal is to identify opportunities and challenges for model development and criticism and to begin to outline approaches to assessment of complex models. This requires bringing together leading practitioners and philosophers of scientific, Bayesian and frequentist modelling statistics with leading researchers in model assessment, validation and goodness-of-fit.

Robust Statistics and Statistical Computing deal with methods designed for processing large data sets of uneven quality (databases containing outliers, gross errors, missing data, etc.). One focus is on the efficient computation of robust estimates using very large data sets.

Design and Analysis of Experiments are at the heart of the statistical sciences. Yet –unlike the designs originating from agricultural problems developed by Sir Ronald Fisher in the 1920's– many industrial problems are not well-explored in the statistical literature. To help North American industry compete globally, advanced statistical methods suitable for real applications need to be further developed.

Programme Organizers:

Richard Lockhart (SFU)
Charmaine Dean (SFU)
Peter Guttorp (U. Washington)
Chris Field (Dalhousie)
R. H. Zamar (UBC)
Randy Sitter (SFU)
Agnes Herzberg (Queen's)

Programme:

Workshop on the Role of Statistical Modelling in the 21st Century
PIMS-SFU, May 4–6, 2002

International Conference on Robust Statistics (ICORS 2002)
UBC, May 12–18, 2002

3rd MITACS Annual General Meeting: Statistics for Large Scale Industrial Modeling
UBC, Vancouver, May 23-25, 2002

Design and Analysis of Experiments
Vancouver, July 14–18, 2002

Workshop on the Role of Statistical Modelling in the 21st Century, PIMS-SFU, May 4–6, 2002

Organizers: Richard Lockhart and Charmaine Dean (SFU) and Peter Guttorp (U. Washington).

Statistical models became, in the late 20th century extremely complex and high dimensional. This workshop will bring together leading practitioners and philosophers of scientific, Bayesian and frequentist modelling statistics with leading researchers in model assessment, validation and goodness-of-fit. The goals are to identify opportunities and challenges for model development and criticism and to begin to outline approaches to assessment of complex models.

Confirmed Speakers:

David Brillinger (UC at Berkeley)
Alan Gelfand (University of Connecticut)
Jim Berger (Duke University – tentative)
Jerry Lawless (University of Waterloo)
Iain Currie (Heriot-Watt University)
Karim Abadir (University of York, York, UK)
Federico O'Reilly (IIMAS, UNAM – Mexico)

Invited Speakers:

Joe Gani (Australian National University)
Anthony Pettitt (Queensland University of Technology)
Christian Genest (Universite Laval)
Persi Diaconis (Stanford University)
Jianqing Fan (North Carolina and Chinese Univ of Hong Kong)

International Conference on Robust Statistics (ICORS 2002), University of British Columbia, May 12–18, 2002

Conference Organisers: Luisa Fernholz (Temple Univ.), Ursula Gather (Dortmund), Chris Field (Dalhousie) and R. H. Zamar (UBC).

This conference will be a forum for new developments and applications of robust statistics and statistical computing. Experienced researchers and practitioners, as well as younger researchers, will come together to exchange knowledge and to build scientific contacts.

The conference will centre on methods designed for processing large datasets of uneven quality (databases containing outliers, gross errors, missing data, etc.). This conference expects to touch upon many different aspects of data analysis in a fashion which integrates theoretical and applied statistics. One focus will be on the efficient computation of robust estimates using very large data sets.

Confirmed Participants:

Laury Davies (Univ. of Essen, Germany)
Luisa Fernholz (Temple Univ.)
Chris Field (Dalhousie Univ.)
Ursula Gather (Univ. of Dortmund, Germany)
Xuming He (Univ. of Illinois)
Ricardo Maronna (Univ. of La Plata, Argentina)
Doug Martin (Univ. of Washington)
Stephan Morgenthaler (EPFL, Switzerland)
Elvszio Ronchetti (Univ. of Geneva)
Peter Rousseeuw (Univ. of Antwerpen, Belgium)
Werner Stahel (ETH Zurich)
David Tyler (Rutgers University)
Doug Wiens (Univ. of Alberta)
Victor Yohai (Univ. of Buenos Aires)
Julie Zhu (Univ. of Victoria)
Christopher Croux (Univ. of Brussels)

Design and Analysis of Experiments, Coast Plaza Suites Hotel, Vancouver, July 14–18, 2002

Organizers: Randy Sitter (SFU), Derek Bingham (Michigan), Bruce Ankenman (Northwestern) and Agnes Herzberg (Queen's U.).

Many industrial problems are not well-explored in the statistical literature. To help North American industry compete globally, advanced statistical methods suitable for real applications need to be further developed. Statistical experimental designs, developed by Sir Ronald Fisher in the 1920's, largely originated from agricultural problems. Although the design of experiments for industrial and scientific problems may have

the same basic concerns as design for agricultural problems, there are many differences: (i) industrial problems tend to require investigation of a much larger number of factors and usually involve a much smaller total number of runs (observations), (ii) industrial results are more reproducible, (iii) industrial experimenters are obliged to run their experimental points in sequence and are thus able to plan their follow-up experiments guided by previous results, unlike agriculture, in which all results are often harvested at one time, and (iii) models can be very complicated in industrial and scientific experimentation, sometimes requiring the need for nonlinear models or for computer modelling and finite element analysis.

Invited Speakers:

C. S. Cheng (UC at Berkeley)
V. Federov (SmithKline Beecham Pharmaceutical)
M. Hamada (Los Alamos National Laboratory)
J. Lawless (University of Waterloo)
M. Morris (Iowa State University, Ames)
R. Mukerjee (Indian Institute of Management, Calcutta)
V. Nair (University of Michigan, Ann Arbor)
J. Stufken (Iowa State University, Ames)
C. F. J. Wu (University of Michigan, Ann Arbor)
J. Zidek (UBC)

II. CORE SCIENTIFIC PROGRAMMES

From the left: M. Stevenson (President, SFU), N. Ghoussoub (PIMS Director), T. Li (Prog. Coordinator, APCTP), K. S. Viswanathan (Physics, SFU), H. Morris (Chair of Board, PIMS), G. Semenoff (Physics, UBC), B. K. Chung (Executive Director, APCTP) at the signing ceremony for the APCTP-PIMS Cooperative agreement.

Group photo from the NATO Advanced Research Workshop, August 2001.

PIMS Mini-Programmes

Mini-programmes are more focused events than the thematic programmes and span a shorter period of time. They are supposed to place the focus on having fewer formal lectures and more opportunities for active collaborative work between the participants. Unlike the regular workshops, most participants should be present and involved for an extended period.

Frontiers in Mathematical Physics on Workshop on String Cosmology, PIMS-UBC, July 24 – August 4, 2000

Organizers: Robert Brandenberger (Brown U.), Chaiho Rim (APCTP), Alexander Rutherford (PIMS), Bill Unruh (UBC) and Ariel Zhitnitsky (UBC).

The goal of the workshop was to bring together experts in string theory, nonperturbative gauge field theory and cosmology to explore the consequences for cosmology of the recent breakthroughs in fundamental field and string theory. These consequences may lead to a greatly improved understanding of the early Universe, and to the resolution of some fundamental problems for cosmology left unanswered by the present theories of the early Universe.

This workshop was co-sponsored by PIMS, the Canadian Insitute for Advanced Research and the Asia Pacific Center for Theoretical Physics.

Main Speakers:

Brian Greene (Columbia Univ): *What Every Cosmologist Should Know About String Theory*

Nemanja Kaloper (CITA, U. Toronto): *Cosmology of Brane Worlds, Cosmological Constant in the Brane World Scenario*

Lev Kofman (CITA, U. Toronto): *Supergravity Cosmology*

Burt Ovrut (U. Pennsylvania): *Branes from String Theory, Horava-Witten Cosmology, Heterotic M-theory*

Sang-Jin Sin (Hanyang Univ.): *Brane Gases and Cosmology*

Dam Son (Columbia U.): *Nonperturbative QFT, RHIC Physics and Cosmology*

Paul Steinhardt (Princeton): *Questions for String Cosmology from the Perspective of Cosmology, Modular Cosmology*

Gabriele Veneziano (CERN): *Black Hole and String Entropy, Progress in Pre-Big-Bang Cosmology*

Herman Verlinde (Princeton Univ.): *Brane Worlds from String Theory, Holographic RG Flow and the Cosmological Constant*

Eric Zhitnitsky (UBC): *Nonperturbative QCD and Cosmology*

From the left: B. K. Chang, T. Li, B. Russell, A. Gupta, G. Semenoff and H. Morris at SFU'S Diamond Club.

APCTP, Perimeter and PIMS Collaborate on *Frontiers in Mathematical Physics*

The newly established Perimeter Institute for Theoretical Physics has joined the Asia Pacific Center for Theoretical Physics (APCTP) and PIMS in sponsoring the *Frontiers in Mathematical Physics* (FMP) workshop held annually in Vancouver.

The Asia Pacific Center for Theoretical Physics (**www.apctp.org**) is an international organization based in Seoul, South Korea. The member countries or regions of the institute are Australia, China, Japan, Malaysia, Philippines, Singapore, Taiwan, Thailand and Vietnam.

The APCTP has a mandate to promote and foster high level research in theoretical physics. Since its inception in 1996 it has maintained an active programme of international meetings which has earned it a worldwide reputation for excellence.

Since 1998, APCTP has cooperated with PIMS on jointly organizing and funding the *Frontiers in Mathematical Physics* workshops which have taken place in Vancouver every summer. This year's workshop was used an occasion to sign a cooperative agreement between PIMS and APCTP, which formalizes an already strong record of scientific collaboration and cements future plans for cooperation. Professor B. K. Chung, Executive Director of the APCTP, and Professor Nassif Ghoussoub, Director of PIMS joined SFU President Michael Stevenson and more than fifty participants of the workshop to celebrate this unprecedented collaborative event.

The Perimeter Institute for Theoretical Physics (**www.perimeterinstitute.com**) is based in Waterloo, Ontario, Canada. It was founded in 2000 through a personal donation by Mike Lazaridis, President and Co-Chief Executive Officer of Research In Motion Limited (RIM) to "serve as a state-of-the-art Canadian physics institute dedicated to bold, provocative research of the fundamental aspects of the physical world...". Both PIMS and APCTP welcome the involvement and support of the Perimeter Institute to the *Frontiers in Mathematical Physics* series.

Frontiers in Mathematical Physics on Workshop on Particles, Fields and Strings PIMS-SFU, July 16–27, 2001

Organizers: K. S. Viswanathan, chair (Simon Fraser University), Taejin Lee (Kangwon University, Korea), Yuri M. Makeenko (Niels Bohr Institute, Copenhagen/ITEP, Moscow), John Ng (TRIUMF), Alexander Rutherford (PIMS) and Gordon W. Semenoff (University of British Columbia)

The sixth workshop in the Frontiers in Mathematical Physics Series focused on the consequences of recent breakthroughs in the rapidly developing areas of superstring theory and nonperturbative gauge field theory.

Invited Speakers:

Dongsu Bak (University of Seoul, Korea)

Bruce Campbell (University of Alberta)

Steve Giddings (University of California): *Strong Gravity at the TEV Scale*

Seungjoon Hyun (Seoul National University, Korea) :

Y. Kitazawa (KEK, Japan)

Per Kraus (Enrico Fermi Institute)

Robert Leigh (University of Illinois): *D-branes on Orbifolds: The Standard Model*

Shiraz Minwalla (Harvard University)

Rob Myers (McGill University): *Dielectric Branes*

Soonkeon Nam (Kyung Hee University, Korea): *Orientifolds, Conifolds and Quantum Deformations*

Mark Van Raamsdonk (Stanford University)

Simon Ross (University of Durham, U.K.)

Savdeep Sethi (University of Chicago)

Richard Szabo (Heriot-Watt University, Edinburgh): *Gauge Symmetries in Noncommutative Yang-Mills Theory*

Arkady Tseytlin (Ohio State University): *Magnetic Backgrounds and Tachyons in Closed Strings*

NATO Advanced Research Workshop: New Techniques in Topological Quantum Field Theory University of Calgary and Delta Lodge at Kananaskis, August 23–27, 2001

Directors: John M. Bryden (University of Calgary and Southern Illinois University), F. Deloup (Université Paul Sabatier) and Victor A. Vassiliev (Steklov Mathematical Institute, Independent University of Moscow).

Organizers: D. Rolfsen (University of British Columbia), V. Turaev (Université Louis Pasteur, CNRS Strasbourg) and P. Zvengrowski (University of Calgary).

This workshop was held from August 23–24 at the University of Calgary and August 25–27 at the Delta Lodge at Kananaskis.

Objective of the ARW: The objective of the meeting was to develop a common framework for ideas coming from many important areas of mathematical resear ch related to topological quantum field theory (tqft). In particular, the intent was to examine the interaction between algebraic topology and Vassiliev Theory with Turaev's development of both topological quantum field theory and homtopy quantum field theory. It also dealt with the study of the interaction between the representation theory of braids and other related subjects with tqft.

Plenary Speakers:

D. Bar-Natan (Hebrew University)

S. Bigelow (University of Melbourne): *Homology and the Hecke algebra*

J. Birman (Columbia University)

M. Karoubi: *Braiding of Differential Forms and Homotopy Type*

G. Masbaum: *Matrix-Tree Theorems and the Alexander-Conway Polynomial*

Speakers:

D. Auckly (Kansas State U.): *Twisted Yang-Mills Theory*

M. Boileau (Université Paul Sabatier): *Uniformization of Small 3-Orbifolds*

P. Bona (U. of Bratislava): *Nonlinear Quantum Systems as Subsystems in Quantum Field Theory*

J. Bryden (U. of Calgary & Southern Illinois U.): *Quantum Homotopy theory II*

F. Cohen (U. of Rochester): *Braid Groups and Modular form*

L. Crane (Kansas State U.): *Matheamtical Lessons from Quantum General relativity*

C. Cunningham (U. of Calgary): *Perverse Sheaves and Loop Groups*

F. Deloup (Université Paul Sabatier): *How to Recognize a Linking Summand*

S. Duzhin (Steklov Mathematical Institute, St. Petersburg): *On Kleinian Weight systems*

I. Dynnikov (Moscow State U.): *Finitely Presented Groups and Semigroups in Knot Theory*

M. Heusener (Université Blaise Pascal): *Regenerating Singular Hyperbolic Structures From Sol*

S. Lando (Independent U. of Moscow): *Vassiliev Invariants Obtained from Graph Invariants*

R. Lawrence (Hebrew U.): *Representation Theory of the Braid Groups and Computation of Quantum Invariants*

J. Milgram (Stanford)

S. Natanzon (Moscow State U. & Independent U. of Moscow): *Topological Classification of* $\mathbf{Z}/p$ *Actions on Surfaces*

M. Polyak (Tel Aviv University)

J. Przytycki (George Washington U.): *Symplectic Structure on Coloring of Tangles*

D. Rolfsen (UBC): *Orderable Three-Manifold Groups*

D. Sjerve (UBC): *Automorphisms of Bilyea Surfaces*

D. Thurston (Harvard): *Wheels and Wheeling*

V. Tourtchine (Independent U. of Moscow): *On the Homology of the Spaces of Long Knots*

A. Tralle (U. of Warmia and Mazuria):

V. Turaev (U. Louis Pasteur): *Quantum Homotopy I*

L. Vainerman (Kiev State U.): *Quantum Invariants of 3-Manifolds from Quantum Groupoids*

V. Vassiliev (Steklov Mathematical Institute & Independent U. of Moscow): *New Invariants of Spaces of Knots*

V. Vershinin (Novosibirsk State U.): *Homological Properties of Virtual Braids*

Pacific Northwest Seminar Series

These are annual or bi-annual meetings that bring together various regional groups of mathematicians in areas represented by strong communities in British Columbia, Alberta, Washington, Oregon and Northern California. Some of the scientific goals of the Pacific Institute, e.g. promoting communication and interactions among mathematical scientists, are served by *ad hoc* organizations formed in Western Canada and the U. S. Pacific Northwest.

PNW Algebraic Geometry Seminar

October 13, 2001 at Western Washington University: This meeting in Bellingham featured the following three speakers.

Speakers:

Mark Haiman (UC Berkeley): *The Hilbert scheme and Bridgeland-King-Reid correspondence for the diagonal action of S_n*

Brendan Hassett (Rice University): *Moduli spaces and the minimal model program*

Aaron Bertram (Utah): *Reconstructing genus zero Gromov-Witten invariants*

PNW Geometry Seminar

The Pacific Northwest Geometry Seminar (PNGS) is a regional meeting for geometers of all kinds. It is held at least twice during the academic year, rotating among the University of British Columbia, Oregon State University, University of Oregon, Portland State University, University of Utah, and the University of Washington.

May 6–7, 2000 at PIMS-UBC: This meeting was co-sponsored by PIMS and the National Science Foundation of the United States.

Organisers: Jim Carrell (UBC) and Jingyi Chen (UBC).

Speakers:

Gang Liu (UCLA): *The Equivalence of Ring Structures in Floer and Quantum Cohomology*

Stephan Stolz (Notre Dame): *Metrics of Positive Scalar Curvature*

Rahul Pandharipande (CalTech): *Integrals over the moduli space of curves*

Paul Yang (Princeton and USC): *A Fully Nonlinear Equation in Conformal Geometry and 4-manifolds of Positive Ricci Curvature*

Jim Carrell (UBC): *Which Schubert Varieties are Smooth*

October 27–28, 2001 at Univ. of Oregon

Organisers: Boris Botvinnik, Peter Gilkey, Jim Isenberg (University of Oregon) and Christine Escher (Oregon State University).

Speakers:

Egidio Barrera-Yanez (Instituto de Matematicas, UNAM, Cuernavaca, Mexico): *The eta invariant and the "twisted" connective real K-theory*

Ben Chow (UC San Diego): *Hamilton's injectivity radius estimate for the Ricci flow*

Claude LeBrun (SUNY Stony Brook): *Curvature and smooth topology in dimension four*

Gregor Weingart (University of Bonn and OSU): *Spectral Sequences arising in Differential Geometry*

Kazuo Akutagawa (Shizuoka University, Japan & U of Oregon): *Yamabe metrics on cylindrical manifolds*

Western Canada Linear Algebra Meeting (W-CLAM)

W-CLAM is a bi-annual sequence of meetings on linear algebra and related fields; previous meetings have been held in Regina, Lethbridge and Kananaskis. The objective is to foster research in linear algebra and its applications. While the primary purpose of W-CLAM is to enable researchers (including graduate students) from Western Canada to get together to present current work and to exchange ideas, the meeting is open to anyone.

May 26–27, 2000 at University of Manitoba: This was co-sponsored by CRM and Fields.

Organisers: Hadi Kharaghani (Univ. of Lethbridge), Steve Kirkland (Univ. of Regina), Peter Lancaster (Univ. of Calgary), Dale Olesky ((Univ. of Victoria), Michael Tsatsomeros (Univ. of Regina) and Pauline van den Driessche (Univ. of Victoria).

Invited Speakers:

Hans Schneider (Univ. of Wisconsin): *Perron-Frobenius & Some Readings in Population Demography*

Bryan Shader (Univ. of Wyoming): *Linear Systems with Signed Solutions*

Henry Wolkowicz (Univ. of Waterloo): *Semidefinite Programming and Matrix Completion*

PNW Number Theory Seminar

April 28, 2001 at Redmond, Washington: This was the 5th PNW Number Theory Seminar.

Organizers: Matt Klassen (DigiPen Institute of Technology), Kristen Lauter (Microsoft Research) and Peter Borwein (Simon Fraser University).

Speakers:

Ed Schaefer (Santa Clara Univ.): *How to compute the p-Selmer group of an elliptic curve for an odd prime p*

Audrey Terras (UC San Diego): *Comparison of Selberg's Trace Formula with its Discrete Analogues*

Nike Vatsal (University of British Columbia): *Ergodic theory and Heegner points*

Trevor Wooley (University of Michigan): *Slim exceptional sets in Waring's problem*

July 5, 2001 at PIMS-SFU: A Day of Number Theory at SFU.

Speakers:

Doug Bowman (University of Illinois): *Zeta Values: From Leibniz to Today*

David Bradley (University of Maine): *Research Update on Multiple Polylogarithms*

Nils Bruin (Simon Fraser University): *Skolem-Mahler-Lech and Chabauty-Coleman*

Edlyn Teske (University of Waterloo): *Factoring $N = pq^2$ with the Elliptic Curve Method*

PNW Numerical Analysis Seminar

October 28–29, 2000 at Vancouver Museum: Vancouver Numerical Analysis Weekend: Potlatch 2000 & Fast Multipole Workshop.

Organisers: Uri Ascher (UBC), Mary Catherine Kropinski (SFU), Steven Ruuth (SFU), Manfred Trummer (SFU) and Jim Varah (UBC).

Speakers at the Potlatch:

Frank Stenger (Utah): *A unified approach to solving PDEs*

Russell Luke (University of Washington): *Nonparametric Phase Retrieval: Iterative transform algorithms and analytic techniques*

Dhavide Aruliah (UBC): *Multigrid Preconditioning of time-harmonic Maxwell's equations in 3D*

Leslie Greengard (Courant Institute): *Robust Algorithms for Computational Engineering*

Sorin Mitran (University of Washington): *Algorithms for computing bubbly flows*

Oliver Dorn (UBC): *A level set approach for shape reconstruction in electromagnetic cross-borehole tomography*

Sharon Filipowski (Boeing): *Applications of nonsmooth optimization in industry*

Ricardo Carretero (SFU): *Metastability and blow-up in reaction diffusion systems: Some computational challenges*

Speakers at the Fast Multipole Workshop:

Michael Epton (Boeing): *Application of Multipoles to Compressible Aerodynamics: Interesting Issues and Observations*

Leslie Greengard (Courant Institute): *A new version of the fast multipole method for screened Coulomb interactions*

Ben Dembart (Boeing): *The Search for an O(N) FMM for the Helmholtz/Maxwell's Equation*

Vikram Jandhyala (University of Washington): *FMM variations for quasi-planar structures and related applications*

Frank Ethridge (Courant Institute): *Fast Algorithms for Volume Integrals in Potential Theory*

Mary Catherine Kropinski (SFU): *Fast Integral Equation Methods for Interfaces in a Stokes Flow*

September 29, 2001 at Western Washington University: The 15th annual PNWNAS.

Organiser: Tjalling Ypma (Western Washington University)

Speakers:

Randy Bank (UC San Diego): *Pre-conditioning*

Tim Chartier (University Colorado Boulder): *Multigrid*

Lisa Stanley (Montana State University): *Sensitivity Computation*

Wei-Pai Tang (Boeing): *Linear Algebra*

Harold Trease (Batelle): *Large-Scale Computation*

West Coast Optimization Seminar

The West Coast Optimization Meeting takes place twice each year, and alternates between Vancouver and Seattle. In Vancouver, SFU/CECM and UBC/Math share the hosting duties, with local contacts Jonathan M. Borwein and Philip D. Loewen. In Seattle, UW/Math and UW/Applied Math contribute the organizational personnel: R. T. Rockafellar and J. V. Burke do most of the work. The meetings involve an informal get-together for social and technical discussions on Friday evening, followed by a series of talks on Saturday. Speakers are drawn from the considerable body of optimization talent now gathered in the five PIMS partner sites, the University of Washington, and Washington State University; a featured guest from outside is usually invited to round out the programme.

May 12–13, 2000 at PIMS-SFU

Speakers:

Heinz Bauschke (Okanagan University College): *How JPEG Works*

Jim Burke (University of Washington): *Variational Analysis of Spectral Functions*

Lisa Korf (University of Washington): *Pricing Contracts Contingent on a Market: A Mathematical Programming Perspective*

Ivaylo Kortezov (SFU): *Some Generic Results on Non-attaining Functionals*

Yuri Ledyaev (Western Michigan University): *Sub- and Supergradients of Envelopes, Semicontinuous Closures and Limits of Functions*

Martin Puterman (UBC): *The Censored Newsvendor and the Optimal Acquisition of Information*

Jim Zhu (Western Michigan University): *Generalized Extremal Principle and its Applications*

May 4–5, 2001 at PIMS-SFU

Speakers:

Heinz Bauschke (Okanagan University College): *The method of cyclic projections - the inconsistent case*

James Burke (University of Washington): *Approximating of subdifferentials by random sampling of gradients*

Warren Hare

Lisa Korf (University of Washington): *Duality Theorems in Stochastic Programming*

Mason Macklem (Simon Fraser University): *Current Models in Image Quality Evaluation*

R. T. Rockafellar (University of Washington): *Variational Geometry and Equilibrium*

Stephen Simons (UC, Santa Barbara): *Hahn-Banach and minimax theorems*

Herre Wiersma (Simon Fraser University): *A C^1 function that is even on a sphere and has no critical points in the ball*

Jim Zhu (Western Michigan University): *Necessary conditions for constrained optimization problems in smooth Banach spaces and applications*

PNW PDE Seminar

Organisers: Richard Froese (UBC), Nassif Ghoussoub (PIMS and UBC) and Gunther Uhlmann (U. Washington).

May 20, 2000 at PIMS-UBC

Speakers:

Daniel Tataru (Northwestern): *Local well-posedness for nonlinear hyperbolic equations*

Tatiana Toro (U. Washington): *Potential theory and regularity of non-smooth domains*

Juncheng Wei (Chinese U. of Hong Kong): *On A Simple ODE and Anisotropic Curvature Flows*

May 19, 2001 at University of Washington

Speakers:

James Colliander (UC, Berkeley): *Global well-posedness and long-time behavior of solutions of nonlinear dispersive equations*

Izabella Łaba (UBC): *Recent work on the Kakeya conjecture*

Hart Smith (University of Washington): *Global Existence for Quasilinear Wave Equations outside of Star-Shaped Domains*

Luis Vega (Universidad del Pais Vasco, Spain): *Formation of singularities for the vortex filament motion under LIA*

PNW Probability Seminar

This seminar is organized by the probability groups at the UBC, Univ. of Washington and Oregon State University. It usually attracts 25–30 participants and gives the various groups a chance to interact with each other. As these are among the strongest probability groups in North America it has been easy to attract outstanding scientists as speakers. This is also a good way for these groups to share many of the visiting scientists with the other sites.

Scientific advisory committee: Martin Barlow (UBC), Richard Bass (UW), Chris Burdzy (UW), Ed Perkins (UBC) and Ed Waymire (OSU).

March 4, 2000 at Univ. of Washington

Speakers:

Christian Borgs (Microsoft Theory Group): *Partition function zeros: A generalized Lee-Yang theorem*

Xiaowen Zhou (University of British Columbia): *Sample path continuity of continuous-site stepping-stone models*

December 2, 2000 at Univ. of Washington

Speakers:

Zhenqing Chen (University of Washington): *Girsanov transform and absolute continuity of Markov processes*

Antal Jarai (PIMS and UBC): *ncipient infinite clusters in 2D percolation*

Mina Ossiander (Oregon State University): *Multiplicative Random Cascades: Structure and Estimation*

Prasad Tetali (Georgia Tech and Microsoft Research): *A Gittins-type index for Markov systems*

October 20, 2001 at Univ. of Washington

Speakers:

David C. Brydges (UBC): *Branched Polymers and Dimensional Reduction*

Jim Fill (Johns Hopkins University and Microsoft Research): *he Randomness Recycler: A new technique for perfect sampling*

Christopher Hoffman (University of Washington): *Phase Transition in Dependent Percolation*

Enrique Thomann (Oregon State University): *Stochastic Cascades applied to the Navier Stokes Equations*

PNW Statistics Meeting

November 17, 2000 at the Univ. of Washington

Speakers:

June Morita (University of Washington-Bothell): *Contributions to Statistical Literacy*

Constance van Eeden (University of British Columbia): *Estimation in Restricted Parameter Spaces: Some History and Some Recent Developments*

March 16, 2001 at SFU

Speakers:

Merlise Clyde (Duke University): *Empirical Bayes Prior Distirbutions and Bayesian Model Averaging*

Julia Wirch (Simon Fraser University): *Coherent Risk Measures and Stochastic Dominance*

PNW Seminar on String Theory

March 17, 2001 at UBC

Organisers: Konstantin Zarembo (UBC), Gordon Semenoff (UBC) and Sandy Rutherford (PIMS).

Speakers:

Washington Taylor (MIT): *Tachyon condensation in open string field theory*

Kostas Skenderis (Princeton University): *Holographic renormalization*

Amanda Peet (University of Toronto): *String theoretic mechanisms for spacetime singularity resolution*

Emil Martinec (University of Chicago): *D-branes as noncommutative solitons: an algebraic approach*

Hiroshi Ooguri (Caltech): *Strings in AdS_3 and the* $SL(2,R)$ *WZW model*

PIMS Lecture Series

- IAM-PIMS Joint Distinguished Lecture Series in Applied Mathematics
- PIMS-MITACS Mathematical Finance Seminar
- PIMS String Theory Seminar
- PIMS Centre for Scientific Computing Seminar
- PIMS Centre for Theoretical Biology Seminar

IAM-PIMS Joint Distinguished Colloquium Series

This series of seminars is co-hosted by the Institute for Applied Mathematics at UBC and PIMS.

Organizer:
Bernie Shizgal (Director of the IAM)

2000/01 Series

Anne Greenbaum (U. Washington), *Analysis of Krylov Space Methods for Solving Linear Systems*, January 31, 2000

Marc Feldman (Stanford), *Mathematics and Statistics of Human DNA Polymorphisms: Forward and Backwards to History*, February 28, 2000

Alwyn Scott (U. Arizona and U. Denmark), *Nonlinear Science: Past, Present and Future*, March 13 2000

Carlo Cercignani (Politecnico di Milano, Italy), *Kinetic Models for Granular Materials; An Exact Solution*, 13 September 2000

David Brydges (University of Virginia), *Gaussian Integrals and Mean Field Theory*, September 27, 2000

Linda Petzold (UC at Santa Barbara), *Algorithms and Software for Dynamic Optimization with Application to Chemical Vapor Deposition Processes*, 1 November 2000

David Baillie (Simon Fraser University), *Comparative Genomics*, 16 January 2001

Gunther Uhlmann (University of Washington), *The Mathematics of Reflection Seismology*, 6 March 2001

Bengt Fornberg (University of Colorado, Boulder), *Radial Basis Functions - A future way to solve PDEs to spectral accuracy on irregular multidimensional domains?*, 27 March 2001

Planned 2001/02 Series

Philippe R. Spalart (Boeing), *Detached-Eddy Simulation (DES)*, October 1, 2001

David Gottlieb (Brown University), *Spectral Methods for Discontinuous Problems*, October 29, 2001

Joel H. Ferziger (Stanford University), *Numerical Simulation of Turbulence*, November 26, 2001

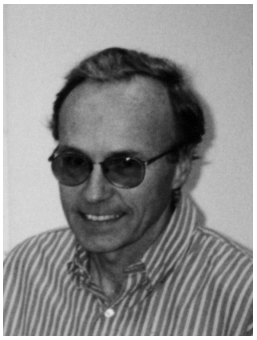
Russel Caflisch (UCLA), *Modeling and Simulation for Epitaxial Growth*, January 28, 2002

Adam Arkin (UC Berkeley), *Signal Processing in Cellular Regulatory Networks: Physical Models, Formal Abstractions and Applications*, February 18, 2002

Eva Tardos (Cornell University), *Approximation Algorithms and Games on Networks* , March 11, 2002

PIMS-MITACS Mathematical Finance Seminars

In conjunction with research activities of MITACS, PIMS hosts a series of talk on recent work in financial mathematics.



Organizer: Ulrich Haussmann (Math, UBC)

Seminars for 2000/2001

G. Stoica (MITACS PDF, UBC): *Calibration of the 2-factor electricity model,* January 27, 2000

Y. Zhao (UBC): *Portfolio selection with minimum wealth requirement,* February 10, 2000

Ulrich Haussmann (UBC): *Optimal portfolio selection with limited diversification,* February 24, 2000

N. Dokuchaev (St. Petersburg State University): *Optimal portfolio selection based on historical prices,* March 2, 2000

J. Chadam (Pittsburgh University): *The Exercise Boundary for an American Put Option: Analytical and Numerical Approximations,* March 9, 2000

J. Cvitanic (USC) *Methods of partial hedging,* March 16, 2000

R. Uppal (UBC): *Risk Aversion and Optimal Portfolio Policies in Partial and General Equilibrium Economies,* March 30, 2000

H. Geman (Paris Dauphine), April 2000

R. Stamicar (MITACS PDF, UBC): *A Survey of Stochastic Volatility Models,* May 2, 2000

J. Walsh (UBC): *The Speed of Convergence of the Binomial Tree Scheme,* May 25, 2000

S. Hatch (Powerex): *Pricing Power Caps by Monte Carlo: Three Factor Mean Reverting Model with Exogenously Heteroskedastic/ARCH Diffusion,* July 20, 2000

M. Lai (UBC and Powerex): *Parameter Estimation of 2-Factor Energy Models: Kalman Filter Approach,* August 31, 2000

D. Chan (UBC): *Introduction to Value at Risk,* September 14, 2000

S. Shreve (Carnegie-Mellon University): *Valuation of Exotic Options Under Shortselling Constraints,* September 18, 2000

J.'Rodriguez (math finance student UBC): *More on Value at Risk,* September 28, 2000

S. MacNair (PIMS UBC): *Utility Maximization with Stochastic Factors,* October 12, 2000

P. Laurence (U. Roma & NYU): *American options on multiple assets: bounds via a comparison principle,* November 2, 2000

V. Dion (UBC): *Tutorial on Mortgage Backed Securities,* November 15, 2000

D. Duffie (Stanford): *Valuation in Dynamic Bargaining Markets,* December 1, 2000

A. Lazrak (USC and U. d'Evry): *Incomplete Information with Recursive Preferences,* January 11, 2001

Tan Wang (UBC): *Model Misspecification and Under-Diversification,* February 8, 2001

Simon McNair (UBC): *Delta Hedging and Survival Probabilities in Markets with Frictions,* March 1, 2001

Dilip Madan (University of Maryland): *Levy Processes in Financial Modeling,* March 9, 2001

Alan King (IBM Research Division): *A Contingent Claims Approach to Setting the Franchise Fee for Capacity Constrained, Quantity-Flexible Supply Contracts,* March 22, 2001

Robert Jones (SFU): *Valuing Revolving Lines of Credit Under Jump-Diffusion Credit Quality,* March 29, 2001

A. Lazrak (U. d'Evry): *Information Neutrality in Stochastic Differential Utility and Related Backward Stochastic Differential Equations,* September 6, 2001

R. Tompkins (T. U. Vienna): September 27, 2001

J. Cvitanek (USC): October 11, 2001

PIMS String Theory Seminar for 2000/2001

This is a series of lectures on String theory held approximately once per week at the PIMS facility at UBC.

