

Pacific Institute
for the Mathematical Sciences

Institute Report 2001/02



University of British Columbia from the air.

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 programmes, 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 University, University of Alberta, University of British Columbia, University of Calgary, University of Victoria, University of Washington) and affiliated Institutions (University of Lethbridge and University 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.

My association with the Pacific Institute for the Mathematical Sciences (PIMS) continues to be an exciting and rewarding experience. I am as fascinated by the energy, the vitality and the pace that the mathematical scientists of PIMS are

putting into their task as I was when I became Chair of the PIMS Board of Directors back in 1998.

The reallocation results of NSERC echo my faith in PIMS as one of the most innovative and promising research institutes in the mathematical sciences.

The opening of the Banff International Research Station (BIRS) is just weeks away. BIRS is destined to provide a tremendous boost for research in the mathematical sciences all over the world, and it will be exciting to see BIRS actually open its doors after all the hard work.

This annual report represents a compendium of the various activities and programmes organized and

supported by PIMS during 2001–02, 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 the Industrial Problem Solving Workshop and the Graduate Industrial Mathematics Modelling Camp continued the highly successful format of previous years.

This year PIMS has continued its involvement in mathematics education, π in the *Sky* magazine is now distributed to more schools, and as you will see there are many education activities taking place in British Columbia and Alberta. PIMS is certainly doing a lot to reveal to students of all levels how much fun mathematics can be.

The development of the PIMS Collaborative Research Groups is something to truly be proud of. I look forward to seeing what these multi-university groups of mathematical scientists achieve in 2003.

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

Director's Notes

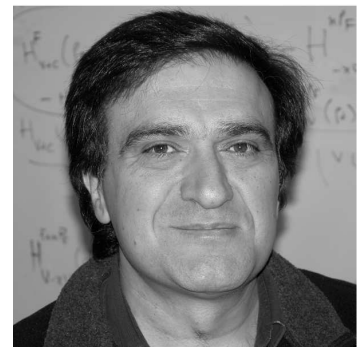
Nassif Ghoussoub, FRSC

NSERC's reallocations results are out and PIMS and the Canadian mathematical community have every reason to be proud of the accomplishments of the last 5 years. The site visit report had much to say about the institute's contributions: "*PIMS activities have broken through discipline and geographical boundaries*". They echoed the referees comments: "*PIMS has become in a very short time a model for the research institute of the twenty first century*" and "*PIMS has moved from an "idea" to a leading international institute*". One anonymous referee wrote about the international leadership shown by the Canadian mathematical community adding: "*Here, PIMS seems to be in the driver's seat with incredible results for the world's mathematical community*". Another referee concurred: "*Although [PIMS] is the youngest of the three, I believe that its reputation is rapidly on the rise, so I find the incremental funding which is requested in the PIMS proposal to be compelling. I believe that the leadership of PIMS is energetic and creative, and PIMS is perhaps the most ambitious of the three Canadian Institutes*".

PIMS: A Model for the Research Institute of the 21st Century

The site visit committee also stated that "*PIMS has been successful at multiplying the opportunities provided by NSERC funds. However, it is also particularly underfunded compared to the other two institutes.*" NSERC's reallocations committee agreed by awarding PIMS a 60% increase in its budget. Each one of the 3 Institutes (PIMS, Fields and CRM) will receive a grant of approximately \$1 million/year for the period 2003–07. In addition, a joint proposal of

the 3 institutes with the Statistics Grant Selection Committee (GSC 14) for a 4-year "National Programme on Complex Data Structures" has also been funded at the rate of \$172K/year.



Nassif Ghoussoub, Director of PIMS

NSERC Increases its Funding for the Mathematics Grant Selection Committees

The synergies between the math community and the institutes have again played a major role, even as the institutes carry on with their outreach efforts to other disciplines. Indeed, mathematics is one of only six submissions (out of 19 GSCs) that ended up with a budget increase: A major change from the dynamic of the first NSERC re-allocation exercise in 1994.

The reallocations committee first recognized the importance of increased funding to new applicants by returning \$805K/year to the GSC 336/337. In addition, the committee allocated \$270K/year to promote structured initiatives by recognized leaders. Indeed, this innovative approach was well received by the Committee which noted that "*initiatives that are built around a leader have been a recognized model for success in mathematics and other disciplines. The institutes are also using this model quite extensively*".

All are encouraged to take a look at the NSERC webpage, www.nserc.ca, so as to be aware of the new opportunities created by this result. Congratulations to all involved, especially to Richard Kane and Robert V. Moody who led this year's exercise for mathematics with exemplary judgment, skill, and patience.

Referees' Unanimity on the Banff International Research Station (BIRS)

BIRS has been referred to as a major coup for the Canadian community. The annual budget of BIRS is about \$2M (\$500K from each of NSF, ASRA, and NSERC's MFA program; \$100K from MITACS and \$400K from PIMS). In addition \$1.1M have finally been secured to renovate and upgrade the facilities (\$300K from the PIMS universities and \$800K from the Alberta government). We are looking forward to an outstanding inaugural programme for 2003 and we anticipate that our recently approved 2004 programme will be of an equally high calibre. Many thanks to Robert V. Moody for the incredible amount of work and energy he is investing to help set up this great continental resource.

The MITACS Network up for Renewal

The MITACS Network of Centres of Excellence developed by the 3 institutes has been a great boost to the applied and industrial mathematical science community in Canada. It has continued to thrive under the capable hands and entrepreneurial spirit of Arvind Gupta. The \$14.4M grant (given for the period 1999/03) is up for renewal next year. We invite the math. science research community to join the institutes in vigourously preparing for a successful renewal of MITACS.

Supporting Atlantic Canada and the Completion of the National Network for Collaboration in the Mathematical Sciences (NNCMS)

The directors of CRM, Fields and PIMS have just finished a tour of universities in Atlantic Canada, for the

purpose of completing the National Network for Research in the Mathematical Sciences (A first attempt at an NSERC's RPP research network had failed in 1997!). The 3 institutes funding for AARMS (Atlantic Association for Research in the Mathematical Sciences) has been matched by the Memorial University of Newfoundland in St. John's, the University of Nova Scotia at Dalhousie and the University of New Brunswick at Fredericton. In addition, MITACS has committed substantial funds for seed projects subject to appropriate matching from the provincial governments and local industries. The \$600K/year package should provide a great boost to Atlantic Canada research in the mathematical sciences. Here Hermann Brunner is to be heartily congratulated for his efforts and leadership.

The National Programme Committee to be Restructured

The National Programme Committee of the 3 institutes will be restructured soon so that it can effectively deal with the developing picture across the country. Every active Canadian researcher should/will have access to the infrastructural resources and to the research opportunities, new and old.

Search for a New Director

Though my mandate as director ends on June 30, 2004, I have recommended that the Board launches a search for a new director. The PIMS organization is complex and by now quite extensive, hence the need for time to select the next leadership and to insure a smooth transition. I am hoping that the new director can take over sometime between the summer of 2003 and June 2004.

It has been a great ride!

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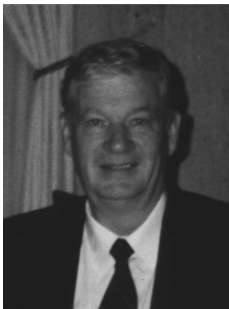
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PIMS PERSONNEL

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.



Hugh Morris

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 Chair-

man 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, UK, 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 Ph.D. 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*.



Michael Boorman

Mr. Robert Chase has been a businessman for thirty years. He is a graduate of the University of Manitoba and a Chartered Accountant. From 1979-1994, Mr. Chase was associated with the Westar Group where he was Senior Vice-President, Finance and Chief Financial Officer from 1989-1994. He has been President and Chief Executive Officer of Lexacal Investment Corp. since 1995 and Chief Financial Officer of Biometric Identification from 1999 until it merged with BioScript. In 2000, Mr. Chase became President of Safeguard BioMetric Corp., the predecessor of Devon. Mr. Chase also serves on the board of other public companies.



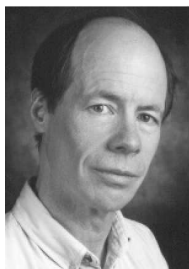
Robert Chase



Bruce Clayman

Dr. Bruce Clayman received his Ph.D. 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.



James Delgrande



Don Denney

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.

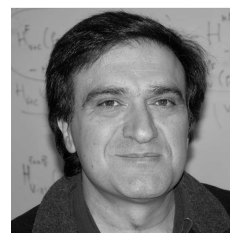
Dr. Denney spent 10 years at Syncrude Research developing On-line Sensors and applying Pattern Recognition techniques to data analysis. He is currently Manager of Advanced Control Alliance at Syncrude Canada Ltd.

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.



Ken Foxcroft

Dr. Nassif Ghoussoub obtained his Doctorat d'état in 1979 from the Université Pierre et Marie Curie in Paris, France and is currently a Professor of Mathematics at the University of British Columbia. His present research interests are in non-linear analysis, optimization and partial differential equations. He was the recipient of the Coxeter-James prize in 1990, of a Killam senior fellowship in 1992 and has been a fellow of the Royal Society of Canada since 1993.



Nassif Ghoussoub

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 was Editor-in-Chief of the Canadian Journal of Mathematics from 1993 to 2002 and is currently on the editorial board of various international journals.

He is the founder Director of PIMS since 1996. He is a founding member of the Board of Directors of MITACS since 1998. He is also the founding Chair of the executive committee of BIRS since 2001.

Dr. Gary Kachanoski has been the Vice-President (Research) and Professor (Department of Renewable Resources) at the University of Alberta since August 2001. From 1996–2001 he was Dean, College of Graduate Studies and Research, and Professor at the University of Saskatchewan. He received



Gary Kachanoski

his B.Sc. (honors Biology 1976) and M.Sc. (Soil Science 1980) from the University of Saskatchewan, and his Ph.D. (Soil Physics 1984) from the University of California, Davis. At the University of Saskatchewan he was also appointed Dean, Virtual College of Biotechnology, a university wide initiative to coordinate teaching and research in the social, ethical, legal, commercial, and science issues related to biotechnology. From 1985 to 1996 Gary was at the University of Guelph, finishing his appointment there as Chair, Department of Land Resource Science, and Director of Research (Environment and Natural Resources) in the Vice-President (Research) Office. At Guelph he had significant involvement in the planning, coordination, and transfer of research and technology to industry, government, user groups, and the general public. He was awarded the Distinguished Faculty Extension and Service Award for his work in this area.



Prabha Kundur

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. Barry McBride has been the Vice-President Academic and Provost of UBC since 1999. He received his Ph.D. from the University of Illinois (Urbana) in 1970. He was the Dean of Science at UBC (1990–1999), Head of the Microbiology Department at UBC (1986–1989) and Head of the Oral Biology Department at UBC (1981–1986). 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 pathogenesis of the microbial flora of man with specific reference to pathogens of the mouth.