Organizer: K. Zarembo (PIMS PDF, UBC)

Joel Erickson (UBC): *T-duality,* January 25, 2000

Joel Erickson (UBC): *Orbifolds of Conformal Field Theories,* February 1, 2000

W. Mueck (SFU): *Discouraging Facts about the Randall-Sundrum Metric: Geodesics and Newton Law,* February 8, 2000

Emil Akhmedov (UBC): *Black Holes in String Theory,* February 29, 2000

Emil Akhmedov (UBC): *Black Holes in String Theory (continued),* March 7, 2000

Peter Matlock (SFU): *Compactification, Supergravity Domain Walls and Brane World Scenario,* March 14, 2000

Andrew DeBenedictis (SFU): *Introduction to the Weyl Anomaly,* March 21, 2000

Noureddine Hambli (UBC): *A Holographic Renormalization Flow in String Theory,* March 28, 2000

Joel Erickson (UBC): *Orbifolds of Conformal Field Theories,* February 1

Damien Easson (Brown University): *The Limiting Curvature Hypothesis and Nonsingular Dilation Cosmology,* April 4, 2000

Stephon Alexander (Brown University): *A String/M Theory Inspired Alternative to Inflation (VSL Scenario),* April 11, 2000

Noureddine Hambli (UBC): *A Holographic Renormalization Flow in String Theory (continued),* April 1, 2000

Gordon Semenoff (UBC): *Matrix Theory Interpretation of the World Sheet of DLCQ String,* May 2, 2000

Mark Laidlaw (UBC): *Noncommutative geometry from bosonic strings: The disk and annulus,* September 14, 2000

Don Witt (UBC): *Topological Censorship and the AdS/CFT Correspondence,* September 21, 2000

Konstantin Zarembo (UBC): *Dielectric Branes,* September 25, 2000

Emil Akhmedov (UBC): *D-branes and Microscopic Description of Yang-Mills Instantons,* October 2, 2000

Radoslav Rachkov (Sofia State University and SFU): *Dielectric branes, magnetic moment effect and Giant gravitons,* October 16, 2000

Noureddine Hambli (UBC): *Spacetime Boundaries as Orbifolds in String Theory,* October 23, 2000

Sumati Surya (UBC): *Localization and Brane Scattering,* October 30, 2000

Neil Constable (McGill University): *Non-abelian Brane Intersections and Fuzzy Geometry,* November 2, 2000

Sachindeo Vaidya (UC Davis): *Magnetic Moments of Branes and Giant Gravitons,* November 10, 2000

Peter Matlock (SFU): *Giant Gravitons: Configurations, Instantons, and Oscillations,* November 20, 2000

Mark van Raamsdonk (Stanford University): *D-particles with multipole moments of higher dimensional branes,* November 28, 2000

Gordon Semenoff (UBC): *Strings in external electromagnetic fields,* January 22, 2001

Konstantin Zaremb (UBC): *String theory: a link between gravity and gauge fields,* January 26, 2001

Gordon Semenoff (UBC): *Matrix strings in a B-field,* February 5, 2001

Sumati Surya (UBC): *Phase transitions for flat AdS black holes,* February 26, 2001

Moshe Rozali (Rutgers University): *Thermodynamics of Nongravitational String Theories,* March 5, 2001

Konstantin Zarembo (UBC): *Testing AdS/CFT correspondence with Wilson loops,*March 12, 2001

Jorgen Rasmussen (University of Lethbridge): *Superconformal algebras on the boundary of AdS_3,* March 19, 2001

Sachindeo Vaidya (UC Davis): *Perturbative dynamics on fuzzy surfaces,* May 1, 2001

Sumati Surya (UBC): *Discussion of "Fluxbranes in String Theory" by M. Gutperle and A. Strominge,* May 14, 2001

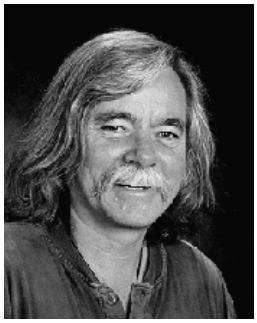
Emil Akhmedov (UBC): *On Unification of D-Brane Couplings to RR Fields,* May 28, 2001

Robert Brandenberger (Brown University): *Review of approaches to string cosmology,* June 18, 2001

Robert Brandenberger (Brown University): *Review of approaches to string cosmology (ctd),* June 25, 2001

Robert Brandenberger (Brown University): *Review of approaches to string cosmology (ctd),* July 9, 200

PIMS-MITACS Centre for Scientific Computing Seminar for 2000/01



Organizer: Bob Russell (CSC Director)

Randy Leveque (University of Washingto): *High-resolution Finite-Volume Methods for Waves in Rapidly-Varying Heterogeneous Media,* January 28, 2000

Mary Catherine Kropinski (Simon Fraser University): *Time Evolving Interfaces in a Viscous Fluid,* February 4, 2000

Andrew Calvert (SFU): *A wave-equation-based approach to the compensation of attenuation and dispersion in seismic reflection data,* February 11, 2000

Keith Geddes (University of Waterloo): *Hybrid Symbolic-Numeric Methods Applied to Definite Integrals and ODEs,* February 25, 2000

Manfred Trummer (SFU): *Spectral Differencing with a Twist – Two Wrongs Can Make It Right,* March 3, 2000

Michael Ward (UBC): *Asymptotics and the Regular Part of the Green's Function for Elliptic Equations,* March 10, 2000

Jared Bronski (University of Illinois): *Passive Scalar Intermittency in the Majda Model,* March 17, 2000

Konstantina Trivisa (Northwestern University): *Hyperbolic Conservation Laws With Large Initial Data,* March 24, 2000

David Boal (SFU): *Numerical Simulations of Biological Cells,* March 31, 2000

Raphael Hauser (Cambridge University): *About the SVD Approach for Computing Lyapunov Exponents,* April 14, 2000

Ray Spiteri, May 26, 2000

Jim Verner (Queen's University): *Applications of Deriving Runge-Kutta Methods: Some Two-step Pairs,* June 16, 2000

Giovanni Alberti, (Universita di Pisa): *Variational convergence for functionals of Ginzburg-Landau type,* June 21, 2000

Colin Fox (University of Aukland): *Exact MAP States and Perfect Expectations: Greig Porteous and Seheult revisited,* June 30, 2000

Chris Budd (University of Bath): *Geometric integration of ODEs with scaling invariance,* August 4, 2000

William Rheinhardt (University of Washington): *Non-linear Dynamics in the Bose-Einstein Condensate,* September 8, 2000

Ricardo Carretero (Simon Fraser University): *Hypersolitons and Breathers in soliton chains,* September 15, 2000

Raghu Machiraju (Ohio State University): *Feature-significant Exploration of Terascale Datasets,* September 29, 2000

David Muraki (SFU): *Vortex Asymmetries in the Mid-latitude Atmosphere,* September 29, 2000

Chris Bailey (University of Greenwich): *Physics-based Modelling - A Key Component of Design,* October 4, 2000

Frederic Pio (SFU): *Identification of new Distant Homologs in Genomic Databases by combining multiple intermediate sequence search and threading methods,* October 5, 2000

Steven Jones (Genome Sequence Centre): *Bioinformatics at the Genome Sequence Centre, October 5, 2000*

Jean-Paul Berrut (University of Fribour): *The linear rational collocation method with iteratively optimized poles for two-point boundary value problems,* October 13, 2000

Robert D. Russell (SFU): *Qualitative Study of Dynamical Systems with Adaptive Numerical Methods,* October 20, 2000

Francis Clarke (Université de Lyon and Instituut universitaire de France): *The Feedback Problem in Control Theory,* October 25, 2000

Linda Petzold (University of Santa Barbara): *Algorithms and Software for Dynamic Optimization with Application to Spacecraft Trajectory Optimization,* November 2, 2000

Alejandro Garcia (San Jose State University): *Stochastic Particle Algorithms: From DSMC to CUBA,* November 9, 2000

Jim Cavers (SFU): *Interference Mitigation in Wireless Communications,* November 17, 2000

Diane Finegood (SFU): *Modeling Applications in the Study of Diabetes,* November 24, 2000

Brian Wetton (UBC): *The MITACS/Ballard Collaborative Project: Rivulets and Condensation Front Modelling,* December 1, 2000

Todd Kapitula (University of New Mexico): *Stability of waves in perturbed Hamiltonian systems,* December 11, 2000

Stephen Whitaker (UC Davis): *Coupled Transport During Drying in Porous Media,* January 5, 2001

Tom Manteuffel (University of Colorado): *arge First-order Systems Least-squares Functionals for Linear Elasticity,* January 12, 2001

Radu Bradean (SFU): *Heat and Mass Transfer in Porous Fuel Cell Electrodes,* January 19, 2001

Ray Zahar (SFU): *A Uniform Analysis of Difference Systems,*February 2, 2001

Wolfgang Heidrich (UBC): *Towards Realistic Materials and Lighting in Interactive Applications,* February 9, 2001

John Bowman (University of Alberta): *A Statistical Description of Two and Three-Dimensional Turbulence,* February 16, 2001

Lia Bronsard (McMaster University): *Phase Boundaries in Ginzburg-Landau Models of Materials Science,* February 19, 2001

Bernard Deconick (University of Washington): *The computation of quasi-periodic solutions of integrable partial differential equations,* March 2, 2001

Ian Frigaard (UBC): *Super-Stable Parallel Flows of Multiple Visco-Plastic Fluids,* March 9, 2001

Bjorn Sandstede (Ohio State University): *Stability and bifurcations of spiral waves,* March 16, 2001

Chris Jones (Brown University): *Do Invariant Manifolds Hold Water?,* March 23, 2001

Bengt Fornberg (University of Colorado): *Radial Basis Functions - A future way to solve PDEs to spectral accuracy on irregular multidimensional domains?,* March 30, 2001

Jane Wang (Cornell University): April 6, 2001

Emily Stone (Utah State University) and **Abe Askari** (Boeing): *Nonlinear Models of Dynamics in Drilling,* May 4, 2001

Yannis Kevrekidi (Princeton): *Enabling Microscopic Simulators To Perform System-Level Analysis,* May 18, 2001

Nicolas Robidoux (SFU): *Numerical solution of the Poisson equation — divkgradd = f with discontinuous diffusion tensor k and source term f,* September 7, 2001

PIMS Centre for Theoretical Biology Seminar

Organizer: Gerda de Vries (Univ. of Alberta)

Dr. Kerry Landman, Department of Mathematics and Statistics, University of Melbourne, October 1, 2001
Can you still read the fine print? Water transport in eye lenses and "How does your stomach feel? Development of the nervous system in the gut"

Dr. Hal Smith, Department of Mathematics, Arizona State University 1 November 2001

Dr. Sebastian Schreiber, Department of Mathematics, Western Washington University
Allee effects, chaotic transients, and extinction in simple population models, 19 November 2001

Dr. Kevin Painter, Department of Mathematics, Heriot-Watt University
26 November 2001

Dr. Brian Denis, Department of Fish and Wildlife Resources and Division of Statistics, University of Idaho
28 January 2002

Dr. Leah Edelstein-Keshet, Department of Mathematics, University of British Columbia
8 April 2002

III. GENERAL SCIENTIFIC EVENTS

At the *Second Canada-China Congress,* August 20–23, 2001, in Vancouver, Dr. Tom Brzustowski, President of the Natural Sciences and Engineering Research Council of Canada (NSERC) is shown with the Canadian and Chinese delegations.

Extra-Thematic Scientific Workshops

Due to its unique structure, PIMS is able to move quickly to produce and promote the latest advances in the mathematical sciences and involve PIMS' scientists in them. Rather than centering all its scientific activities around a few topics for an entire academic year, thus tying up resources and limiting participation, PIMS also runs shorter, more intensive programmes to emphasize rapidly developing areas. The flexibility of this structure improves communication between PIMS' members and the larger scientific community, resulting in better trained personnel and establishing vigourous dialogue between the mathematical sciences and the other disciplines.
This section describes the extra-thematic scientific activities of the institute. Each workshop has its own organizing committee and they are mostly held in the various PIMS sites. The selection and funding decisions are made by the Scientific Review Panel.

Northwest Dynamics Symposium, University of Victoria, May 6–8, 2000

Organisers: Chris Bose (Univ. of Victoria), Doug Lind (Univ. of Washington) and Ian Putnam (Univ. of Victoria).

This workshop covered a variety of topics, including ergodic theory, symbolic dynamics, topological dynamics, aperiodic tilings and K-theory.

Speakers:

Dan Rudolph (University of Maryland): *Entropy and Orbit Equivalence*

Robert Moody (University of Alberta): *Diffraction, Aperiodic Order, and Dynamical Systems*

Jeff Steif (Georgia Institute of Technology): *On the Existence and Non-existence of Finitary Codings for a Class of Random Fields*

Karl Petersen (University of North Carolina at Chapel Hill): *Maximal Measures for Factor Maps*

Bob Burton (Oregon State University): *Tilings with Intermediate Mixing Properties*

Beverly Diamond (Mathematics College of Charleston): *A Complete Invariant for the Topology of Substitution Tiling Spaces*

Nicholas Ormes (University of Texas, Austin): *A Homeomorphism Invariant for Pinwheel Tiling Spaces*

Mike Boyle (University of Maryland): *"Positive K-Theory" in Symbolic Dynamics*

Sujin Shin (University of Victoria): *About Compensation Functions for Factor Maps*

Danrun Huang (St. Cloud State University): *Flow Equivalence and Its Applications*

Chris Hoffman (University of Washington): *Which Endomorphisms Are Isomorphic to Bernoulli Endomorphism*

Genevieve Mortiss (University of New South Wales): *Some Approaches Towards a Non-Singular Entropy*

Manfred Einsiedler (University of East Anglia): *Generalized Dominoes and Fundamental Cocycles*

Michael Baake (Univeristy of Tubingen): *Symmetries and Reversing Symmetries of Toral Automorphisms*

Sam Lightwood (University of Victoria): *Morphisms for Square Filling Mixing Shifts of Finite Type*

Anthony Quas (University of Memphis): *Ergodic Averaging Sequences*

2d International Workshop on Scientific Computing & Applications, Kananaskis, Alberta, May 28 – June 1, 2000

Organisers: P. Minev and Y. Lin (U. Alberta)

The Second International Workshop on Scientific Computing and Applications continued the tradition of the highly successful workshop held at the City University of Honk Kong in December 1998. The workshop brought together mathematicians, scientists and engineers working in the field of scientific computing and its applications to solve scientific and industrially oriented problems. The workshop was sponsored by PIMS and the University of Alberta.

Main Speakers:

O. Axelsson (Catholic U. Nijmegen): *An Optimal Order Multilevel Preconditioner with Respect to Problem and discretization parameters*

R. Ewing (Texas A&M): *Modelling and Simulation of Multiphase Flow in Porous Media*

M. Fortin (U. Laval): *A Mesh Adaptation Procedure Based on a Hierarchical Error Estimator*

K. Y. Fung (Hong Kong Polytechnic U.): *Time-Domain Computation of Waves with Realistic Geometry and Impedance Boundary Conditions*

P. Gresho (Lawrence Livermore Laboratory): *On Rapid and Impulsive Transients for Viscous In- compressible Flow*

B. Guo (University of Manitoba): *Ective Parallel and Iterative Solvers for General-Setting h-p Finite Element Approximation*

R. Lazarov (Texas A&M): *Mortar Methods for Locally Conservative Schemes on Non-matching Grids*

B. Lee (NRC, Ottawa): *Fluid-Structure Interaction: Application in Nonlinear Aeroelasticity*

M. Salcudean (UBC): *Mathematical Modelling of Industrial Processes*

W. Sun (City University of HK): *The Collocation Method for PDE's*

T. Tang (Hong Kong Baptist U.): *Moving Mesh Methods for Partial Dirential Equations based on Harmonic Maps*

Zhong-Ci Shi (Academia Sinica): *A Class of High Accuracy Unconventional Finite Elements*

Meeting in Honour of Cindy Greenwood, UBC, June 2, 2000

There was a meeting on the afternoon of Friday, June 2, 2000 to commemorate the early retirement of Professor P. E. Greenwood.

Speakers:

Ildar Ibragimov (St Petersburg): *On a theorem of Stone concerning additive regression*

Jim Pitman (Berkeley): *Random trees and random partitions associated with Brownian excursions*

CECM/MITACS/PIMS Live Collaborative Mathematics on the Net, Simon Fraser University, June 19–20, 2000

This one and a half day workshop brought together people from academia and industry involved in mathematical computation, visualization, teaching and learning. This includes issues relating to communication, publication, and commerce using the Internet and related technologies. The half-day session on June 20 was dedicated to talks and tutorials on topics in Parallel Computing.

Speakers:

Lyn Bartram (Simon Fraser University): *Interactive and Collaborative?*

Konrad Polthier (Technische Universität, Berlin): *Mathematical Visualization and Online Experiments with JavaView*

Richard Smith (SFU): *CJC-Online: electronic scholarly publishing and research experience*

Ulrich Kortenkamp (Institut für Informatik, Freie Universität Berlin): *Visions of Geometry on the Net*

Neil Calkin (Clemson University): *An Open Source Model For Mathematical Content*

June Lester (Simon Fraser University): *What fascinates me about this online math stuff ...*

Loki Jörgenson (Simon Fraser University): *Components in Mathematics Learning: What is the Future for User Construction of Tools?*

Jason Ventrella (UBC): *Assembling the UBC vn Beowulf Cluster*

Martin Siegert (SFU): *Parallel Computing on a Cluster and a SMP Machine: A Comparison*

Jimmy Scott (Silicon Graphics Inc.): *Scalability of the Origin ccNUMA Architecture*

Victoria Computational Cosmology Conference, University of Victoria, August 21–25, 2000

Organisers: Arif Babul (University of Victoria), Julio Navarro (University of Victoria) and Hugh Couchman (McMaster University).

This highly successful 5-day conference known as VC3, brought together some of world's leading computational, theoretical and observational cosmologists — both established, pre-eminent figures as well as young rising stars — to discuss: (a) the latest progress in art and science of large-scale numerical simulations of galaxy systems; (b)to assess critically the insight into the formation and evolution of galaxy structures gained through these large numerical experiments; (c) to contrast the state-of-the-art numerical results against relevant, recent observational evidence; (d) and to chart the way forward on the computational, algorithmic and scientific fronts.

The conference, which attracted over 150 participants, also served as a backdrop for the first meeting of the governing council of the **Canadian Computational Cosmology Collaboration (C4)** to set the priorities for the first year of operations. **C4** draws together the leading numerical cosmologists from across Canada in an effort to determine a computational strategy for carrying numerical study of galaxy formation in unprecedented detail. This effort is undertaken in partnership with three leading numerical cosmology groups in the world: the N-body shop at the University of Washington led by T. Quinn, the University of Durham group led by C. S. Frenk and the Max Planck Institut for Astrophysik group led by S. D. M. White.

The conference week was capped by a public lecture — sponsored by the President of University of Victoria — titled *The Evolution of Structure in the Universe* given by Prof. Jeremiah P. Ostriker, the Provost and the Charles A. Young Professor of Astronomy at Princeton University. The public lecture drew a crowd in excess of 1000.

Invited speakers Rosemary Wyse (JHU) and Leo Blitz (Berkeley) discuss the morning's presentations over coffee with colleagues.

Prof. Jeremiah P. Ostriker (left) (Charles A. Young professor of astrophysics and provost of Princeton University) in intense discussions with Prof. George Efstathiou (University of Cambridge).

Speakers:

Rosemary Wyse (Johns Hopkins), **Sidney van den Bergh** (DAO/HIA/NRC), **Michael Rich** (UCLA), **Leo Blitz, Tim Robishaw, David Sherfesee, Josh Simon** (UC Berkeley), **Steven Majewski** (U. of Virginia), **James Taylor, Arif Babul** (U. of Victoria), **Martin Weinberg** (U. of Massachusetts at Amherst), **Ortwin Gerhard** (Basel), **Amina Helmi** (Leiden Observatory), **Simon White** (MPA Garching), **Volker Springel** (CfA), **Ben Moore** (Durham), **Lucio Mayer, Monica Colpi** (U. of Milan), **Fabio Governato** (Osservatorio Astronomico di Brera), **Ben Moore** (U. of Durham), **Thomas Quinn, Joachim Stadel, James Wadsley & George Lake** (U. of Washington), **Adrian Jenkins, Carlos Frenk, Shaun Cole** (Durham), **Joerg Colberg, Simon White, Naoki**

Yoshida (MPA Garching), **August Evrard** (U. of Michigan), **August Evrard** (U. of Michigan), **Ue-Li Pen** (CITA), **Richard Ellis** (Caltech), **Simon Driver** (St Andrews), **Ignacio Ferreras, Joseph Silk** (Oxford), **Harald Kuntschner, Roger L. Davies, Russell J. Smith, Matthew Colless** (Durham), **Elizabeth Barton** (DAO/HIA/NRC), **Carlos Frenk** (Durham), **Bernd von Kuhlmann et al** (Max-Planck-Institute of Astronomy Heidelberg), **M. Sawicki** (Caltech), **David Schade, D. Durand** (DAO/HIA/NRC), **Gabriela Mallen-Ornelas, Felipe Barrientos** (PUC, Santiago, Chile), **Luc Simard** (Steward Observatory), **Ray Carlberg and the CNOC2 and LCIR collaboration** (U. of Toronto), **Myungshin Im and DEEP team** (UCO/Lick Observatory), **Kelly Holley-Bockelmann, Douglas Richstone** (U. of Michigan), **Dan McIntosh** (Steward Observatory), **Hans-Walter Rix** (MPIA, Heidelberg), **Nelson Caldwell** (CfA & Arizona), **Tadayuki Kodama, Richard Bower** (U. of Durham), **Jennifer Lotz** (Johns Hopkins U.), **Crystal Martin** (Caltech), **Henry C. Ferguson** (STScI), **Michael Balogh, Richard Bower** (U. of Durham), **Julio Navarro** (U. of Victoria), **Simon Morris** (DAO, HIA, NRC), **Warrick Couch** (UNSW), **Daniel D. Kelson, P. van Dokkum, M. Franx, G. Illingworth** (Carnegie), **Kim-Vy H. Tran** (U. of California, Santa Cruz), **Garth D. Illingworth** (U. of California Observatories/Lick Observatory), **Sebastiano Ghigna** (Milano), **Ben Moore** (Durham), **Fabio Governato** (Milano), **Tom Quinn, Joachim Stadel, George Lake** (Washington), **Bodo Ziegler** (Goettingen), **Roger Davies, Richard Bower, Ian Smail, Michael Balogh** (Durham), **David Tytler** (UCSD), **Dick Bond** (CITA), **Len Cowie** (Hawaii), **Jeremiah Ostriker** (Princeton), **James Wadsley, Tom Quinn, Joachim Stadel** (U. of Washington), **Fabio Governato, Lucio Mayer** (Milano), **Simon White** (MPA Garching), **Neal Katz** (UMass) **Kentaro Nagamine, Renyue Cen & Jeremiah P. Ostriker** (Princeton U.), **Guinevere Kauffmann** (MPA Garching), **Frazer Pearce and the Virgo Consortium** (U. of Durham), **John S. Mulchaey** (Carnegie Observatories), **Volker Springel** (Harvard-Smithsonian Center for Astrophsyics), **Jan Vrtilek, Larry David, Laura Grego, D. Jerius, C. Jones, W. Forman, R. Donnelly** (Center for Astrophysics), **Trevor Ponman** (U. of Birmingham), **Gary Mamon**, (Institut d'Astrophysique de Paris), **S. Dos Santos** (U. of Leicester), **Anatoly Klypin** (NMSU), **Yehuda Hoffman** (Jerusalem), **Antonaldo Diaferio** (Universita' di Torino), **Ravi Sheth** (Fermilab), **Timothy M. Heckman** (Johns Hopkins U.), **Liese van Zee** (Herzberg Institute of Astrophysics), **Crystal Martin** (Caltech), **Susan Ridgway and Timothy Heckman** (Johns Hopkins U.), **Daniela Calzetti** (STScI), **M. Lehnert** (MPE Garching), **George Efstathiou** (Cambridge), **Matthias Steinmetz** (Arizona), **Paul Shapiro** (U. of Texas), **Alejandro Raga** (Instituto de Astronomia, UNAM, Mexico), **Daniel Pfenniger** (Geneva Observatory), **Mauro Giavalisco** (STScI), **Alice Shapley, C. Steidel, K. Adelberger** (Caltech), **Max Pettini** (Institute of Astronomy, Cambridge), **Marc Dickinson** (Space Telescope Science Institute), **Henry C. Ferguson** (Space Telescope Science Institute), **Art Wolfe** (UCSD), **Michael Rauch** (Observatories of the Carnegie Institution of Washington), **Renyue Cen** (Princeton U. Observatory), **Simon Morris** (DAO/HIA/NRC), **Buell Jannuzi** (NOAO), **Romeel Dave'** (Princeton Univ Observatory), **Lars Hernquist** (Harvard Center for Astrophysics), **Neal Katz** (Univ. of Massachusetts), **David Weinberg** (Ohio State U.), **Greg Bryan** (MIT), **Joop Schaye** (Institute of Astronomy, Cambridge), **Tom Theuns, Houjun Mo** (Institute of Astronomy, Cambridge and Max-Planck Institut fur Astrophysik), **Joop Schaye** (Institute of Astronomy, Cambridge), **Saleem Zaroubi** (Max-Planck Institut fur Astrophysik), **Todd M. Tripp, Edward B. Jenkins** (Princeton U. Observatory), **Blair D. Savage** (U. of Wisconsin), **Alain Smette, Sarah. R. Heap, Gerard M. Williger** (NASA/GSFC), **Ed B. Jenkins, Todd Tripp** (Princeton U. Observatory) and **David Weinberg** (Ohio State U.).

Biophysics and Biochemistry of Motor Proteins, Banff, AB August 27 – September 1, 2000

Organiser: Jack Tuszynski (U. Alberta)

Invited Speakers:

D. Astumian (U. of Chicago): *Reversible and Intrinsically Irreversible Molecular Motors*

S. Block (Princeton): *Force Production by Single Kinesin Motors*

T. Duke (Cambridge, UK): *Cooperativity in Sensory and Motor Systems*

Y. Engelborghs (Katholieke Universiteit Leuven, Belgium):

H. Flyvbjerg (RisøNational Laboratory, Denma): *Mechanical Stability of Microtubules*

E. Frey (Harvard U.): *Collective Phenomena in Microtubule Kinesin Interaction*

R. Goldman (Northwestern U.): *The Motile Properties of Intermediate Filaments*

L. S. Goldstein (UC San Diego): *Transport Pathways, Receptors, and Human Diseases*

R. S. Hodges (U. of Alberta): *Analysis of Kinesin and Kinesin-Like Neck Regions: Implications for Motor Structure and Function*

J. Howard (U. of Washington): *Force Generation by Kinesin and its Regulation*

F. Jülicher (Curie Institute, France): *Theoretical Approaches to Active Biological Systems: Bundle Contractions, Axonemal Beating and Sound Detection*

T. R. Kelly (Boston College): *A Rationally Designed Prototype of a Molecular Motor*

F. Kozielski (Institute for Structural Biology, France): *Structural Links to Kinesin Directionality and Movement*

A. Maniotis (U. of Iowa): *Gel Contraction and Spheroid Generation via Deregulation of Actomyosin Interactions Consistently Predicts Metastatic and Invasive Potential of Tumor Cells in a Variety of Aggressive Cancers*

A. Mogilner (UC Davis): *Control of Actin Dynamics and Force Generation at the Leading Edge of Migrating Cells: Quantitative Model*

C. D. Montemagno (Cornell U.): *Biomolecular Motors: Engines for Nanofabricated Systems*

D. Odde (Michigan Technical U.): *Chemical and Mechanical Interactions in Microtubules*

G. Oster (Berkeley): *The Mechanochemistry of ATP Synthase*

D. Sackett (National Institute of Health): *Kinesin-Mimetic Proteins: HIV-1 Rev*

E. Unger (IMB, Jena, Germany): *Regulation of Kinesin-mediated Motility and Co-operative Unidirectional Force Orientation*

R. Vallée (U. of Massachusetts): *Mutations in the the LIS-1 Gene Dramatically Alter Brain Development Through Defects in Mitotic Cytoplasmic Dynein Function*

T. Vicsek (Eötvös U., Hungary): *Biopolymer Dynamics in Silico: Applications to Motility Assays and DNA Transport in Confined Geometries*

T. Yanagida (Osaka, Japan): *Sub-steps Within the Step per ATPase Cycle of Myosin and Kinesin*

CMS Winter 2000 Meeting, Vancouver, BC December 10–12, 2000

PIMS supported two additional sessions at this CMS meeting.

Session on Financial Mathematics

Organiser: U. Haussmann (UBC)

Speakers:

Daniel Dufresne (University of Montreal): *Pricing Asian options*

Michael Taksar (State University of New York): *Optimal financing of a corporation subjuct to random returns*

Fernando Zapatero (University of Southern California): *Executive stock options with effort disutility and choice of volatility*

Jerome Detemple (U. Montreal)

Ulrich Haussmann (University of British Columbia): *Optimal portfolio selection based on observed prices*

Session on PDE

Organisers: R. Froese and N. Ghoussoub (UBC)

Speakers:

Stephen Anco (Brock): *Well-posedness of the Caunchy problem for a novel generalization of Yan-Mills*

Changfeng Gui (UBC): *On some mathematical problems related to phase transition*

Dirk Hundertmark (Caltech): *An optimal Lp bound on the Krein spectral shift function*

Reinhard Illner (University of Victoria): *Existence and use of kinetic equilibria in traffic dynamics, diffusive granular flow and rarefied gases*

Alex Iosevich (Columbia-Missouri)

Peter Perry (University of Kentucky): *Zeta functions and determinants on hyperbolic manifolds of infinite volume*

Daniel Pollack (University of Washington): *Gluing and wormholes for the Einstein constraint equations*

Randall Pyke (Ryerson Ploytechnic University): *Characterization of bound states for nonlinear wave and Schrodinger equations*

Hart Smith (University of Washinton): *Fundamental solutions for low regularity wave equations*

Catherine Sulem (University of Toronto): *The water-wave problem and its long-wave and modulational limits*

Gunther Uhlmann (University of Washington): *Determining riemannian manifolds from the Dirichlet-to-Neumann map*

Man-Wah Wong (York University): *The special Hermite semigroup*

Design Theory: Resolvability and Parallelisms, PIMS-SFU, May 16–18, 2001

Organisers: Brett Stevens and Luis Goddyn (SFU)

Parallel classes and resolvability are two powerful substructures in Combinatorial Design theory. Full and partial Parallel classes are necessary for Wilson's Fundamental construction.

Recent generalizations of traditional resolvability are an exciting new area of study and application. There have been two recent generalizations of resolvability to Pairwise Balanced Designs, RRPs where every resolution class is made of of blocks of a fixed size and CURDs where every resolution class is isomorphic as a spanning subgraph of the complete graph. Resolvable packings and partial resolutions have been shown to be powerfully applicable to synchronous unipolar multi-user communication systems. These exciting recent developments prompted this mini workshop on the subject.

Speakers:

Charles Colbourn (University of Vermont): *Doubly resolvable Steiner triple systems*

Mark Chateaunef (University of Waterloo): *Resolving to avoid parallelisms*

Izabella Adamczak (Michigan Technical University): *On the hole-size bound for incomplete block designs*

Myra Cohen (University of Aukland, NZ): *Cluttered Orderings for the Complete Graph*

Peter Danzinger (Ryerson Polytechnic University): *Class-Uniformly Resolvable Designs*

Peter Dukes (Caltech): *New Lower Bounds on the Maximum Number of Mutually Orthogonal Steiner Triple Systems*

Eric Mendelsohn (University of Toronto): *Resolvability and Configurations*

Rolf Rees (Memorial University): *Direct product constructions for resolvable group divisible designs*

Don Kreher (Michigan Technical University): *On PBIBD Designs Based on Triangular Schemes*

Alan Ling (Michigan Technical University)

John Stardom (Simon Fraser University)

Alex Rosa (McMaster University): *Upper Chromatic Index and Specialized Block Colourings of Steiner Triple Systems*

Ninth Canadian Conference on General Relativity and Relativistic Astrophysics, University of Alberta, May 24–26, 2001

Organisers: C. P. Burgess (McGill), J. Gegenberg (New Brunswick), D. Hobill (Calgary), H. P. Künzle (Alberta) and R. G. McLenaghan (Waterloo).

This was the ninth in a series of meetings, held every two years, designed to bring together researchers in gravitation, relativity, astrophysics, and related fields and to enhance the interaction between the Canadian and wider international research communities in these areas. There were three mornings of plenary talks, two afternoons of contributed talks in parallel sessions and poster presentations.

The conference was held in conjunction with Black Holes III, in Kananaskis, Alberta, in the Canadian Rocky Mountains, May 20–22.

Invited Speakers:

John Baez (University of California at Riverside): *New developments in canonical quantum gravity*

Dick Bond (CITA): *Cosmic Parameters from the CMB*

Viqar Hussain (University of New Brunswick): *Dualities and Wilson loops*

Amanda W Peet (University of Toronto): *Recent developments in string theory and applications to black holes*

Eric Poisson (University of Guelph): *Gravitational radiation reaction in strong fields*

Kristin Schleich (University of British Columbia): *Topological censorship*

Saul Teukolsky (Cornell University): *Numerical simulations of black holes*

Kip S Thorne (California Institute of Technology): *Gravitational waves: A status report*

Virginia Trimble (University of California at Irvine): *Looking into the potential wells: Observations of compact objects*

S-T Yau (Harvard University): *Existence of black holes*

CAIMS Annual Meeting, University of Victoria, June 7–9, 2001

PIMS sponsored two additional sessions at the 2001 Annual Meeting of the Canadian Applied and Industrial Mathematics Society.

Applied Dynamical Systems

Organizer: Florin Diacu (Univ. of Victoria)

Speakers:

William Langford (University of Guelph): *Normal Form Analysis of Nayfeh's Abnormal Resonance*

Jerry Marsden (Caltech): *Dynamical systems, celestial mechanics and space mission design*

James Montaldi (INLN (Nice, Fr) & UMIST (UK)): *Persistence of Relative Equilibria*

Ernesto Perez (University of Pemambuco): *Central Configurations for Charged Problems*

Hildeberto Cabral (Universidade Federal de Pemambuco): *Periodic solutions of perturbations of the Kepler problem*

Carmen Chicone (University of Missouri): *What are the calssical equations of motion with radiation reaction taken into account?*

Daniel Offin (Queens University): *Stability of periodic solutions and the variational principle*

Christina Stoica (University of Victoria): *Classical Scattering and Block Regularization*

Mathematical Biology

Organizer: Pauline van den Driessche (Univ. of Victoria)

Speakers:

Leah Keshet (University of British Columbia): *Modelling cell and chemical interactions in Alzheimer's Disease*

Michael Li (University of Alberta): *Mathematical Analysis of the Global Dynamics of a Model for HTLV-1 Infection and ATL Progression*

Mark Lewis (University of Utah): *How predation can slow, stop or reverse a prey invasion*

Mark Kot (University of Washington): *Do Invading Organisms do the Wave?*

Hal Smith (Arizona State University): *Colonization resistance in the gut and microbial surface colonization of bio-reactors*

Gail Wolkowicz (McMaster University): *Mathematical Modeling of Self Cycling Fermentation*

Mary Lou Zeeman (The University of Texas at San Antonio): *Modeling the Human Menstrual Cycle*

William Langford (University of Guelph): *Normal Form Analysis of Nayfeh's Abnormal Resonance*

Sally Blower (UCLA): *Live attenuated HIV vaccines: predicting the trade-off between efficacy & safetyn*

Shigui Ruan (Dalhousie University): *Codimension Two Bifurcations in Ecological and Epidemiological Models*

Designs, Codes, Cryptography and Graph Theory, University of Lethbridge, July 9–14, 2001

Organisers: Wolf Holzmann, Hadi Kharaghani and Jim Liu (University of Lethbridge).

This was the second workshop on Designs, Codes, Cryptography and Graph Theory at the University of Lethbridge. Instructional lectures were held each morning, with talks on individual papers in the afternoons.

Brian Alspach (University of Regina) gave a series of 3 instructional lectures on vertex-transitive graphs. **Charles Colbourn** (Arizona State University) gave a series of 3 instructional lectures on applications of combinatorial designs. **Chris Rodger** (Auburn University) gave a series of 3 instructional lectures on coding theory. **Doug Stinson** (University of Waterloo) gave a series of 3 instructional lectures on the Discrete Logarithm Problem as applied to cryptography. **Vladimir Tonchev** (Michigan Technical University) gave an instructional lecture on combinatorial designs as applied to digital communication. All of the instructional lectures were well-balanced, entertaining and informative, pitched at a level appropriate to non-experts with some discrete mathematical background, yet describing some of the cutting edge of research in these fields. Workshop organisers were extremely fortunate in attracting mathematicians of such eminence in their fields who are also talented expositors of their work.

There were 44 registered participants in the workshop, from 8 countries around the world: Canada, the United States, the United Kingdom, Australia, Italy, Spain, Korea and Iran. Participants included employees of SaskTel and the Department of National Defense, in addition to the academic registrants. Communication and a collaborative atmosphere were fostered by a session on open problems, as well as much informal discussion during the times available for social activities during the week.

The workshop was an enjoyable, informative and invigorating experience for participants, who left with their understanding of designs, codes, cryptography and graph theory having been both broadened and enriched.

Additional Invited Speakers:

M. Buratti (Università di Perugia, Italy): *Selected Topics on Sharply-Vertex-Transitive Designs*

R. Craigen (U. of Manitoba): *Complementary Pairs of Sequences*

G. Hahn (U. of Montreal): *Absorbing Sets in Coloured Tournaments*

S. Hedayat (U. of Illinois at Chicago): *Adding More Runs to Saturated D-Optimal Resolution III Designs*

Y. Ionin (Central Michigan U.): *Decomposable Symmetric Designs*

G. B. Khosrovshahi (IPM and Tehran U., Iran): *Some Results on the Existence of Large Sets of t-Designs*

T. Kloks (Royal Holloway U. of London): *Fixed Parameter Complexity*

D. Kreher (Michigan Technological U.): *A Hole-Size Bound for Incomplete t-Wise Balanced Designs*

A. Ling (Michigan Technological U.): *The Existence of Kirkman Squares — Doubly Resolvable* $(v;3;1)$*-BIBDs*

K. Murty (U. of Toronto): *The Number of Words in Certain Non-linear Codes*

R. Rees (Memorial U. of Newfoundland): *On Holes in t-Wise Balanced Designs*

C. Rodger (Auburn U.): *A Very Basic Intoduction to Error Correcting Codes, The Graph Theoretical Approach to Convolutional Codes, and Encoding on Compact Discs*

R. Safavi-Naini (U. of Wollongong, Australia): *Error and Deletion Correcting c-Secure Codes*

P. Shiue (U. of Nevada Las Vegas): *On the Number of Primitive Polynomials over Finite Fields*

D. Stinson (U. of Waterloo): *The Discrete Logarithm Problem: Theory and Cryptographic Applications*

V. Tonchev (Michigan Technical U.): *Perfect Codes and Balanced Generalized Weighing Matrices, and Combinatorial Designs and Digital Communication*

R. Wei (Lakehead U.): *On Cover-Free Families*

H. Williams (U. of Manitoba): *Applications of a Numerical Sieving Device*

Group photo from the Designs, Codes, Cryptography and Graph Theory workshop.

International Conference on SCIentific Computation And Differential Equations, Coast Plaza Hotel, Vancouver, July 29 – August 3, 2001

Organisers: U. Ascher (chair, UBC), G. Bock (Heidelberg), K. Burrage (Brisbane), A. Iserles (Cambridge), L. Petzold (Santa Barbara) and R. Russell (SFU)

This meeting was concerned with scientific computing involving the numerical solution of differential equations. Numerical techniques in applications were emphasized. These included optimization and optimal control, chemical and mechanical engineering, stochastic differential equations, level-set methods, molecular dynamics, computer graphics, robotics.

The meeting is part of the SCICADE series, the last of which was held in Fraser Island (Australia), August 9–13, 1999. The next meeting is planned for June 30–July 4, 2003, in Trondheim, Norway.

Plenary Speakers:

Lorenz Biegler (Carnegie Mellon University): *Dynamic Chemical Process Optimization*

Kevin Burrage (University of Queensland): *An overview of numerical methods for stochastic ordinary differential equations*

Stephen Campbell (North Carolina State University): *Optimization and Differential Equations*

Luca Dieci (School of Mathematics, Georgia Tech): *Some computational problems in dynamical systems*

Leslie Greengard (Courant Institute, New York University): *Integral equations and computational engineering*

Thomas Hou (Caltech): *Numerical Solutions to Free Boundary Problems*

Christian Lubich (Universitaet Tuebingen): *Fast convolution for non-reflecting boundary conditions*

Reinout Quispel (La Trobe University, Melbourne): *Geometric Integration of ODEs*

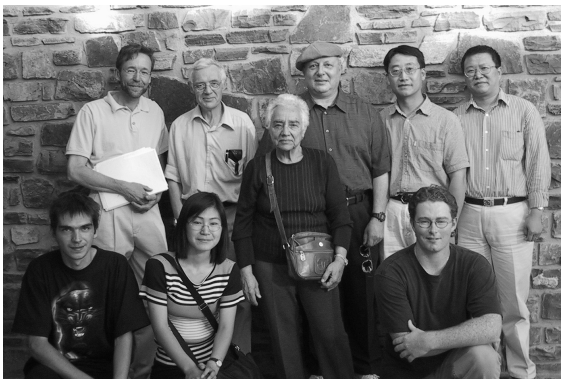
Sebastian Reich (Department of Mathematics, Imperial College, London): *Conservative Methods for Wave and Fluid Dynamics*

Gustaf Soderlind (Center for Mathematical Sciences, Lund University): *Digital Filters in Adaptive Time-Stepping*

Demetri Terzopoulos (Universities of New York and Toronto): *Differential Equations in Vision, Graphics and Design*

Aspects of Symmetry on the occasion of the 60th birthday of Robert Moody, Banff, AB, August 26–29, 2001

Organisers: Michael Baake (Universität Greifswald) and Arturo Pianzola (U. Alberta)



Maria's Group (all mathematical children and grandchildren of Maria). Top (left-right): A. Pianzola, R. Moody (U. Alberta), M. Wonenberger (Spain), S. Berman (U. Saskatchewan), K. Liu (UBC), Y. Gao (York). Bottom (left-right): N Strungaru, J.-Y. Lee, S Sullivan (U. Alberta).

Speakers:

James Arthur (University of Toronto)
Georgia Benkart (University of Wisconsin)
Stephen Berman (University of Saskatchewan)
H.S.M. (Donald) Coxeter (University of Toronto)
Terry Gannon (University of Alberta)
Victor Kac (MIT)
Jeffrey Lagarias (AT&T Labs-Research)
Ian Macdonald (Oxfordshire)
Kumar Murty (University of Toronto)
Jiri Patera (CRM)
Ian Putnam (University of Victoria)
Peter Slodowy (Universitat Hamburg)
Louis Solomon (University of Wisconsin)
Boris Solomyak (University of Washington)
Efim Zelmanov (Yale University)
Andrei Zelevinsky (Northeastern University)

A Glimpse at 2002

Round Group Rings seminar, Jasper, BC, February 18–21, 2002

Workshop on the role of statistical modeling in the 21st century, SFU, May 4–6, 2002

International conference on robust statistics, UBC, May 12–18, 2002

3rd Pacific Northwest PDE conference and workshop in honor of John Cannon for his 65th birthday, Washington State Univ., May 15–18, 2002

MSRI Summer Graduate Camp on Computational Number Theory, Hosted by PIMS at SFU, June, 2002

Workshop on Filtering Theory and Applications, University of Alberta, July 20–26, 2002

Frontiers in Mathematical Physics: Workshop on Brane Worlds and Supersymmetry UBC, Vancouver July 22 – August 02, 2002 co-sponsored by PIMS, APCTP and the Perimeter Institute

Symposium on Aperiodic order, dynamical systems, operator algebras and toplogy, University of Victoria, August 4–8, 2002

National Programme Committee

In 1999 the three Canadian Institutes in the Mathematical Sciences, CRM, Fields and PIMS, initiated a new programme for the support of joint activities in the mathematical sciences. This programme is administered by a National Programme Committee, which makes recommendations to the Directors of the three institutes. The mandate includes:

- Allocating funds provided by the three institutes to support conferences and workshops in the mathematical sciences across Canada. These are primarily activities that fall outside of the main purview of the three institutes, or that would benefit from joint institute funding.
- Allocating funds for the support of activities that are held at the meetings of the three Canadian mathematical science societies: Canadian Mathematical Society (CMS), Canadian Applied and Industrial Mathematical Society (CAMS), Statistical Society of Canada (SSC).
- Assist the National Societies in supporting graduate students to attend these scientific meetings and coordinating annually the organization of three Institute Sessions to be held at the meetings of the Canadian Mathematical Society.
- Coordinating international programs and other ventures where it is advantageous for the three Institutes to act as a whole.

The six member committee consists of the Deputy Director and one member of the scientific advisory panel at each institute.

A call for proposals is made annually with submitted proposals considered semi-annually (September 15 and March 15). Primary administrative responsibility for the program rotates between the three Institutes on an annual basis. Submissions are made to the Deputy Director of the institute administering the program in that year. Last year, the Committee approved the following slate of scientific activities:

Activities 2000/2001:

Western Canada Linear Algebra Meeting
University of Manitoba, May 26 – 27, 2000
Contact: P. ven den Driessche (UVic)

Mathematical Year 2000 meeting
Universite Laval, May 5–7, 2000
Contact: Frederic Gourdeau

Special Functions 2000
Arizona State University, May 29 – June 9
Contact: L. Vinet (McGill)

Statistical Society of Canada, 2000 Conference
Ottawa, June 4–7, 2000
Contact: D. Murdoch (UWO)

Math 2000 Meeting
McMaster University, June 10–13, 2000
Contact: Ian Hambleton

Approximation, Complex Analysis and Potential Theory
Université de Montréal, July 3–7, 2000
Contact: Aubert Daigneault

First Prairie Industrial Problem Solving Workshop

Brandon, Manitoba, August 7–11, 2000
Contact: L. Batten, (U. Manitoba)

CITA/ICAT Meeting
Toronto, Ontario, August 26–30, 2000
Contact: J. Richard Bond

12th Canadian Conference on Computational Geometry
Fredericton, New Brunswick, August 2000
Contact: David Bremner

CMS Winter 2000 Meeting
Vancouver, December 10–12, 2000
Contact: Dale Rolfsen (UBC)

Novel Approaches to Hard Discrete Optimization
University of Waterloo, April 26–28, 2001
Contact: Henry Wolkowicz (U. of Waterloo)

Canadian Annual Symposium on Operator Algebras,
MSRI, Berkeley, California, April 26 – May 2, 2001
Contact: George Elliott (UT)

Black Hole, III Conference
Kananaskis, Alberta May 19-23, 2001
Organizer: A. Frolov (U. of Alberta)

Groups, Rings Lie and Hopf Algebras
St. John's, Newfoundland, May 8 – June 1, 2001
Contact: Yuri Bahturin (AARMS/Memorial)

PIMS Sessions at the CMS Summer 2001 Meeting
University of Saskatchewan, June 2–4, 2001
Contact: Keith Taylor

Joint meeting of SSC, IMS and WNAR,
SFU, June 10–14, 2001
Contact: Mary Lesperance (U. of Victoria)

International Workshop on Dynamical Systems & their Applications in Biology
Cape Breton, Nova Scotia, August 2–6, 2001
Contact: Shigui Ruan (AARMS/Dalhousie)

13th Canadian Conference on Computational Geometry
University of Waterloo, August 13–15, 2001
Contact: Therese Biedl (U. of Waterloo)

Second Gilles Fournier Memorial Conference
University of Sherbrooke, August 13–15, 2001
Contact: Tomasz Kaczynski (U. of Sherbrooke)

Second Workshop on the Conley Index and Related Topics
University of Sherbrooke, August 15–18, 2001
Contact: Tomasz Kaczynski (U. of Sherbrooke)

Aspects of Symmetry on the occasion of the 60th birthday of Robert Moody
Banff, Alberta, August 26–29, 2001
Contact: Arturo Pianzola, Alberta

Modelling and Scientific Computation
Fredericton, New Brunswick, Sept. 29–30, 2001
Contact: Viqar Husain (AARMS/UNB)

CMS Winter 2001 Meeting
York University, December 8–10, 2001
Contact: Tom Salisbury (York)

International Initiatives

Second Canada-China Mathematics Congress, UBC, August 20–23, 2001

This initiative builds on the success of the first Congress held at Tsinghua University, Beijing, in August 1999, and is aimed at developing further the collaborative research effort between the two countries. It is sponsored by the 3×3 Canada-China initiative, Centre de Recherches Mathématiques, Fields Institute for the Mathematical Sciences, Pacific Institute for the Mathematical Sciences and MITACS Network of Centres of Excellence.

Organizing Committee:

Nassif Ghoussoub (National Math. Coordinator for 3x3 Canada-China Initiative), Dale Rolfsen (PIMS UBC-Site Director), JingYi Chen (UBC), Xiao Jiang Tan (Peking University), Lizhong Peng (Peking University), Dayong Cai (Tsing Hua University), XingWei Zhou (Nankai University), JiaXing Hong (Fudan University).

Officers of the Chinese Delegation

- **Zhi Xing Hou** (President of Nankai University, Director of Mathematical Centre of Chinese Education Ministry)
- **Wang Jie** (Vice director, Chinese Nature Scientific Foundation)
- **Zhiming Ma** (President, Mathematical Society of China)
- **L.Z. Peng** (Secretary, the Mathematical Society of China)
- **K.C. Chang** (Director, Mathematical Centre of Chinese Education Ministry)

Officers of the Canadian Delegation

- **Tom Brzustowski** (President of NSERC)
- **Barry McBride** (Vice-President Academic, UBC)
- **Nassif Ghoussoub** (PIMS Director and National Math. Coordinator for 3x3 Canada-China Initiative)
- **Arvind Gupta** (MITACS program leader)
- **Ken Davidson** (Director, Fields Institute)
- **Jacques Hurtubise** (Director, CRM)

From left: Robert Moody, Arvind Gupta, Tom Brzustowski, Nassif Ghoussoub, Mark Lewis, Jacques Hurtubise and Hugh Morris at the Canada-China banquet at UBC.

Plenary Speakers:

- **Robert Moody** (U. of Alberta), *The World of Aperiodic Order*
- **Catherine Sulem** (Toronto): *The Nonlinear Schrödinger equation: Self-focusing and Wave Collapse*
- **Zhiming Ma** (Academic Sinica), *Some New Results/Directions in Probability Theory*
- **Mark Lewis** (Alberta): *Realistic models for biological invasion*
- **Jie Xiao** (Tsinghua), *Hall Algebras and Quantum Groups*
- **Yiming Long** (Director of the School of Mathematical Sciences, Nankai U.), *Iteration theory of Maslov-type index with applications to nonlinear Hamiltonian systems*
- **Xiaoman Chen** (Fudan), *On the Structure, K-theory of Roe Algebras*
- **Weiyue Ding** (Director of the Institute of Mathematics, Peking U.), *On the Schrodinger Flow*
- **Gordon Slade** (UBC): *Scaling limits and super-Brownian motion*
- **Ian Putnam** (Victoria): *Operator algebras and hyperbolic dynamical systems*
- **Gang Tian** (MIT): *Kahler-Einstein metrics and geometric stability*
- **Henri Darmon** (McGill): *Periods of modular forms and rational points on elliptic curves*

Session Speakers

I. Algebra and Number Theory:

- **Qingchun Tian** (Peking): *Iwasawa Theory for p-adic Representation*
- **Xingui Fang** (Tsinghua): *On 1-arc Regular Graphs*
- **Weisheng Qiu** (Peking): *Completely Settling of the Multiplier Conjecture for the case of* $n = 3p^3$
- **Yonghui Wang** (Capital Normal): *Some Results on Analytic Number Theory*
- **Jim Carrell** (UBC): *Cohomology and vector fields*
- **Kai Behrend** (UBC): *Equivariant vector fields and the cohomology of stable map spaces*
- **Terry Gannon** (Alberta): *The algebraic combinatorics of rational conformal field theory,*
- **Zinovy Reichstein** (UBC): *Trace forms of Galois field extension in the presence of roots of unity*
- **Jim Bryan** (UBC): *Curves in Calabi-Yau 3-folds and integrality in Gromov-Witten theory*
- **Tony Geramita** (Queens): *Tensor Rank, Secant Varieties of Segre Varieties and Schemes of Fat Points in Multiprojective Spaces*
- **Henri Darmon** (McGill): *Periods of modular forms and rational points on elliptic curves*

II. Mathematical Physics and PDE:

- **Yunbo Zeng** (Tsinghua): *Integral-type Darboux transformations for soliton hierarchy with self-consistent sources*
- **Peidong Liu** (Peking): *Entropy and Iyapunov Exponents for Stationary Random Maps*
- **Chengming Bai** (Nankai): *The Happer's Puzzle Degeneracies and Yangian*
- **Songmu Zheng** (Fudan): *Maximal attractor for some non-linear PDEs*
- **Jiayu Li** (Fudan): *Geometric Analysis*
- **Li Ma** (Tsinghua): *Some new results about mean field equations*
- **Shuxiang Huang** (Shang Dong): *Global Solutions and Asymptotic Behaviour for Reaction-diffusion Equations*
- **Dmitry Jakobson** (McGill): *Some new and old results on eigenfunctions*
- **Jia Quan Liu** (Peking): *Solutions for Quasilinear Elliptic Equations*
- **Shoulin Zhou** (Peking): *On a Singular Equation*
- **Shenghong Li** (Zhejiang): *Second Boundary Problem for Parabolic Equations with Gradient Obstacle*
- **Nassif Ghoussoub** (PIMS and UBC): *On De Giorgi's conjecture in higher dimensions*
- **S. Gustafson** (UBC):
- **Peter Greiner** (Toronto): *Subelliptic PDEs and Subriemannian Geometry*
- **Gordon Semenoff** (UBC): *Boundary states for background independent string field theory*
- **Izabella Łaba** (UBC): *Spectral Measure*
- **Jiquang Bao** (PIMS): *Local Estimates for Special Lagragian Equations in Dimension Three*
- **Changfeng Gui** (UBC):
- **Peter Orland** (CUNY, visiting UBC) $SU(2) \times SU(2)$ *gauging of integrable XXX models*
- **John Harnad** (CRM, Concordia): *Duality in Random Matrices and Biorthogonal Polynomials*

III. Probability and Statistics:

- **Guanglu Gong** (Tsinghua): *The annealing of an iterative system*
- **Yongjin Wang** (Nankai): *A probabilistic analysis to a class of non-linear differential equations on unbounded domains and application to superprocesses*
- **Tianping Chen** (Fudan): *Independent, Principal and Minor Component Analysis*
- **Runchu Zhang** (Nankai): *Optimal Blocking of* 2^{n-k} *and* 3^{n-k} *Fractional Factorial Designs*
- **Martin Barlow** (UBC): *Geometry and escape times for random walks on graphs*
- **Ed Perkins** (UBC): *Degenerate stochastic differential equations and super-Markov chains*
- **Jonathan Taylor** (McGill): *Geometry of smooth Gaussian fields on manifolds*

- **Remco Van der Hofstad** (Microsoft, Delft U of Tech): *Weak interaction limits for one-dimensional polymers*
- **Peter Hooper** (Alberta): *Statistical recognition methods for protein secondary structure*
- **Harry Joe** (UBC): *Continuous time stochastic processes with given univariate marginals*

IV. Wavelets and their Applications:

- **Xingwei Zhou** (Nankai): *Some results on Wavelet frames*
- **Lizhong Peng** (Peking): *Orthogonal Wavelets on the Heisenberg Group*
- **Heping Liu** (Peking): *The Joint Spectral Multipliers on Heidelberg Groups*
- **Ding-Xuan Zhou** (Hongkong City): *Estimating the Approximation Error in Learning Theory*
- **Hoi Ling Cheung** (Hongkong City): *Supports and Local Linear Independence of Multivariate Refinable Functions*
- **Serge Dubuc** (Montreal): *Convergence in Distribution of Hermite Subdivision Schemes*
- **Bin Han** (Alberta): *Symmetry Properties of Multivariate Refinable Functions*
- **Rong-Qing Jia** (Alberta): *Convergence Rates of Cascade Algorithms*
- **Jean-Marc Lina** (Montreal):
- **Remi Vaillancourt** (Ottawa):

V. Computational, Industrial & Applied Analysis:

- **Houde Han** (Tsinghua): *The Numerical solutions of Heat Equation on Unbounded Domains*
- **Dayong Cai** (Tsinghua): *Multi-solution of Power System and its Fast Algorithm*
- **Ping Zhou** (St. Francis Xavier): *Explicit Construction of Multivariate Padé Approximants and Some Applications*
- **Jianwei Hu** (Nankai): *Finite Element-Finite Volume Type Method for Nonlinear Convection-Diffusion Problems and its Applications*
- **Yongji Tan** (Fudan): *On some Inverse Problems*
- **Zhongmin Wu** (Fudan): *Quasi interpolation for solving ordinary differential equations*
- **Yangfeng Su** (Fudan): *Some problems on GTH algorithm for Stochastic matrices*
- **Xunjing Li** (Fudan): *On Optimal Control Theory for Infinite Dimensional Systems*
- **Shufang Xu** (Peking): *Numerical Analysis of the Maximal Solution of the matrix Equation* $X + A^*X^{-1}A = P$
- **Wenxun Xing** (Tsinghua): *Computational Applied Analysis*
- **Yanren Hou** (Xi'An Jiaotong): *Full Discrete Post-processing Procedure to the Galerkin Approximation Based on AIMD*
- **Zheng Jian Hua** (Tsinghua): *Hyperbolic metric and its application in complex dynamics*
- **Huaxiong Huang** (York): *Industrial Analysis*
- **M. Fortin** (Laval): *Computational Analysis*
- **Hermann Brunner** (Memorial U. of Newfoundland):
- **Jianhong Wu** (York): *Neural Networks for Clustering Large Data Sets in High Dimensions*
- **Brian Seymour** (UBC): *Self-similar flows of immiscible fluids*
- **Rex Westbrook** (U. of Calgary): *Sag Bending*
- **Hang Gao** (Northeast Normal U.):
- **Anthony Peirce** (UBC): *Analysis of a novel preconditioner for solving lower rank extracted systems derived from convolution integral equations*
- **Brian Wetton** (UBC): *Industrial and Computational Analysis*
- **Michael Ward** (UBC): *Applied Analysis*
- **Uri Ascher** (UBC): *Multilevel computational techniques for inverse electromagnetic problems in 3D*
- **Steven Ruuth** (SFU): *Strong Stability Preserving (TVD) High Order Time Discretization Methods*

VI. Geometry/Topology:

- **Rick Jardine** (Western Ontario): *Stacks and Homotopy Theory*
- **Maung Min-Oo** (McMaster): *K–area and scalar curvature*
- **Denis Sjerve** (UBC):
- **Youcheng Zhou** (Zhejiang): *On Moeckel-like boundary of the local Siegel disk*
- **Hui Kou** (Sichuan): *U_k–admitting dcpos and the largest tcc subcategories of domains: two topological problems in Domain theory*
- **Jacques Hurtubise** (CRM/McGill): *Representation with Weighted Frames and Framed Parabolic Bundles*
- **Qing Ding** (Fudan): *The Schodinger flow and its application in integrable systems*
- **Eckhard Meinrencken** (Toronto): *The Duflo homomorphism for subalgebras*
- **Xiaojiang Tan** (Peking): *On Petri Map for Rank 2 Vector Bundles*
- **Shaoqiang Deng** (Nankai): *Dipolarizations in Lie Algebras and Homogeous ParaKaehler Manifolds*
- **Jianhua Zheng** (Tsinghua U.): *An application of hyperbolic metric on complex dynamics*
- **Kunio Murasugi** (Toronto): *On double torus knots*
- **K.C. Chang** (Peking): *An Evaluation of Minimal Surfaces*
- **McKenzie Wang** (McMaster): *A Variational Approach for Homogeneous Einstein Metrics*
- **Jinkun Lin** (Nankai): *Some new families of filtration six in the stable homotopy spheres*

VII. Operator Algebra:

- **Shuang Zhang** (Cincinnati): *Purely infinite simple C^*-algebras generated by an isometry and a bilateral shift*
- **Mahmood Khoshkam** (U. of Saskatchewan): *On finiteness of the lattice of intermediate subfactors*
- **Allan Donsig** (Nebraska): *Algebraic Isomorphisms of Limit Algebras*
- **Kenneth Davidson** (Waterloo): *Perron–Frobenius Theorem for Completely Positive Maps*
- **Thierry Giordano** (Ottawa):
- **Guanggui Ding** (Nankai): *Some Recent Advances and the Open Problems on Perturbations and Extensions of Isometric operators*
- **Man Duen Choi** (Toronto): *The Norm Estimate for the Sum of Two Matrices*
- **Massoud Amini** (U. of Saskatchewan): *Locally Compact Pro-C^*-algebras*
- **James Mingo** (Queen's): *Spectral Measures of the Almost Mathieu Operator*
- **Andu Nica** (Waterloo): *Levels of operator-valued R-transforms in free probability*
- **Chris Phillips** (U. of Oregon): *Ordered K-theory for crossed products of the Cantor set by free minimal actions of $\mathbf{Z}^d$*
- **Sam Walters** (UNBC): *The structure of the Fourier transform on the rotation algebra*
- **Qing Lin** (U. of Victoria and Ericsson):

VIII. Mathematical Finance:

- **Abel Cadenillas** (Alberta): *Executive Stock Options with Effort Disutiliy and Choice of Volatility*
- **Duo Wang** (Peking): *Bifurcation of the ABS model of fundamentals versus trend chasers with positive share supply*
- **John Walsh** (UBC):
- **Junyi Guo** (Nankai): *Compound models and their ruin probabilities for risk processes with correlated aggregate claims*
- **Ali Lari-Lavassani** (Calgary):
- **Uli Haussmann** (UBC): *A Stochastic Equilibrium Economy with Optimal Capacity Expansion*

IX. ODE and Dynamical systems:

- **Weinian Zhang** (Sichuan U.): *Bifurcations of a Polynomial Differential System of Degree n in a Biochemical Reaction*
- **Leon Glass** (McGill): *Dynamics in High Dimensional Models of Genetic Networks*
- **William Langford** (Guelph): *Synchronized Chaos for Authentication and Communication*
- **Jacques Belair,** (Montréal): *Delays and dynamics in neural networks*
- **Meirong Zhang** (Tsinghua): *The rotation number approach to eigenvalues of the one-dimensional p-Laplacian*
- **Wagne Nagata** (UBC): *Reaction-diffusion models of growing plant tips: bifurcations on hemispheres*
- **Weigu Li** (Peking): *Planar Analysis Vector Fields with Generalized Rational First Integrals*
- **Michael Li** (Alberta): *Poincaré s Stabiltiy Conditions for Orbital Stability of Almost Periodic Solutions*
- **Christiane Rousseau** (Montréal): *Finite cyclicity of graphics of planar vector fields and Hilberts 16th problem for quadratic vector fields*
- **Florin Diacu** (Victoria): *On the dynamics of the classical atom*
- **Oleg Bogoyavlenskij** (Queen's): *Lie algebraic invariant meaning of the non-degeneracy conditions in the Kolmogorov - Arnold - Moser (KAM) theory*
- **Victor LeBlanc** (Ottawa): *Forced symmetry breaking for spiral waves*
- **Yun Tang** (Tsinghua): *Singularities of quasi-linear DAE in the setting of real algebraic geometry*

From left: Zhiming Ma (President of Chinese Math. Society), K. C. Chang (Director at Chinese Ministry of Education) and L. Z. Peng (Secretary of Chinese Math. Society) at the CCC opening ceremony.

Second Pacific Rim Conference on Mathematics, Taipei, Taiwan, January 4–8, 2001

Organizing Committee: Shui-Nee Chow (National U. of Singapore), Craig Evans (U. of California, Berkeley), Fon-Che Liu (Academia Sinica, Taiwan), Masayasu Mimura (Hiroshima U.), Robert Miura (PIMS), Ian Sloan (U. of New South Wales) and Roderick S.C. Wong (Liu Bie Ju Centre for Mathematical Sciences, Kowloon)

Approximately 150 mathematicians from Australia, Canada, China, France, Hong Kong, India, Japan, Korea, New Zealand, the Philipines, Singapore, Switzerland, Tajikstan, the United States, and Uzbekistan attended the Second Pacific Rim Conference on Mathematics on January 4–8, 2001 at Academia Sinica in Taipei, Taiwan. The six main themes of the Conference were Combinatorics, Computational Mathematics, Dynamical Systems, Integrable Systems, Mathematical Physics, and Nonlinear Partial Differential Equations.

There were 12 one-hour plenary talks, approximately forty 45 minute invited talks, and 55 contributed papers. The plenary talks were excellent with each speaker giving a general background for the audience and then presenting more details later in the talk.

Plenary Speakers:

Ian Affleck (UBC): *Applications of Boundary Conformal Field Theory to Condensed Matter Physics*

Craig Evans (UC Berkeley): *Homogenization and Hamiltonian Dynamics*

Joel Feldman (UBC): *Asymmetric Fermi Surfaces for Magnetic Schrodinger Operators*

Genghua Fan (Academia Sinica, China): *Integer Flows and Circuit Covers*

Alberto Grunbaum (UC Berkeley): *Diffuse Tomography: An Nonlinear Inverse Problem in Medical Imaging*

Song-Sun Lin (Chiao Tung U., Taiwan): *Celluar neural Networks: Pattern and Waves*

Junkichi Satsuma (Univ. of Tokyo):

Leon Simon (Stanford): *Singularities of Minimal Surfaces and Harmonic Maps*

Stephen Smale (City U, Hong Kong): *On the Mathematics of Learning Theory*

Gilbert Strang (MIT): *Structured Matrices and Good Bases*

Yingfei Yi (Georgia Tech): *A Quasi-Periodic Poincar-'s Theorem*

Xuding Zhu (Sun Yat-Sen U., Taiwan): *Circular Chromatic Number and Circular Flow Number of Graphs*

The two plenary speakers from Canada were in the Mathematical Physics Session, along with Izabella Łaba (UBC), Robert McCann (Toronto), and Gordon Semenoff (UBC), who were invited speakers. Brian Alspach (Regina) and Rong-Qing Jia (Alberta) were invited speakers in the Combinatorics and Computational Mathematics Sessions, respectively. The Canadian Representative on the Organizing Committee was Robert Miura (UBC). PIMS provided support for the Canadian participants in the conference.

A committee meeting was held after the Conference Reception to discuss the site of the Third Pacific Rim Conference on Mathematics and was attended by representatives from Australia, Canada, China, Hong Kong, Japan, Taiwan, and the United States. It was proposed that the next Conference be held in Vancouver in the summer of 2004 under the sponsorship of PIMS. This was accepted enthusiastically and unanimously by the committee, as well as by the participants after it was announced at the Conference Banquet.

Upcoming International Activities:

Pan American Advanced Studies Institute on Inverse Problems and Nonlinear Analysis
Santiago, Chile
January, 2003

3rd Pacific Rim Conference on Mathematics,
Vancouver, Canada
2004

IV. INDUSTRIAL PROGRAMME

Participants at the 4th annual PIMS GIMMC enjoyed dry days and summer sunshine in Victoria.