Barry McBride

Dr. Edwin Perkins is Professor of Mathematics at UBC where he was first appointed as a postdoctoral fellow in 1979. He did his undergraduate degree at U. Toronto and obtained his doctoral degree from the U. 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) (CMS), the Rollo Davidson Prize (1983) (Cambridge) 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'Institut 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.



Edwin Perkins



Indira Samarasekera

Dr. Indira Samarasekera, Vice President Research UBC, has been a Professor in the Department of Metals and Materials Engineering and the Centre for Metallurgical Process Engineering at UBC since 1980. She obtained a Ph.D. degree at UBC in 1980. Dr. Samarasekera was the first incumbent of the Dofasco Chair in Advanced Steel Processing at UBC and has received the Killam Prize and the McDowell Medal from UBC for research excellence. In 1991 she was awarded an E.W.R. Steacie Fellowship by the Natural Sciences and Engineering Research Council of Canada and the B.C. Science Council Award for New Frontiers in Research in 1997. She is a Fellow of the Royal Society of Canada, of the Canadian Academy of Engineering and of CIMM. In 2002 she was appointed an Officer of the Order of Canada. Dr. Samarasekera currently serves on the Board of Directors of Discovery Parks Inc., The Michael Smith Foundation for Health Research, Genome British Columbia and the Provincial Health Services Authority.



Dennis Salahub

Dr. Dennis R. Salahub assumed the position of Vice-President (Research) at the University of Calgary on July 1, 2002. He was the Director General of the Steacie Institute for Molecular Sciences at the National Research Council of Canada in Ottawa, from 1999 until June, 2002. Prior to this he was a Professor of Chemistry at the Université de Montreal from 1976 to 1999, holding a McConnell Chair from 1990.

A native of Alberta, Dr. Salahub has been interested in theoretical and computational chemistry since his undergraduate days in Edmonton and his doctorate at the Université de Montreal. Following postdoctoral studies at Sussex, Waterloo, Johns Hopkins and the General Electric laboratories in Schenectady, New York, he returned to the Université de Montreal and set up an internationally recognized research program in quantum chemistry, specializing in the development of Density Functional Theory and its applications in materials and biomolecular modeling. He has published some 250 research papers, four edited books and has delivered more than 300 invited lectures on the na-

tional and international scenes.

Dr. Salahub has served the science and innovation communities on a broad front. He was the Program Leader of the Centers of Excellence in Molecular and Interfacial Dynamics (CEMAID) from 1991 to 1994 and a founding member of the Centre de Recherche en Calcul Appliqué (CERCA) in 1991. He has served on NSERC's Grant Selection Committee and twice on the Reallocation Steering Committee for Chemistry (1997, 2001, Chair). He was the lead applicant for an \$18M Canada Foundation for Innovation grant that brought high-performance computing to Quebec in 1998 and was an early proponent of the c3.ca organization which is fostering high-performance computing and networking in Canada. He has been a consultant for industry and the Steacie Institute is currently fostering several incubation and spin-off companies.

At the Steacie Institute, Dr. Salahub shaped research thrusts in nanoscience and technology, bioscience and technology, and optical science and technology, under the banner of the Institute's motto "The fundamental things apply". He contributed to NRC's vision for nanotechnology in Canada and to the founding of the new \$120M National Institute for Nanotechnology in Edmonton, Alberta.

Dr. Salahub has been the recipient of a CNC-IUPAC Award, the Noranda Award of the Canadian Society for Chemistry and a Killam Research Fellowship. In 1998 he was named as a Fellow of the Royal Society of Canada.



Martin Taylor

Dr. Martin Taylor has a BA in Geography from the University of Bristol (UK), and an MA and Ph.D. from UBC. 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.

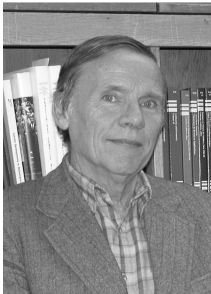
The *Steering Committee* of the Board consists of M. Boorman (Chair), J. Delgrande, N. Ghoussoub, G. Kachanoski, E. Perkins and M. Taylor.

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 longterm 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 people:



David Brillinger

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. David Brillinger is a member of the American Academy of Arts and Sciences and is a Fellow of the Royal Society of Canada. He received a D.Sc. degree from the University of Western Ontario in 1999.



David Brydges

David Brydges received the Ph.D. in 1976 at the University of Michigan under the direction of Paul Federbush. He held a postdoctoral position at Rockefeller University working for James Glimm. In 1978 he became Assistant Professor at the University of Virginia. He was promoted to Full Professor of Mathematics and Physics in 1981 and became Commonwealth Chair in 1996. He was recently appointed as a Canada Research Chair at the University of British Columbia.

Brydges received the Alfred P. Sloan Research fellowship in 1982. He has given numerous lectures through-

out the world including courses in the Troisième Cycle at Lausanne in 1992, Centre Emile Borel in 1998 and the NachDiplom program at ETH, Switzerland. He is on the Executive Committee and is the treasurer for the International Association of Mathematical Physics.

His interests are centred on the Renormalization Group in quantum field theory, statistical mechanics and probability, in particular self-avoiding walk.

Randy Goebel is currently professor and chair in the Department of Computing Science at the University of Alberta. He received the B.Sc. (Computer Science), M.Sc. (Computing Science), and Ph.D. (Computer Science) from the Universities of Regina, Alberta, and British Columbia, respectively.



Randy Goebel

Professor Goebel's research is focused on the theory and application of intelligent systems. His theoretical work on abduction, hypothetical reasoning and belief revision is well known, and his recent application of practical belief revision to scheduling and web mining is now having industrial impact. Randy has previously held faculty appointments at the University of Waterloo and the University of Tokyo, and is actively involved in academic and industrial collaborative research projects in Canada, Australia, Europe and Japan.

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



Ron Graham

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.



Robert Moody

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 CRM and the Fields Institute, and on the Council of the Academy of Science, Royal Society of Canada.



Ian F. Putnam

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.

Bob Russell received the Ph.D. in 1971 at the University of New Mexico under the direction of Lawrence Shampine. In 1971 he became Assistant Professor at Colorado State University and in 1972 he moved to Simon Fraser University. He was promoted to Full Professor in 1981. He has held numerous visiting positions throughout the world, including at Stanford, University of Auckland and Imperial College (as an SERC Fellow).



Bob Russell

Russell's travels include as an Invited Scholar at the USSR and Chinese Academies of Science and as a plenary speaker at SIAM's Dynamical Systems Conference in 2000. His journal editorships have included SIAM Journal on Numerical Analysis and SIAM Journal for Scientific Computing. He is a founding member and past Vice President of CAIMS, has served two terms on NSERC's Grant Selection Committee in Computer Science, is on IMACS Board of Directors, and is a Canadian representative for ICIAM.

His field of research is scientific computing, with special emphasis on the numerical solution of PDEs and ODEs. An interest is in dynamical systems and computational methods which preserve qualitative features of solutions of differential equations. This has recently been in the context of developing mathematical software using adaptive gridding techniques.

Elizabeth Thompson received a B.A. in Mathematics (1970), a Diploma in Mathematical Statistics (1971), and Ph.D. in Statistics (1974), from Cambridge University. In 1974–5 she was a NATO/SRC post-doc in the Department of Genetics, Stanford University. From 1975–



Elizabeth Thompson

81 she was a Fellow of King's College, Cambridge, and from 1981–5 was Fellow and Director of Studies in Mathematics at Newnham College. From 1976–1985 she was a University Lecturer in the Department of Pure Mathematics and Mathematical Statistics, University of Cambridge. She joined the faculty of the University of Washington in December 1985, as a Professor of Statistics. Since 1988, Dr. Thompson has been Professor also of Biostatistics, and since Spring 2000, she is also an Adjunct Professor in Genetics (now Genome Sciences) at the University

of Washington, and an Adjunct Professor of Statistics at North Carolina State University. She served as Chair of the Department of Statistics from 1989–94.

In 1981, she was elected a member of the International Statistical Institute, and in 1988, she was awarded an Sc.D. degree by the University of Cambridge. In 1994, she gave the R.A. Fisher Lecture at the Joint Statistical Meetings in Toronto. In 1996, she gave the Neyman Lecture (IMS) at the Joint Statistical Meetings in Chicago. In 1998, she was elected a Fellow of the American Academy of Arts and Sciences. In 2001, she received the inaugural Jerome Sacks Award for Cross-Disciplinary Research from the National Institute for Statistical Science, and was also awarded the Weldon Prize, an international prize for contributions to Biometric Science awarded by the University of Oxford.

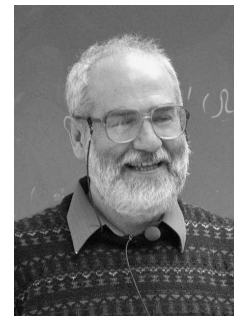
Dr. Thompson's research interest is in the development of methods for inference from genetic data, and particularly from patterns of genome sharing observed among members of large and large and complex pedigree structures, whether of plants, animals, or humans. Questions of interest range from human genetic linkage analysis to gene extinction in highly endangered species, and from inference of relationship to inferences of the genetic basis of traits. Her current focus is on developing research and education in Statistical Genetics at the University of Washington.



Gang Tian

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 at Massachusetts Institute of Technology. Prof. Tian is a recipient of the Alfred P. Sloan research fellowship (1991–1993). He presented a 45-minute 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. Tian received the Veblen Prize of the American Mathematical Society.

Gunther Uhlmann received the Ph.D. in 1976 at MIT under the direction of Victor Guillemin. He held postdoctoral positions at Harvard, Courant Institute and MIT. In 1980 he became Assistant Professor at MIT and in 1985 he moved to the University of Washington as an Associate Professor. He was promoted to Full Professor in 1987.



Gunther Uhlmann

Uhlmann was awarded the Annual National Prize of Venezuela in Mathematics in 1982. He received the Alfred P. Sloan Research fellowship in 1984 and a John Simon Guggenheim fellowship in 2001. He has given numerous lectures throughout the world included an invited address at the Portland meeting of the AMS in 1991, the CBMS-NSF lectures on "Inverse Problems and Nondestructive Evaluation" in 1995 and an invited lecture at the International Congress of Mathematicians in Berlin in 1998.

His current interest is inverse problems in particular inverse boundary value problems and inverse scattering problems. In these problems one attempts to determine internal parameters of a medium by making measurements at the boundary of the medium or by remote observations.

Hugh Williams holds the iCORE Chair in Algorithmic Number Theory and Computing at the University of Calgary and is a professor in the Mathematics and Statistics Department at that institution. His main research interests are in computational number theory, cryptography and the design and development of special-purpose hardware devices. His work in computational number theory extends from analyzing the complexity of number theoretic algorithms to the actual implementation and testing of such algorithms.



Hugh Williams

Dr. Williams has published more than 130 refereed journal papers, 20 refereed conference papers and 20 books or (chapters therein). From 1983–85, he held a national Killam Research Fellowship. He has been an associate editor for *Mathematics of Computation* since 1978 and is also a member of the editorial boards of two other journals. Dr. Williams has also served on the Natural Science and Engineering Research Council (NSERC) Grant

Selection Committees for both Computing and Information Science (1972–75) and Pure and Applied Mathematics (1991–94), and chaired the latter from 1993–4. He has also been a member of the Steacie Awards Selection Committee.