PIMS/MITACS Industrial Partners

- Advanis
- Amber Computer Systems
- APPEGA
- Ballard Power Systems Inc.
- Barrodale Computing
- Bayer Inc.
- BC Cancer Research Center
- BC Hydro
- BioTools
- The Boeing Company
- Canadian Cable Labs
- Canadian Marconi
- Charles Howards & Associates
- Chemex Labs
- Computer Modeling Group
- Corel Corporation
- Crystar Research Inc.
- Diagnostic Engineering Inc.
- Dynapro
- Eastman Kodak
- Enbridge
- FinancialCAD Corporation
- Firebird
- Galdos Systems
- Harley Street Software
- Hughes Aircraft
- Husky Oil
- IBM Canada Ltd
- IBM T. J. Watson Res. Center
- ICBC
- Imperial Oil
- In Silico
- Insightful
- ISE Research Ltd.
- Integrated Flight Systems
- Kinetek Pharmaceuticals Inc.
- Itres Research Ltd.
- Lockheed Martin Canada
- Lockheed Martin Tactical Defense Systems
- Math Resources Inc.
- MathSoft
- MacMillan Bloedel Ltd.
- McMillan-McGee
- MDSI
- Menex Technologies
- Merak
- Michelin
- NALCO Canada Inc.
- NORTEL Networks
- Novacor
- PanCanadian Petroleum Ltd.
- Petro Canada
- Progas
- Powerex
- Powertech Labs Inc.
- Precision Biochemicals
- Prestige Telecommunications
- Quatronix Media
- Raytheon
- RSI Technologies
- Searle
- Shaw Cable
- Siemens Research
- Simons International Copr.
- SmithKline BeeCham Pharma
- Sperry-Sun
- Soundlogic
- StemCell Technologies Inc.
- StemSoft Software Inc.
- Stentor
- Stern Stewart & Co.
- Sun Microsystems
- Syncrude
- Telecom. Research Labs
- Telus
- TransAlta
- Veritas DGC
- VisionSmart
- Vortek Industries Ltd.
- Waterloo Maple Inc.
- Worker's Compensation Board

Industrial Problem Solving Programme

The format of the **Industrial Problem Solving Workshops** is mainly based on the Oxford Study Group Model, in which problems of relevant and current interest to the participating companies are posed to the workshop participants by experts from industry. The participating graduate students and academics will spend five days working on the problems and the results will be published in the workshop's proceedings. 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.
- Help PIMS and mathematics in general, by showing businesses and governments the tangible benefits of supporting the mathematical sciences.

4th PIMS Industrial Problem Solving Workshop (IPSW 4)

University of Alberta, May 29–June 2, 2000

Organizers:
J. Macki (U. Alberta)
B. Moodie (U. Alberta)
M. Paulhus (PIMS/UC)

Industrial Participants:
Stern Stewart & Company
McMillian-McGee
Imperial Oil
Vision Smart
Michelin

5rd PIMS Industrial Problem Solving Workshop (IPSW 5)

University of Washington, June 18–22, 2001

Organizers:
Randy LeVeque (U. Washington)
Chris Bose (U. Victoria)
Huaxiong Huang (York U.)
Marc Paulhus (U. Calgary)
Keith Promislow (SFU)
Ian Frigaard (UBC)

Industrial Participants:
Microsoft Research
Firebird Semiconductors
Communications Security Establishment
Alberta Energy Company
IBM
Algorithmics

PIMS Industrial Problem Solving Workshop (IPSW 4), University of Alberta, May 29 – June 2, 2000

Organizers: J. Macki (U. Alberta), B. Moodie (U. Alberta), M. Paulhus (PIMS/UC)

More than 70 participants spent a full week working intensely on five problems posed by industrial companies from across North America. The fourth annual Industrial Problem Solving Workshop was hosted by the Department of Mathematical Sciences at the University of Alberta in Edmonton, May 29-June 2, 2000. Among the participants were 40 graduate students who had spent a week at a training camp hosted by Simon Fraser University. The students were truly representative of Canadian Universities–there were students from Memorial University of Newfoundland, McGill and Concordia Universities in Quebec, McMaster, Guelph, York, Toronto, and Western Ontario in Ontario, Manitoba, University of Saskatchewan and University of Regina, Universities of Alberta and Calgary, and in B.C., UBC, Simon Fraser, and the University of Victoria. (throw in New York University as well). Participating faculty also spanned the country.

On the last day, we received a pleasant surprise from the Canadian Mathematical Society. With some help from one of its spies present at the workshop, the CMS had selected UBC's Kyle Biswanger to win the CMS Leadership Award for his contributions to the workshop.

International Experts:

Dr. J. DeWynne (Oxford University)
Dr. H. Huang (York University, Toronto)
Dr. J. King (Nottingham University)
Dr. D. Ross (Kodak University)

Workshop Problems:

Designing Incentive-Alignment Contracts in a Principal-Agent Setting in the Presence of Real Options. Stern Stewart & Co. is a global consulting firm that specializes in helping client companies in the measurement and creation of shareholder wealth through the application of tools based on modern financial theory. The company pioneered the development of its proprietary EVA (Economic Value Added) framework, which offers a consistent approach to setting goals and measuring performance, communicating with investors, evaluating strategies, allocating capital, valuing acquisitions, and determining incentive bonuses that make managers think like owners.

How can we reward managers of firms for making decisions which involve reduced returns now for greater returns in the long run, maybe even after they have left? This problem generated considerable debate and intense analysis among three different subgoups, and each subgroup presented a report. Their mentor was Professor Jeff DeWynne from Oxford University, and expert on financial modelling. In addition, U. of Calgary Professors Dan Calistrate, Gordon Sick and Tom Cottrell all played a major role in the work.

Wellbore Modeling — Boundary Value Problems in the Recovery of Petroleum Fluids from an Oil Reservoir. McMillian-McGee is a Calgary based engineering company. The company works according to its motto: "The Power Behind Energy".

How do we most efficiently apply induction heaters in oil well shafts to increase the flow? Owner Bruce McGee is a U of A Engineering graduate, so he participated enthusiastically during the week. Led by mentor Dr. David Ross of Eastman-Kodak in Rochester, New York, the group developed some important new ideas and made significant progress.

Complex System Modelling: Application to Imperial Oil's Cold Lake Oil Sands Facilities. Imperial Oil is Canada's largest producer of crude oil and a major producer of natural gas. It is also the largest refiner and marketer of petroleum products – sold primarily under the Esso brand – with a coast-to-coast supply network. As well, the company is a major supplier of petrochemicals. Imperial Oil shares (IMO) are listed on the Toronto stock exchange and are admitted to unlisted trading on the American Stock Exchange.

If you have a huge oilfield with, say, 3,000 wells, which wells should you choose for steam injection to enhance the production of the field? Applied mathematicians in group immediately did the right thing–"Let's start with two well...". At the end, substantial progress was reported. The group was ably led by mentor Huaxiong Huang of York University. Imperial Oil sent three representatives for the full week, and company representative Glynis Carling kept the group entertained with her marvelouw sense of humour.

The Tennis Ball Problem. VisionSmart is a group of engineering professionals specializing in solving difficult industrial scanning problems. The company strives to provide customers with cost-effective, highly customized solutions integrating high-speed digital signal processing with state-of-the-art machine vision technology.

Using two cameras to take digital images of a tennis ball as it begins its flight, how accurately can we predict

the future trajectory? This group was assisted by mentor Professor John King, head of the Theoretical Mechanics Group at Nottingham University. They ended up doing a lot of basic trig and geometry (what is the optima placing of two cameras?), some engineering (use a laser to sight the cameras), and a lot of physics –people were busy reading articles on the trajectory of a ball when it is spinning. President Dan Kenway and company representative Wolfgang Engler spent the full week assisting the team, and progress was excellent.

General Statistical Design of Experimental Problem for Harmonics. The Michelin Group of companies make tires for all types of vehicles: from bicycles to the space shuttle, including cars, trucks, motorcycles, earthmover equipment, buses, subway trains and aircraft. Every day they produce more than 830,000 tires over a broad product range, with the smallest under 200 grams (0.5 pounds) and the biggest over 5 tons.

How do you find the vibration characteristics of each of the many layers of a tire when you can only determine the composite vibrations after the tire is made? One trick is to build many tires with the various layers rotated by specific amounts. What is the least amount of tires we need to construct? Michelin Engineer Bill Mawbry came all the way from Michelin's research group in South Carolina to spend the week with the team. Would you believe prime numbers play a role? The team which worked on this one, ably led by mentor Professor Michael Lamoureux of U. Calgary, made significant progress in solving this problem. Bill said that he could see direct savings of up to $500,000 a year from their work.

PIMS Industrial Problem Solving Workshop (IPSW 5), University of Washington, June 18–22, 2001

Organizers: Randy LeVeque (U. Washington), Chris Bose (U. Victoria), Huaxiong Huang (York U.), Marc Paulhus (U. Calgary), Keith Promislow (SFU) and Ian Frigaard (UBC).

This year's **Industrial Problem Solving Workshop** (IPSW) was held at the University of Washington in Seattle. About 100 people registered for the event, including the 58 graduate students who had taken part in the graduate modelling camp the week before. Faculty from a number of universities around the world were also involved. Participants split up into six groups to attack the industrial problems brought to the workshop, spanning a broad range of applications and mathematical techniques. Most of the industrial participants were able to stay all week this year, and were actively involved in working with the groups. A brief description of the problems and some of the progress made is given below. More complete problem descriptions may be obtained from the website, **www.pims.math.ca/industrial/2001/ipsw** and proceedings papers are being written by each group.

Workshop Problems:

Disk Layout Problem: Representing local Seattle industry, **John DeTreville** brought a problem from **Microsoft** on optimizing the layout of files on a disk, given an expected order in which the files will be accessed. The group learned a great deal about the complex details involved in hard drive technologies. They also quickly established that the problem was equivalent to the intractable Travelling Salesman Problem. After building some one- and two-dimension disk models, they applied various heuristic techniques to try to find the optimal solution for some sample data that Microsoft provided. It was concluded that the heuristic methods appear to provide better solutions more quickly using the 2-D model than with the 1-D model, suggesting that the more realistic 2-D (or the even more realistic 3-D model not studied) should be used when disk performance is critical. Current hardware limitations make the 1-D model the industry standard.

Model For InSb Czochralski Growth: Many of the participants who specialize in continuous modelling were attracted to the problem presented by **Bill Mickleth-wiate** of **Firebird Semicondutors**, arising from growing large single crystals of Indium Antimonide (InSb) from a melt. These crystals, about the size of a wine bottle, may develop imperfections due to thermal stresses as they cool. This problem contained something for everyone in continuum mechanics – fluid dynamics coupled with convective, diffusive, and radiative heat transfer, Stefan problems for the moving phase boundary, and temperature-dependent stress analysis within the solid phase. This group split into several subgroups to tackle various aspects of the problem by both analytical and numerical approaches. Some new insights were gained into the expected shape of the moving boundary and the relative importance of different heat-transfer mechanisms.

Network Search Theory: **Allan Douglas** from the **Communications Security Establishment** brought a problem relating to computer security on the large computer networks, such as the internet. Mobile software

objects that move around between computers are becoming more common and the problem concerns the ability of the "good guys" to track down malicious software of this form. This led to an extensive literature search on problems of graph searching and random walks. The group discovered a vast and richly developed literature that was directly applicable to the problem at hand. They then expanded on that literature and established some new results based on the particulars of the problem.

Decline Analysis: Ron Forth presented a problem from the **Alberta Energy Company** on decline analysis, attempting to extrapolate trends in production rate data from oil and gas wells to forecast future production. The current practice is for a petroleum engineer to perform the extrapolation using visual curve fitting biased heavily by personal experience. The data is typically very noisy and has the additional feature that physical parameters in operation during the period of data collection are randomly changing (changes to pumping schedules, shutdowns, production enhancement, etc) so no one model can be expected to fit the entire time series. The workshop group concentrated on three aspects of the problem. First, the partitioning of the time series into intervals over which one physical model may be applied. Moving average and wavelet techniques were investigated; both seemed sufficient to perform the partition, provided reasonable thresholding values were used. Second, a curve fitting over each subinterval was performed. This was fairly straightforward as physical considerations lead to a parametric family of model curves and a simple, weighted, least-squares fit within that family appears to suffice. Finally a weighting of the various extrapolations obtained in the previous step determines the final decline curve estimate. A heuristic weighting scheme was proposed and tested with reasonable results on a restricted data set. The possibility that this last step would lend itself to a neural-net approach was discussed.

Web Hosting Service Agreements: Alan King of **IBM** brought a problem on properly pricing web-hosting service agreements. A web-hosting service provider may have a large number of clients with different needs, and a finite amount of computer resources to distribute amongst those customers in order to satisfy certain Quality-of-Service (QoS) agreements. However, the web-hosting service can also dynamically reallocate its resources based on the observed needs of its clients at any given time. The team tackled this extremely complex problem and built a very realistic model taking into account a wide range of complexities such as requests of different size with different priorities, time-lag in the hardware re-distribution, as well as penalties for failing to meet the QoS agreements.

A Problem in Financial Mathematics: The final problem came from **Algorithmics**, a financial mathematics firm. **Alex Kreinin** presented a problem on measuring the credit risk of a given portfolio, based on the credit ratings of the obligors. Standard Monte-Carlo techniques do not work very well since the interesting events (default by the obligors) are very rare and hence require a large number of simulations. Algorithmics came to the workshop with a very well thought out model and everyone was pleasantly surprised that the group discovered an analytical solution based on using the Lindberg-Feller Theorem (basically the Central Limit Theorem in this context) to approximate the credit risk of all counterparties in a single (credit driver) scenario. This resulted in approximating the risk across scenarios by a mixture of Gaussians, the latter being one of the current methods for treating distributions with long tails. The group then proceeded to test this fast, approximate solution against much more time-consuming full Monte Carlo simulations for one time step. They found reasonable agreement and expect much better results for longer time horizons since the CLT is better suited when the number of independent random variables increases. This was viewed as a significant development in the important area of credit risk, and we look forward to seeing it developed further.

A Glimpse at 2002

MITACS Annual General meeting
UBC, May 23–25, 2002

6th Industrial Problem Solving Workshop
UBC, May 27–31, 2002

PIMS-MITACS Workshop on Facility Location Problems,
SFU, June 8–11, 2002

Workshop on Design and Analysis of Experiments,
Coast Plaza Suites Hotel,
Vancouver, July 14–18, 2002

Participants in IPSW 2001 outside the Miller Building at the University of Washington.

Industrial and Scientific Training Activities

Basic Components of Programme:

The PIMS Graduate Industrial Mathematics Modeling Camp: Graduate students from Canadian universities come to learn various aspects of high-level techniques for solving industrial mathematics problems. The camp prepares them for:

The PIMS Summer School in Industrial Fluid Dynamics: The participants attend a comprehensive series of graduate-level lectures and are also given hands-on experience performing and analyzing experiments in the Environmental and Industrial Fluid Dynamics Laboratory, as well as running numerical simulations using research-level codes.

The IAM-CSC-PIMS School in Industrial Math for Senior Undergraduates shows students how the mathematics they are learning can be useful. Faculty mentors lecture on various industrial problems to all the participants. Subsequently, the students have the option of choosing one or more problems to work on during the three-day workshop.

The PIMS/MITACS Undergraduate Industrial Case Study Workshop giving students in their senior year the opportunity to compete in a 3-day industrial case study competition.

The Industrial Workshops and Mini-courses with topics of interest to both industry and academia serve to disseminate newly developed mathematical tools that can be of use in industry. The workshops are more interactive than the mini-courses.

3rd PIMS Graduate Industrial Math Modeling Camp
SFU, May 23–27, 2000
Coordinator: Keith Promislow (SFU)

4nd PIMS Graduate Industrial Math Modeling Camp
University of Victoria, June 11–15, 2001
Coordinator: Chris Bose (U. Victoria)

2nd PIMS Summer School in Fluid Dynamics
University of Alberta, July 30 – August 11, 2000
Organizers: B. R. Sutherland (U. Alberta) and T. B. Moodie (U. Alberta)

3rd PIMS Fluid Dynamics Summer School
PIMS at the University of Alberta, May 27 – June 8, 2001
Organizers: B. R. Sutherland (U. Alberta) and T. B. Moodie (U. Alberta)

IAM-PIMS Senior Undergraduate Industrial Math Workshop
UBC, February 18–20, 2000
Organizers: Anthony Peirce (UBC) and Michael Ward (UBC)

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop
PIMS-UBC & PIMS-SFU, February 17–18, 2001
Organizers: R. Russell (SFU) & B. Shizgal (IAM)

PIMS/MITACS Undergraduate Industrial Case Study Workshop
Centre for Operations Excellence at UBC, October 25–29, 2001
Organizers: M. Puterman (Commerce and Business Admin, UBC) and Stephen Jones (COE, UBC)

Statistical Genetics and Computational Molecular Biology Workshop
Univ. of Washington, December 16–18, 2001
Organizer: Elizabeth Thompson (UWashington)

Month of Industrial Math at PIMS: A wealth of opportunities for Canadian and US graduate students

The month of June 2001 witnessed a succession of scientific events in industrial mathematics at PIMS. More than 300 researchers, graduate students and senior undergraduates came from 25 Universities in Canada and the US to learn, research, interact, network and solve industrial problems at several interrelated events. The timetable was configured so that visiting students could participate in more than one of the worskhops.

The program started by the *PIMS-MITACS-Ballard Inc. Workshop on Computational Dynamic Fuel Cells* at Simon Fraser University held on June 4–8. This was organized in conjunction with the **PIMS Center for Scientific Computing**.

This was followed on June 9-10, by a PIMS-NSF-MITACS Workshop on *Inverse Problems and Imaging* at the PIMS facility at the University of British Columbia. This was organized in conjunction with the **PIMS Center for Inverse Imaging and Applications**.

Between June 11–15, the 4th PIMS Graduate Industrial Mathematics Modelling Camp was held at the University of Victoria. This year, 20 US graduate students were admitted to the program in addition to the customary 40 Canadian participants. As usual, it was followed by the 5th PIMS Industrial Problem Solving Workshop held this year at University of Washington in Seattle June 18–22.

John Chadam wrote to the organizers: "Just wanted to thank you all for your efforts in organizing three wonderful workshops. All three were intellectually stimulating and exceptionally well run. Hope I see you all soon in the east."

3rd PIMS Graduate Industrial Math Modeling Camp, Simon Fraser University, May 23–27, 2000

Organizers: K. Promislow (SFU), M. Kropinski (SFU) and S. Jungic (SFU)

Forty-one graduate students came from North America came to SFU to work five mentors from industry. Almost all the students came from 16 universities across Canada, however one came from as far away as New York University. The mentors were:

Rachel Kuske (University of Minnesota)
Colin Please (University of Southampton)
David Ross (Eastman Kodak)
Donald Schwendeman (Renssalar Polytechnic Institute)
Brett Stevens (IBM)

The problems examined over the course of the programme were:

- Catalytic Converter: A Simple Mathematical Solution to Understanding Operation
- Queue Compatible Gray Codes and Applications
- Optimal Design of a Micro-Electrical-Mechanical Systems Actuator
- Temperature Effects on a River or Estuary Due to the Construction of a Power Station
- Optimal Policies for Disk Controllers

4rd PIMS Graduate Industrial Math Modeling Camp, University of Victoria, June 11–15, 2001

Organizers: Chris Bose (Ui. Victoria), Randy LeVeque (University of Washington), Huaxiong Huang (York University), Mark Paulhus (University of Calgary), Keith Promislow (Simon Fraser University) and Ian Frigaard (University of British Columbia).

From June 11–15, the University of Victoria hosted the fourth annual **PIMS Graduate Industrial Math Modelling Camp** (GIMMC). The students followed up with a second week of industrial mathematics at the IPSW in Seattle, June 18–22. A record 58 students attended the Camp, led by 8 academic mentors on a selection

of industrial problems. This year's hardworking mentors were:

Sergei Bespamyatnikh (UBC)
John Chadam (Univ. of Pittsburgh)
Ian Frigaard (UBC)
Lisa Korf (U. Washington)
Hedley Morris (San Jose State)
Tim Myers (Univ. of Capetown)
Miro Powojowski (Algorithmics Corp.)
Moshe Rosenfeld (Univ. of Washington)

The problems examined over the course of the programme were:

- Problems in Portfolio Analysis
- Locating Watchtowers in Terrains (PDF)
- Modelling a metal spray forming process
- Web-hosting Service Agreements
- Defect analysis using Depth from Defocus methods
- Modeling Ice Accretion
- Risk Neutral Probability Measure
- Optimal Control of Streetlight Networks

As with previous camps, students from all regions of Canada were eligible to attend. This year the programme was expanded to include 60 invited participants, up from the usual cap of 40. Further, in recognition of our newest PIMS institution, University of Washington, a special effort was made to attract students from US universities. In all, we had more than 130 applicants to the Camp, and we accepted participants representing 25 North American Universities. Thirty-nine participants were from Canada and the remaining 19 were from the United States. Many favourable comments were collected from our mentors attesting to the excellent academic preparedness and to the enthusiasm of the students.

John Chadam

Increased exposure throughout North America given to this year's Camp will result in even more applications next year.

Graduate students doing numerical simulations.

2nd PIMS Summer School in Fluid Dynamics, University of Alberta, July 30 – August 11, 2000

Organizers: B. R. Sutherland (U. Alberta) and T. Bryant Moodie (U. Alberta)

Participants at the Second Annual PIMS Summer School in Fluid Mechanics will attend a comprehensive series of lectures and will be given hands-on experience performing and analyzing experiments in the Environmental and Industrial Fluid Dynamics Laboratory, as well as running numerical simulations using research-level codes. Topics will include fluid dynamics fundamentals, industrial and environmental flows, geophysical fluid dynamics, turbulence modelling and computational fluid dynamics. Subjects will be taught at the graduate level.

Invited Speakers:

Paul F. Linden (UC San Diego)
James C. McWilliams (UCLA)
Frans T. W. Nieuwstadt (Delft University of Technology)

Core Lecturers:

John C. Bowman, *Turbulence Modelling*
Andrew B. G. Bush, *Climate Modelling*
Peter Minev, *Computational Fluid Dynamics*
T. Bryant Moodie, *Wave Theory*
Bruce R. Sutherland, *Stratified Flows*
Gordon E. Swaters, *Physical Oceanography*

3rd PIMS Fluid Dynamics Summer School, PIMS at the University of Alberta May 27 – June 8, 2001

Organizers: B. R. Sutherland (U. Alberta) and T. Bryant Moodie (U. Alberta)

Eighteen graduate students from all over the world attended a comprehensive series of lectures, and were given hands-on experience performing and analyzing experiments in the Environmental and Industrial Fluid Dynamics Laboratory, as well as running numerical simulations using research-level codes. Topics included fluid dynamics fundamentals, industrial and environmental flows, geophysical fluid dynamics, turbulence modelling and computational fluid dynamics. Subjects were all taught at a graduate level.

This year's summer school was particularly rewarding for the students since it was held in conjunction with a PIMS Thematic Programme on Wave Phenomena and Fluid Dynamics. Special invited speakers were T. G. Shepherd (Univ. of Toronto) who spoke on *The Fluid Dynamics of the Middle Atmosphere* and H. J. S. Fernando (Arizona State) who spoke on *Turbulence and Mixing in Stably Stratified Fluid Layers.*

The Core Lecturers for the courses were **John C. Bowman** (Univ. of Alberta), *Turbulence Modelling*; **Andrew B. G. Bush** (Univ. of Alberta), *Climate Modelling*; **Peter Minev** (Univ. of Alberta), *Computational Fluid Dynamics*; **T. Bryant Moodie** (Univ. of Alberta), *Wave Theory*; **Bruce R. Sutherland** (Univ. of Alberta), *Stratified Flows* and **Gordon E. Swaters** (Univ. of Alberta), *Physical Oceanography.*

IAM-PIMS Senior Undergraduate Industrial Math Workshop, University of Brtish Columbia, February 18–20, 2000

Organizers: Anthony Peirce (UBC) and Michael Ward (UBC)

The workshop's goal was to show students how the mathematics they are learning can be useful. It ran for three days during which time faculty mentors firstly outlined each of the industrial problems (such as a tumor imaging problem) to all the participants. Each one of the students had the option of choosing one or more problems to work on during the three day workshop. Lectures on each of the problems were presented by the mentors in which the tools for the modeling and analysis of the problem were developed. The mentors then helped groups of approximately eight students to develop the models and answer the questions posed. The workshop culminated with a brief presentation by each of the groups working on the chosen problems. The mathematical tools used in the workshop were accessible to third and fourth year undergraduates in mathematics, applied mathematics, physics and applied science. The workshop also proved to be an excellent opportunity to meet students from across BC and Canada.

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop, PIMS-UBC and PIMS-SFU February 17–18, 2001

Organizers: Bernie Schizgal (UBC) and Bob Russell (SFU)

The annual SFU-UBC-PIMS Senior Undergraduate Math Modelling Workshop was held on February 17 and 18, with Saturday's portion organized by UBC's **Institute for Applied Mathematics** and Sunday's by SFU's **Centre for Scientific Computing**. The students came from across Canada — Acadia, University of Western Ontario, University of Alberta, University of Calgary, University of British Columbia, Memorial University of Newfoundland, McGill University, University of Toronto, York University, and SFU.

On Saturday, the students were given the choice of working on one of three projects: *Nonlinear Heat Conduction in the Microwave Heating of Ceramics* with Michael Ward (Math, UBC), *An Analytical and Numerical Study of Solitary Waves (Solitons)* with Bernie Shizgal

(Chemistry, UBC and Director of the Institute for Applied Mathematics) or *Modelling the Flight Path of a Softball* with Douw Steyn (Earth and Ocean Science, UBC).

On Sunday, the students were given the choice of participating in one of two projects: *Liquid Mobility in Fuel Cells* run by Keith Promislow (Math, SFU) with help from Ron Haynes (Math Ph. D. student at SFU) or *Visualizing A Snowstorm* run by Dave Muraki (Math, SFU) and Torsten Moeller (Computing Science, SFU).

Both days of the workshop were highly successful, with the mentors being rewarded by an enthusiastic and lively response from the students. For more information, see **pims.math.ca/industrial/2001/suimw**.

Participants in the IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop.

PIMS/MITACS Undergraduate Industrial Case Study Workshop, Centre for Operations Excellence at UBC, October 25–29, 2001

Organizers: Martin Puterman and Stephen Jones (UBC)

Selected students in the summer preceding their senior year are invited by PIMS and MITACS to compete in a 3-day industrial case study competition. Fifteen students from across North America, in undergraduate programmes such as Engineering, Mathematics, Statistics, Computer Science and Economics, will be chosen for this intensive three-day industrial case study competition. Business problems will be selected to require mathematical analyses, complemented with problem formulation, problem solving, and presentation skills.

This workshop is designed to:

- Introduce students to current research initiatives and industrial problems in the operations research sector.
- Provide a unique opportunity for students to work in teams to solve challenging problems with mathematical and business content.
- Allow industry executives the opportunity to become acquainted with students and evaluate them for potential future employment.
- Inform students of the exciting opportunities for graduate studies in applied math and operations research.

For more information and registration please see **http://pims.math.ca/industrial/2001/uicsw**.

Statistical Genetics and Computational Molecular Biology, University of Washington, December 16–18, 2001

The programmes in **Statistical Genetics** and **Computational Molecular Biology** at the University of Washington will host a Workshop in Statistical Genetics and Computational Molecular Biology. The workshop is aimed at students from the mathematical, computational, and statistical sciences who may be considering graduate study and research in these areas of mathematical and computational biology. The intended participants are primarily undergraduate seniors or first-year graduate students at Colleges and Universities of the Pacific Northwest Region or Western Canada. PIMS will provide support for graduate students from the PIMS universities.

Topics will be in computational molecular biology, genomics, statistical genetics, and bioinformatics. Lectures will be given by: **David Baker** (Biochemistry, Univ. of Washington) *Protein Structure Prediction*; **Joe Felsenstein** (Genetics, Univ. of Washington); **Jinko Graham** (Statistics and Actuarial Science,

SFU) *Testing and Estimation of Recombination Breakpoints in a Set of Aligned Sequences*; **Phil Green** (Molecular Biotechnology, Univ. of Washington) *Analyzing Genome Sequences*; **Kathleen Kerr** (Biostatistics, Univ. of Washington) *Gene Expression Microarrays: Classical Statistics and Modern Genomics*; **Leonid Kruglyak** (FHCRC); **John Mittler** (Microbiology, Univ. of Washington); **Stephanie Monks** (Biostatistics, Univ. of Washington); **Jim Mullins** (Microbiology, Univ. of Washington) *Genomics is Solving Problems in Infectious Diseases*; **Maynard Olson** (Univ. of Washington Genome Center) *Resequencing Segments of the Human Genome: Experimental and Statistical Considerations*; **Steve Self** (or other representative from the Bioinformatics Group of the FHCRC); **Elizabeth Thompson** (Statistics, Univ. of Washington) *Inferring Gene Locations from Genetic Data on Pedigrees*; **Martin Tompa** (Computer Science and Engineering, Univ. of Washington) *An Exact Algorithm to Identify Motifs in Orthologous Sequences from Multiple Species*; and **Ellen Wijsman** (Division of Medical Genetics, School of Medicine, U.Washington).

A Glimpse at 2002

3rd IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop,
UBC and SFU,
February 16-17, 2002

1st School of mathematical biology for senior undergraduates,
University of Alberta,
May 11–19, 2002

5th Graduate Industrial Math. Modeling Camp
SFU, May 18–23, 2002

Summer school in Applications of Computational Geometry,
SFU, June 3–7, 2002

4th School of environmental and industrial fluid dynamics,
University of Alberta,
July 28–August 9, 2002

Industrial Collaborative Projects

The Industrial Collaborative Program supports innovative research in the mathematical sciences which is driven by industrial applications and which will lead to new, creative mathematical and statistical results to be available to industry and for wide dissemination. A critical component in these collaborative projects is the active involvement of both academic researchers to guide the scientific research, and industrial partners to focus the project on industrially relevant problems. The PIMS contribution is directed towards the support of highly qualified personnel (graduate students, postdoctoral fellows and research assistants) in the mathematical sciences working directly on the activity.

Industrial Postdoctoral Fellowship Programme

Central to the PIMS strategy is the identification of industrial projects that can be tackled by young mathematical scientists.

Jointly supervised by PIMS scientists working in concert with their industrial counterparts, PIMS postdoctoral fellows split their time between the university and the company, exchanging intellectual ideas between these two domains. The PDFs are expected to participate in the PIMS industrial workshops and conferences. They act as the conduit for dissemination of knowledge between the industrial partner and the university research group.

PIMS Industrial Postdoctoral Fellows for 2000/2001

The following projects have been supported in 2000/2001.

1. **Hongwei Long**
   Industrial Partner: Lockheed Martin
   Sponsors: Mike Kouritzin (U. Alberta)
   Project: Markov Chain Methods of Filtering
2. **Sun Wei**
   Industrial Partner: Lockheed Martin, Vision Smart and APR
   Sponsors: Mike Kouritzin (U. Alberta)
   Project: Filtering for Diffusions in Random Environments
3. **Joseph Mmbaga**
   Industrial Partner: Paprican
   Sponsors: Bob Hayes (Chemical Engineering, U. Alberta)
   Project: Computer Modelling of Forward Roll Coating
4. **Simon MacNair**
   Industrial Partner: Powerex
   Sponsors: U. Haussmann (UBC)
5. **Alexandra Chavez-Ross**
   Industrial Partner: In Silico
   Sponsors: L. Keshet (UBC)
6. **Matias Salibian-Barrera**
   Industrial Partner: Mathsoft
   Sponsors: Ruben Zamar (Statistics, SFU?)
   Project: Data mining
7. **Sviatoslav Pelipenko**
   Industrial Partner: Schlumberger
   Sponsors: Ian Frigaard (Math, UBC)
8. **Janez Ales**
   Industrial Partner: Maple
   Sponsors: M. Monagan (SFU)
9. **Brett Stevens**
   Industrial Partner: IBM
   Sponsors: L. Goddyn (SFU)

MITACS: A Network of Centers of Excellence in the Mathematical Sciences

Founders of MITACS: Nassif Ghoussoub, Don Dawson, Steve Halperin. Missing is Luc Vinet (seen below).

Mathematics of Information Technology and Complex Systems (MITACS) is one of the three new Networks of Centers of Excellence (NCE) created in 1998. The MITACS NCE is a joint venture of the three Canadian mathematical sciences institutes: the Centre de Recherches Mathématiques, the Fields Institute in Mathematical Sciences and the Pacific Institute for the Mathematical Sciences. MITACS harnesses mathematical power for the benefit of the Canadian economy. The network brings together more than 150 researchers at 22 Canadian universities with more than 70 Canadian industrial, medical, and financial organizations. The network comprises 23 projects addressing problems in five sectors of the Canadian economy, including two new projects funded in 2000.

Luc Vinet

The creation of the MITACS network provides an exceptional opportunity for the mathematical sciences community to develop a large scale systematic programme for research, HQP training and the development of partnerships with key business, industrial and health care sectors across the country.

Arvind Gupta,
MITACS
Programme Leader

MITACS Projects at PIMS

There are 21 ongoing MITACS projects across the country in five themes. Here are the current 11 projects coordinated by PIMS:

Pseudodifferential Operator Theory in Seismic Imaging

Leaders: Dr. M. Lamoureux (Math), Dr. G. Margrave (Geophysics), University of Calgary

Members: R. Aggarwala (Math, U. Calgary), W. Allegretto (Math, U. Alberta), J. Bancroft (Geophysics, U. Calgary), L. Bentley (Geophysics, U. Calgary), P. Binding (Math, U. Calgary), A. Calvert (Earth Sciences, SFU), R. Ferguson (Chevron), S. Gray (Veritas D.G.C.), C. Laflamme (Math, U. Calgary), P. Lancaster (Math, U. Calgary), L. Lines (Geophysics, U. Calgary) , E. Nyland (Physics, U. Alberta), M. Slawinski (Mechanical Eng, U. Calgary), M. Sacchi (Physics, U. Alberta), J. Sniatycki (Math, U. Calgary), D. R. Westbrook (Math, U. Calgary)

Industrial Affiliates: Consortium for Research in Elastic Wave Exploration Seismology, including AEC, BP-Amoco, Chevron, Pan Canadian, Petro-Canada, Talisman, Veritas D.G.C., Imperial Oil, Shell and others.

Mathematical Modeling in Pharmaceutical Development

Leader: Dr. J.A. Tuszynski, Physics, U. Alberta

Members: Dr. G. de Vries (Math, U. Alberta), Dr. G. A Dumont (Elec. & Computer Engg., UBC), Dr. M. Klobukowski (Chemistry, U. Alberta), Dr. B. MacLeod (Anaesthesia, Pharmacology & Therapeutics, UBC), Dr. J. Muldowney (Math, U. Alberta), Dr. K. Rubenson (CHET, Education, UBC), Dr. J. Samuel (Pharmacy & Pharmaceutical Sc., U. Alberta), Dr. Y. Tam (Pharmacy & Pharmaceutical Sc., U. Alberta), Dr. D. Wiens (Stats Centre, U. Alberta), Dr. D. Bevan, Dr. D. Quastel, Dr. C. Ries, Dr. M. Sutter, Dr.M. Walker, Dr. J. Wright

Industrial Affiliates: Drs. Y.K. Tam and D. Ridgway (Kinetana), Dr. R.R. Koganty (Biomira, Inc.), Mr. Willaim Gough (Universal Dynamics Technologies), Dr. M. Huzmezant (M.I.H. Consulting Group), Dr. W. de Brouwer (Starlab, Belgium)

Other Affliates: Canadian-European Research Initiative on Nanostructure (Belgium), Drs. P.L. Christiansen and E. Mosekilde (Inst. of Math. Modeling, Danish Technical University), Dr. Y. Engelborghs (Biomolecular Dynamics, K. U. Leuven), Dr. M. Kimmel (Stats, Rice University) Jim Laukes (Psychology, U. Arizona), Dr. E. Unger (Molecular Biotechnology, Jena, Germany),

Modeling, Trading and Risk in the Market

Leader: U. Haussmann (Math, UBC)

Members: L. Bates (Management, U. Calgary) M. Barlow (Math, UBC) M. Buchko (Trader, Powerex Corporation) D. Druce (Research Scientist, BC Hydro) D. Glassco (Chairman & CEO, Financial CAD Corporation) C. Gui (Math, UBC) A. Lari-Lavassani (Math, U. Calgary) J. Liu (Math, UBC) N. Ghoussoub (Math, UBC) M. Margolis (Head Trader, Powerex Corporation) A. Peirce (Math, UBC) E. Perkins (Math, UBC) G. Sick (Finance, U. Calgary) J. Walsh (Math, UBC) O. Walsh (Director of Financial Engineering, Fiancial CAD Corporation)

Industrial Affiliates: Financial CAD, Powerex Corporation, BC Hydro, Transalta

Biomedical Models of Cellular and Physiological Systems in Health and Disease

Leader: L. Keshet (Math, UBC)

Members: Dr. G. de Vries (Math, UA), Dr. D. Finegood (Kinesiology, SFU), Dr. R. Miura (Math, UBC), Dr. J. Piret (Biotech Lab, Chemical Eng, Bioresource Eng, UBC), Dr. E.Puil (Pharmacology, UBC) Dr. D. Schwarz (Research Director, Dept of Surgery, UBC), Dr. C. Shaw (Opthalmology, UBC), Dr. Y. Xian Li (Math, UBC) Dr. M. Mackey (Math, McGill)

Industrial Affiliates: Bayer Inc., InSilico Biosciences, Kinetek Pharmaceuticals, Precision Biochemicals, StemCell Technologies, SmithKline Beecham, BC Cancer Research Center.

Symbolic Analysis

Leader: P. Borwein (Math & Stats, SFU)

Members: F. Bergeron (Math, Université de Québec à Montréal), J. Borwein (Math & Stats, SFU), R. Corless (Math, UWO), S. Devitt (Waterloo Maple Inc), D. Jeffrey (Math, UWO), L. Jorgenson (Math & Stats, SFU), M. Lamoureux (Math & Stats, U. Calgary), M. Monagan (Math & Stats, SFU), J. Stafford (Math, UWO), S. Watt (Math, UWO)

Industrial Affiliates: Math Resources, Sun Microsystems, Waterloo Maple

Mathematical Methods for Modeling, Verification and Testing in Information Technology

Leader: B. Kapron (CS, U. Victoria)

Members: M. Cheng (CS, U. Victoria), J. Delgrande (CS, SFU), M. Greenstreet (CS, UBC), A. Hu (CS, UBC), P. Panangaden (CS, McGill)

Industrial Affiliates: Nortel Networks

Prediction in Interacting Systems

Leader: M. Kouritzin (Math, U. Alberta)

Members: D. Blount (Math, Arizona State University), J. Bowman (Math, U. Alberta), D. Dawson (Director, Fields), R. Eliott (Math, U. Alberta), S. Feng (Math, McMaster), K. Fleischmann (Math, U. Alberta), E. Gombay (Math, U. Alberta), A. Heunis (Engineering, Waterloo), A. Jouan (Research and Development, Lockheed Martin-Montial), B. Kapron (CS, U. Victoria), B. Leininger (Lockheed Martin Tactical Defence Systems at Eagan), R. Mahler (Lockheed Martin Tactical Defence Systems at Eagan), C. Poling (Lockheed Martin Tactical Defence Systems at Eagan), N. Prasad (Math, U. Alberta), B. Remillard (Université du Québec à Trois Rivihres), B. Schmuland (Math, U. Alberta), E. Shahbazian (Lockheed Martin-Montréal), S. Shen (Math, U. Alberta), Y. Shu Wong (Math, U. Alberta),

Industrial Affiliates: Advantis, Lockheed Martin Canada, Lockheed Martin Tactical Defence, VisionSmart

Facility Location Optimization

Leader: B. Bhattacharya (School of Computer Sciences, Simon Fraser University)

Members: P. Bose (CS, Carleton U.), J. M. Keil (CS, U. Saskatchewan), D. Kirkpatrick (CS, UBC), T. Shermer (CS, SFU), J. Snoeyink (CS, UBC), G. Toussaint (CS, McGill U.)

Industrial Affiliates: Soundlogic, Quatronix.

The Mathematics of Resource Allocation and Scheduling

Leader: P. Hell (CS and Math & Stats, SFU),

Members: B. Alspach (Math & Stats, SFU), J. M. Bourjolly (Concordia), W. Cunningham (C & O, U. Waterloo), L. Goddyn (Math & Stats, SFU), A. Gupta (CS, SFU), L. Hafer (CS, SFU), R. Krishnamurti (CS, SFU), W. Pulleyblank (Director, Math. Sciences, T.J.Watson Labs, IBM), M. Queyranne (Manag. Sci, UBC)

Industrial Affiliates: Amber Systems, HA Simons, IBM, Prestige Telecommunications

Probabilistic Mathematical Models for Complex Industrial Systems

Leader: M. Puterman (Commerce, UBC)

Members: D. Atkins (Commerce, UBC), J. Bookbinder (Waterloo), C. Boutilier (CS, UBC), H. Chen (Commerce, UBC), M. Gendreau (Université de Montréal), B. Lamond (Université Laval), J. McGill (Queen's U.), D. Lawson (Commerce, UBC),

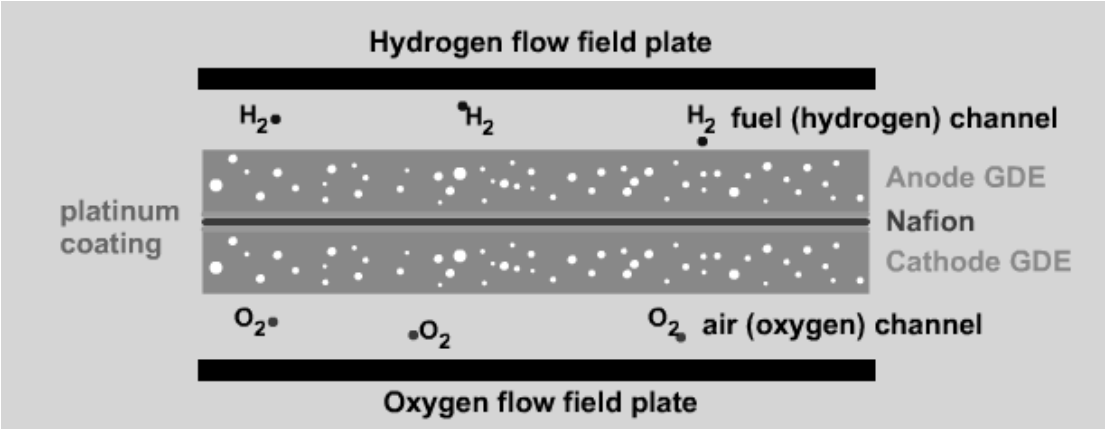
Industrial Affiliates: BC Tel, Canadian Airlines, Workers Compensation Board of BC

Mathematical Modeling and Scientific Computation

Leader: B. Wetton (Math, UBC),

Members: R. Choksi (Math & Stats, SFU), H. Huang (Math, York U.), M. C. Kropinski (Math & Stats, SFU), A. Peirce (Math, UBC), K. Promislow (Math & Stats, SFU), B. Russell (Math & Stats, SFU), B. Seymour (Math, UBC), M. Ward (Math, UBC), R. Westbrook (Math & Stats, U. Calgary)

Industrial Affiliates: Ballard Powersystems, Powertech Labs, Vortek Industries

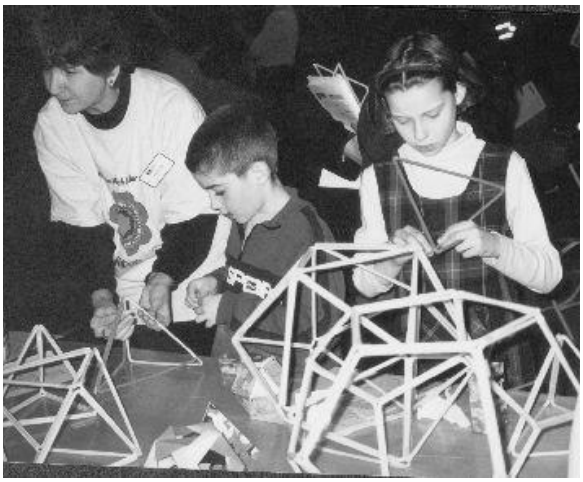


MITACS-Ballard Power Systems Collaboration: Condensation and water management are crucial issues in fuel cells. Sufficient water must be present to keep the membrane (typically Nafion) wet. Too much water will block pores and prevent gases diffusing to the catalyst sites. Condensation modeling in porous media is complicated by the capillary pressure, the pressure difference between gas and liquid phases. The widely used models of capillary pressure for wetting media are not valid in the teflonated carbon fibre paper of the GDE. In addition, the modeling and computation of the movement of boundaries between wet and dry zones inside the GDL present a considerable scientific challenge.

PIMS affiliated MITACS Postdoctoral Fellows (2000/2001)

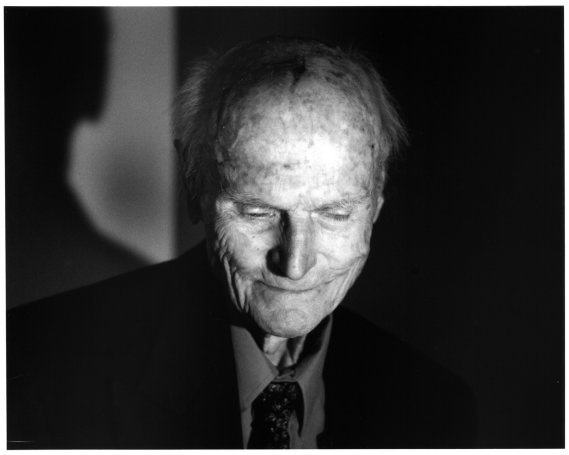
1. Ales Janez, Simon Fraser University
2. Bespamyatnikh Sergei, University of British Columbia
3. Bradean Radu, Simon Fraser University
4. Cao Jun Simon Fraser University
5. Chavez-Ross Alexandra, University of British Columbia
6. Cheb-Terrab Edgardo, Simon Fraser University
7. Derbez Eric, UQATR
8. Desharnais Josee, University of Victoria
9. Enns-Ruttan Jennifer, University of British Columbia
10. Ferguson Ron, Simon Fraser University
11. Glenn David, University of Michigan
12. Gibson Peter, University of Calgary
13. Gusev Y., University of British Columbia
14. Klassen Matt, Simon Fraser University
15. Kononov Alexander, Simon Fraser University
16. Lewis Gregory, University of British Columbia
17. Lewis Mark, Georgia Institute of Technology
18. Li Ruisheng, University of Alberta
19. Long Hongwei, University of Alberta
20. Lyder David, University of Alberta
21. MacNair S., University of British Columbia
22. Novruzi Arian, University of British Columbia
23. Pen Y., University of Calgary
24. Ram Gaur Daya, Simon Fraser University
25. Sadeghi A., University of Calgary
26. Sinha Sanjoy, University of Alberta
27. Solomon Andrew, Simon Fraser University
28. Spiros Athan, University of British Columbia
29. Stacho Ladislav, Simon Fraser University
30. Stamicar R., University of British Columbia
31. Stevens Brett, Simon Fraser University
32. Sun Wei, University of Alberta
33. Ware Tony, University of Calgary
34. Wenpin Jiao, University of Victoria
35. Wehner Stephan, Simon
36. Xia Y., University of Calgary
37. Yan L., University of British Columbia
38. Yao Zhengsheng, University of Calgary
39. Zhang Xue-Wu, University of British Columbia

V. MATHEMATICS EDUCATION PROGRAMME



Students at Sir James Douglas enjoy Math Mania in 2001.

Students discuss with Akbar Rhemtulla (Univ. of Alberta) during the 2001 PIMS Graduate Information Week.



H. S. M. Coxeter who spoke at Changing the Culture 2000.

Initiatives for K-12 Students

PIMS is continuing to bring members of the scientific community and the community at large closer together through an increasing number and variety of events. Events have continued during the 2000/2001 academic year in both Alberta and British Columbia.

Activities for Elementary Schools

Math Mania

Math Mania is part of PIMS "Alternative Math Education" programme where Faculty and Staff from the PIMS Universities present "fun" methods for teaching math and computer science to children (and adults!) using games and art. It takes place at elementary schools in Victoria BC. Typically included in the presentations are soap bubble demonstrations, constellations as 2D networks, geometry and paper, the Set Game, a binomial probability experiment using pennies, and exciting geometrical models from straws and paper. Other demonstrations involve chess games, parallel algorithms of network sorts, and recursive methods in mathematical puzzles. These events attract around 300 students and parents each evening.

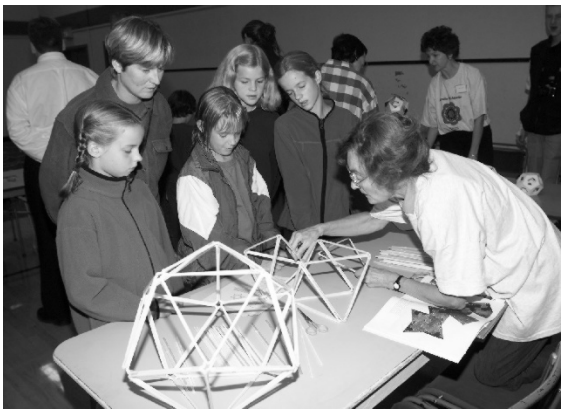


Photo courtesy of *Victoria Times Colonist*.

Pauline van den Driessche (PIMS-UVic) holds the attention of some Cordova Bay elementary students.

The Math Mania events in 2000/2001 were:

1. **Burnside Community School, Victoria** on March 1, 2000.
2. **Cordova Bay Elementary School, Victoria** on October 3, 2000.
3. **Sir James Douglas Elementary School, Victoria** on February 28, 2001.

Enthusiastic volunteers from faculty members and grad students provided a series of interactive displays, games, and art designed to show kids and teachers some fun ways to learn math and computer science in everyday devices and concepts. People who participated in these events include James Andersen, Peter Anderson, Kathy Beveridge, Charlie Burton, Jeff Campbell, Kelly Choo, Mike Crowle , Florin Diacu, Malgorzata Dubiel, Rod Edwards, Irina Gavrilova, Mike Fellows, Denton and Merilyn Hewgill, Elies Hoepner, Reinhard Illner, David Leeming,

Making bubbles with Dr. Denny Hewgill.

Shaun Pack, Jan and Paul Nienaber, Elena Prieto, Geoff Schmidt, Pauline van den Driessche and Julie Zhou.

Mathematics Unplugged

This annual event is a Student Mathematics Conference which takes place at Westwook Elementary School in Coquitlam BC, a school of approximately 250 students. All the students attend a full day math conference, including workshops chosen by themselves following a keynote address. Workshops are presented by all levels of instructors, including university professors, school district personnel, school staff, parents and Science World staff. Just as Eric Clapton and Rod Stewart "unplugged" their music, PIMS will provide students with an opportunity to see that mathematics can be an exciting and enjoyable topic, and that it is all around them! The goal of for the conference is to:

- utilize expertise from the community
- show students that Mathematics is in all aspects of everyday life, and other subject areas
- show students that Mathematics is more than what they can find in school textbooks
- give students lots of hands-on experience by keeping the number of students in workshops small (20 or less)

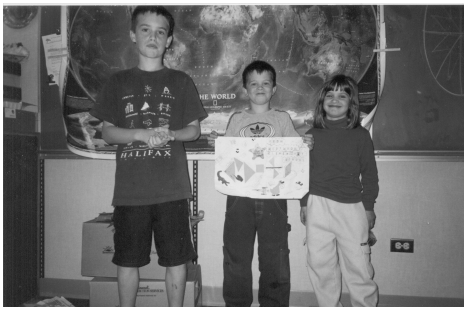
Five sessions of Mathematics Unplugged have been held and PIMS has supported this event since it began.

Westwood Elementary and Pamela Hagen, the originator and organizer of **Mathematics Unplugged,** were honoured in 2000 with *Educational Excellence in Innovative Planning* awards by the Ministry of Education of British Columbia.

Mathematics Unplugged IV, which was held on April 27, 2000, was given the theme *Mathematics in Our World* with particular focus on the blending of mathematics and social studies.

Prior to this year's event, students received a brochure with all activities described, and were given the opportunity to select their favourites. On the day, kids arrived prepared with their conference packages and proceeded to their selected sessions, which had intriguing titles such as "All Aboard! Calling all Engineers!", "Measure, Measure, Measure!!!", "In A Giant's Footsteps!!", "Fly Across Canada!!", "Mathematical IMPOSSIBLITIES!", "The Lost Treasures" and "Simply Super Solids".

In the spirit of an "adult" conference, keynote lectures were delivered by Dr. Mike Fellows and Dr. Fran Roasamond about *Dots and Lines: How Scientists Use Dots and Lines for Just About Everything.* These lectures were made possible through the sponsorship of PIMS.



Christian Price (centre) with his siblings Jordan and Christina at Math Unplugged V.

Mathematics Unplugged V took place on April 26, 2001. The event is styled just like an adult conference with a keynote speaker followed by workshops for the students to attend during the day. The keynote speaker has a difficult job to do as he/she needs to be able to hold the attention of students from K – G5 for at least 30 minutes and make it fun and interesting. This year every student went home with a tangram set, and a copy of the Tangram story.

The main goal of this event is to try to lay an enjoyable and fun foundation for further mathematical awareness and engagement, which can last a lifetime.

Klaus Hoechsmann, PIMS Education Coordinator, helped plan the conference and visited the school on the day. The conference was a success with the students who participated in it. One student replied when told it was time to go out to recess, "Oh, do we have to go out to recess, Math Unplugged is so much more fun!"

Elementary Math Nights

Elementary Math Nights are held at schools in the Calgary area. Volunteers from Mount Royal College and the University of Calgary assisted the teachers to guide participants through a variety of activities. Activities such as map colouring, games on graphs, dominating sets of graphs, Fibonacci numbers, binary numbers, patterns in Pascal's triangle, the travelling salesman problem, and finite state automita may be included.

The success of these evenings can be directly attributed to the volunteers: Rob Petzold, Jean Springer, Laura Marik, Peter Zizler, Scott Carlson, and Sharon Friesen.

- October 12, 2000 **Glamorgan School, Calgary**
- October 19, 2000 **Braeside School, Calgary**
- October 24, 2000 **Big Rock School, Calgary**
- February 13, 2001 **Science Alberta School, Calgary**
- February 22, 2001 **Sunnyside Community School, Calgary**
- May 15, 2001 **Westmount Elementary School, Strathmore**

At the Math Night at Sunnyside Elementary School in Calgary on May 25, 2000 students and parents gathered to play with coloured beads and learn some interesting mathematics in the process.

In five groups of about 20, children and adults constructed strings of coloured beads based on a Fibonacci-like sequence, modulo 10. For instance, if the starting numbers are 1 and 3, the sequence is 1, 3, 4, 7, 1, 8, 9, 7, 6, 3, 9, 2, 1, 3, and the sequence repeats.

Each colour bead represented a different number and the beads were threaded on a string according to the sequence until the starting point was reached. Then the string was tied into a loop to give a bracelet, necklace, a belt, or perhaps a belt for dad.

It did not end there however. Participants were challenged to find the longest or the shortest strings that keep on going and the number of possible different strings. The evening was a great success with those involved looking forward with anticipation to the next Math Night.

Activities with High School Students

The PIMS education panel is organizing a number of events aimed at high school students. Here we describe three such events, highlighting the breadth of activities that PIMS offers.

Junior High Math Nights

Supported by PIMS, these events were organised by Dr. Jean Springer of Mount Royal College, Calgary. In 2000 and 2001 on six consecutive Mondays, students, parents and teachers at Mount Royal College are provided with the opportunity to engage in mathematical exploration. This event happened January 31 – March 27, 2000 and January 29 – March 4, 2001. The emphasis of these evenings was to dispell the myths that mathematics is a set of facts innate to certain individuals and that mathematics is *not* an experimental discipline.

Discussions took place under the following titles: *Facts about Five*, *Map Colouring*, *Sorting out Sorting*, *The Secret of NIM*, and *Nothing But Zeros and Ones*. This event is biannual, resuming again in the fall.

Facts About Five: This evening was a potpourri of topics about the number five, including 5 by 5 magic squares, Pentagonal numbers, Tessalation of the plane using various polygons including pentagons, compass and straight-edge constructions, and Ramsey theory.

Map Colouring: This evening the question of how many colours are needed to colour a planar map was asked and also applications to some scheduling problems were investigated.

Sorting out Sorting: Sorting algorithms, their benefits, and their drawbacks were discussed.

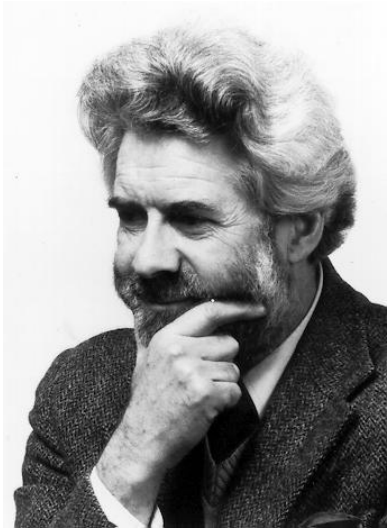
The Secret of NIM: This evening, analysing NIM and similar games with a view towards developing winning strategies was the topic.

Nothing But 0's and 1's: This evening an exploration of number systems with different bases was on the agenda.

Evening of Mathematics

On March 2, 2000 the Department of Mathematics and Statistics, SFU and the Pacific Institute for the Mathematical Sciences hosted Grades 11 and 12 students, their teachers and parents, and other interested participants to an evening of lectures on some of the newest applications of mathematics. The most recent event took place Tuesday, March 2, 2000 at Fletcher Challenge Theatre, SFU at Harbour Centre. The first talk, on the Mathematics of Fuel Cells was given by Dr. Keith Promislow (Mathematics and Statistics, SFU and consultant to Ballard Power Systems). The talk explained mathematical models of fuel cells developed in conjunction with engineers at Ballard Power Systems. The second talk, *Mathematics and Literature: Beyond Alice in Wonderland,* was presented by Dr. Brett Stevens (Mathematics and Statistics, SFU, and PIMS/IBM Post Doctoral Fellow). The talk examined a connection between Samuel Beckett's "Quad" and Dante's "Divine Trilogy" that poses a very deep and hard combinatorial question about Gray Codes, and an application of Mutually Orthogonal Latin Squares by French Oulipoian author Georges Perec to the plot structure of his novel *Life: a Manual.* The evening was organized by Dr. Malgorzata Dubiel (Department of Mathematics and Statistics, SFU).

Master Class in Mathematics



Sir Christopher Zeeman.

On March 22, 2000, the renowned British mathematician, Sir Christopher Zeeman gave a lecture at the University of Victoria. It was one of three lectures given by Sir Christopher during his week long visit to UVic. His lecture was entitled *Master Class for Thirteen-Year Olds.* The lecture was sponsored jointly by the University of Victoria and the Pacific Institute for the Mathematical Sciences. Forty-one attended the lecture, including twenty teens from the local school district.

The Mathematics Master classes in Britain have grown out of the Christmas Lectures given at the Royal Institution by Professor Zeeman in 1978. Now given in about 50 centers in the U.K., a typical master class lasts for 2–3 hours on Saturday morning and runs for ten weeks. Studies conducted four years later showed that the participants in the Master Classes demonstrated increased confidence and increased problem-solving skill in all branches of science. The objective of the Master Class program is to introduce topics not found in the school syllabus using an approach that allows these young teens access to some university level material.

In a one-hour presentation, Sir Christopher gave the audience a sample of some of the activities that take place in a Master Class. He demonstrated the proof of a theorem relating the sum

of angles of a spherical triangle to its area. He did a demonstration on perspective showing the existence and uniqueness of vanishing points and observation points. His demonstration on gyroscopes used an apparatus made from a bicycle wheel, which he brought all the way from England for the presentation. Finally, Sir Christopher demonstrated coupled oscillations using two keys hanging from a thread. His presentations were both informative and entertaining and he engaged many of the students in the audience to assist him with his demonstrations.

Mathematics Competitions

Traditionally, mathematics skill and interest can be uncovered in students by exposure to challenging mathematical exams and contests. PIMS sponsors Alberta and BC participation in a number of such national and internation competitions. A number of such are listed below:

MathCounts Vancouver Island Competition

MathCounts Vancouver Island is a regional competition, which is part of MathCounts British Columbia. Sponsored locally by the Association of Professional Engineers and Geoscientists of BC (APEGBC) and PIMS, it provides a combination of math coaching and a competitive programme for students in grades eight and nine.

The 2001 competition was held on Friday, February 9 at **Lambrick Park Secondary School** in Victoria. Teams of four students competed in various rounds to determine the team and individual winners. There were six grade eight and seven grade nine teams in this year's competition. The competition concluded with the exciting Countdown Round. This year, the top grade eight team was **Cedar Hill Junior Secondary (Green) Team** and the top grade nine team was **Lambrick Park Secondary (IBS) Team**. The top grade eight individual was **Jeremy Li Foa Wing** of Cedar Hill and the top grade nine individual was **Kailyn Young** of Lambrick Park. The grade nine team from **Mt. Klitsa Junior Secondary School** in Port Alberni travelled the furthest to take part in the regional competition. David Leeming, UVic PIMS Education Coordinator, was the Site Coordinator and Leo Neufeld of Camosun College (retired) was the Head Judge. The event was cohosted by James Bern Aldez and Jan Buermans of APEGBC along with the support of many volunteers from APEGBC, Camosun College and the University of Victoria.

CMS Regional Math Camps

To identify and nurture future members for the Canadian team for the International Mathematical Olympiad, the CMS, Esso, and PIMS sponsor this yearly event where students in grades 8 to 10, as well as exceptional elementary grade students are invited based on merit. Topics in Combinatorics, Number Theory, Algebra and Geometry will be covered at the difficulty level of the Olympiad. This is part of a long-range goal of the CMS to develop mathematical talent in Canadian students to compete on the world stage.

A math camp was held on August 16–23, 2000 at the University of Alberta. The feature event was be a media day on August 17, with Lieutenant Governor Lois Hole of Alberta attending.

The **2001 Esso-CMS-PIMS Summer Math Camp** was held at SFU on June 25–29, 2001. It was organised by Malgorzata Dubiel and Petr Lisonek (SFU) and was designed for students from grades 10–11. Participation in the Camp was by invitation only, based on recommendations from teachers, and results of various mathematics competitions.

Tournament of Towns

An international mathematics contest originating in Russia and held in the spring and fall each

year, is a challenging exam written around the world. PIMS provides support to Dr. Bill Sands of the University of Calgary to help encourage young Albertans to take part in the mathematical contest and introduce them to the wider mathematical community. Although the *Tournament of Towns* has been written in Edmonton for several years, Dr. Sands has been developing more Calgary participation. It is anticipated that Edmonton and Calgary will alternate hosting both the contest and awards ceremony for Alberta.

Alberta High School Contest

An annual two part competition taking place in November and February of each school year, with book prizes for the first part, and cash prizes and scholarships for the second part.

The 2000–2001 season took place on November 21, 2000 and February 7, 2001. The first part of the 2001-2002 season will take place on November 20, 2001.

PIMS provides funding to ensure participation for students across the province. The PIMS Awards Dinner for the 2000-2001 season was on April 11, 2001.

PIMS Elementary Grades Math Contest

The annual **PIMS Elementary Grades Math Contest** (**ELMACON**) is open to students in Grades 5 to 7. It provides an opportunity for them to experience mathematics as an exciting sport. The contest is modelled after the successful *MathCounts* competitions (which are also supported by PIMS). However, there are some important differences, because it is aimed at younger students, many of whom will likely "graduate" to MathCounts once they get to high school. There they will learn to work collaboratively in the Team Round, which has here been replaced by a Problem Solving Round. The latter not only relieves the competitive pressure for a while, but also affords an opportunity for learning some mathematics in a state of heightened awareness and motivation. The other rounds are designated Sprint, Target, and Countdown, each with their own special characteristics.

Both the 2000 and 2001 events were organized by PIMS under the guidance of Dr. Cary Chien of David Thompson Secondary School, in collaboration with the BCAMT and volunteers from Lower Mainland schools of all levels.

Last year, 180 students participated in the second ELMACON, which took place on May 13, 2000 at UBC.

The third annual ELMACON took place on May 26, 2001, at UBC. A total of 223 students attended the contest this year, a substantial increase from last year. We implemented an improved online registration procedure allowing students to sign up for the contest as well as to download their admission tickets.

The format of the contest followed the formula of previous years. Students competed in three divisions in the sprint, target and countdown rounds. The sprint and target rounds consisted of two sets of written questions which were evaluated immediately while contestants enjoyed refreshments and listened to a lively presentation of problem-solving strategies.

Klaus Hoechsmann (PIMS Education Facilitator) with the Grade 7 winners at the 2000 PIMS Elementary School Math Contest: #1 Irene Yu (Berkshire Park), #2 Michael Li (MacCorkindale), #3 Paul Collier (Kitchener)

In the countdown round, the top ten students in each division— determined by combined scores from Sprint and Target rounds (with correct answers in the latter counting double)— participated in individual competitions. The tenth ranking student competed against the ninth, the winner then faced the eighth, and so on. A projector displayed one question at a time, and the contestants were required to ring a buzzer—within a certain time limit—as soon as they had an answer. A correct answer, scored a point; otherwise the opponent had the rest of the time limit to come up with the solution. This was repeated several times to determine which of the two could advance. Eventually an overall winner was found.

The top ten finishers in each grade received a commemorative T-shirt and medal, together with a stylish binder donated by the BC Association of Mathematics Teachers. The top three also received a trophy, and an electronic calculator donated by **Sharp**.

About 50 on-site volunteers from the UBC Science Ambassadors Program, various schools throughout BC as well as some parents helped the organising committee stage the event.

PIMS Math Fair Programme

Once again PIMS is sponsoring a programme of developing mathematical exhibits in the framework of the Science Fair Foundation (BC). This is particularly suitable for students in Grades 7 to 12 who are looking for longer term projects, to get a feel for the adventure of a self-directed exploration.

Unlike, say, sports or music, mathematics does not offer many extracurricular activities in school, except for various kinds of contests, which — for all their admirable motivating qualities — stress just one side of mathematics: the quick grasp. And yet, most mathematical work could be more aptly likened to a marathon than to a sprint. The steadfast persevering quest, so vital to the subject, is minimally represented in the school environment.

The use of science fairs as a vehicle for popularising and teaching mathematics might eventually prove to be a way of filling this void. It is still in its infancy — the wheel has not yet been invented. Mathematics is traditionally not a showy subject. When we get a problem to work on, we retreat into a corner like a squirrel with a nut and come back into the light of day only when we have cracked it. Sure enough, we need some time for quiet concentration. But must it be unrelieved solitary confinement? There ought be a better way – and preparing projects for public display might help push us in the right direction.

The projects usually fall under one of the following three headings, although many will present a mixture of two or even all three of them.

Original Research: There are lots and lots of open problems in mathematics. However, most of them lie on the outskirts which can only be reached by air. Since the field is so old, most of the rocks near the centre have been turned over more than once, so finding something really new there is a very lucky break. Nevertheless it happens now and again — and, hey, you never know!

Applications: There is an inexhaustible supply of problems of all shapes and sizes in science, in technology, and even in the arts. Many of them are close to home. The challenge here is to tease out the interesting ones (say, the geometry of rose petals) and not get bogged down in mere routine (like counting them) or too engrossed in extraneous activities (like smelling them).

Exposition: Again and again it happens that somebody gives an old hat a brand-new twist — and most of the time, a new insight comes with it. There are hundreds of ready made proofs of the Pythagorean Theorem, but some people are still rolling their own. The area of the regular dodecagon inside a unit circle (3 square units) had been known for many centuries before recent beautiful proofs were found.

Whichever flag it sails under, a project should always aim at engaging the visitors' minds, not only their eyes. In this connection, a low-tech, home-spun implementation is sometimes more successful than a glitzy computerized one – which might impress without enlightening, unless special care is taken.