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 Ghossoub, (UBC, Math)

SFU Site-Dir.: Manfred Trummer (SFU, Math)

UA Site-Dir.: James Muldowney (UA, Math) **UBC**

Site-Dir.: Dale Rolfsen (UBC, Math)

UC Site-Dir.: Gary Margrave (UC, Math)

UVic Site-Dir.: Florin Diacu (UVic, Math)

UW Site-Dir.: S. Paul Smith (UW, Math)

Education and Communication

Education Facilitator: Klaus Hoechsmann (UBC)

Local Committees

The Local Coordinators are 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 2001/02 committee consisted of:

Chair: Anne Bourlioux (CRM & Universit e de Montr eal)

John Harnad (CRM & Concordia University)

Bradd Hart (Fields Institute & University of Toronto)

Lisa Jeffrey (University of Toronto)

Subhash Lele (University of Alberta)

Niky Kamran (CRM & McGill University)

Dale Rolfsen (PIMS & UBC)

David Sankoff (Universit e de Montr eal)

PIMS Site Personnel

PIMS Main Office

Dr. Nassif Ghoussoub, Director
Dr. Sandy Rutherford, Scientific Executive Officer
Dr. Klaus Hoechsmann, Education Officer
Ms. Andrea Hook, PIMS Administrator
Mr. Derek Bideshi, Programme Coordinator
Ms. Heather Jenkins, Communications Officer
Ms. Fanny Lui, Financial Clerk
Mr. Kelly Choo, Website Administrator
Mr. Shervin Teymouri, Computer Systems Administrator
Ms. Clarina Chan, MITACS Administrator
Ms. Jessica Douglas, BIRS Programme Coordinator



Fanny Lui, Derek Bideshi, Andrea Hook and Clarina Chan (l-r).

PIMS at University of British Columbia

Dr. Dale Rolfsen, Site Director
Dr. Martial Agueh, PDF
Dr. Dominic Brecher, PDF
Dr. R. Fazio, PDF
Dr. Kazuyuki Furuuchi, PDF
Dr. Xavier Granier, PDF
Dr. Yuri Gusev, PDF
Dr. Antal Jarai, PDF
Dr. Luis Lehner, PDF
Dr. Nathaniel Newland, PDF
Dr. Ehud Schreiber, PDF
Dr. Xiang Tao, PDF
Dr. Yuqing Wang, PDF
Dr. Zhenya Yan, PDF
Dr. Ana Granados, MITACS PDF
Dr. Joern Sass, MITACS PDF



Dale Rolfsen,
UBC-PIMS Site
Director,
1997-2002.

PIMS at Simon Fraser University

Dr. Manfred Trummer, 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. Grace Chiu, PDF
 Dr. Will Galway, PDF
 Dr. Russell Luke, PDF
 Dr. Riste Skrekovski, PDF
 Dr. Janez Ales, MITACS PDF
 Dr. Peter Berg, MITACS PDF
 Dr. Edgardo Cheb-Terrab, MITACS PDF
 Dr. Ronald Ferguson, MITACS PDF
 Dr. Daya Gaur, MITACS PDF
 Dr. Alexander Kononov, MITACS PDF
 Dr. Stefan Langerman, MITACS PDF
 Dr. Snezana Mitrovic-Minic, MITACS PDF
 Dr. Andrew Solomon, MITACS PDF
 Dr. Bettina Speckmann, MITACS PDF
 Dr. Brett Stevens, MITACS PDF



Manfred Trummer,
 SFU-PIMS Site
 Director, 2001–02.

PIMS at University of Alberta

Dr. Jim Muldowney, Site Director
 Ms. Shirley Mitchell, Executive Assistant
 Dr. Ted Lewis, Education Coordinator
 Dr. Wen Chen, PDF
 Dr. Christina Cobbold, PDF
 Dr. Matthias Neufang, PDF
 Dr. Sumati Surya, PDF
 Dr. Chuong Tran, PDF
 Dr. Roman Vershynin, PDF
 Dr. Hongwei Long, Industrial Collaborative Associate



James Muldowney,
 U. Alberta-PIMS
 Site Director,
 2001–02.

PIMS at University of Calgary

Dr. Gary Margrave, Site Director
Ms. Marian Miles, Administrative Assistant
Dr. Indy Lagu, Education Coordinator
Dr. Peter Hoyer, PDF
Dr. Luigi Santocanale, PDF
Dr. Tatjana Stykel, PDF
Dr. Hugh Geiger, MITACS-PDF
Dr. Peter Gibson, MITACS-PDF



Gary Margrave,
U. Calgary-PIMS
Site Director,
2001–02.

PIMS at University of Victoria

Dr. Florin Diacu, Site Director
Ms. Dil Bains, Admin. Assistant
Mrs. Timea Halmi, Admin. Assistant (on leave)
Dr. David Leeming, Education Coordinator
Mr. Kelly Choo, Web Manager
Dr. Vladislav Panferov, PDF
Dr. Inhyeop Yi, PDF
Dr. Joachim Stadel, PDF
Dr. Julien Arino, MITACS PDF

Florin Diacu,
U. Victoria-PIMS
Site Director,
1998–2002.



PIMS University of Washington

Dr. S. Paul Smith, Site Director
Ms. Jessica Baird, Administrative Assistant

S. Paul Smith,
U. Washington-
PIMS Site Director,
2002.



University of Lethbridge

Dr. Jorgen Rasmussen, PDF

PIMS Scientific Personnel

PIMS Distinguished Chairs

PIMS Distinguished Chairs for 2001/02

Vladimir Turaev (CNRS Strasbourg VI)

Site: University of Calgary
July–August, 2001

Gang Tian (MIT)

Site: University of British Columbia
August 2001

Michael Shelly (Courant Institute)

Site: Simon Fraser University
November–December 2001

PIMS Distinguished Chairs for 2002/03

Donald G. Saari (University of California, Irvine)

Site: University of Victoria
September 2002

Klaus Schmidt (University of Vienna and Director,
Erwin Schrödinger Institute)

Site: University of Victoria
November 2002

Gunther Uhlmann (University of Washington)

Site: University of British Columbia
November 2002

See page 62 for more information about the PIMS Distinguished Chairs for 2001/02 and 2002/03.

PIMS PDFs for 2002/03

The review panel for the 2002/03 competition were Michael Lamoureux, (Chair, Math, UC), David Brydges (Math, UBC), Leah Keshet (Math, UBC),

Richard Lockhart (Stats, SFU), Bryant Moodie (Math, UA) and Frank Ruskey (Comp Sci, UVic).

1. **Inhyeop Yi**: Dynamical systems and operator algebras. Supervised by Ian Putnam (UVic).
2. **Vladislav Panferov**: PDEs (kinetic theory). Supervised by Reinhard Illner (UVic).
3. **Kazuyuki Furuuchi**: Theoretical physics (string theory). Supervised by Gordon Semenov (UBC).
4. **Zhenya Yan**: Applied math (soliton theory and nonlinear integral systems). Supervised by George Bluman (UBC).
5. **Xavier Granier**: Computer science (computer graphics). Supervised by Wolfgang Heidrich (UBC).
6. **Ehud Schreiber**: Theoretical physics (quantum field and string theories). Supervised by Moshe Rozali, Mark Van Raamsdonk (UBC).
7. **William Galway**: Computational number theory. Supervised by Jonathan Borwein, Peter Borwein, Imin Chen, Stephen Choi and Petr Lisonek (SFU).
8. **Russell Luke**: Applied math (image processing). Supervised by Jon Borwein (SFU).
9. **Grace Chiu**: Statistics (applications to the life sciences). Supervised by Richard Lockhart and Rick Routledge (SFU).
10. **Riste Skrekovski**: Computer science (graph theory). Supervised by Pavol Hell (SFU).
11. **Wen Chen**: Signal & image processing. Supervised by Bin Han and Rong-Qing Jia (U of A).
12. **Roman Vershynin**: Geometric functional analysis. Supervised by Nicole Tomczak-Jaegermann (U of A).
13. **Christina Cobbold**: Mathematical biology. Supervised by Mark Lewis (U of A).
14. **Chuong Tran**: Applied math (fluid dynamics). Supervised by John Bowman (U of A).
15. **Peter Hoyer**: Algorithmics, data structures, complexity theory and quantum computing. Supervised by Richard Cleve (U of C).
16. **Tatjana Stykel**: Applied math (numerical linear algebra, control theory). Supervised by Peter Lancaster (U of C).

THE BANFF INTERNATIONAL RESEARCH STATION



Corbett Hall at the Banff Centre on a fall morning.



Robert V. Moody, BIRS
Scientific Director

The official announcement of the Banff International Research Station (BIRS) occurred on September 24, 2001 at the Banff Centre in Banff, Alberta, and at the National Science Foundation in Washington D.C. The ceremony included speeches by: Dr. Rita Colwell (Director, NSF), Dr. Tom Brzustowski (President, NSERC), Dr. Robert Church (Chair of Board, Alberta Science and Research Agency), Dr. Philippe Tondeur (Director of Division for the Mathematical Sciences, NSF), Hon. Cindy Ady (MLA for Calgary Shaw), Ms. Mary Hofstetter (President and CEO of The Banff Centre) and Mr. Raul E. Chavera (US Consul General in Calgary). The ceremony is available in realvideo from www.pims.math.ca/birs/past_menu/announce/.

The Location of BIRS

BIRS is located in two adjacent buildings at the Banff Centre: the Max Bell building will have two lecture rooms and several smaller meeting and discussion rooms, and Corbett Hall, which will be entirely taken over by BIRS, will house the living quarters for all BIRS visitors.

Modes of Operation

Five-Day Workshops

The fundamental mode of BIRS is the five-day workshop, which runs from Sunday a.m. through to Thursday p.m. 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.

Two-day Workshops

The normal scheduling of the five-day workshops will leave 2 day periods open (Friday and Saturday) that may be used for a variety of shorter meetings such as Pacific Northwest Seminars and special events.

Research in Teams

In addition to its ongoing workshops, the station may host teams of 2–4 researchers for periods of 2–4 weeks. This programme 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.

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 10–15 mathematicians each, up to 8 of them being in residence at BIRS for 2–4 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 research schools directed principally towards graduate students and postdoctoral fellows.

The Opening of BIRS

BIRS will open its doors on March 15, 2003. To celebrate the remarkable achievement of creating this new institution there will be a reception on February 28, 2002 at the Banff Centre. This will be a gala affair involving the Boards of Trustees of PIMS, MSRI

The BIRS Scientific Advisory Board

- Robert V. Moody (Chair, U. Alberta): **Lie Theory and Mathematical Physics**
- Doug Arnold (U. Minnesota): **PDE and Numerical Analysis**
- James Arthur (U. Toronto): **Representation Theory**
- Jennifer Chayes (Microsoft Research): **Complexity theory and Statistical Mechanics**
- Richard Cleve (U. Calgary): **Quantum Computing**
- Ronald Coifman (Yale): **Harmonic Analysis**
- Henri Darmon (McGill): **Number Theory**
- David Gross (UC, Santa Barbara): **Quantum Field Theory and String Theory**
- Peter Guttorp (U. Washington): **Environmental Stats**
- Craig Huneke (U. Kansas): **Algebra**
- Nancy Kopell (Boston University): **PDE and Applied Mathematics**
- Mark Lewis (U. Alberta): **Math Biology and Ecology**
- L'aszl'o Lov'asz (Microsoft Research): **Combinatorial Optimization, Algorithms and Complexity**
- Jitendra Malik (UC, Berkeley): **Computer Vision**
- Dusa McDuff (SUNY, Stony Brook): **Topology and Symplectic Geometry**
- David Mumford (Brown University): **Machine and Natural Intelligence**
- Robert Myers (McGill and Perimeter Institute): **Superstring Theory and Quantum Gravity**
- Edwin Perkins (UBC): **Probability Theory**
- Nicholas Pippenger (UBC): **Computer Science**
- Ian Putnam (U. Victoria): **Dynamics and Operator Algebras**
- Nancy Reid (U. Toronto): **Statistics**
- Gang Tian (MIT): **Geometry**
- Robert Tibshirani (Stanford): **Data Mining and Computational Statistics**
- Margaret Wright (Courant Institute): **Algorithmic Optimization**
- David Eisenbud (Director, MSRI): **Commutative Algebra, Algebraic Geometry, Computation**
- Nassif Ghoussoub (Director, PIMS): **Non-linear Analysis, PDE**
- Arvind Gupta (Program leader, MITACS): **Combinatorics, Optimization, Complexity Theory**
- Ken Davidson (Director, Fields Institute): **Operator Theory, Nonselfadjoint operator algebras, C^* -algebras**
- Jacques Hurtubise (Directeur, CRM): **Topology, Geometry**

and MITACS, the Academic Sponsors of MSRI, the Scientific Advisory Board of BIRS, and representatives of NSERC, ASRA, and the NSF—approximately 150 people. The speakers will include James J. Heckman (U. Chicago), Jay Ingram (Discover Channel) and Donald Saari (UC, Irvine).

The Evaluation of the BIRS 2003 Programme

The Call for Proposals for workshops at BIRS in 2003 was very enthusiastically received, resulting in 108 proposals. The overall level of proposals was outstanding. The various committees were guided by the principle that BIRS has to be inclusive of all the mathematical sciences and that each year its programme should provide a broad sampling of these. Thus the proposals were broken down into some 22 areas, and within each area the proposals were evaluated and compared against each other. The committee then made sure that these were represented and that no area was grossly over- or underrepresented. Not surprisingly many fine proposals were omitted in this process.

The features the committees look for when making their selections were:

- The proposal should be well focused.
- The set of proposed applicants should be realistic and should be logical to the coherence and goals of the workshop.
- The workshop ought to be sufficiently innovative or sufficiently timely that holding it has significant potential to make a difference to the subject.
- The organizers (at least some) should be of recognized stature.
- The proposal should be written carefully, placing the above points clearly in the context of the present state of the subject.

The following points, although not of primary importance, were also considered:

- The committee would like to see each workshop make some effort to involve young and emerging talent in the form of post-docs or advanced graduate students.

- It is always good to keep in mind the appropriate representation of women in the list of participants.
- Priority will be given to those workshops that promote Canada-US research collaboration. Therefore each workshop ideally would have at least one organiser from a Canadian institution and one from an institution in the US.

The Other Programmes at BIRS

There were also about fifteen proposals for the other aspects of the BIRS programme: Focused Research Groups and Research in Teams. These were all very worthwhile proposals and it was possible to satisfy all these requests, including hosting the Canadian Mathematical Olympiad Team for 2 weeks in the summer of 2003.

The Review Process

The selection process is a multistage process. All incoming proposals are placed in one master file and all 27 members of the BIRS Scientific Advisory Board (SAB) can provide their written evaluations online about any proposal they wish to comment on.

In addition, each proposal gets reviewed by two members of the SAB, assigned by the Scientific Director according to expertise in the subject area. In some cases, external refereeing was also solicited.

All available information goes to the scientific panels of PIMS (resp., MSRI) who have the responsibility to select 12 (resp., 6) BIRS proposals of interest to their own scientific programmes from this file. The BIRS Scientific Steering Committee finishes off the selection process choosing another 22 workshops, based on the recommendations of its SAB and on the input of the MITACS Scientific Director so that there are at least two weeks of industrially oriented workshops.

The PIMS Proposals

The PIMS Scientific Review Panel has the responsibility of selecting 12 of the full set of proposals. An appropriate BIRS workshop proposal for the PIMS Scientific Review Panel has to satisfy all criteria of excellence and innovation that are required by the BIRS evaluation process. In addition, they have to be

compatible with the PIMS scientific, industrial and educational programmes, as dictated by the provincial funding sources for the institute and of BIRS.

Priority is given to events that fit into other parallel PIMS activities—particularly the Graduate Industrial Modelling Camps, the Periods of Concentration for Collaborative Research Groups, the Thematic Programmes, as well as various educational activities. Beyond that the proposals should also have a strong connection to groups, strengths, or ongoing activities within the PIMS participating universities in Canada and the US.

BIRS Calendar for 2003

From the 118 proposals that were received the following were selected.

2003 Programme for 5-day Workshops

Mar 15–20: **Recent Developments in Superstring Theory**

Organizers: Jim Bryan, Moshe Rozali, Gordon W. Semenoff, Mark Van Raamsdonk (UBC), Steve Giddings (UC, Santa Barbara), Mikhail Kapranov, Amanda W. Peet (Toronto), Andreas Karch (Washington), K. Viswanathan (SFU)

Mar 22–27: **Scattering and Inverse Scattering**

Organizers: Richard Froese (UBC), Gunther Uhlmann (Washington)

Mar 29–Apr 3: **Commutative Algebra and Geometry**

Organizers: Mark Green (IPAM), Jürgen Herzog (Gesamthochschule-Essen), Bernd Sturmfels (UC, Berkeley)

Apr 5–10: **BIRS Workshop on Noncommutative Geometry**

Organizers: Alain Connes (IHES), Joachim Cuntz (Muenster), George Elliott (Toronto), Masoud Khalkhali (Western Ontario), Boris Tsygan (Penn State)

Apr 12–17: **Quantum Mechanics on the Large Scale**

Organizers: P.C.E. Stamp, G.A. Sawatzky (UBC) A.J. Leggett (Illinois, Urbana), T. Havel (MIT), S. Popescu (HH Wills Lab), R. Gill (Utrecht)

Apr 19–24: **Computational Fuel Cell Dynamics—II**

Organizers: John Kenna (Ballard), Trung Van Nguyen (Kansas), Keith Promislow (SFU), Brian Wetton (UBC)

Apr 26–May 1: **The Many Aspects of Mahler’s Measure**
Organizers: David Boyd (UBC), Doug Lind (Washington), Fernando Rodriguez Villegas (Texas, Austin), Christopher Deninger (Muenster)

May 3–8: **Recent Advances in Algebraic and Enumerative Combinatorics**

Organizers: Sara Billey (MIT), Ian Goulden, David Jackson (Waterloo), Curtis Greene (Haverford College), Richard Stanley (MIT)

May 10–15: **Statistical Mechanics of Polymer Models**

Organizers: Christine E. Soteros (Saskatchewan), De Witt Summers (Florida State), Stuart G Whittington (Toronto)

May 24–29: **Constraint Programming, Belief Revision, and Combinatorial Optimization**

Organizer: Randy Goebel (Alberta)

May 31–Jun 5: **Symmetry and Bifurcation in Biology**

Organizers: Martin Golubitsky (Houston), William F. Langford (Guelph), Ian Stewart (Warwick)

Jun 7–12: **Applicable Harmonic Analysis**

Organizers: Rong-Qing Jia (Alberta), Sherman D. Riemenschneider (West Virginia), M. Victor Wickerhauser (Washington)

Jun 14–19: **Integration on Arc Spaces, Elliptic Genus and Chiral de Rham Complex**

Organizers: Mikhail Kapranov (Toronto), Anatoly Libgober (Illinois at Chicago), François Loeser (ENS),

Jun 21–26: **Point Processes—Theory and Applications**

Organizers: Peter Guttorp (Washington), Bruce Smith (Dalhousie)

Jun 28–Jul 3: **Joint Dynamics**

Organizers: Douglas Lind, Boris Solomyak (Washington), Daniel Rudolph (Maryland), Klaus Schmidt (Vienna)

Jul 5–10: **Mathematical Biology: From Molecules to Ecosystems; The Legacy of Lee Segel**

Organizers: Leah Keshet (UBC), Simon A. Levin (Princeton), Mark Lewis (Alberta)

Jul 12–17: **Perspectives in Differential Geometry**

Organizers: Richard Schoen (Stanford), Gang Tian (MIT), Jingyi Chen (UBC)

Jul 19–24: **Differential Invariants and Invariant Differential Equations**

Organizers: Niky Kamran (McGill), Peter J. Olver (Minnesota)

Jul 26–31: **Analysis and Geometric Measure Theory**

Organizers: Ana Granados (UBC), Hervé Pajot (U. Cergy-Pontoise), Tatiana Toro (Washington)

Aug 2–7: **Monge-Ampere Type Equations and Applications**

Organizers: Alice Chang, Paul Yang (Princeton), Pengfei Guan (McMaster)

Aug 9–16: **Localization Behavior in Reaction-Diffusion Systems and Applications to the Natural Sciences** (1/2 workshop)

Organizers: A. Bernoff (Harvey Mudd College), P. Fife (Utah), T. Hillen (Alberta), M. J. Ward (UBC), J. Wei (Chinese U.)