BC Science Fair Foundation

At the Greater Vancouver Regional Fair (GVRSF) PIMS supplies judges, mathematical expertise, and prizes. PIMS initiated the inclusion of a Mathematical Sciences exhibit category within the existing Science Fairs, which are organized and administered by the Science Fair Foundation of British Columbia. PIMS is committed to informing and involving mathematics teachers, giving presentations and workshops to groups of students, helping and providing assistance to students that have undertaken mathematics projects, judging the projects, and supplying the monetary awards.

Projects are judged as gold, silver or bronze based on a point system.

At the GVRSF on April 6–7, 2000, there were 25 projects exhibited within the Mathematical Sciences category. These consisted of 13 junior projects (grades 7 and 8), 7 intermediate (grade 9 and 10), and 5 senior (grades 11 and 12). University-Hill Elementary, Point Grey Mini School, and Killarney Secondary School were quite highly represented. Other participating schools were Windermere Secondary, Our Lady of Perpetual Help School, Albion Elementary, and Gladstone Secondary.

The 2001 GVRSF took place at UBC, April 5–7. It held 26 projects within the Mathematical/Computer Sciences exhibit category. Within this category, there were 2 computer science projects while all others were mathematical.

In terms of the grade-level distribution, there were 10 junior projects (grades 7, 8), 10 intermediate (grades 9, 10), and 6 senior (grades 11, 12). Projects came from the following schools: University-Hill Secondary, Point Grey Mini School, Britannia Secondary School, York House, Collingwood School, Sir William Osler Elementary School, Windermere Secondary, and Vancouver Technical.

Although participation did not increase (there were 26 math projects last year as well) we have witnessed a significant increase in the quality of projects. Two of the projects made it into the Canada Wide Science Fair in Kingston, Ontario,and won multiple awards even at this very top level. These projects were *"Trees A Math Lesson from Nature"* by **Christine Pop** from Sir William Osler Elementary and *"Calculating Equilateral Triangles within an Equilateral Triangular Grid"* by **Mahmoud Bazargan** from U-Hill Secondary.

The special award judges for PIMS were David Boyd, Klaus Hoechsmann, Leah Keshet, and Sandy Rutherford.

Forever Annual Mathematics Exhibition (FAME)

Students in the Greater Victoria School District took part in the third annual **FAME**, the **Forever Annual Mathematics Exhibition**, at S.J. Willis School on April 27, 2000. There were 65 mathematics-related exhibits, which showed off the accomplishments of 118 students from both elementary and secondary schools. The event was organized (for the third time) by **Wendy Swonnell,** a mathematics teacher at Lambrick Park Secondary School. It was sponsored in part by the Pacific Institute for the Mathematical Sciences. The purpose of FAME is to allow students to present math displays in the same way that science fairs allow students to put science projects on display.

The students chose a wide variety of subjects for their exhibits, including probability, cryptography, Fibonacci sequences, paradoxes, and mathematics and music. Others chose to showcase the accomplishments of such famous mathematicians as Daniel Bernoulli and John von Neumann.

Mathematicians from Camosun College and UVic as well as engineers judged the exhibits, which were split into three levels — intermedi-

ate (up to grade 7), junior (grades 8 and 9) and senior (grades 8–10). The top three exhibits in each category were awarded trophies.

The forth **FAME** was held at **S. J. Willis School** on April 21, 2001. This year, there were over eighty entries at three levels: Elementary (up to grade 7), Junior (grades 8-9) and Senior (grades 10-12). The event was organized by Wendy Swonnell, Betty Doherty, Betty McAskill and Tanis Carlow and was sponsored, in part, by PIMS.

The exhibits presented at **FAME** are judged for creativity, skill, dramatic value and mathematical thought. For the first time this year, every entrant was given an award — the categories being Distinction, First Class and Runner Up. A School trophy is presented at each level (Elementary, Junior and Senior) based on the best aggregate score of the top three projects. With more schools participating in **FAME** each year, this annual event will continue to attract outstanding mathematical exhibits from students in a wide range of grades.

Elementary Math Fairs in Edmonton

The yearly Math Fairs in elementary schools in the Edmonton area are gaining in popularity. Initiated upon requests by schools, and supported mainly by PIMS and the Edmonton Public School Board, the Math Fairs were held in previous years at Our Lady of Victories and Parkallen Elementary Schools. This year, Clara Tyner and Terrace Heights Elementary Schools were involved. Demand is growing with requests received from an additional six schools for next year. In fact, the Math Fairs are so popular that planning is underway for a Math Day where several schools can participate.

The Edmonton Math Fairs are unique in that all students in the school participate. This event is about problem solving, not winning and loosing. The schools themselves play a major role in the planning and thus the format can vary from school to school. In some Math Fairs, Education students from the University of Alberta were available to help, primarily by providing a "model" for a Math Fair that students can emulate in planning their own event. The extensive involvement of students both in planning, staging and participating in the Math Fair may be one of the secrets of its success.

Prior to the Math Fair, students choose or are given problems to work on. They work in small groups to solve the problem and subsequently create a table-top display. On the day of the Math Fair, spectators are invited to tackle the problem, with hints and guidance provided by students in charge. The displays are not poster sessions. Rather, the students are actively involved in the presentations.

Calgary Youth Science Fair

PIMS provided a prize at the Calgary Youth Science Fair. On the morning of April 7, 2001 a $100 PIMS prize and a plaque will be awarded for "Secondary project making major use of mathematics in the project".

Michael Lamoureux (PIMS Deputy Director) presenting the plaque to the winner, Jonathan Sick.

The winner was Jonathan Sick, a grade 9 student as Queen Elizabeth Junior High School. The project was "Sunspot Morphology & Magnetic Shear", which explored how solar flare activity could be predicted based on observations of sunspots, which are dark, magnetically- active storms on the Sun. Jonathon went on to win the Intermediate level at the National Youth Science Fair.

Initiatives with K-12 Teachers

With new mathematics curricula being developed across Western Canada, PIMS scientists have found considerable demand for teacher training and retraining. Teachers are also interested in exchanging ideas with academics.

PIMS Conferences on Changing the Culture

Organized by M. Dubiel (SFU), P. Hagen (Westwood Elementary), K. Heinrich (SFU), B. McAskill (BC Ministry of Education), E. Perkins (UBC), these conferences are intended to forge closer ties between the mathematics community, mathematics teachers and the industry. Erasing barriers between these communities and looking for common ground is an essential step in any attempts at changing the mathematics culture.

Changing the Culture III, SFU at Harbour Center, April 28, 2000

The Third Annual Conference, organized and sponsored by PIMS, brings together mathematics researchers, educators and school teachers from all levels to work towards narrowing the gap between those who enjoy mathematics and those who think they don't. Its theme this time is Visualising Mathematics.

What is the question? The advent of affordable computers with huge storage and communication capabilities seems to promise a golden age of mathematical visualisation. The question is to what extent it can relieve us of the laborious doodling and imagining that has always been an integral part of mathematical activity.

When asked about the nature of his thinking, Einstein once replied that it was a mixture of visual and kinesthetic elements. The plausibility of that reply is corroborated by any observation of people grappling with mathematics — say, students taking an exam. When they are not busy writing or drawing, they tend to stare into space or at the ceiling, stab or stroke the air, drum or scribble with their fingers, and the like.

Our question therefore has two parts: (1) what exactly is going on there, and (2) how can computers be integrated into that process?

Programme:

- Keynote lecture by Walter Whiteley (York University): *Visual Work and the Mathematics Classroom*
- Three concurrent workshops: *Hi-tech*, *Lo-tech*, *No-tech*.
- Panel Discussion: What role can visualisation play in the teaching of mathematics? Panel: Peter Borwein, Chair (SFU), Sue Haberger (Centennial Secondary), Nancy Heckman (UBC), Susan Oesterle (Douglas College), Walter Whiteley (York University)
- Public lecture: H. S M. Coxeter (University of Toronto): *The Mathematics in the Art of M. C. Escher*

The Workshops:

Hi-tech: Cinderella is a new constructive geometry program along the lines of Geometer's Sketchpad but with an enlarged and differently

designed arsenal of tools. June Lester, University of New Brunswick, will give a demonstration of it and lead a couple of workshops for those interested in a closer acquaintance.

Lo-tech: Malgorzata Dubiel, SFU, is one of Canada's leading exponents in constructing geometric models on the crucial hands-on level. She is also the main organiser this conference. Her workshop will include pop-up fractals, origami, polyhedra, and more.

No-tech: The third workshop will re-examine high school geometry in the light of the Geometry Resource Package released by the BC Student Assessment and Program Evaluation Branch in September 1999. It will be led by Bill Casselman (UBC).

Changing the Culture IV, SFU at Harbour Center, May 11, 2001

The **Fourth Annual Changing the Culture Conference** was held at SFU, Harbour Centre on May 11 ,2001. This conference, sponsored by PIMS, brings together mathematicians, mathematics educators and school teachers from all levels to work together towards narrowing the gap between mathematicians and teachers of mathematics.

This year's theme was: *Writing, Speaking and Thinking Mathematics.* The conference participants - over 90 people from elementary and high schools, colleges and universities - explored connections between numeracy and literacy, mathematics and anguage, mathematics and literature, and how we can use language to teach mathematics.

There were two plenary talks:

Mathematics and Literature: Cross Fertilization by Brett Stevens, PIMS/IBM PDF, SFU.

Breaking the Cycle of Ignorance by John Mighton, NSERC postdoctoral fellow at the Fields Institute for Research in Mathematical Sciences.

Brett Stevens explored the mathematics in the works of Samuel Beckett, especially in his play Quad, inspired by the ideas of movement and freedom from Dante's Divine Trilogy; about Euler's work on Latin Squares and it's impact on the works of George Perec and other French writers connected to the group Oulipo; and about his own work on Gray Codes, inspired by the play Quad.

John Mighton is the founder and coordinator of JUMP, Junior Undiscovered Mathematical Prodigies, an educational no-cost outreach program for students who are doing badly in mathematics in school. This program has been very successful and is rapidly gaining momentum in Toronto. John talked about his experiences with JUMP and how to make math accessible for kids whom the standard methods have not reached. John is also a Governor's General award winning playwright. Robert LePage's latest film, Possible Worlds, was adapted from one of his plays, and he was a math consultant and actor in *Good Will Hunting.* He is also a professional mathematician at the Fields Institute. This talk was open to the general public.

Each participant was able to attend two of the following workshops:

1. JUMP: Junior Undiscovered Mathematical Prodigies program. Leader: John Mighton
2. Contextualizing Mathematics. Leader: Brett Stevens and Karen Meagher
3. Connecting Early Numeracy and Literacy. Leaders: Cynthia Nicol and Heather Kelleher

For further information, see the webpage **www.pims.math.ca/education/2001/ctc**. Both plenary lectures are available via streaming video from this webpage.

PIMS Technology Workshops

Using Graphing Calculators in the Classroom, University of Calgary, May 24–26, 2000

The use of graphing calculators in the K-12 classroom has been mandated by the govern-

ment. However, how this potentially useful tool can be effectively applied in a teaching environment is not necessarily self-evident. With this problem in mind, Professor Michael Stone and Galileo Network head Sharon Friese held a workshop on May 24–26, featuring Professor Stuart Moskowitz of Humboldt State University of California. The event was designed to bring together K-12 teachers, and College and University professors to explore ways that graphing calculators can be used in the classroom to effectively increase understanding of topics at hand. The mathematical content of the workshop ranged from introductory problems in graphing simple functions to application in university level calculus. The course also included calculator programming, use of TI Graph Link software, testing and pedagogical issues, and Internet information.

Cinderella Author's Workshop SFU Burnaby Campus June 16, 2000

In recent years the *Geometer's Sketchpad* has become the standard software for teaching geometry in the classroom. Now, however, there is a new program, Cinderella, which provides a useful alternative.

Developed in Germany, Cinderella implements features already familiar to Sketchpad users. In addition, Cinderella is capable of constructions in spherical and hyperbolic geometry. It also has a special theorem prover, and many animation features. Cinderella users can generates Java applets for pasting into web pages.

The author of Cinderella, Ulrich Kortenkamp from Berlin University, held the workshop. It was dedicated to giving an introduction to both classroom use and internet features of the software. The 20 participants were given the opportunity to test the software and create example web pages. There was a door price of a copy of the software which was won by Natasha Davidson from Douglas College.

Math Enrichment Activities in the UK: A talk by Chris Budd SFU Burnaby Campus August 8, 2001

Chris Budd is a professor of mathematics at the University of Bath and the Royal Institution, UK. The Royal Institution has been strongly involved in the popularization of mathematics and sciences in the UK by organizing public talks, contests and other activities. Chris himself, apart from being a distinguished researcher in applied mathematics, has been involved in many outreach events, including math camps, the UK Year 2000 poster campaign and what he calls "Mathematics Magic Show", which he says was inspired by our Math in the Malls. He recently received a large grant in support of the enrichment activities. Chris Budd is also a co-author (with C.J.Sangwin) of a book "Mathematics Galore!" recently published by the Oxford University Press, containing material for workshops designing to enthuse students (from the age 11 through high school) into mathematics. His talk on August 8 was about his work with high school student and how his workshops for students are organized.

Professional Development Day for High School Math Teachers St. Francis School, Calgary June 26, 2000

This workshop which was on creating and analysing mathematical fractals using familiar software tools was run by Michael Lamoureux. It was attended by some 35 enthusiastic math teachers from across the city. The new Western Canada Protocol for Mathematics includes a requirement for students to learn some of the basics of fractals, as a mathematically rich and aesthetically beautiful creation arising from recent mathematical research. Using simple and widely available computer tools such as Geometer's SketchPad(TM), it is possible for our junior high and high school students to explore this fascinating area by recursive renderings of really simple shapes or objects. Ms. Ellen Radomski,

Secondary Math Consultant for the Calgary Separate School System, organized the workshop.

Elementary School Teacher Meetings

Organized by Dr. Indy Lagu (PIMS Education Coordinator in Calgary) these meetings provide an opportunity for Calgary teachers to be exposed to interesting problem solving activities. The main goal of the programme is to improve the general attitude of teachers towards mathematics. **Due to the unanimous positive response, this event is rescheduled for the fall.** Two series of encounters are in progress:

Sunnyside Elementary School: A series of monthly meetings with the primary school teachers ran from January-May, 2000. The teachers themselves who participated in the meetings expressed frustration with the frequently encountered negative perceptions of the subject of mathematics and they were eager to participate as agents for change.

West Dalhousie Elementary School: The unexpected usefulness of mathematics as social mortar was also noticeable in the math workshop which filled an entire professional day (May 3, 2000) at West-Dalhousie Elementary in Calgary. Under the leadership of their principal **Judy Gray,** the teachers of that school have set themselves the task of developing a *perspective* on mathematics (as they have on other subjects), to give coherence and momentum to their teaching. At their request, PIMS supplied mathematician Indy Lagu to lead their workshop and help anchor their discussions. The event was so well received that a repeat is planned for next year. The contact between PIMS and West-Dalhousie was made through *MathWorks*, a remarkable experiment in professional development, invented and maintained by **Sharon Friesen,** a Calgary middle school teacher (and recent winner of the Prime Minister's Teaching Award) with a long-standing connection to the local PIMS team. Attended by teachers from several schools, each monthly meeting of MathWorks is built around a math workshop, which, whenever possible, involves a mathematician — usually from PIMS.

Guy Weadick Elementary: Dr. I. Lagu led a teacher workshop at this school on January 29, 2001.

Teacher Association Meetings

Annual meeting of teacher associations provide an important venue for connections between PIMS researchers and school teachers. Two recent events are highlighted here.

ATA Meetings

Dr. I. Lagu and Scott Carlson presented two workshops to teachers in 2000. On October 23 to Rockyview School District and on October 27 at Annual Meeting of the Math Council, Alberta Teachers' Association.

BCAMT Meetings

PIMS participated in the 2000 and 2001 big October meetings of the BCAMT. Both years PIMS had a table there, and in 2000 a presentation was made as well. Cynthia Nicol and Klaus Hoechsmann talked about *The sound of numbers.* This presentation used copper pipes, a make-shift harp and water filled test tubes to demonstrate the connection between musical scales and ratios. In 2000 the table was organised by Natasa Sirotic and in 2001 by Janet Martin.

Initiatives for Undergraduate Students

PIMS Graduate Weekends

The purpose of the weekends is to let the students know about many of the very exciting research projects and initiatives taking place in the Mathematical Sciences departments.

PIMS Graduate Information Weekend III, SFU-UBC, February 12–13, 2000

Organizers: Kori Inkpen (SFU), Randy Sitter (SFU), Denis Sjerve (UBC), Sandy Rutherford (PIMS)

The PIMS Graduate Weekend for 2000 was held at UBC and SFU on February 12–13. PIMS hosted 43 of the top undergraduates in mathematics, computer science and statistics from across Canada. The students attended a variety of lectures and presentations on graduate programmes in the mathematical sciences at the PIMS universities.

On Saturday, the students visited SFU. In the morning they attended presentations by Peter Borwein, Kori Inkpen, Luis Goddyn and Charmain Dean from SFU. Pauline van den Driesche spoke about the graduate programmes in the mathematical sciences at the University of Victoria and Michael Lamoureux presented information on graduate studies at the University of Calgary. In the afternoon the students toured some of the research facilities at SFU and ended the day with a buffet dinner at the Diamond University Club.

On Sunday, the students visited the University of British Columbia, where they were hosted at the PIMS-UBC facilities. Presentations were made to the students by Denis Sjerve, Goerge Bluman, Nassif Ghoussoub, Anthony Peirce, Robert Miura, Dave Boyd, Dale Rolfsen, Martin Barlow, Alan Wagner and Nancy Heckman. Samuel Shen, from the University of Alberta, gave a presentation on the benefits of doing graduate work at the University of Alberta. After lunch, the students broke up into small groups to tour the research facilities and discuss with faculty members.

PIMS Graduate Information Week, Universities of Alberta and Calgary January 9–12, 2001

The PIMS Graduate Student Information Week was a great success. Twenty-four top fourth year undergrads in mathematics, statistics, and computer science from universities all across Canada arrived in Calgary on the Tuesday afternoon.

After a welcoming student/faculty mixer that evening, students were treated on Wednesday

Visiting students attend a talk at the Univ. of Alberta.

to a full program of presentations about graduate studies at the University of Calgary, including talks by research groups in discrete math, analysis, industrial and collaborative mathematics, the math finance lab, computer graphics, quantum computing, and several others.

The Dean of Graduate Studies, James Frideres, outlined some of the many attractions in studying at Calgary, while the PIMS Deputy Director, Michael Lamoureux, described the advantages of joining the PIMS team of western universities. The departments' Director of Graduate Programs, John Collins, detailed the scholarship possibilities and amenities of each of the programs. Gary MacGillivray gave a presentation on programs at the University of Victoria. At a western-style dinner that evening, the Associate Dean of Science, Robert Woodrow, discussed additional funding opportunities from the Government of Alberta that make graduate study in the province particularly rewarding.

After further informative sessions and meetings with faculty members on Thursday morning, the students went by bus to Edmonton that afternoon. Dick Peter, Dean of Science, and Peter Steffler, Associate Dean of Graduate Studies, along with faculty and graduate students from the departments of Computing Science and Mathematical Sciences welcomed them to the University of Alberta campus at a banquet at the Faculty Club. Bryant Moodie, PIMS University of Alberta Site Director, gave a brief account of PIMS and its particular relevance to graduate studies in the mathematical sciences.

Friday morning activities were kicked off with a presentation by Bob Moody (U. Alberta) on "Graduate Studies in Mathematical Sciences: 2001". Jim Hoover (U. Alberta) talked about "The relationship between theoretical computer science and 'standard' mathematics". Presentations on graduate studies at PIMS universities were given by Denis Sjerve (UBC), Randy Sitter (SFU), Lorna Stewart (U. Alberta) and Jim Muldowney (U. Alberta).

After a lunch with local CS and MathSci faculty and graduate students, the visitors had a full afternoon of small group meetings, interviews and tours scheduled to address their individual interests. Over 100 meetings with local researchers and representatives of the other PIMS sites were arranged by PIMS staff. A farewell party and supper was held at the Varscona Hotel on Whyte.

Financial support for the seminar was provided by PIMS and each of the two host universities. Travel and accommodation for the whole event were arranged by John Collins, Sheelagh Carpendale and Marian Miles (PIMS Administrator, U. Calgary). Local arrangements in Edmonton were taken care of by Jim Muldowney, Lorna Stewart, Martine Bareil and Lina Wang (PIMS Administrator, U. Alberta).

IAM-PIMS Senior Undergraduate Industrial Math Workshop, UBC, February 18–20, 2000

Organizers: Anthony Peirce (UBC) and Michael Ward (UBC).
(See chapter on *Industrial and Scientific Training Programme.*)

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop, UBC, February 17–18, 2001

Organizers: R. Russell (SFU) and B. Shizgal (IAM).
(See chapter on *Industrial and Scientific Training Programme.*)

PIMS/MITACS Undergraduate Industrial Case Study Workshop, COE, UBC, October 25–29, 2001

Organizers: M. Puterman (Commerce and Business Admin, UBC) and Stephen Jones (COE, UBC).
(See chapter on *Industrial and Scientific Training Programme.*)

Statistical Genetics and Computational Molecular Biology Workshop, University of Washington, December 16–18, 2001

Organizer: Elizabeth Thompson (U. Washington)
(See chapter on *Industrial and Scientific Training Programme.*)

Initiatives for Graduate Students

Graduate Industrial Math Modeling Camps

Each spring, the Pacific Institute for the Mathematical Sciences (PIMS) sponsors a five day workshop for graduate students on mathematical modeling. The goal of the Mathematical Modeling Camp is to provide experience in the use of mathematical modeling as a problem solving tool for graduate students in mathematics, applied mathematics, statistics, and computer science.

The Mathematical Modeling Camp is one of two components of the annual PIMS Industrial Forum. The other component is the Industrial Problem Solving Workshop. At this Workshop, industrial and academic mathematicians work together to solve particular problems posed by industrial sponsors. Graduate students who are accepted to the Mathematical Modeling Camp are also invited to this Workshop.

Students work together in teams, under the supervision of invited mentors. Each mentor poses a problem arising from an industrial or engineering application and guides his or her team of graduate students through a modeling phase to a resolution. At the end of the workshop, reports are presented and a written summary of conclusions is made available for distribution.

Outstanding graduate students at both the Masters and PhD level in the fields of mathematics, applied mathematics, statistics, and computer science, or related disciplines, are invited to apply.

3rd PIMS Graduate Industrial Math Modeling Camp,
Simon Fraser University,
May 23–27, 2000

Organizer: K. Promislow (SFU), M. Kropinski (SFU), S. Jungic (SFU)

(See chapter on *Industrial Training Programme.*)

4nd PIMS Graduate Industrial Math Modeling Camp,
University of Victoria,
June 11–15, 2001

Organizer: Chris Bose (U. Victoria)

(See chapter on *Industrial Training Programme.*)

2nd PIMS Summer School in Fluid Dynamics,
University of Alberta,
July 30 – August 11, 2000

Organizers: B. R. Sutherland (U. Alberta) and T. Bryant Moodie (U. Alberta)

(See chapter on *Industrial Training Programme.*)

3rd PIMS Fluid Dynamics Summer School
PIMS at the University of Alberta,
May 27 – June 8, 2001

Organizers: B. R. Sutherland (U. Alberta) and T. Bryant Moodie (U. Alberta)

(See chapter on *Industrial Training Programme.*)

A Glimpse at 2002

4th PIMS Graduate Information Week, UBC, SFU and UVic, January 12–13, 2002

Junior High Math Nights at Mount Royal College, Calgary, January–March, 2002

The Alberta High School Mathematics Competition, Part II of 2001–2002 season, Feb 6, 2002

Greater Regional Vancouver Science Fair, UBC, April 4–6, 2002

Calgary Youth Science Fair, April 10–13, 2002

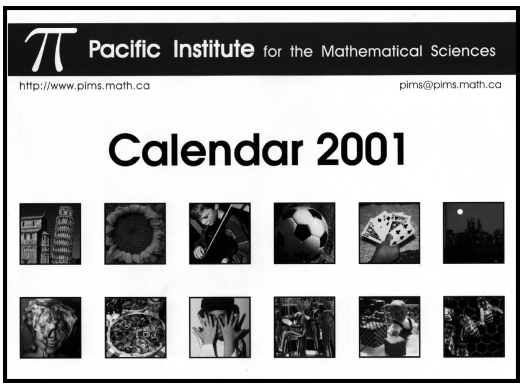
Changing the Culture V, Harbour Centre, SFU, April 26, 2002

PIMS Elementary Grades Math Contest, UBC, May 25, 2002

Summer Math Camp, University of Alberta, August 14–21, 2002

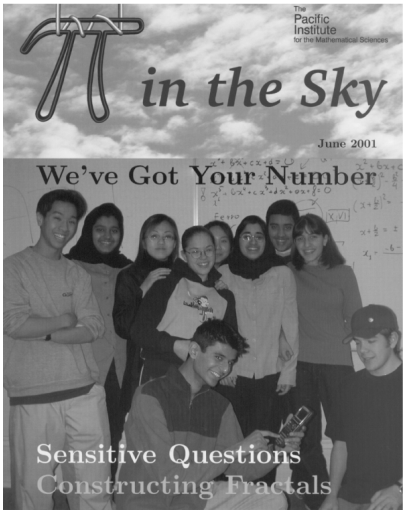
The Alberta High School Mathematics Competition, Part I of the 2002–2003 season November 19, 2002

VI. COMMUNICATION OF THE MATHEMATICAL SCIENCES



PIMS Calendar for 2001 which features the *Mathematics is Everywhere* posters.

The July poster in the 2001 *Women and Mathematics* campaign: Florence Nightingale was infuential in the application of statistics.



The third issue of *Pi in the Sky*. Students from Old Scona Academic High School in Edmonton are featured on the cover.

Promoting Mathematics Awareness

Mathematics is Everywhere

Coordinator: Klaus Hoechsmann (PIMS)

Mathematics is Everywhere was a poster campaign featuring the ever growing importance of Mathematics in modern society and its ubiquity in the world around us. A series of eye-catching posters in a mathematical theme were placed in public transport in Vancouver and Victoria and in public schools in Calgary. These also appeared in schools, exhibitions, calendars, etc.

Mathematics is Everywhere was part of PIMS' contribution to the World Mathematical Year 2000 sponsored by UNESCO and the IMU and was one of the many activities in PIMS' continuing Mathematics Awareness Campaign.

A new poster came out at the start of every month. Each poster contains an interesting math question and invites the viewer to visit a web page to learn more about the problem. Also on the web page it was possible to submit a solution to the problem. Those submitting a correct solution were elgible for a prize of $100.

The motivating force behind this PIMS project, conceived and created by **Klaus Hoechsmann**, was the desire to increase public awareness of the surprising ways mathematics is touching many aspects of our lives. At the very least, the hope was to catch the attention of many, capture the imagination of some, and convince a few to dig deeper.

Each month, a snapshot of the familiar world around us was presented: a sunflower, a child playing the violin, a soccerball, a hand of cards, the full moon above the city skyline, a shampoo-covered head, a pizza, painted fingernails, a puppet, cubes, honeycomb and the Leaning Tower of Pisa. The posters are shown on the next page.

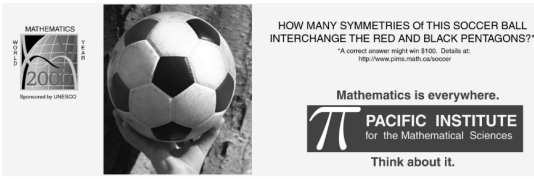
The questions are designed to highlight a wide range of mathematical topics, such as combinatorics, probability, logarithmic curves, Fibonacci numbers and more. They also vary in level of difficulty to stimulate public interest among all age groups from elementary school students to adults. The questions were posed in such a way that unambiguous numerical answers can be given. Each month, one winner was drawn from the correct answers. However, it is nourishing the mind, rather than nourishing a competitive spirit, that stood out as the primary goal of the project. This is most evident to those who venture to probe the intricate connections that the sometimes deceivingly simple questions conceal. Such an exploration is possible through browsing the webpage and the associated links, made available with each month's question.

In order the winners were Pam Liem, Stefan Lukits, Katy Cheng (Vancouver), Jordan Wan (Saskatoon), Collin Tsui (Calgary), Wayne Chevrier (Burnaby), Albert Chan (Boston), Chad Simpson (Vancouver), Paige Zanewick (Calgary), Yakov Shklarov (Calgary), Tom Watson (Surrey) and Russell Wierzba (Calgary).

The contest series has been very successful and its closing was marked by the publication of 2001 wall calendar designed by Heather Jenkins (PIMS). It was distributed to numerous schools and mathematics departments in Canada and USA. It has a complete collection of the pictures and associated questions of the poster campaign.

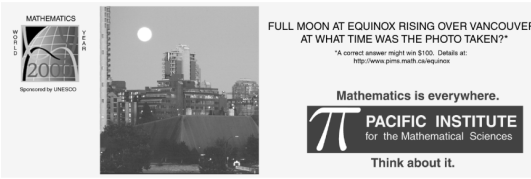
February Poster on "The Sunflower Spiral Count

March Poster on "The Violin String"

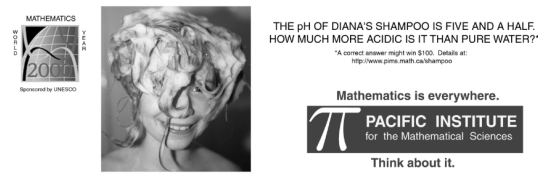


April Poster on "Soccer Ball Symmetries"

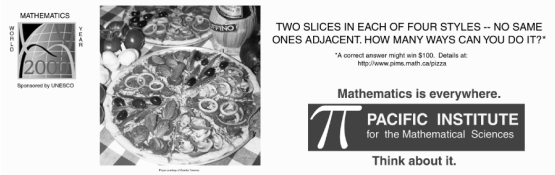
May Poster on "Chance and Randomness"



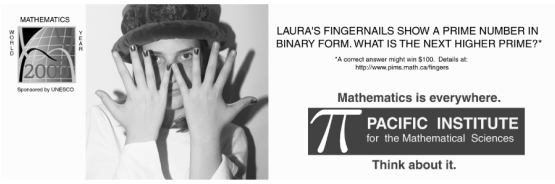
June Poster on "Telling Time by the Sun and Moon"



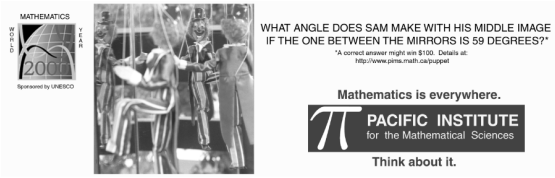
July poster on "the pH of shampoo"



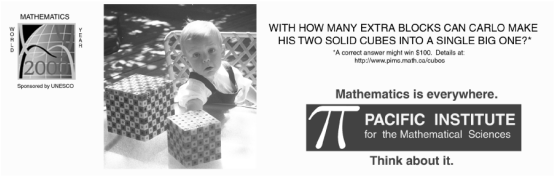
August poster on "combinatorics and pizza"



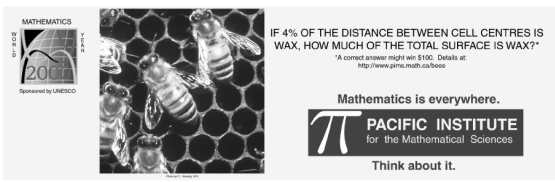
September poster on "primes in binary"



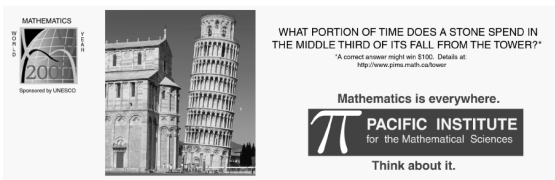
October poster on "puppets and linear mappings"



November poster on "arithmetic and cubes"



December poster on "honeycomb packings"



January poster on "calculus of falling objects"

Women & Mathematics

Coordinators: Krisztina Vásárhelyi and Heather Jenkins (PIMS).

Building on the momentum of the *Mathematics is Everywhere* poster campaign, PIMS is continuing the project in 2001 with a new theme and new format. Klaus Hoechsmann's innovative poster series has demonstrated that given the right approach, it is possible to rouse interest in the "terminally unpopular".

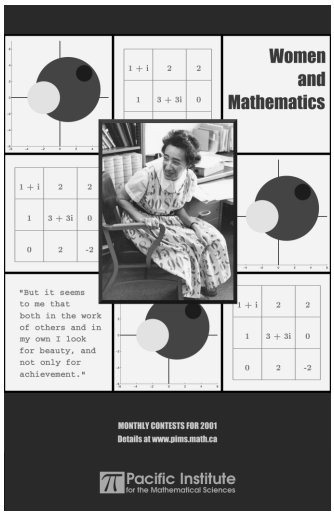
With the intention of introducing the public, and in particular young people, to the idea that mathematics is a career asset, a colourful palette of biographies will be presented monthly. The poster series **Women and Mathematics** will showcase portraits of twelve women who have made contributions to the broad field of the mathematical sciences.

Mathematics is expanding rapidly beyond its traditional domains. With the growth of information technologies in all fields, the demand for mathematically trained individuals in the work force will continue to rise. Ironically, mathematics still suffers from a bad reputation. Fear and loathing of the subject is firmly established already at the elementary school level. The attitude that mathematics is a career obstacle continues to influence education choices. Girls are especially susceptible to rejecting a course of study which favours mathematical content. The "smart girl" stigma among teenagers can be a powerful deterrent.

The *Women and Mathematics* campaign will present an alternative, much more positive, image of mathematics in the lives of women. Mathematics can involve lifelong dedicated research, it can be an enjoyable pursuit and it can represent a valuable tool in a variety of endevours. The last point is aptly illustrated by the case of Florence Nightingale. She is a prominent figure and role model, widely acknowledged for her achievements in the fields of nursing and public health. Yet her perhaps less well known contributions to statistics have been pivotal to her other accomplishements.

The target audience for this project includes students in elementary and secondary schools as well as the general public of any age or gender. However, by focusing on women we want to draw attention to the problem of low female participation in the mathematical sciences.

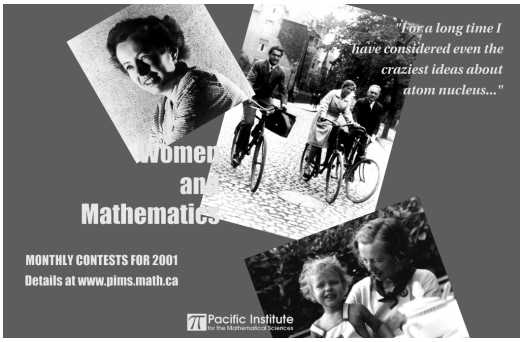
The contest itself promotes internet-based biographical research in addition to problem-solving. A set of quiz questions will be posted on the contest website. One of the questions will be a mathematics problem, highlighting the field of involvement of the featured individual. Answers to the remaining biographical questions can be found by searching the web. This approach encourages contestants to read and learn about women in mathematical pursuits. Posters have been distributed to schools in BC and Alberta to encourage initiatives for class projects. The posters have also appeared in public libraries as well as in universities across North America and internationally.



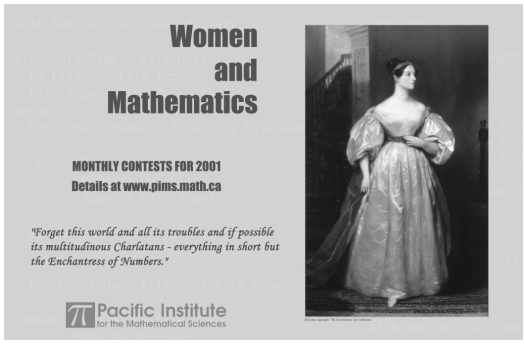
Olga Taussky-Todd from April.

Her life might have been the subject of a storybook: **Sophie Germain** dressed up as a man to be admitted to the École Polytechnique where her mathematical genius was discovered, and she was the secret saviour of Gauss, whose life was threatened during Napoleon's invasion. In May, PIMS was treated to a special poster-presentation of Sophie Germain. **Jeni Rae Duschak**, a young American artist who studied mathematics and liberal arts, generously donated her time to produce a beautiful poster for the contest. Jeni Rae has a website about Sophie's life which includes a biography that she tells as a story illustrated with her drawings. Our discovery of her site led to an enjoyable collaboration which resulted in the special poster.

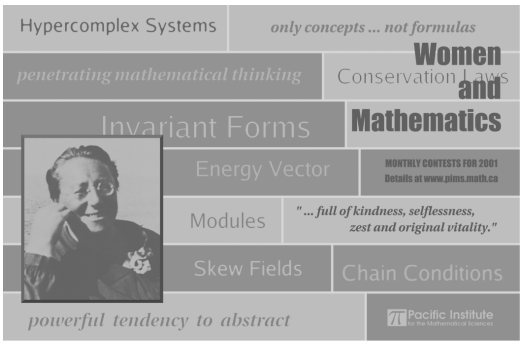
The February poster featuring Hypatia of Alexandria, last of the Alexandrian scholars.



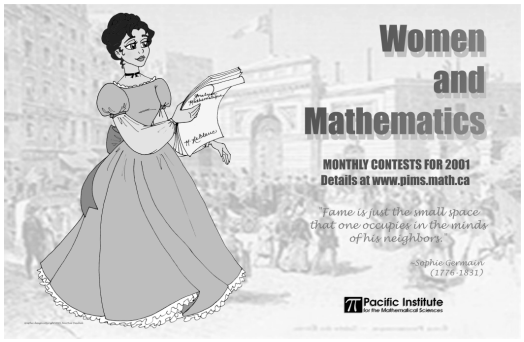
Nobel Prize winning theoretical physicist Maria Goeppert-Mayer in August.



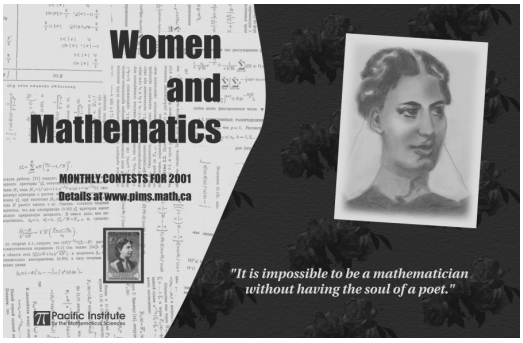
Ada Lovelace, namesake of the computer language Ada from March.



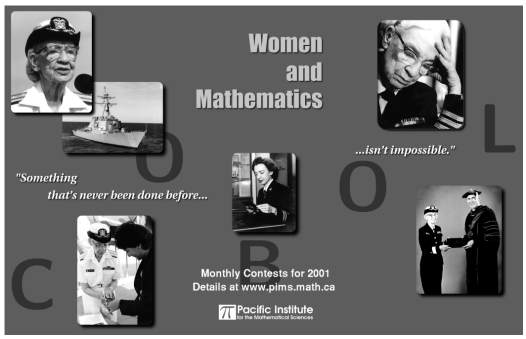
Emmy Noether one of the great mathematical minds of this century featured in September.



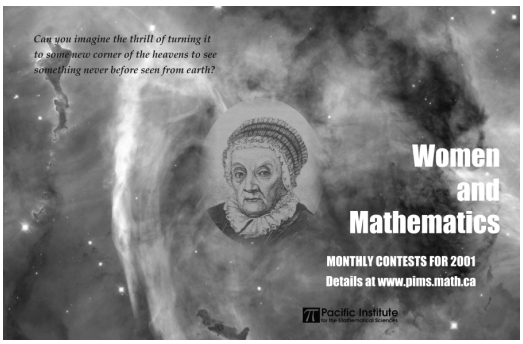
The May poster designed by Jeni Rae Duschak.



October's poster featuring Sofia Kovalevskaya.



Grace Hopper developed the computer language COBOL and featured on the June poster.



Observational astronomer Caroline Herschel featured in November.

Pi in the Sky

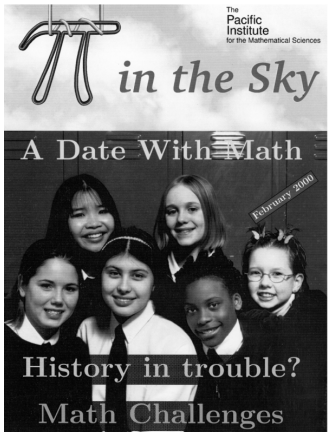
Pi in the Sky is a mathematical newsletter targeted at the Junior and Senior High School students and educators, *Pi in the sky* is produced by mathematicians at the University of Alberta, for distribution across the BC and Alberta. This new and popular semi-annual publication promotes all aspects of the mathematical sciences. The first 3 issues are available online through the PIMS website. The Editors in Chief are Nassif Ghoussoub (PIMS Director) and Wieslaw Krawcewicz (U. Alberta). John Bowman, also from U. Alberta is the Associate Editor. The rest of the editorial Board consists of Peter Borwein (SFU), Florin Diacu (UVic), Klaus Hoechsmann (UBC), Michael Lamoureux (U. Calgary) and Ted Lewis (U. Alberta).

Pi in the Sky is a periodical designated for high school students in BC and Alberta with the purpose of promoting mathematics, establishing direct contact with teachers and students, increasing the involvement of high school students in mathematical activities, and promoting careers in mathematical sciences.

This journal, aimed at an average student, has the following objectives:

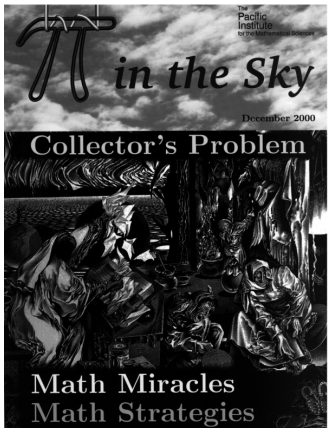
- to promote meaningful and exciting mathematics;
- to inform students and teachers about mathematical sciences;
- to increase participation of students in math related activities;
- to encourage girls to get involved in mathematical sciences;
- to establish a dialog between students, teachers and academics;
- to promote new and/or innovative teaching methods;
- to change any negative stereotype image of math.

The first issue of *Pi in the Sky* includes the articles *The Perfect Education System for an Affluent Society* by Andy Liu, *Solving Problems can be Fun* by Ambikeshwar Sharma, and *How do I love thee? Let me count the ways!* by Laurent W. Marcoux. The cover features students from the Nellie McClung Girls' Junior High Program at Oliver School in Edmonton.



The first issue of *Pi in the Sky*.

In the second issue of *Pi in the Sky* Akbur Rhemtulla writes about *Counting with Base Two and the Game of Num*, and Byron Schmuland about the *Collector's Problem*. Readers learn about π in *The Number π and the Earth's Circumference* by Wieslaw Krawcewicz. The cover shows a fragment of a painting by prominent Russian mathematician Anatoly T. Fomenko which was inspired by mathematical ideas.



The second issue of *Pi in the Sky*.

The June 2001 and third issue of *Pi in the Sky* includes *We've Got Your Number* by Ted Lewis, *Have You Used Illegal Drugs Lately? or How to Ask Sensitive Questions* by Carl Schwarz, and *Constructing Fractals in Geometer's SketchPad* by Michael Lamoureux. These articles explain how visa card companies, for example, determine whether or not you have entered a valid number, the ideas behind randomized response surveys, and how to build fractals using Geometer's SketchPad software.

Hypatia's Street Theatre, Frederic Wood Theatre, UBC December 10, 2000

PIMS hosted the premier of a new play about mathematics that was shown to the general public at the Frederic Wood Theater at UBC. The play, *Hypatia's Street Theatre,* is co-authored by PIMS Education Facilitator, Klaus Hoechsmann and playwright Ted Galay. It represents an experiment of mathematical exposition in a theatrical context and is organized around three mathematical skits. The principal ambition of this play is to show mathematics on stage—not just *talking* about it, but actually *doing* it—in whatever form the public can take. To be honest, this "public" includes most professional mathematicians, because they, too, are easily confused when some one radically alters their frame of reference. The fact that most people cannot dance like Astaire, sing like Domingo, or write like Shakespeare, does not exclude them from these activities. Hypatia's imaginary skits invite us to approach mathematics in the same way.

Director Bryan Wade (left) with Klaus Hoechsmann.

Dramatis Personae

Historical: Cyril, Archbishop of Alexandria; Hierax, a religious fanatic; Hypatia, mathematician, astronomer, and philosopher; Orestes, Roman Prefect.

Fictional: Dario and Lydia, disciples of Hypatia; Samuel, junior colleague of Hypatia, Chrysostomos, poet and play-wright.

The Setting

Hypatia, the last of the Alexandrian scholars recorded by history, was brutally murdered by a fundamentalist mob in March of 415 AD. Her father Theon, a mathematician, philosopher, and director of the University (called the "Museum") of Alexandria, had seen to it that his talented daughter received the best available training in all conceivable disciplines from rhetoric through music to mathematics. Blessed with physical strength and beauty, she was by all accounts a model of rectitude and modesty. It is difficult to exaggerate the esteem in which she was held by contemporaries, whether in Athens, Rome, or Alexandria itself.

Though none of her written work has survived, we know that it included books on the mathematics of Diophantus and Apollonius, and probably one on Ptolemy's astronomical system. Even today, these topics would not be easily accessible to the occasional amateur: they indicate that mathematics must have been Hypatia's major focus. She also made a name for herself as one of the main proponents of Neo-Platonism. It is said that she often donned her "philosopher's cloak" and went among the crowds to philosophise with strangers. The present play takes the liberty of imagining this urge to communicate expanded to the more difficult subject of mathematics — through theatrical sketches — motivated by her love for the theatre which is mentioned in some of the writings about her.

Although a play like this cannot avoid distorting history — for instance, by the use of modern idiom and images — it will try to respect major facts and events, as far as these are known. What it cannot undertake, however, is to transplant the general outlook and mind-set of these ancient personages faithfully into the present.

Outside mathematics, the main historical reference for the play is Edward Gibbon's *Decline and Fall of the Roman Empire.*

The Plot

The plot unfolds in Cyril's third year as Bishop of Alexandria, a position which appears, at that time, to have been more important than the Sees

of Rome or Constantinople. In the play he resolutely but uncomfortably follows the footsteps of his ruthless uncle Theophilus. His fate is to be a man of action, while his temperament would have been more suited to a life of quiet contemplation. In his drive to forge a unified Christian civilisation, he comes down hard on Jews and Christian heretics, and must still fight rearguard actions with Hellenic elements.

Orestes's dilemma is the power vacuum in which he must maintain an appearance of order. Theodosius I — personal friend to Theophilus — had been the last emperor who ruled the whole Roman Empire, east and west. In the time of the play, the Eastern Emperor was a boy, the Western one a weakling. Historically, Orestes and Cyril knew each other well enough that they could have been friends, had not Hypatia — according to some of her detractors — bewitched the former.

Hypatia's dilemma is caused by her enormous intellectual capacity, which keeps pulling her into the ivory tower, and her political instinct, which tells her that the fate of Civilisation will be decided on street and market place. She is further motivated by a sense of obligation toward her father Theon. We are still indebted to this father-and-daughter team for some exceptionally valuable scientific work, and it is acknowledged that the daughter on her own ventured into even loftier mathematical fields. What is fictional (but not impossible) is Theon's involvement in the education of both Orestes and Cyril and in the salvaging of treasures from the gutted Serapeum.

Hierax is portrayed as a religious fanatic. According to one chronicler, he was "a Christian possessing understanding and intelligence who used to mock the pagans but was a devoted adherent of the illustrious Father the patriarch, Cyril, and was obedient to his monitions." At any rate, he got himself beaten up after some heckling during a theatrical performance. In this play, he has his own larger agenda: rousing the populace to do God's will as defined by Hierax. Another shady historical figure — one Peter the Reader — is his invisible rival.

Technology-based Mathematics

The Pacific Institute is working to provide a useful, comprehensive collection of tools for teaching, learning and promoting mathematics and disseminating research with computers. Examples of such resources will include on-line interactive courses and modules, reusable software components, research and computational tools and an interactive electronic mathematics journal. The target user group includes mathematicians, scientists, educators (mostly secondary and post-secondary) and students of the mathematical sciences.

A number of technology projects have received PIMS funding in the past and are continuing under their own resources. One ongoing project, described below, is indicative of the objectives of PIMS technological innovations.

The KnotPlot Project

Coordinator: Bob Scharein (UBC)

This project builds on the research described in the author's doctoral dissertation *Interactive Topological Drawing.* In particular, one goal is to make the large amount of experimental data obtained during the thesis research widely available to the mathematical community at large via the World Wide Web (WWW). A second goal was to make the software used to obtain the data (principally KnotPlot) available for academics and other researchers, or for artists and people with a general interest in knots.

KnotPlot Download Site

The KnotPlot program has been ported to a variety of computers and operating systems. Versions of the program for Windows 85/98/NT, Macintosh (PowerPC), Linux, Silicon Graphics workstations and Sun workstations, can be downloaded from

www.math.ca/knotplot/download.html.

Knot Theory on the World Wide Web

The web site provides mathematicians with a comprehensive encyclopaedia of information on cataloged knots and links. Initially, this will be limited to the nearly 400 knots and links found in Appendix C of D. Rolfsen's book, *Knots and Links.* In addition to providing images of each knot (in several different formats), the database will also contain topological information of use to knot theorists. In particular the following topological and geometric data are available:

- Crossing number, stick number, unknotting number
- Signature, Arf invariant, knot group
- Fourier coefficients
- Closed braid description(s)
- Conway number
- Alexander, Jones, HOMFLY, Kauffman and other polynomials
- Known symmetries along with a catalogue of interesting symmetric presentations (both for smooth version and minimal stick version)
- Sufficient invariants to distinguish from any other knot in the Rolfsen catalogue
- Vertex data giving an instance of the knot type

In addition to providing a resource for research mathematical scientists, the knot theory

website will also provide an on-line, high-quality, and interactive instructional tool for learning knot theory and its relation to other areas of mathematics and science. The pedagogical section of the knot theory website will be accessible to wide audience and suitable in some degree for instructional purposes for students from K through 12 and beginning university level. Activity areas will include being able to draw your own knot and obtain output, learning about tying simple knots with real rope (this will include animations of knot tying), and knot art in which the students will learn appreciation for mathematics through beautiful images of knots.

The UBC Sun SITE Project

Coordinator: Bill Casselman (UBC)

The SITE is one of about eight in North America, among them some of the most useful and popular Internet sites for University users. The official goal of Sun's project is for each SITE to operate as "a library, a publishing house, a distribution center and a technology showcase." In this vein, the aims of the UBC SITE include the introduction of more professional standards in high-tech electronic mathematics publication as well as involving local groups in a collaborative effort to produce high quality Internet material for use in the Mathematics community at large. The location of the UBC Sun SITE is: *sunsite.ubc.ca.*

New advances in programming languages—for example, Java, Postscript and HTML—together with the interconnectivity of the World Wide Web are providing mathematicians with unique opportunities to express their ideas in novel ways and to a wider audience. Although the role of the Internet in explaining mathematics is already beyond easy comprehension, the Sun SITE at UBC hopes to make a small start in raising standards. We hope to find a role as a moderator in the development of this new medium by providing a forum for the electronic publication of suitable work and by providing guidance through technical assistance and by example.

As one of roughly fifty Sun SITEs worldwide, the UBC project is the only Sun SITE serving primarily mathematical content. Because the SITEs are authorized by Sun and are known to have generally high standards, these sites have a tremendous number of users.

PIMS Offers Lectures via Streaming Video over the Internet

PIMS is now offering a new service to the mathematical sciences community: lectures over the internet using on-demand streaming video. The format that we are following is to offer both video of the lecture in Realvideo format and high resolution JPEG images of the speaker's slides, when possible. Our library of lectures is available at **www.pims.math.ca/video**.

Lectures currently available are:

Panagiotis Souganidis, U. Texas at Austin, *Fully nonlinear stochastic partial differential equations* (4 lectures), PIMS Thematic Programme in PDEs - Workshop on Viscosity Methods, UBC, July 3-4, 2001

David Gillman, UCLA, *Odd embeddings on lens spaces,* PIMS Distinguished Lecturer Series, UBC, May 31, 2001

Brett Stevens, PIMS, SFU, *Mathematics and Literature: Cross Fertilization,* PIMS Changing the Culture, SFU at Harbour Centre, May 11, 2001

John Mighton, Fields Institute, *Breaking the Cycle of Ignorance,* PIMS Changing the Culture, SFU at Harbour Centre, May 11, 2001

Douglas Arnold, Director, Institute for Mathematics and its Applications (Minnesota), *Colliding Black Holes and Gravity Waves: A new Computational Challenge,* PIMS Distinguished Lecturer Series, UBC, May 16, 2001

John Rice, UC Berkeley, *A Simple Model for a Complex System: Predicting Travel Times on Freeways,* PIMS-MITACS Seminar on Computational Statistics and Data Mining, UBC, April 26, 2001

David Eisenbud, Director, MSRI (Berkeley, *Chow Forms and Resultants - old and new,* PIMS Distinguished Lecturer Series, UBC, April 12, 2001

Bengt Fornberg, University of Colorado, *Radial Basis Functions - A future way to solve PDEs to spectral accuracy on irregular multidimensional domains?,* IAM-PIMS Joint Distinguished Colloquium, UBC, March 27, 2001

Emil Martinec, University of Chicago, *D-branes as noncommutative solitons: an algebraic approach,* PIMS Pacific Northwest Seminar on String Theory, UBC, March 17, 2001

Amanda Peet, University of Toronto, *String theoretic mechanisms for spacetime singularity resolution,* PIMS Pacific Northwest Seminar on String Theory, UBC, March 17, 2001

Washington Taylor, MIT, *Tachyon condensation in open string field theory,* PIMS Pacific Northwest Seminar on String Theory, UBC, March 17, 2001

Dilip Madan, University of Maryland, *Levy Processes in Financial Modeling,* PIMS-MITACS Financial Seminar Series, UBC, March 9, 2001

Gunther Uhlmann, University of Washington, *The Mathematics of Reflection Seismology,* IAM-PIMS Joint Distinguished Colloquium, UBC, March 6, 2001

R. Douglas Martin, University of Washington, *MathSoft Robust Factor Model Fitting and Visualization of Stock Market Returns,* PIMS-MITACS Seminar Series on Computational Statistics and Data Mining, UBC, January 25, 2001

David Baillie, Simon Fraser University, *Comparative Genomics,* IAM-PIMS Joint Distinguished Colloquium, UBC, January 16, 2001

Tudor Ratiu, École Polytechnique Fédérale de Lausanne, *Variational Principles, Groups and Hydrodynamics*, PIMS Distinguished Lecturer Series, U. Victoria, January 12, 2001

Mark van Raamsdonk, Stanford University, *D-particles with multipole moments of higher dimensional branes*, PIMS String Theory Seminar, UBC, November 28, 2000

Linda Petzold, UC at Santa Barbara, *Algorithms and Software for Dynamic Optimization with Application to Chemical Vapor Deposition Processes,* IAM-PIMS Joint Distinguished Colloquium, UBC, November 1, 2000

Robert Devaney, Boston University, *The Mandelbrot Set, the Farey Tree, and the Fibonacci Sequence,* PIMS Distinguished Lecturer, University of Victoria, October 20, 2000

David Brydges, University of Virginia, Series of 4 lectures on *Self-Interacting Walk and Functional Integration,* PIMS Distinguished Chair, UBC, Sept.–Oct., 2000

Beno Eckmann, ETH Zürich, *Idempotents in Group Algebras, Traces, and Geometry of Groups,* PIMS Distinguished Lecturer, U. Calgary, September 21, 2000

Beno Eckmann, ETH Zürich, *Projections, Group Algebras, and Geometry of Groups,* Algebra-Topology Seminar, UBC, Sept. 14, 2000

Beno Eckmann, ETH Zürich, *The Euler Characteristic - Some Variations and Ramifications,* PIMS Distinguished Lecturer, UBC, September 13, 2000

Thomas Duke, Cambridge, UK, *Cooperativity in Sensory and Motor Systems Biophysics and Biochemistry of Motor Proteins,* Banff, August 27, 2000

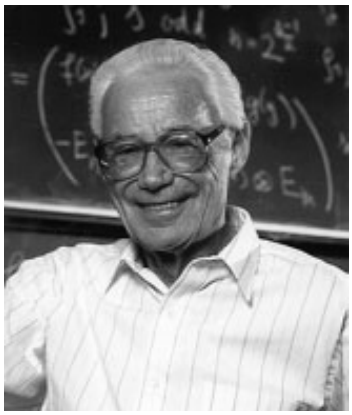
George Oster, UC Berkeley, *The Mechanochemister of ATP Synthase Biophysics and Biochemistry of Motor Proteins,* Banff, August 27, 2000

Peter Winkler, Bell Labs, *Random Homomorphisms,* PIMS Workshop on Colourings and Homomorphisms, SFU, July 20, 2000

Noga Alon, Tel Aviv University, *Acyclic coloring, strong coloring, list coloring and graph embedding,* PIMS Workshop on Colourings and Homomorphisms, SFU, July 19, 2000

Joan Hutchinson, Macalester College, *A 3-color theorem for some graphs evenly embedded on orientable surfaces,* PIMS Workshop on Colourings and Homomorphisms, SFU, July 19, 2000

Adrian Bondy, Université Claude Bernard, *Colourings and orientations of graphs,* PIMS Workshop on Colourings and Homomorphisms, SFU, July 18, 2000



Beno Eckmann (ETH)

Michael Albertson, Smith College, MA, *Extending graph colourings,* PIMS Workshop on Colourings and Homomorphisms, SFU, July 17, 2000

Bertrand Guenin, University of Waterloo, *Integral polyhedra related to even-cycle and even-cut matroids,* PIMS Workshop on Flows, Cycles, and Orientations, SFU, July 11, 2000

Matt DeVos, Princeton University, *Antisymmetric Flows PIMS Workshop on Flows, Cycles, and Orientations,* SFU, July 4, 2000

Chris Rodger, Auburn University, *Amalgamations of Graphs* (2 lectures), PIMS Workshop on Graph Decompositions, SFU, June, 2000

Ron Gould, Emory University, *Graph Decompositions* (2 lectures), PIMS Workshop on Graph Decompositions, SFU, June, 2000

H.S.M Coxeter, University of Toronto, *The Mathematics in the Art of M.C. Escher,* PIMS Changing the Culture 2000, SFU Harbour Centre, April 28, 2000

Sir Christopher Zeeman, *Geometric Unfoldings of a Difference Equation,* PIMS Distinguished Lecturer, U. Victoria, March 21, 2000

Yuri Matiyasevich, Steklov Institute of Math, *How to draw a tree correctly,* PIMS Distinguished Chair, U. Calgary, Mar. 9, 2000

Yuri Matiyasevich, Steklov Institute of Math, *On Hilbert's Tenth Problem - What can we do with Diaphantine Equations* (5 lectures), PIMS Distinguished Chair, U. Calgary, Feb, 2000

Israel Gohberg, Tel Aviv University, *Infinite Systems of Linear Equations,* PIMS Distinguished Lecturer, U. Calgary, September 30, 1999

Sir Andrew Huxley, Trinity College, *The Background to the Hodgkin-Huxley Equation,* PIMS Workshop on Mathematical Cellular Biology, UBC, August 19, 1999

Nobel Laureate Sir Andrew Huxley

Richard Karp, University of Washington, *The Design of Molecular Bar Codes: A Combinatorial Problem from Molecular Biology,* PIMS Distinguished Lecturer, SFU, May 13, 1999

Mitchell Luskin, University of Minnesota, *Modelling, analysis and computation of crystalline microstructures,* PIMS Distinguished Lecturer, UBC, Sept. 10, 1998

Avi Wigderson, Hebrew Univ. of Jerusalem, *A Computational View of Randomness,* PIMS Distinguished Lecturer, UBC, April 6, 1998

Katherine Heinrich, Simon Fraser University, *PIMS and Mathematics Communication,* PIMS Opening Meeting, U.Victoria, Oct. 4, 1996

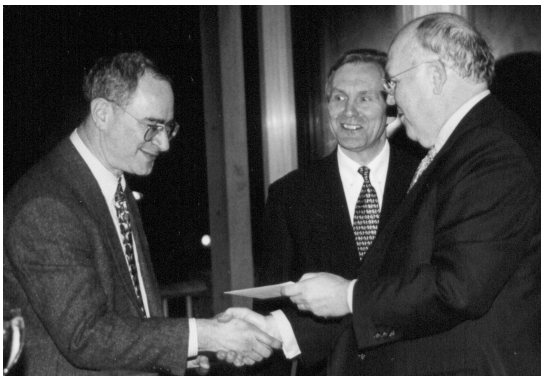
Richard Karp, University of Washington, *Combinatorial Optimization as a Tool for Molecular Biology,* PIMS Opening Meeting, U.Victoria, Oct. 4, 1996

Donald Saari, Northwestern University, *The Chaotic Complexity of Economics and the Social Sciences,* PIMS Opening Meeting, U.Victoria, Oct. 4, 1996

Donald Saari, Riverside

VII. PIMS PRIZES:

2000



George Bluman receives PIMS Education Prize from Martin Taylor (VP Research, Univ. of Victoria) and Ken Foxcroft (TD Securities).

From left, Brian Wetton, Huaxiong Huang, and Keith Promislow receive the PIMS Industrial Outreach Prize from Murray Margolis (Powerex Corp.) and Ken Foxcroft (TD Securities). Missing is the 4th recipient, John Stockie (UNB, Fredericton).

Indira Samarasekera (VP Research, UBC) congratulates PIMS Research Prize winner Terry Gannon (left).

The first annual PIMS Prizes in Education, Research and Industrial Outreach were awarded on December 10 at a Banquet held at the UBC University Centre. The prizes, valued at $3000 each, were donated by the Toronto Dominion Bank Financial Group and TD Securities.

The **PIMS Education Prize** rewards individuals who have played a major role in encouraging activities which have enhanced public awareness and appreciation of mathematics, as well as fostering communication among various groups and organizations concerned with mathematical training at all levels. The review committee for the PIMS Education Prize was Michael Lamoureux (chair of the committee and PIMS Deputy Director), Florin Diacu (PIMS-UVic Site Director), Arvind Gupta (MITACS Programme Leader), Bryant Moodie (PIMS-UA Site Director) and Dale Rolfsen (PIMS-UBC Site Director).

The **PIMS Education Prize** was awarded to **George Bluman**, who is the chair of the UBC Math Department. George Bluman's lifetime commitment to mathematics education in British Columbia, both in the public school system and at the University of British Columbia, make him an outstanding recipient for the PIMS Education Prize. Many aspects of his activities were highlighted by his nominees, including: providing stimulating mathematics experiences for students, through the Euclid contest and various school workshops; supporting math teachers in the schools; working to raise and maintain high standards in the school system; developing a healthy dialogue with the BC Ministry of Education; encouraging math students at UBC to pursue careers in teaching; and encouraging a strong commitment to teaching at UBC.

Typical of his activities and impact is his over-twenty-year involvement with the Euclid contest as the BC and Territories organizer for this high school enrichment contest in mathematics. George supports the idea that the Euclid contest is an event every Math 12 student should be able to enter and, in doing so, feel a sense of accomplishment. Beyond organizing the contest, he has developed three levels of School Workshop programs which give students (elementary, junior high, and senior high) the opportunity to participate in problem solving workshops with university faculty and students. BC enjoys the highest level of participation, per capita, in the Euclid contest and its universities benefit from the excellent preparation these students receive through the program. In the words of the nominators, much of the BC success in Euclid can be directly attributed to George's efforts.

George personally knows most of the mathematics teachers from around the province and uses this network to provide a dialogue between the BC secondary school system and the universities. He has been tracking high school students' performance at university for over twenty year, and often makes personal phone calls or writes to high schools to give suggestions on how to improve their students' performance. Again, his nominators attest to the positive impact his work has had on the designs, and successes, of their mathematics program. The scope and magnitude of his service to mathematical education over the past twenty years is phenomenal.

In his comments after receiving the award, George Bluman states that, "It is not easy for mathematicians to be involved in educational activities. Education issues are often very sensitive with many different (often unfairly stereotyped) 'conflicting' groups and interests— pontificating university professors, strict union mentalities of teachers, anxious students and parents, scandal-seeking media, politicking Ministries of Education paying little attention to common sense and giving lip-service to the opinions of informed teachers and professors. It is essential that all such special interest groups trust each other and stop bickering for the common good. After all we should want our students to have the best education possible within our means."

"PIMS is to be congratulated for taking a sincere interest in Education with its various Education activities including the recognition of those involved through this Award."

He drew particular attention to the semi-annual publication of **Pi in the Sky**, prizes for Math projects in Science Fairs, the support of elementary school Math activities such as the **PIMS Elementary Grades Math Contest**,

the **Mathematics is Everywhere** poster campaign, the **Senior Undergraduate Industrial Math Workshop**, and the **Graduate Industrial Math Modeling Camp**.

"All of the above are new initiatives and continuing activities which certainly would not have happened without the existence of PIMS. Moreover PIMS is very fortunate to have the services of Klaus Hoechsmann for developing and promoting its educational activities. We all now know that Klaus is also a budding playwright from his very well-written and PIMS-sponsored play Hypatia which should be performed for students in schools around the world."

NSERC Director, Danielle Menard speaking at the PIMS Awards Ceremony.

The **PIMS Research Prize** is given for a particular outstanding contribution to the mathematical sciences, disseminated during the past five years. Nominations for the Research Prize were adjudicated by the PIMS Scientific Review Panel, the members of which are chair Nassif Ghoussoub (PIMS Director), David Boyd (UBC), David Brillinger (Berkeley), Ron Graham (UCSD), Alistair Lachlan (SFU), Richard Karp (Berkeley), Bernard Matkowsky (Northwestern), Robert Moody (Univ. of Alberta), Nicholas Pippenger (UBC), Ian Putnam (Univ. of Victoria), Gordon Slade (UBC), and Gian Tian (MIT).

The Research Prize was awarded to **Terry Gannon** of the Dept. of Mathematical Sciences, University of Alberta. Terry's accomplishments cover two separate directions, both of which have won him international recognition. The first accomplishment is his work on the "Moonshine Conjectures", which concern a fantastic connection between the representations of the Monster Group and certain classes of modular forms. Richard Borcherds was awarded the Fields Medal in 1998 for his proof of these conjectures. However, Borcherds' proof contained one part that was non-conceptual and had to be shown by brute force computation. Terry provided a conceptual argument to replace this computation. The second and more extensive of Terry's accomplishments concerns the classification of two-dimensional conformal field theories. The problem involves determining all modular invariants which can be constructed from characters of the representations of the underlying affine Kac-Moody Lie algebras. The first success in classifying two-dimensional conformal field theories was the A-D-E classification of Capelli, Itzykson and Zuber for affine-$SU(2)$. In 1994, Terry discovered a solution to the affine-$SU(3)$ problem and has since made enormous advances towards a solution of the general problem.

In describing his research, Terry states, "My bias as a mathematician is toward breadth. Most mathematicians, it seems, try to strike oil by drilling deep wells. This strategy makes a lot of sense. But actually I'm more drawn towards half-completed bridges and wobbling fences. The theory in those places is relatively undeveloped, so there's a lot of basic results still open. And I get a little restless staying too long in one place."

"Some of my work which attracted a little attention was in an area called Monstrous Moonshine. It was noticed that 196 884 –the first interesting coefficient of a function (the j-function) important to classical number theory– equals $1 + 196\,883$, the sum of the first two dimensions of representations of a very special symmetry (the Monster group). The second, third,... coefficients of that function were likewise related to the higher dimensions. The challenge was to explain what that classical number theory had to do with this newly discovered symmetry. A bridge had to be built! Borcherds did most of the work, and for this was awarded a Fields

Medal in 1998. He showed that there's a new and very complicated algebraic structure (a vertex operator algebra) whose symmetry is that Monster group, and whose 'graded dimension' is the j-function. If we twist the graded dimension by various elements of the Monster, we get other special functions (Hauptmoduls) of classical number theory. The best known way to show this is by a theorem I found with Chris Cummins."