Aug 9–16: **Defects and their Dynamics** (1/2 workshop)

Organizers: Peter W. Bates (Brigham Young), Lia Bronsard (McMaster), Changfeng Gui (Connecticut)

Aug 16–21: **Current Trends in Arithmetic Geometry and Number Theory**

Organizers: Imin Chen (SFU), Brian Conrad, Chris Skinner (Michigan), Eyal Goren (McGill), Adrian Iovita (Washington), Nike Vatsal (UBC)

Aug 23–28: **Computational Techniques for Moving Interfaces**

Organizers: Randy LeVeque (Washington), Robert D. Russell, Steven Ruuth (SFU)

Aug 30–Sep 4: **A Scientific Creative Writing Workshop at BIRS** (1/2 workshop)

Organizers: Marjorie Senechal (Smith College), Chandler Davis (Toronto)

Aug 30–Sep 4: **Locally Finite Lie Algebras** (1/2 workshop)

Organizers: Yuri Bahturin (Memorial Newfoundland), Georgia Benkart (Wisconsin-Madison), Ivan Penkov (UC-Riverside), Helmut Strade (Hamburg), Alexander Zaleskii (Northern Anglia)

Sep 6–11: **Regularization in Statistics**

Organizers: Ivan Mizera (Alberta), Roger Koenker (Illinois)

Sep 13–18: **Topology in and around Dimension Three**

Organizers: Steve Boyer (Quebec), Martin Scharlemann (UC Santa Barbara), Abigail Thompson (UC Davis)

Sep 20–25: **Structural and Probabilistic Approaches to Graph Colouring**

Organizers: Professor Bruce Reed (McGill), Paul Seymour (Princeton)

Sep 27–Oct 2: **Stochastic Partial Differential Equations**

Organizers: Martin Barlow, Edwin Perkins (UBC), Krzysztof Burdzy (Washington), Robert Dalang (Ecole Polytechnique Fédérale)

Oct 4–9: **Quadratic forms, Algebraic Groups, and Galois Cohomology**

Organizers: R. Elman, A.S. Merkurjev (UCLA), J. Minac (Western Ontario), C. Riehm (McMaster)

Oct 11–16: BANFF Credit Risk Conference 2003

Organizers: Tom Astebro (Waterloo), Peter Beling (Virginia), David Hand (Imperial College), Robert Oliver (Fair Isaac Companies), Lyn Thomas (Southampton)

Oct 18–23: MITACS Special Industrial Forum

Organizer: Arvind Gupta (MITACS)

Oct 25–30: Current Trends in Representation Theory of Finite Groups

Organizers: Jonathan L. Alperin (Chicago), Michel Broue (Paris VII), Gerald Cliff (Alberta)

Nov 1–6: PIMS HOT TOPICS: Galaxy Formation; a Herculean Challenge

Organizers: Arif Babul, Julio Navarro, Frank van den Bosch (Victoria), Jeremiah Ostriker (Cambridge), Tom Quinn (Washington), Neal Katz (Massachusetts)

Nov 8–13: MSRI HOT TOPICS

Organizer: Michael Singer (MSRI)

Nov 15–20: The Interaction of Finite Type and Gromov-Witten Invariants

Organizers: Jim Bryan (UBC), David Auckly (Kansas State)

Nov 22–27: Theory and Numerics of Matrix Eigenvalue Problems

Organizers: J. W. Demmel (UC Berkeley), N.J. Higham (Manchester), P. Lancaster (Calgary)

Nov 29–Dec 4: Nonlinear Dynamics of Thin Films and Fluid Interfaces

Organizers: A. L. Bertozzi, R. P. Behringer, T.P. Witelski (Duke), R. Almgren, M. C. Pugh (Toronto), M. Shearer (NC State)

Dec 6–11: Calabi-Yau Varieties and Mirror Symmetry

Organizers: Victor Batyrev (Tübingen), Shinobu Hosono (Tokyo), James D. Lewis (Alberta), Bong H. Lian (Brandeis), S.-T. Yau (Harvard), Noriko Yui (Queen's), Don Zagier (Max-Planck)

Dec 13–18: p-adic Variation of Motives (1/2 workshop)

Organizers: Kevin Buzzard (Imperial College), Robert Coleman (UC Berkeley), Matthew Emerton (Northwestern), Eyal Goren (McGill)

Dec 13–18: Coordinate Methods in Nonselfadjoint Operator Algebras (1/2 workshop)

Organizers: Allan Donsig (Nebraska), Michael Lamoureaux (Calgary)

2003 Programme for Focused Research Groups (FRG), Research in Teams (RIT), Summer Schools (SS) and 2-Day Workshops**Mar 28–29: Northwest Functional Analysis Symposium (2-day workshop)**

Organizers: Michael Lamoureaux (Calgary), Tony Lau, Nicole Tomczak-Jaegermann (Alberta), Ian Putnam (Victoria)

Apr 3–6: Restricting syzygies of algebraic varieties (RIT)

Organizer: David Eisenbud (MSRI)

Apr 11–12: Mathfair Workshop (2-day workshop)

Organizers: Ted Lewis, Andy Liu (Alberta)

Apr 26–May 10: Topological Orbit Equivalence for Dynamical Systems (RIT)

Organizers: T. Giordano (Ottawa), C. Skau (Norwegian Science & Technology), I. Putnam (Victoria)

Apr 26–May 10: Field Theory & Cohomology of Groups (RIT)

Organizers: J. Minac (Western Ontario), A. Adem (Wisconsin-Madison), D. Karagueuzian (Binghamton)

May 10–24: Regularity for Hypergraphs (FRG)

Organizers: P. Haxell (Waterloo), V. Rodl (Emory), J. Skokan (Illinois Urbana-Champaign), L. Thoma (Rhode Island)

May 15–17: The regression discontinuity method in economics: theory and applications (2-day workshop)

Organizer: Thomas Lemieux (UBC)

May 17–22: PIMS Graduate Industrial Mathematics Modelling Camp (SS)

Organizers: R. Kuske (PIMS), F. Santosa (IMA)

May 24–Jun 7: Topology and Analysis: Complementary Approaches to the Baum-Connes and Novikov Conjectures (FRG)

Organizers: N. Higson (Penn State), J. Kaminker (Indiana-Purdue), S. Weinberger (Chicago)

Jun 7–21: Quantum Algorithms & Complexity Theory (FRG)

Organizer: R. Cleve (Calgary)

Jun 21–27: Summer School in Differential Geometry (SS)

Organizer: R. Bryant (UC Berkeley)

Jun 28–Jul 10: 2003 Summer IMO Training Camp (SS)

Organizer: W. Sands (Calgary)

Jul 12–26: Problems in Discrete Probability (FRG)

Organizers: R. Pemantle (Ohio State), Y. Peres (UC Berkeley), P. Winkler (Bell Labs)

Jul 26–Aug 16: **Representation Theory of Linearly Compact Lie Superalgebras and the Standard Model** (RIT)

Organizers: V. Kac (MIT), A. Rudakov (NTNU)

Aug 2–16: **Variance of Quasi-coherent Torsion Cousin Complexes** (RIT)

Organizers: J. Lipman (Purdue), S. Nayak (Harish-Chandra Research Inst.), P. Sastry (Toronto)

Aug 16–30: **Invariant Manifolds for Stochastic PDEs** (RIT)

Organizers: T. Caraballo (Universidad de Sevilla), J. Duan (Illinois Tech), K. Lu (Brigham Young), B. Schmalfuss (Merseburg)

Aug 16–Sep 6: **Local Uniformization and Resolution of Singularities** (RIT)

Organizers: S.D. Cutkosky (Missouri-Columbia), F.-V. Kuhlmann (Saskatchewan)

Aug 28–30: **Theoretical Physics Institute, University of Alberta Symposium** (2-day workshop)

Organizer: Helmy Sherif (Alberta)

Sep 6–20: **Arithmetic of Fundamental Groups** (RIT)

Organizers: D. Harbater (Pennsylvania), F. Pop (Bonn)

Sep 18–20: **Canadian Mathematics Chairs Meeting** (2-day workshop)

Organizer: Ted Bisztriczky (Calgary)

Sep 20–Oct 2: **Mathematical Models for Plant Dispersal** (FRG)

Organizers: M. Lewis (Alberta), J. Bullock (NERC Centre for Ecology and Hydrology)

Oct 2–4: **West Coast Operator Algebra** (2-day workshop)

Organizer: B. Brenkan (Calgary)

BIRS Calendar for 2004

2004 Programme for 5-day Workshops

Mar 13–18: **Interactions between model theory and geometry**

Organizers: Deirdre Haskell (McMaster), Jan Denef (Leuven), Ehud Hrushovski (Hebrew U.), Angus Macintyre (Edinburgh), Anand Pillay (UIUC), Patrick Speissegger (Wisconsin & McMaster)

Mar 20–26: **Topology of Manifolds and Homotopy Theory**

Organizers: Ian Hambleton (McMaster), Erik Pedersen (SUNY, Binghamton), Gunnar Carlsson (Stanford)

Mar 27–Apr 1: **Orthogonal Polynomials; Interdisciplinary Aspects**

Organizers: Jacek Szmigielski (Saskatchewan), Percy Deift (Courant), Lance Littlejohn, David Sattinger (Utah State)

Apr 3–8: **Model Reduction Problems and Matrix Methods**

Organizers: Anne Greenbaum (Washington), Gene Golub (Stanford), Jim Varah (UBC)

Apr 10–15: **Analytic and Geometric Aspects of Stochastic Processes**

Organizers: Martin Barlow (UBC), Alexander Grigoryan (Imperial College), Elton Hsu (Northwestern)

Apr 17–22: **Celestial Mechanics** (1/2 workshop)

Organizers: Florin Diacu (Victoria), Donald Saari (UC, Irvine)

Apr 17–22: **BIRS Workshop in Creative Scientific Writing** (1/2 workshop)

Apr 24–29: **Microeconometrics of Spatial and Grouped Data**

Organizers: Thomas Lemieux (UBC), David Card (UC, Berkeley)

May 1–6: **Mathematical structures in economic theory and econometrics** (1/2 workshop)

Organizers: Ivar Ekeland (UBC), Pierre-Andre Chiappori (Chicago)

May 1–6: **Singular Cardinal Combinatorics** (1/2 workshop)

Organizers: Claude Laflamme (Calgary), Matthew Foreman (UC, Irvine), Stevo Todorovic (Toronto, CNRS Paris)

May 8–13: **Knots and their manifold stories**

Organizers: Orr Kent (Indiana), Tim Cochran (Rice), Dale Rolfsen (UBC)

May 15–20: **New developments on variational methods and their applications**

Organizers: Changfeng Gui (Connecticut), Kung-Ching Chang (Peking), Paul Rabinowitz (Wisconsin, Madison), Jingyi Chen (UBC)

May 22–27: **Mathematical Foundations of Scientific Visualization, Computer Graphics, and Massive Data Exploration**

Organizers: Torsten Moller, Robert Russell (SFU), Bernd Hamann (UC, Davis)

May 29–Jun 3: **Aperiodic Order: Dynamical Systems, Combinatorics, and Operators**

Organizers: Michael Baake (Institut fuer Mathematik), David Damanik (Caltech), Ian Putnam (Victoria), Boris Solomyak (Washington)

Jun 5–10: **Semimartingale Theory and Practice in Finance**

Organizers: Tom Hurd (McMaster), Thaleia Zarihopoulou (Texas, Austin), Philip Protter (Cornell), Lane Hughston (King's College)

Jun 12–17: **New Horizons in String Cosmology**

Organizers: James Cline (McGill), Robert Brandenberger (Brown), Steve Giddings (UC, Santa Barbara), Brian Greene (Columbia), Rob Myers (Perimeter Institute), Gordon Semenoff (UBC)

Jun 19–24: **PIMS Hot Topic Workshop**

Jun 26–Jul 8: **PIMS International Summer School** (2 weeks)

Jul 10–15: **Convex Geometric Analysis**

Organizers: Nicole Tomczak-Jaegermann (Alberta), Vitali Milman (Tel Aviv), Elisabeth Werner (Case Western Reserve)

Jul 17–22: **Modeling Protein Flexibility and Motions**

Organizers: Walter Whiteley (York), Michael Thorpe, Leslie Kuhn (Michigan State)

Jul 24–29: **Geometric Evolution Equations**

Organizers: Christine Guenther (Pacific University), Jingyi Chen (UBC), Bennett Chow (UC, San Diego), Klaus Ecker (Freie Universitaet Berlin)

Jul 31–Aug 5: **Conformal Geometry**

Organizers: Thomas Branson (Iowa), Michael Eastwood (Adelaide), McKenzie Wang (McMaster)

Aug 7–12: **Stochastic processes in evolutionary and disease genetics**

Organizers: Ellen Baake (Greifswald), Don Dawson (Carleton), Warren Ewens (Pennsylvania), Bruce Rannala (Alberta)

Aug 14–19: **Statistical Science for Genome Biology**

Organizers: Jennifer Bryan (UBC), Sandrine Dudoit, Mark van der Laan (UC, Berkeley)

Aug 21–26 : **Computation and Dynamics in Genetic and Metabolic Networks, and Mathematical Control Theory in Systems Biology**

Organizers: Leon Glass (McGill), Erik Winfree (Caltech), John Reinitz (SUNY, Stony Brook), Brian Ingalls (Waterloo), Eduardo Sontag (Rutgers), Jim Collins (Boston)

Aug 28–Sep 2: **Combinatorial Hopf Algebras**

Organizers: Frank Sottile (Massachusetts), Nantel Bergeron (York), Louis Billera (Cornell), Stephanie van Willigenburg (UBC)

Sep 4–9: **Pluripotential Theory and its Applications**

Organizers: Len Bos, Alex Brudnyi (Calgary), Eric Bedford (Indiana), Al Taylor (Michigan)

Sep 11–16: **Commutative Algebra: Homological and Birational Theory**

Organizers: Ragnar-Olaf Buchweitz (Toronto), Paul Roberts (Utah), Bernd Ulrich (Purdue)

Sep 18–23: **Quantum Computation and Information Theory**

Organizers: John Watrous, Richard Cleve (Calgary), Umesh Vazirani (UC, Berkeley)

Sep 25–30: **Interaction of Finite Dimensional Algebras with other areas of Mathematics**

Organizers: Vlastimil Dlab (Carleton), Claus Ringel (Bielefeld), Leonard Scott (Virginia)

Oct 2–7: **Self-Stabilizing Distributed Systems**

Organizers: Lisa Higham (Calgary), Anish Arora (Ohio State), Faith Fich (Toronto), Maurice Herlihy (Brown), Ted Herman (Iowa),

Oct 9–14: **Free probability theory**

Organizers: Alexandru Nica (Waterloo), Roland Speicher (Queen's), Dan Voiculescu (UC, Berkeley)

Oct 16–21: **Braid Groups and Applications**

Organizers: Dale Rolfsen (UBC), Joan Birman (Columbia), Patrick Dehornoy (Caen), Roger Fenn (Sussex), Vaughan Jones (UC, Berkeley)

Oct 23–28: **Mathematical Image Analysis and Processing**

Organizers: Mary Pugh (Toronto), Selim Esedoglu (UCLA), Sung Ha Kang (Kentucky), Jackie Shen (Minnesota)

Oct 30–Nov 4: **The structure of amenable systems**

Organizers: George Elliott (Toronto), Andrew Dean (Lakehead), Thierry Giordano (Ottawa), Guihua Gong (Puerto Rico), Huaxin Lin, N. Christopher Phillips (Oregon)

Nov 6–11: **New Techniques in Lorentz Manifold** (1/2 workshop)

Organizers: Virginie Charette (Manitoba), Todd Drumm (Swarthmore College), William Goldman (Maryland)

Nov 6–11: **Functional Differential Equations** (1/2 workshop)

Organizers: Jianhong Wu (York), Hans-otto Walther (Giessen), John Mallet-paret (Brown)

Nov 13–18: **Explicit Methods in Number Theory**

Organizers: Peter Borwein (SFU), H. W. Lenstra (UC, Berkeley), P. Stevenhagen (Leiden), H. Williams (Calgary)

Nov 20–25: **Diophantine approximation and analytic number theory**

Organizers: Michael Bennett, Greg Martin (UBC), John Friedlander (Toronto), Andrew Granville (Montreal), Cameron Stewart (Waterloo), Trevor Wooley (Michigan)

Nov 27–Dec 2: **Mathematical Models for Biological Invasions**

Organizers: Mark Lewis (Alberta), Mark Kot (Washington), Pauline van den Driessche (Victoria)

Dec 4–9: **Numeracy and Beyond** (1/2 workshop)

Organizers: Klaus Hoechsmann (PIMS), Tony Gardiner (Birmingham), Yarom Sagher (Illinois), Guenter Toerner (Duisburg)

Dec 4–9: **Generalizations of de Bruijn Cycles and Gray Codes** (1/2 workshop)

Organizers: Brett Stevens (Carleton), Joe Buhler (Reed College), Persi Diaconis (Stanford), Fan Chung, Ronald Graham (UC, San Diego), Frank Ruskey (Victoria)

Dec 11–16: **Workshop on resolution of singularities, factorization of birational mappings, and toroidal geometry**

Organizers: Kenji Matsuki, Jaroslaw Włodarczyk (Purdue), Dan Abramovic (Boston), Edward Bierstone, Pierre Milman (Toronto), Steven Dale Cutkosky (Missouri)

2004 Programme for Focused Research Groups (FRG), Research in Teams (RIT), Summer Schools (SS) and 2-Day Workshops

Jun 5–19: **Robust Analysis of Large Data Sets** (FRG)

Organizers: Ruben Zamar (UBC), Stefan Van Aelst

(U. Ghent, Belgium)

Jul 10–24: **String Field Theory Camp** (FRG)

Organizers: Gordon Semenoff, Mark van Raamsdonk, Moshe Rozali (UBC)

May 15–Jun 5: **Maximal functions in non-commutative analysis** (RIT)

Organizers: Marius Junge (U. Illinois, Urbana-Champaign), Quanhua Xu (Besancon, France)

May 22–Jun 5: **Geometric analysis of One and Several Complex Variables** (RIT)

Organizers: Steven Krantz (Washington U. St. Louis), Joseph Cima (North Carolina), Ian Graham (Toronto), Kang-Tae Kim (Pohang Institute, Korea)

Jul 24–Aug 7: **Stability and Computations for Stochastic Delay Differential Equations** (RIT)

Organizers: Salah Mohammed (Southern Illinois), Evelyn Buckwar (Humboldt), Tony Shardlow (Manchester), Rachel Kuske (UBC)

Jul 25–Aug 22: **Modular Invariants and NIM-Representations** (RIT)

Organizers: Terry Gannon (Alberta), Matthias Gaberdiel (Kings College)

Mar 18–20: **Retreat on Mathematical Ecology and Evolution** (2-day workshop)

Organizers: Mark Lewis, Thomas Hillen (Alberta), Ed McCauley (Calgary), Michael Doebeli (UBC), Mark Kot (Washington)

Mar 25–27: **Human Infant Speech Perception and Language Acquisition** (2-day workshop)

Organizers: Janet Werker (UBC)

May 6–8: **Directions in Combinatorial Matrix Theory** (2-day workshop)

Organizers: Shaun Fallat, Steve Kirkland (Regina), Hadi Kharaghani (Lethbridge), Bryan Shader (Wyoming), Michael Tsatsomeros (Washington State), Pauline van den Driessche (Victoria)

May 12–14: **Decentralized Discrete Event Systems: Structure, Communication and Control** (2-day workshop)

Organizers: Peter Caines (McGill), Stephane Lafortune (Michigan), Laurie Ricker (Mount Allison), Karen Rudie (Queen's), John Thistle (Waterloo)

I. COLLABORATIVE RESEARCH GROUPS

As part of its second phase of development, PIMS is embarking on a plan that will create and support collaborative multi-university teams of mathematical scientists. These Collaborative Research Groups (CRGs) will pool talent across universities to form world-class research groups that will generate and sustain the scientific programme of PIMS in the years to come.

The research programmes of these groups will be supported through a new PIMS programme that supports concentrated activities in 5–10 research areas each year. This programme, run on a competitive basis, will support multi-site activities of selected CRGs over a 1–2 year period of concentration.

Upcoming Areas of Concentration: 2003–05

String Theory

Scientific Computing

Number Theory

Mathematical Ecology and Evolution

Topological Dynamics

Upcoming Areas of Concentration: 2004–06

Topology and Knot Theory

Probability and Statistical Mechanics

What is a PIMS CRG?

The CRGs typically consist of researchers with a common research interest and with a common desire to collaboratively develop some aspects of their research programmes. Groups may already be organizing joint seminars and workshops, making joint PDF appointments, or developing joint graduate training programmes. However, with the resources and organizational structure of PIMS they will be able to do considerably more.

The CRGs act as a vehicle for networking between universities. They effectively integrate the mathematical sciences community at the various PIMS universities into the scientific infrastructure of PIMS. They will build on already existing joint efforts and links between the researchers of Western Canada and the US Pacific Northwest thereby opening up a new era of scientific collaborations between the two countries. They will also will assume scientific leadership at the Banff Station and some will have the potential to lead industrial projects through the MITACS network.

The CRGs will create critical mass that will substantially enhance training programmes at all levels. The pooling of PIMS support with other sources and the joint planning of resource allocation will allow the CRGs to support a large number of PDFs and graduate students and will create new research opportunities for these young scientists, including exchanges, joint supervision, and summer schools.

The CRGs directly address the problems of retention and recruitment of faculty. They are a venue for new faculty to get plugged into a larger community, they give young faculty an effective network to build their research programme, and they enhance the attractiveness of the universities.

PIMS has identified 32 potential CRGs within its community, spanning five broad areas of research to which PIMS is committed: Fundamental Mathematics, Applied and computational Mathematics, Mathematical Biology and Medicine, Statistical Sciences and Theoretical Computer Science. While some are already well established and structured, in most cases they are just forming. Each CRG, which consists of 10–15 Canadian and US researchers, are to be jointly coordinated by at least 3 senior researchers representing various PIMS sites.

Periods of Concentrated activities for the CRGs

The Periods of Concentration are designed to promote and support longer term, multi-event, multi-site coordinated activities of competitively selected CRGs, in tandem with their national and international collaborators and visitors. Every year, the PIMS Scientific Review Panel will select on a competitive basis, up to 5 areas of research from those proposed by existing or developing CRGs. The selected areas will be the focus of much of the institute's programme over a 1–2 year period of concentrated activities that will be delivered through the selected CRGs. Thus, at any given time, as many as 10 CRGs may be leading the PIMS scientific enterprise. Proposals can vary greatly according to the needs of the particular group and may combine a number of existing PIMS activities. During its period of concentration, a CRG can expect to receive priority for:

- Thematic programmes and mini-programmes
- PIMS postdoctoral fellowships
- Pacific Northwest mini-conference series
- 5-day workshops at BIRS
- Focussed workshops at host universities
- Intensive two week graduate courses
- Distinguished chairs & long term visitors
- Graduate students exchanges
- Graduate & senior undergrad schools
- Industrial training camps
- International collaborations
- Research fellowships for teaching relief

With this support, a CRG can plan to gather a significant portion of the world's experts in its focus topic for periods of intense collaboration. The fruits of such intensity can be expected to persist for many years and to be exponentially greater than the results of more normal activity levels.