"But much of my work thus far has occurred near a certain wobbling fence separating math from physics. String theory, or more precisely, conformal field theory (CFT), was created by physicists for their own shady purposes, but its impact has been far greater in math. Five of the twelve Fields medals awarded in the 1990s were to men whose work directly concerned CFT (namely, Drinfeld, Jones, Witten, Borcherds, Kontsevich). I've tried to clarify some of the algebra and number theory in CFT, but mostly I've been working towards the classification of all CFTs related to a class of infinite symmetries called Kac-Moody algebras. These CFTs seem to be the fundamental ones, and their classification is uncovering unexpected (and unexplained!) links with other areas of math. I hope to complete this classification within the next couple years."

"Research for me is something like chasing squirrels. As soon as you spot one and leap towards it, it darts away, zigging and zagging, always just out of reach. If you're a little lucky, you might stick with it long enough to see it climb a tree. You'll never catch the damn squirrel, but it'll lead you to a tree. Chasing squirrels is a way to find trees! In math, the trees are called theorems. The squirrels are those nagging little mysteries we write at the top of many sheets of paper. We never know where our question will take us, but if we stick with it, it'll lead us to a theorem, and to our next paper. That I think is what research in math is like."

"Receiving the PIMS Research Prize has been enormously significant for me personally, and surprisingly humbling. Recognition from our peers is notoriously rare for those of us near the beginnings of our careers, and now I have some expectations other than my own to live up to (yikes!). Validating and supporting research is the biggest role PIMS can play, in my view. The PIMS post-doc program is wonderful, and the plan for an Oberwolfach-style institute is really very exciting. But one thing which is still quite disappointing in western Canada is the intellectual isolation of the universities from each other. For instance, Calgary and Edmonton are only 3 car-hours apart and yet it's exceptionally rare when one of us gives a talk at the other university. I wonder if PIMS could actively encourage more of these grassroots interactions, e.g. by supplying each local PIMS office with funds whose sole purpose is to invite other westerners to give colloquium talks. Maybe this could help build more of a western mathematical sciences community."

The **PIMS Industrial Outreach Prize** recognizes individuals who have employed mathematical analysis in the resolution of problems with direct industrial, economic or social impact. The review panel for this prize was chaired by the MITACS Programme Leader Arvind Gupta (SFU). The other members of the panel were Don Denney (Syncrude, Inc.), Shahid Hussain (Telus Corp.), Murray Margolis (Powerex Corp.), Brian Seymour (UBC) and Rex Westbrook (Univ. of Calgary).

The prize was awarded to **Dr. Huaxiong Huang (York), John Stockie (University of New Brunswick), Keith Promislow (SFU) and Brian Wetton (UBC)**. This team of researchers are part of the PIMS-affiliated Mathematical Modeling and Scientific Computation Group in MITACS. They are working with Ballard Systems, the world leader in hydrogen fuel cell design, to develop models to help Ballard improve the efficiency and durability of fuel cells.

Using parabolic poles, they modeled the reactant gas flow through the Gas Diffusion Electrode (GDE), a layer of porous, conducting material on either side of the catalyst and membrane in the fuel cell. Mathematical analysis of the models highlighted the sensitivity of fuel cell performance to certain GDE parameters, giving insight into the performance of various possible GDE materials.

Appendix A: PIMS Management

Board of Directors

The Board of Directors has final responsibility for all aspects of the PIMS' operation. In particular, the Board ensures fiscal accountability, monitors the operation of the PIMS, and advises the Executive Committee.

Chair of the Board: Dr. Hugh Morris holds a Ph.D in Mining Geology from the University of Witwatersrand, Johannesburg, South Africa and has 44 years of experience in the mineral industry. He is a fellow of the Royal Society of Canada and is Chair of the Society's Canadian Global Change Programme.

From 1962 to 1979 he held a series of positions with Cominco Ltd. in its Exploration and Mining Departments in several Canadian locations, eventually becoming Director of Exploration for its worldwide activities. In 1979 Dr. Morris became associated with the E & B-Geomex Group of affiliated companies in Calgary, initially as President and Chief Operating Officer of Geomex Minerals Ltd., and in 1981, as President and Chief Executive Officer of E & B Canada Resources Ltd. Following the merger of the E & B-Geomex Group and Imperial Metals Corporation of Vancouver in May 1983, he was appointed Chairman and Chief Executive Officer of Imperial Metals and of three public companies within the Imperial Metals Group. He resigned from these positions in February 1993 to pursue other interests. Currently, he is a mineral industry consultant and board member of six Canadian public companies.

Dr. Morris has demonstrated special interest in national and international scientific and professional associations. He is a member of NSERC's Council, a member of the Standing Finance committee of ICSU, and Chairman of the Board of Directors of the Lithoprobe Project. He is past-president of both the Geoscience Council of Canada and the Geological Association of Canada, and was also Treasurer of the Canadian Geological Foundation from 1987 to 1996. He is a member of the Geological Society of London, the Institute of Mining and Metallurgy, U.K., the Canadian Institute of Mining and Metallurgy, the Association of Professional Engineers of BC and a number of other scientific and professional associations.

Dr. Michael Boorman received his PhD from University of Nottingham in 1964 and is a professor in the Chemistry Department at the University of Calgary. Currently he is the Dean of Science at the University of Calgary. Dr. Boorman's research activities are in *Inorganic Chemistry* and in *Heterogeneous Catalysis.*

Dr. Bruce Clayman received his PhD from Cornell University in 1968. He is currently a professor of Physics at Simon Fraser University as well as the Vice-President Research. His past administrative duties include Dean of Graduate Studies, President of the Canadian Association for Graduate Studies and Acting Dean of Science. He is a member of the Sigma Pi Sigma Physics Honour Society. His research interests include superconductors, impurity states in solids, and layered compounds. He has published over 80 papers in refereed journals and refereed conferences.

Dr. James Delgrande is a Professor of Computing Science at Simon Fraser University and he is the Director of the School of Computing Science. He received his Ph.D. from the University of Toronto in 1985. His research is in formal aspects of knowledge representation in artificial intelligence.

Dr. Don W. Denney received his Ph.D. from the University of Waterloo in 1978 and spent two years as a post-doctoral fellow at the University of Colorado engaged in atmospheric chemistry studies and in developing statistical pattern recognition techniques. He is a Director of PRECARN/IRIS, serving as a Board Chair for 1999/2000.

Dr. Denney is Manager, Information Services at Syncrude Canada-Ltd, providing telecommunications and computing infrastructure for Syncrude's operations in Fort McMurray, Alberta. Dr. Denney spent 10 years at Syncrude Research developing On-line Sensors and applying Pattern Recognition techniques to data analysis. His current interest is information management to support condition-based maintenance programs.

Mr. Kenneth Foxcroft served on the board of Directors of Factors Limited, Toronto Dominion Securities

(USA) Inc., and of the Ontario Securities Advisory Commission. He has also held the positions of Chairman for Commodity Futures and President for the Forex Association of Canada. Presently, Mr. Foxcroft is the Deputy Chairman & Chief Trading Officer for TD Securities Inc.

Dr. Nassif Ghoussoub is a Professor of Mathematics at the University of British Columbia. He did his undergraduate degree at the Lebanese University in Beirut and obtained his Doctorat détat in 1979 from the Universié Pierre et Marie Curie in Paris. He is a fellow of the Royal Society of Canada and is the current Director of the Pacific Institute for the Mathematical Sciences. His present research interests are in non-linear analysis and partial differential equations.

He was the recipient of the Coxeter-James prize in 1990 and of a Killam senior fellowship in 1992. He was chair of NSERC's grant selection committee for mathematics in 1995-1996 and vice-president of the Canadian Mathematical Society from 1994 to 1996. He is on the editorial board of various international journals and is currently the co-Editor-in-Chief of the Canadian Journal of Mathematics.

Dr. Maria Klawe is currently the Dean of Science at the University of British Columbia, having served as Head of the Department of Computer Science from 1988 to 1995 and Vice-President of Student & Academic Services from 1995 to 1998. Her responsibilities as the Dean of Science are the leadership of the Faculty of Science. Dr. Klawe also holds the NSERC-IBM Chair for Women in Science and Engineering, one of five regional chairs across Canada. Dr. Klawe's chair is responsible for British Columbia and the Yukon, and emphasizes increasing the participation of women in information technology careers.

Prior to joining UBC, Dr. Klawe spent eight years with IBM Research in California, and two years at the University of Toronto. She received her Ph.D. (1977) and B.Sc. (1973) in Mathematics from the University of Alberta. She has made significant research contributions in several areas of mathematics and computer science including functional analysis, discrete mathematics, theoretical computer science, and interactive-multimedia for mathematics education. She is the founder and director of the Electronic Games for Education in Math and Science (E-GEMS) project, a large-scale collaborative project involving computer scientists, mathematics educators, teachers, children and professional game developers. She has also served on many boards and advisory councils, including the Board of Trustees of the American Mathematical Society (chair 1995-96), the Computing Research Association (vice-chair 93-95), and the BC Premier's Advisory Council on Science and Technology (93-present). Dr. Klawe was elected as a Fellow of the Association of Computing Machinery in 1995, and received the Vancouver YWCA Women of Distinction Award in Science and Technology in 1997.

Dr. Prabha Kundur holds a Ph.D in Electrical Engineering from the University of Toronto and has over 30 years of experience in the electric power industry. He is currently the President and CEO of Powertech Labs Inc., the research and technology subsidiary of BC Hydro. Prior to joining Powertech in 1993, he worked at Ontario Hydro for 25 years and was involved in the planning, design and operation of power systems.

He has served as Adjunct Professor at the University of Toronto since 1979 and at the University of British Columbia since 1994. He is the author of the book *Power System Stability and Control* (McGraw-Hill, 1994), which is the standard modern reference for the subject. He has performed extensive international consulting and has delivered technical courses for utilities and universities around the world.

Dr. Kundur is a Fellow of the Institute of Electrical and Electronic Engineers (IEEE). He is also very active in the Conference Internationale des Grands Reseaux Electriques (CIGRE). He is the recipient of the 1997 IEEE Nikola Tesla Award and the 1999 CIGRE Technical Committee Award.

Dr. Peter Lancaster is a Professor Emeritus and Faculty Professor in the Department of Mathematics and Statistics of the University of Calgary. He has doctoral degrees from from the University of Singapore and the University of Liverpool, England, as well as five years experience in the aircraft industry in the 1950's. He came to Canada in 1962 and was elected to the Royal Society of Canada in 1984. His research interests are in matrix and numerical analysis especially as applied to vibrations, systems theory, and signal processing. He is the author or co-author of several texts and monographs and serves on a number of editorial boards. He has completed terms as Vice-President and as President of the Canadian Mathematical Society, and as Vice-President of the Canadian Applied Mathematics Society. He has also served (or is serving) on numerous committees of NSERC and the Royal Society of Canada.

Dr. Barry McBride is the Vice-President Academic and Provost of the UBC since 1999. He received his Ph.D. from the University of Illinois (Urbana) in 1970. He was the Dean of Science at the University of British Columbia from 1990 to 1999, Department Head of the Microbiology Department at UBC from 1986 to 1989 and Department Head of the Oral Biology Department at UBC from 1981 to 1986. He has consulted with Cominco, Energy Mines and Resources Canada, the National Institute of Health, USA and Ventures West. He is a member of many Professional Committees including the Medical Research Council (where he is also on the Executive Committee), the Standing Committee on Manpower (MRC), Scientific Advisory Council - Alberta Council - Alberta Heritage Foundation for Medical Research and the Canadian Institute for Advanced Research - Research Advisory Council. His major area of research is in ecology and pathogensis of the microbial flora of man with specific reference to pathogens of the mouth.

Dr. Edwin Perkins is Professor of Mathematics at the University of British Columbia where he was first appointed as a postdoctoral fellow in 1979. He did is his undergraduate degree at U. of Toronto and obtained his doctoral degree from the U. of Illinois. His research interests in probability include the general theory of processes, Brownian motion, stochastic differential equations and partial differential equations, interacting particle systems, measure-valued diffusions and stochastic models in population genetics. He has won numerous awards for his research including the Coxeter-James Lectureship (1986) and G. de B. Robinson Award (1996) (Canadian Math. Society), the Rollo Davidson Prize (1983) (Cambridge U.) and a Steacie Fellowship (1992-93) (NSERC). He is a Fellow of the Royal Society of Canada and currently sits on the Academy of Science Council. He is presently on the editorial boards of the Canadian J. of Mathematics, the Annals of Applied Probability, the Annales de l'Institute Henri Poincaré, and Probability Theory and Related Fields. He has given several invited lectureships including an invited address at the 1994 International Congress of Mathematicians in Zurich.

Dr. Richard E. Peter received a B.Sc. in Biology from the Univ. of Calgary in 1965 and a Ph.D. from the Univ. of Washington in 1969. Following postdoctoral research in Pharmacology at the University of Bristol, he took up an appointment in the Department of Zoology, University of Alberta, in 1971. Promoted to Professor in 1979, he served as Chairman of Zoology from 1983-1992, and became Dean of Science in 1992. His research is on the brain regulation of reproduction and growth in fish, an area in which he has over 260 publications. Dr. Peter has received numerous honours and awards, including the E.W.R. Steacie Memorial Fellowship in 1980, election as a Fellow of the Royal Society of Canada in 1985 and the Pickford Medal for outstanding contributions to comparative endocrinology. A kit to induce spawning of farmed fish, based on his research, is marketed as OVAPRIM by Syndel Laboratories Ltd., Vancouver.

Dr. Martin Taylor has a BA in Geography from the University of Bristol (UK), and an MA and PhD from the University of British Columbia. He was appointed at McMaster in 1974. He was Chair of Geography (1991-1997), founding Director of the Institute of Environment and Health (1991-96), and Acting Vice-President Research (1994-95). His research and teaching interests focus on environmental health and health promotion issues. His ongoing projects include research on the psychosocial effects of environmental contamination and on community-based heart health promotion. He has authored one book and over 100 papers in peer-reviewed journals. He moved to UVic in July 1998 to be the University's first Vice-President Research as well as being a full professor in the Geography Department.

The *Steering Committee* of the Board consists of D. Peter (Chair), J. Delgrande, N. Ghoussoub, P. Lancaster, M. Taylor and E. Perkins.

PIMS Board member and Provost & VP Academic of UBC, Dr. Barry McBride

Scientific Review Panel

The Scientific Review Panel is responsible for:

- The review and selection of scientific programmes and determination of their funding levels
- The selection of PIMS Distinguished Chairs and *The PIMS Research Prize.*
- Provide advice on long-term scientific planning for PIMS.

Nassif Ghoussoub, Director of PIMS, serves as the chair of the Scientific Review Panel. Members of the Panel include the following:

David Boyd received his Ph.D. in Mathematics from the University of Toronto in 1966. At that time he worked in harmonic analysis and in particular interpolation theory for rearrangement invariant spaces. Subsequently his work shifted into number theory, particularly the theory of Pisot and Salem numbers and Mahler's measure. He is particularly interested in the role of computation in pure mathematics. After his Ph.D., he spent a year at the University of Alberta, then moved to the California Institute of Technology where he spent the next four years, and finally moving to the University of British Columbia where he has been a Professor of Mathematics since 1974. He was awarded the 1978 E.W.R. Steacie Prize in Science for his work on Pisot sequences and Salem numbers. He was the Canadian Mathematical Society's Coxeter-James lecturer for 1979 and was elected to the Royal Society of Canada in 1980.

David Brillinger is a researcher in the area of time series, which involves him in the analysis of random processes in the biological and physical sciences. He has made contributions to the theory and application of statistical methods in subject areas including neurophysiology (the analysis of neural spike trains), seismology, and demography. He is the author of Time Series Analysis: Data Analysis and Theory, former editor of the International Statistical Review, and current President of the Institute of Mathematical Statistics. He is a member of the American Academy of Arts and Sciences and is a Fellow of the Royal Society of Canada.

Richard Ewing is Dean of the College of Science and Professor of Mathematics and Engineering at Texas A & M University. He also is Director of the Institute for Scientific Computation and the Academy for Advanced Telecommunications & Learning Technologies at Texas A & M. Prof. Ewing is an expert in scientific computation. His recent research deals with the multitude of problems that arise from numerical simulation and modeling of multiphase flow and transport in porous media as applied to ground water contaminants and reservoir modeling. He has an extensive background in consulting/advising with the public and private sector especially the petroleum industry.

Ronald Graham is currently Chief Scientist of AT&T Research. He was President of the American Mathematical Society from 1993-95. His other current obligations include: membership of the Scientific Advisory Committee of the Santa Fe Institute, of the National Research Council, Mathematical Sciences Education Board, and of the Joint Policy Board on Mathematics. He is Treasurer of the National Academy of Sciences (1996-2000). Dr. Graham's academic awards include: Membership in the National Academy of Sciences and Fellowships in the American Academy of Arts & Sciences, the New York Academy of Sciences, and the American Association for the Advancement of Science. He was the Scientist of the Year, World Book Encyclopedia in 1981, and won the Polya Prize in Combinatorics in 1972, the Carl Allendorfer Award of the Math. Assoc. of America in 1990, a Lester Ford Award of the Math. Assoc. of America, in 1991, and the Euler Medal of the Institute of Combinatorics in 1994. Ron Graham's current mathematical interests include combinatorics, number theory, graph theory, discrete and computational geometry, theoretical computer science, and applications thereof. In all of these areas he has made fundamental contributions. He is also a very gifted juggler.

Richard M. Karp was born in Boston, Massachusetts in 1935 and was educated at the Boston Latin School and Harvard University, where he received his Ph.D. in Applied Mathematics in 1959. From 1959 to 1968 he was a member of the Mathematical Sciences Department at the IBM Thomas J. Watson Research Center. From 1968 to 1994 he was a professor at the University of California, Berkeley. From 1988 to 1995 he was also associated with the International Computer Science Institute in Berkeley. In 1994 he retired from Berkeley and was named University Professor (Emeritus). In 1995 he moved to the University of Washington, where he has appointments in Computer Science and Molecular Biotechnology. The unifying theme in Karp's work has been the study of combinatorial algorithms. His 1972 paper "Reducibility Among Combinatorial Problems," demonstrated the wide applicability of the concept of NP-completeness. Much of his subsequent work has concerned the development of parallel algorithms, the probabilistic analysis of combinatorial optimization problems, and the construction of randomized algorithms for combinatorial problems. His current research is concerned with strategies for sequencing the human genome. Karp has received the U.S. National Medal of Science,Turing Award (ACM), the Fulkerson Prize (AMS and Math. Programming Society), the von Neumann Theory Prize (ORSA-TIMS), the Lanchester Prize (ORSA) the von Neumann Lectureship (SIAM) and the Distinguished Teaching Award (Berkeley). He is a member of the National Academy of Sciences and the National Academy of Engineering, and holds four

honorary degrees.

Alistair Lachlan obtained his Ph.D. from the University of Cambridge in 1964 and is currently a Professor of Mathematics at Simon Fraser University. Prof. Lachlan was elected as a Fellow of the Royal Society of Canada in 1974. He has served as the Vice-President of the Canadian Mathematical Society (1985–1987), was a member of the NSERC math GSC (1984–1987), was a member of the selection panel for speakers in Mathematical Logic at the 1990 ICM, and served on the steering committee for the CRM (1991–1995). He is and has been an editor for a number of journals including annals of pure and applied logic and the lecture notes in logic.

Bernard J. Matkowsky presently holds the John Evans Chair in Applied Mathematics at Northwestern University. He received his Ph.D. from New York University in 1966. He was at Rensselaer Polytechnic Institute until 1978 and has been at Northwestern University since then. He is the editor of 7 journals (SIAM J. Appl. Math., European J. Appl. Math., Int'l. J. Wave Motion, Random and Computational Dynamics, J. Materials Synthesis and Processing, Int'l. J. SHS, Applied Math. Letters) and one book series (Springer Appl. Math. Sci. series). His honors include being a Fulbright-Hayes Fellow in 1972-1973 and a Guggenheim Fellow in 1982-1983. His research areas include asymptotic and perturbation methods for ordinary and partial differential equations, nonlinear stability and bifurcation theory, stochastic differential equations, and applications to fluid dynamics, elasticity, combustion, flame propagation, and solid state physics.

Robert V. Moody is Professor of Mathematics at the University of Alberta. He received his Ph.D. from the University of Toronto in 1966 and spent most of his academic career at the University of Saskatchewan before coming to Alberta in 1989. He is best known for the discovery, independently with V. Kac, and subsequent investigations of the Kac-Moody Algebras, for which he was awarded the 1994-1996 Eugene Wigner Medal jointly with Kac. He has presented both the Coxeter-James Prize Lecture (1978) and the Jeffrey-Williams Prize Lecture (1995) to the Canadian Mathematical Society. He has served nationally on the Scientific Advisory Boards of both the Centre de Recherches de Mathematique and the Fields Institute for Research in the Mathematical Sciences, and on the Council of the Academy of Science, Royal Society of Canada.

Nicholas Pippenger received his Ph.D. from MIT in Electrical Engineering in 1974. Prior to joining UBC Computer Science department as a professor in 1988, he was a staff member at IBM for sixteen years and at Draper Laboratories for three years. For his last two years at IBM he was an IBM Fellow. His other distinctions include a 1991 UBC Killam Research Prize, a 1983 IBM Outstanding Technical Achievement Award, and a 1981 IBM Outstanding Innovation Award. He has published over 90 research articles in the theory of computation and communication and discrete mathematics.

Ian F. Putnam received his Ph.D. from the University of California at Berkeley in 1985. He was an NSERC University Research Fellow at Dalhousie University before moving to the University of Victoria where he is currently professor in the Department of Mathematics and Statistics. His research concerns the interactions between topological dynamics and C*-algebras. He has received the Israel Halperin Prize and the Andre Aisenstadt prize. He is a Fellow of the Royal Society of Canada.

Gordon Slade received his Ph.D. from the University of British Columbia, in Mathematics, in 1984. Before joining UBC Mathematics Department as a professor in 1999, he was a professor in the Mathematics department at McMaster University. He was the 1995 Coxeter-James Lecturer of the Canadian Mathematical Society, and was one of five Canadian mathematicians invited to give addresses at the 1994 International Conference of Mathematicians in Zurich. In joint work with T. Hara, he has given a rigorous proof of the long-standing conjecture that percolation (and also other important models in statistical physics) exhibit mean-field behaviour in high dimensions.

Gang Tian received his Ph.D. from Harvard University in 1988. After positions at Princeton University and the State University of New York at Stony Brook, he went to the Courant Institute of Mathematical Sciences at New York University in 1991 as full professor. He is currently a professor in Massachusetts Institute of Technology. Prof. Tian is a recipient of the Alfred P. Sloan research fellowship (1991-1993). He presented a 45-minutes invited address at the International Congress of Mathematicians in Kyoto in 1990 and the Bergmann Memorial Lecture at Stanford University in 1994. The same year, he received the 19th Alan Waterman Award from the National Science Foundation. In 1996, Prof. Gang Tian received the Veblen Prize of the American Mathematical Society.

Executive Committee

The Executive Committee consists of the Director, the five Site Directors, and other members appointed by the Board as required. The Executive is responsible for the day to day management of the PIMS as delegated by the Board.

Director: Nassif Ghoussoub, (UBC, Math)
SFU Site-Dir.: Bob Russell (SFU, Math)
UVic Site-Dir.: Florin Diacu (UVic, Math)
UBC Site-Dir.: Dale Rolfsen (UBC, Math)
UC Site-Dir.: Michael Lamoureux (UC, Math)
UA Site-Dir.: Bryant Moodie (UA, Math)

Education and Communication

Education Facilitator: Klaus Hoechsmann (UBC)

Local Committees

The Local Coordinator for each site is indicated by an asterisk.

University of Victoria:
Kelly Choo
David Leeming*
Bill Pfaffenberger

University of BC:
Andrew Adler*
Phillip Loewen
Edwin Perkins

Simon Fraser University:
Malgorzata Dubiel*
Loki Jorgenson
Rina Zaskis

University of Alberta:
Hans Brungs
Ted Lewis*
Andrew Liu

University of Calgary:
Claude Laflamme
Indy Lagu*

National Programme Committee of the Canadian Mathematical Sciences Institutes

The three Canadian Institutes in the Mathematical Sciences CRM, Fields and PIMS have initiated a new programme for the support of joint activities in the mathematical sciences. This programme is administered by a National Programme Committee, which makes recommendations to the Directors of the three institutes.
The 2000/01 committee consists of:

Chair: Bradd Hart (Deputy Director of the Fields Institute)
Michael Lamoureux (Deputy Director of PIMS)
Jacques Belair (Deputy Director of CRM)
Martin Barlow (Mathematics, UBC)
Niky Kamran (Mathematics, McGill)
David Sankoff (CRM)

Appendix B: Financial Report

The PIMS fiscal year runs from April 1, 2000 to March 31, 2001. In this section we outline the PIMS budget for this fiscal year. PIMS has supported its activities on base funding from:

- The six participating PIMS institutions (SFU, U. of Alberta, UBC, U. of Calgary, U. of Victoria, U. Washington) and the affiliated Institutions (U. of Lethbridge and U. of Northern British Columbia).
- The Government of Canada through the Natural Sciences and Engineering Research Council.
- The Government of Alberta through the Alberta Ministry of Innovation and Science.
- The Government of British Columbia through the Science and Information Technology Agency

PIMS also received substantial contributions from 52 industrial partners for its industrial programs as well as for the PIMS-affiliated MITACS industrial collaborative research projects.

Income for 2000–2001

Each founding university makes an annual cash contribution equivalent to one full time faculty position at the respective university. Also, scientific personnel are released under the PIMS research fellowship programme to provide the scientific leadership in the institute. PIMS is only required to make up the course buy-out for these individuals. The universities also make considerable in-kind contributions through office space at the five campuses and computer labs.

SFU: SFU made an annual cash contribution of $75,000. In-kind support in the form of a 4000 square feet research facility is estimated at $150,000 per annum.

UA: The University of Alberta made an annual cash contribution of $70,000. In-kind support of offices totals $60,000.

UBC: The University of British Columbia made an annual cash contribution of $115,000. In-kind support in the form of a 4800 square feet research facility is estimated at $150,000 per annum. As well, the university maintains PIMS financial accounts at an estimated in-kind annual cost of $30,000.

UC: The University of Calgary made an annual cash contribution of $61,000 and released the Deputy Director half-time. In-kind support of offices totals $60,000.

UVic: The University of Victoria makes an annual cash contribution of $60,000. In-kind support of offices totals $60,000.

UW: The University of Washington made an annual cash contribution of $74,446 ($50,000 US) and an in-kind contribution of $25,000 in administrative support.

ULeth: The University of Lethbridge, as an affiliate university of PIMS, makes annual cash contributions of $5,000.

UNBC: The University of Northern British Columbia, as an affiliate university of PIMS, makes annual cash contributions of $5,000.

MITACS contributions are for the administrative and infrastructural support of the PIMS-affiliated projects, for networking activities as well as for theme meetings and related scientific workshops.

PIMS Total Income
April 1,2000– March 31, 2001

Source	Carry forward	Income 00/01	Operating Funds	In–kind Support
NSERC	83536	630000	713536	
BC (ISTA)	23312	197500	220812	
BC (NCE)	29612	100000	129612	
Alberta (ASRA	19942	200000	219942	
Universities	83911	0	83911	
SFU.		75000	75000	150000
U Alberta		70000	70000	60000
UBC		115000	115000	180000
U Calgary		61000	61000	60000
U Victoria		60000	60000	60000
U Lethbridge		5000	5000	
UNBC		5000	5000	
U.Washington		74446	74446	25000
MITACS	32000	197000	229000	
Other	55650	53934	109584	
Total	**327,963**	**1,843,880**	**2,171,843**	**535,000**

Total Operating funds	**2,171,843**
Reserve fund	**50,000**
Industrial Funds Received (PIMS+MITACS)	**1,172,336**

Total Cash Received	**3,394,179**
Total In–Kind Support	**535,000**

Industrial funding

PIMS receives substantial industrial funding in support of its programs: The PIMS prizes, its various industrial workshops as well as its industrial postdoctoral fellows. It also manages the industrial funds provided by various companies to the 11 MITACS collaborative projects associated with PIMS. (See list below)

PIMS/MITACS Industrial Funds

	Company	Before.March.00	Since.April.00	Total
Project 1	IBM	30,000	–	30,000
	MDSI	25,000	–	25,000
	StemSoft	19,500	15,000	34,500
Project 2	Quatronix	15,000	–	15,000
	Soundlogic	25,000	–	25,000
	Webdispatchers.com	–	25,000	25,000
Project 3	Waterloo Maple	85,000	18,750	103,750
	Workfire Development Corp.	–	20,000	20,000
Project 4	FinancialCAD	22,500	53,000	75,500
	Powerex	25,000	37,000	62,000
	TransAlta	19,000	23,000	42,000
Project 5	CREWES	–	10,000	10,000
	Imperial Oil	–	15,000	15,000
Project 6	NORTEL	120,000	–	120,000
Project 7	Kinetek	15,000	–	15,000
	SmithKline Beecham	10,000	150,000	160,000
	In Silico	38,013	39,543	77,556
	StemCell	5,000	–	5,000
	Bayer	10,000	–	10,000
Project 8	VisionSmart	7,473	–	7,473
	Lockheed Martin	–	98,789	98,789
	Acoustic Positioning Research	–	16,000	16,000
Project 9	Canadian Airline	43,500	43,500	87,000
	BCTEL	43,500	–	43,500
	Telus	–	43,500	43,500
	Workers' Compensation Board	43,500	43,500	87,000
	Vancouver International Airport		30,000	30,000
Project 10	Powertech	20,000	–	20,000
	Ballard Power System Inc.	93,000	273,000	366,000
Project 11	Organon Canada	–	20,000	20,000
	Starlab	–	8,141	8,141
	Kinetana	–	27,400	27,400
	National Institute of Health	–	5,941	5,941
Project 12	Monsanto Company	2,920	–	2,920
	Merak	2,000	–	2,000
	Charles Howard & Associates	1,000	–	1,000
Project 13	Imperial Oil	–	4,000	4,000
	McMillam–McGee	–	2,000	2,000
	Michelin	–	2,889	2,889
	Stern Stewart & Co.	–	2,889	2,889
Project 14	Toronto Dominion	–	20,000	20,000
Project 15	MathSoft	–	20,000	20,000
Project 16	Vortek	–	10,000	10,000
Project 17	Schlumberger	–	34,000	34,000
Project 18	Firebird semiconductors	–	2,000	2,000
	Algorithmics	–	2,000	2,000
	IBM	–	2,000	2,000
	Microsoft	–	2,890	2,890
	Dept.of.defense	–	2,000	2,000
	AEC Oil and Gas	–	2,000	2,000
Project 19	Perimeter	–	5,000	5,000
Project 20	Insightful (*)	–	20,000	20,000
Project 21	Nortel/StatCar	–	12,604	12,604
Project 22	Galdos Systems (*)	–	10,000	10,000
	Total	**720,906**	**1,172,336**	**1,893,242**

Other Contributions

In the table above, we have only outlined the operating budget of PIMS. However, this tells only a part of the story since it does not describe the contributions to PIMS scientists and events that did not flow through the PIMS central accounts. Here is a brief description of such indirect contributions.

University Infrastructure: PIMS has offices at all five campuses. Computational facilities and some administration is also provided. The PIMS central office at UBC uses a 4,800 sq.ft research facility that accommodates up to 40 researchers at a time, as well as a scientific computing Lab and a reading room for about 20 researchers. Similarly, SFU has provided PIMS 4,000 sq.ft. of office space that allows up to 20 scientists to be accommodated.

BC/NCE Infrastructure Support: This amounts to over $180,000 in infrastructure support for the PIMS and MITACS research facilities at the University of British Columbia and Simon Fraser University. These funds are made available through offices of the Vice-president Research at UBC and SFU to match and support the federally funded NCE activities.

Additional support for Industrial PDFs: Much of the industrial support mentioned in the table above goes to the PIMS-affiliated MITACS industrial collaborative projects. In addition, the PIMS contributions to the industrial postdoctoral fellows ($15K-20K each) have essentially been matched (on a 1 to 1 basis) by the corresponding industrial partners.

Additional support for Scientific PDFs: The PIMS contributions to the other 22 postdoctoral fellows ($18,000 each) have essentially been matched (on a 1 to 1 basis) by research grants from their supervisors and by stipends for teaching from their associated departments.

Conference support: Most conferences have also been supported by registration fees and have sometimes been co-sponsored by other organizations.

Corporate support: This has materialized through contributions towards official receptions and banquets connected to the scientific events.

Industrial support: The *Problem Solving Workshop*, the *Workshop on computer security*, the *workshop on coding theory and cryptography* (among others) have also been partially supported by direct and indirect contributions from the industrial participants.

Education support: Most educational events have been also co-sponsored by schools, provincial ministries of education and professional societies.

Summary of Expenditures – PIMS 2000/01

Expense Category	*Budget*	*Expenses*	***Balance***
Site Offices	196270	192295	3975
Central Office Admin.	278000	300564	–22564
Scientific Personnel	221000	195674	25326
Special Events	65000	74747	–9747
Industrial Outreach (*)	447000	359503	87497
Educ. Programs	166900	139087	27813
Scientific Activities	351677	330609	21068
PIMS Post–doc fellows (**)	406000	364750	41250
Total Expenses	**2,131,847**	**1,957,228**	**174,619**

(*) Figures do not include industrial funds nor MITACS projects

(**) Figures do not include industrial postdocs nor matching funds

Source	*Income*	*Budget*	*Expenses*	*Carry–forward*
NSERC	713536	698500	637031	76505
ISTA	220812	251000	198670	22142
BC–NCE	129612	135000	129612	0
ASRA	219942	236400	219359	583
Universities	549357	534270	532194	17163
MITACS	229000	218500	199072	29928
Other	109584	58177	41290	68295
Total Expenses	**2,171,843**	**2,131,847**	**1,957,228**	**214,615**

Pacific Institute for the Mathematical Sciences is sponsored by:

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The Alberta Ministry of Innovation and Science
The British Columbia Information, Science and Technology Agency
Simon Fraser University
University of Alberta
University of British Columbia
University of Calgary
University of Victoria
University of Washington
University of Lethbridge
University of Northern British Columbia

PIMS at the University of British Columbia.

PIMS at Simon Fraser University.

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