In due course, all 32 of the PIMS CRGs recognized so far would be given the benefit of a period of concentration. This approach should dramatically increase the effectiveness of the PIMS research programme by making its facilities and its opportunities available to all CRGs on a periodic basis.

Expected Impact of the Periods of Concentration

A targeted and coordinated, yet inclusive grass-roots approach of this form will present a new and innovative way for the institute to drive and stimulate research and will result in a significant impact on the research excellence of its activities. The programme's extended time scale, its multi-event nature and its cross-university character together distinguish it from any other institute programme. Its implementation will allow PIMS to achieve several of its goals. It will:

- Provide new ways of having its scientific programmes driven by its member scientists: The programme will help elicit proposals for thematic summers, miniprogrammes, BIRS events, and distinguished scholars as part of the application process. These programmes will have strong local interest and will encourage grass-roots generation and longterm planning of activities with a much more inclusive and flexible format than standard thematic programmes.
- Foster multi-site interactions and collaborations: The programme will continue to build the inter-site collaborative nature of the PIMS community and will alleviate the problems of interconnection inherent in large geographical separations between the PIMS sites. It creates a context through which researchers can collectively profit from the opportunities created by PIMS, BIRS and the MITACS network.
- Create new research opportunities and enhance training: The periods of concentration will allow for the planning of a series of advanced graduate courses at any one site with the participation of students from multiple PIMS universities. The Western Dean's agreement allows graduate students at any Western Canadian university to take courses, for credit, at any Canadian PIMS university. The result will be new opportunities for PIMS graduate students and a larger audience for PIMS and visiting scientists. This will directly lead to a vigorous graduate student exchange programme.
- Support existing collaborative research groups and foster new groups: The periods of concentration will help to strengthen groups and give them a vehicle for long-range planning of research and advanced education activities. As well it will encourage and empower isolated groups or smaller ones at one university by bringing them into larger collaborative teams.
- Effectively facilitate Canada-US collaborations: The programme will effectively integrate the mathematical sciences community at the U. of Washington into the operations of the institute. It will allow the 12 groups of Canadian and US researchers that are currently organizing the PNW Seminars to develop further their collaborative activities, and allow other groups to launch these types of activities. The programme will also provide researchers with the means to play a leadership role on the national and international level.
- Attract additional support for research: Periods of concentration will provide departments and universities with a mechanism for granting teaching and administrative releases to the scientists involved. Such programmes can also be developed in collaboration with other organizations and institutes, hence multiplying the opportunities.

Upcoming Areas of Concentration: 2003–05

String Theory

Recently, the concentration of research manpower in string theory and closely related fields in the communities associated with PIMS has reached a critical size so that it now has the potential to be a major player in the international research community. The purpose of this Period of Concentration in String Theory is to galvanize this group of researchers into a leading research unit. The members of this group already have a formal structure as a PIMS Collaborative Research Group. The Period of Concentration on String Theory gives this Group the resources to carry on a strong research programme at PIMS, to form a pan-Canadian network with the emerging groups at the University of Toronto and the Perimeter Institute and to communicate and collaborate with other string theory research groups worldwide.

The aim is to incubate significant original research in string theory and those areas of physics and mathematics that are influenced by string theory. The Period of Concentration will contribute by educating researchers on the latest developments in the field, encouraging and enhancing their research activity and providing a ready venue for dissemination of their results.

One essential part of this Period of Concentration consists of hiring Postdoctoral Fellows who help with the organization of events and participate actively in the research themes.

Members of the CRG: B. Campbell, V. Frolov, D. Page, T. Gannon (UA); G. Semenoff, M. Rozali, M. Van Raamsdonk, K. Schleich, D. Witt, M. Chop-tuik, W. Unruh, J. Bryan, K. Behrend (UBC); M. Walton (Lethbridge); R. Myers, L. Smolin (Perimeter Institute); K. Viswanathan (SFU); A. Peet (Toronto); and A. Karch (Washington).

A Glimpse ahead:

Ashoke Sen (Harish-Chandra Research Institute), PIMS Distinguished Chair, UBC, 2003.

PIMS Distinguished Chairs: The CRG will have another Distinguished Chair in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

Ehud Schreiber, PIMS Postdoctoral Fellow, UBC, 2003.

PIMS Postdoctoral Fellows: This CRG will include another PDF.

Pacific Northwest Seminars on String Theory: These seminars will continue in 2003 and 2004.

Frontiers of Mathematical Physics Summer School on String Theory, PIMS-UBC, July 14–25, 2003. PIMS, the Asia Pacific Center for Theoretical Physics and the Perimeter Institute are cosponsoring this summer school. This annual summer school will again concentrate on the most recent developments in string theory and related subjects.

Recent Developments in Superstring Theory, 5-day workshop, BIRS, March 15–20, 2003.

New Horizons in String Cosmology, 5-day workshop, BIRS, June 11–16, 2004.

String Field Theory Camp, Focused Research Group, BIRS, July 9–23, 2004.

Scientific Computing

The major goal of this period of concentration is to develop the group's common research programmes and to promote research in scientific computing and increase related interdisciplinary collaboration within the region. In addition, this period of increased activity in scientific computing provides a focus to kickstart and solidly establish SFU's Centre for Scientific Computing (CSC). The majority of the activity of this concentration period will take place at the PIMS sites at SFU, UW and UBC and at BIRS. The organizers are committed to organizing a number of activities which bring in the other PIMS sites as well.

A special feature of this period of concentration is the promotion of a multidisciplinary approach to the subject and the inclusion of important research topics such as the earth and atmospheric sciences.

Members of the CRG: R. Choksi, M. C. Kropinski, T. Möller, D. Muraki, K. Promislow, B. Russell, S. Ruuth, L. Trajkovic, M. Trummer, J. Verner, R. Zahar (SFU); Y. Lin, J. Macki, P. Mineev, Y. S. Wong (UA); U. Ascher, O. Dorn, S. Dunbar, I. Frigaard, A. Peirce, B. Seymour, B. Shizgal, J. Varah, M. Ward, B. Wetton, M. Yedlin (UBC); T. Ware, R. Westbrook (UC); D. Olesky, P. van den Driessche (UVic); R. LeVeque, L. Adams, D. Durran, A. Greenbaum, G. Hakim, N. Kutz, R. O'Malley, P. Schmid, J. Burke, C. Bretherton (Washington); R. Bradean, J. Kenna (Ballard); J. Lewis, S. Filipowski, M. Epton (Boeing); and S. Reddy (Quadrus Financial).

A Glimpse ahead:

PIMS Distinguished Chairs: The CRG will have two Distinguished Chairs in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2003 and two more in 2004.

Pacific Northwest Seminars on Numerical Analysis: These seminars will continue in 2003 and 2004 with approximately five seminars taking place each year.

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop, UBC, SFU, February 15-16 2003.

Computational Fuel Cell Dynamics—II, 5-day workshop, BIRS, April 19–24, 2003.

Computational Techniques for Moving Interfaces, 5-day workshop, BIRS, August 23–28, 2003.

Mathematical Foundations of Scientific Visualization, Computer Graphics and Massive Data Exploration, 5-day workshop, BIRS, May 21–26, 2004.

Number Theory

Number theory is one of the oldest, deepest and most vibrant branches of modern mathematics. It centrally incorporates some of the most sophisticated and profound mathematical ideas that have been developed (witness the recent proof of Fermat's Last Theorem)

and yet remains broadly useful in many areas of pure and applied mathematics. Indeed, it is remarkable how often number theory comes to bear both in other areas of mathematics and in applications. A notable recent example is cryptography and internet security whose protocols are based on number theoretic problems.

Number theory is particularly strong in Canada with the PIMS Number Theory Group featuring prominently. The PIMS Number Theory Group is large and well distributed in the PIMS Universities. It has a number of prominent senior world-class researchers leading a group of richly talented young mathematicians. The recent influx of new number theorists into several PIMS universities has created an exciting working group.

All areas of Number Theory will be dealt with in this concentration period, including computational and arithmetic aspects.

Members of the CRG: M. Bennett, D. Boyd, B. Casselman, R. Gupta, I. Laba, G. Martin, N. Vatsal (UBC); P. Borwein, I. Chen, S. Choi, P. Lisonek (SFU); R. Guy, J. Jones, R. Mollin, R. Scheidler, H. Williams (UC); R. Greenberg, A. Iovita, N. Koblitz, B. Solomyak (Washington); A. Akbary, O. Kihel (Lethbridge); E. Dobrowolski (College of New Caledonia); M. Klassen (DigiPen Inst of Tech); K. Lauter (Microsoft); and J. Lewis (UA).

A Glimpse ahead:

Jeffrey Vaaler (U. Texas), PIMS Distinguished Chair, SFU and UBC.

PIMS Distinguished Chairs: The CRG will have another Distinguished Chair in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2003 and two more in 2004.

Pacific Number Theory Northwest Seminars: These seminars will continue in 2003 and 2004 with approximately five taking place each year.

Summer School on Diophantine Number Theory, PIMS-SFU, Summer 2003.

The Many Aspects of Mahler's Measure, 5-day workshop, BIRS, April 26–May 01, 2003.

Current Trends in Arithmetic Geometry and Number Theory, 5-day workshop, BIRS, August 16–21, 2003.

Explicit Methods in Number Theory, 5-day workshop, BIRS, November 12–17, 2004.

Diophantine Approximation and Analytic Number Theory, 5-day workshop, BIRS, November 19–24, 2004.

Mathematical Ecology and Evolution

As the current revolution in biological information progresses, there is a well recognized need for new quantitative approaches and methods to solve problems in ecology. One challenge is to model complex ecological systems—systems which depend upon a myriad of inputs, but often with incomplete details regarding the inputs.

The primary goal of this period of concentration is to develop and strengthen the synergistic interactions between mathematics and ecology in PIMS universities.

Areas of mathematical ecology research at PIMS universities include: nonlinear population dynamics, spatially structured populations, adaptive dynamics, model selection and validation and inverse methods, stochastic models for populations, and scaling laws—from individuals to populations.

Members of the CRG: M. Boyce, T. Hillen, S. Lele, M. Lewis, M. Li, J. Roland, J. So (UA); E. McCauley (UC); F. Brauer, M. Doebeli, N. Heckman, L. Keshet, J. Zidek (UBC); J. Anderson, C. Bergstrom, D. Grunbaum, R. Hilborne, M. Kot (Washington); B. Roitberg (SFU); and P. van den Driessche (UVic).

A Glimpse ahead:

Bryan Grenfell (U. Cambridge), PIMS Distinguished Chair, U. Alberta.

PIMS Distinguished Chairs: The CRG will have another Distinguished Chair in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2003 and two more in 2004.

PIMS Mathematical Ecology and Biology Seminar Series: This seminar series will continue in 2003 and 2004 with at least six lectures taking place each year. The lectures will take place at U. Alberta and other PIMS sites.

Mathematics of Biological Systems Undergraduate Summer School, U. Alberta, May 2003.

Mathematical Biology: From Molecules to Ecosystems; The Legacy of Lee Segel, 5-day workshop, BIRS, July 5–10, 2003.

Retreat in Mathematical Ecology and Biology, 2-day meeting, BIRS, 2004.

Mathematical Models for Biological Invasions, 5-day workshop, BIRS, November 26–December 1, 2004.

Topological Dynamics

The study of dynamical systems has had a long and distinguished history in mathematics. This study has ranged from applications involving differential equations and information theory, to more theoretical work focusing on systems with topological or algebraic structure. In the past few decades this field has grown dramatically, and completely new directions have opened up.

Due to the diversity of the researchers in this CRG a wide range of topics will be covered including operator algebras, the dynamics of biological systems, and aperiodic order theory.

Members of the CRG: R. Moody, A. Lau, V. Runde, A. Weiss (UA); M. Lamoureux, B. Brenken, I. Nikolaev (UC); D. Lind, C. Hoffman, S. Rohde, B. Solomyak, S. Tuncel, M. Einsiedler (Washington); I. Putnam, J. Phillips, M. Laca, C. Bose, R. Edwards (UVic); K. Schmidt (Vienna); M. Boyle (Maryland); C. Deninger (Muenster); W. Parry (Warwick); and D. Rudolph (Maryland).

A Glimpse ahead:

PIMS Distinguished Chairs: The CRG will have two Distinguished Chairs in 2003 and two more in 2004. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2003 and two more in 2004.

PIMS Northwest Dynamics Symposium, U. Washington, 2003.

Summer School in Aperiodic Order, U. Victoria, 2004.

Coordinate Methods in Nonselfadjoint Operator Algebras, 5-day workshop, BIRS, December 13–18, 2003.

Aperiodic Order; Dynamical systems, Combinatorics and Operators, 5-day workshop, BIRS, May 28–June 2, 2004.

Upcoming Areas of Concentration: 2004–06

Topology and Knot Theory

The PIMS community has an active group of researchers in topology and related fields. Their research may be roughly divided into two major themes: geometric and algebraic. Among the geometric issues being studied by PIMS topologists are the classification of manifolds (particularly in dimension 3 and 4), group actions on Riemann surfaces, knot theory and its applications, and relating 3-manifold topology to relativity theory. A sample of the contributions in algebraic topology are: application of algebraic topology to robotics, developing equivariant minimal models in homotopy theory, applying subtle algebraic properties of projective spaces and bundles to solve classical problems in quadratic forms and combinatorics. Because of their geographic separation and diversity of interests, this community of scientists is particularly well-served by forming a collaborative research group.

Members of the CRG: G. Peschke, J. Timourian (U. Alberta); J. Bryan, K. Lam, D. Rolfsen, L. Scull,

D. Sjerve (UBC); K. Varadarajan, P. Zvengrowski (U. Calgary); E. Babson, E. Devinatz, M. Freedman, S. Mitchell, J. Palmieri, J. Segal (U. Washington).

A Glimpse ahead:

PIMS Distinguished Chairs: The CRG will have two Distinguished Chairs in 2004. One will be based at UBC and the other at U. Calgary. These chairs will visit the group for at least one month and give a minicourse of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2004.

“Knots at PIMS” Miniprogramme, UBC, 2 weeks, 2004.

MSRI-PIMS Summer Graduate Course, UBC, 2 weeks, 2004.

Topology of Manifolds and Homotopy Theory, 5-day workshop, BIRS, March 19–24, 2004.

Knots and their Manifold Stories, 5-day workshop, BIRS, May 7–12, 2004.

Braid Groups and Applications, 5-day workshop, BIRS, October 15–20, 2004.

Cascade Topology Seminar, 2-day meeting, BIRS, 2004.

Probability and Statistical Mechanics

Much of the original motivation for the study of spatially interactive stochastic systems came from stochastic models in statistical physics. An intensive area of recent research centers around the idea that complex local dynamics can lead to a small number of well-understood continuum models upon space-time rescaling. When the underlying system is at or near criticality the limit invariably seems to be closely related to super-Brownian motion.

Other local interactions arising in models for competing species, predator-prey systems or symbiotic branching lead to more complex stochastic models which behave locally like superprocesses but with branching, migration and drift coefficients which depend on the current state of the system. Two challenging and related topics are therefore:

I. The development of a general theory of interactive superprocesses and in particular methods to characterize these processes and study their properties.

II. The use of such models in mathematical ecology and evolution.

Members of the CRG: D. Brydges, J. Feldman, G. Slade, M. Barlow, E. Perkins, J. Walsh (UBC); B. Schmuland, M. Kouritzin (U. Alberta); C. Burdzy, Z.-Q. Chen, B. Erickson, S. Rohde (U. Washington); J. Chayes, C. Borgs, O. Schramm, D. Wilson (Microsoft Research); C. Soteros, R. Srinivasan (U. Saskatchewan); R. van der Hofstad (Eurandon); Don Dawson (McGill).

A Glimpse ahead:

PIMS Distinguished Chairs: The CRG will have two Distinguished Chairs in 2004. These chairs will

visit the group for at least one month and give a mini-course of lectures.

PIMS Postdoctoral Fellows: This CRG will include two PDFs in 2004.

Pacific Northwest Statistics Meeting: These seminars will be part of this CRG in 2004 with at least two seminars taking place.

PIMS Summer School in Loewner Evolution, UBC, 2004.

Seminar on Stochastic Processes, 2004.

Statistical Mechanics of Polymer Models, 5-day workshop, BIRS, May 10–15, 2003.

Stochastic Partial Differential Equations, 5-day workshop, BIRS, September 27–October 2, 2003.

Analytic and Geometric Aspects of Stochastic Processes, 5-day workshop, BIRS, April 9–14, 2004.

II. THEMATIC PROGRAMMES

The **Asymptotic Geometric Analysis 2002 Thematic Programme** organising committee: Vitali Milman (Tel Aviv), Nicole Tomczak-Jaegermann (U. Alberta) and Gideon Schechman (Weizmann Institute). Missing from photo Nassif Ghoussoub (PIMS and UBC) and Robert McCann (U. Toronto).



International Conference on Robust Statistics (ICORS 2002) participants during their excursion to Capilano. ICORS was part of the **2002 Thematic Programme on Selected Topics in Mathematical and Industrial Statistics**.

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** which was part of the **2001 PIMS Thematic Programme in Nonlinear PDEs**.



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 propagation, and related phenomena. 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 PDEs,
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 programme 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 minicourses of up to four hours each. These ran in the morning and targeted mainly graduate students, post-docs and all nonspecialists who were interested in learning new active directions of research. In addition, about 25 one-hour lectures were selected and invited for each workshop by the programme committee.

Viscosity Methods in PDEs, 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 solu-

tions 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 nonstandard 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.

Minicourse Lecturers:

Xavier Cabré (Universitat Politecnica de Catalunya) 2 lectures on *Non-Convex 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 Non-linear 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 (Norwegian 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 (Università 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 Vladimirovsky (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.

Minicourse 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 U., Bloomington): *The Semi-Classical Limit of Schrodinger-Poisson to Vlasov-Poisson Equations*

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

Xavier Cabré (Universitat Politècnica 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 (U. Tennessee Knoxville): *Motion By Surface Tension In Curved Ambient Space*

Peter Sternberg (Indiana U., 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): *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): *Energy Equilibria of the Copolymer Problem*

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

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

Changfeng Gui (UBC): *About the De Giorgi conjecture in dimensions 4 and 5*

Michelle Schatzman (U. 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): *Dynamics of interfaces for domain growth problems*

Xuefeng Wang (Tulane): *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 variational methods involved. Related equations include Ginzburg-Landau equations, nonlinear Schrödinger equations, Gierer-Meinhardt systems, and others.

Minicourse 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 (UBC), 2 lectures on *Diffusions, cross-diffusions, and their steady states*

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

Main Speakers:

Robert Jerrard (U. Illinois, Urbana-Champaign): *Vortex filament dynamics for the Gross-Pitaevsky equation*

Yuan Lou (Ohio State): *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 Schrödinger 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 (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 Ginzburg-Landau and related equations*

Changfeng Gui (UBC): *Diffusions, cross-diffusions, and their steady states*

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

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

Patricio Felmer (U. 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 (Connecticut)

Jack Xin (U. Texas, Austin): *Focusing PDEs and their Applications in Optics and Speech Processing*

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

Salome Martinez (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 (UBC): *The Dynamics of Spikes for the Gierer-Meinhardt Model (joint work with David Iron (UBC grad student), Juncheng Wei (Chinese U. 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 and Mathematical Physics, PIMS-UBC, July 30–August 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, Hamiltonian systems, pattern formation, fluid dynamics, Riemannian geometry, etc., as they are used to answer questions about existence, multiplicity, location, asymptotics, concentration, etc.

Minicourse Lecturers:

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

Eric Séré (U. 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 di Pisa): *Variational principles for Lorentz invariant field equations*

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

Robert McCann (U. 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 (U. de Chile): *Peaks and Multipeaks for Nonlinear Schrodinger equation: A Variational Approach*

Nassif Ghoussoub (PIMS): *On De Giorgi’s conjecture in dimensions 4 and 5*

Ugo Bessi (Università degli studi Roma III):

Gero Friesecke (Oxford): *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 (U. degli studi di Milano): *On a result by Carleson-Chang concerning the Trudinger-Moser inequality*

Pietro Majer (Università di Parma):

Sergey Bolotin (U. 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 behaviour for rapidly oscillating Hamiltonian systems*

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

Eric Patrel (Université Paris IX).

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

Chao-Nien Chen (National Changhua U. of Education)

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

Patrick Bernard (École Normale Supérieure)

Paul Rabinowitz (U. 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 Kähler-Einstein manifolds, minimal surfaces, scalar curvature, harmonic maps, and other phenomena.

Minicourse Lecturers:

Cliff Taubes (Harvard University), 4 lectures on *Pseudoholomorphic geometry as a tool to study smooth 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*



Gang Tian (MIT), Clifford Taubes (Harvard), Rick Schoen (Stanford) and Jingyi Chen (UBC).

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

Jim Bryan (UBC), *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 Autónoma de Madrid), *Hamiltonian Gromov-Witten invariants*

Peter Li (UC, 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 (UC, 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 (UBC), *Quaternionic maps between hyperkähler manifolds.*

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 behaviour 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 modelling and computational fluid dynamics.

The summer school was particularly rewarding for the students since it was held in conjunction with the PIMS Thematic Programme.

Invited Speakers:

T. G. Shepherd (Toronto): *The Fluid Dynamics of the Middle Atmosphere*

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

Core Lecturers from University of 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, June 11–15, 2001**

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

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.



P. L. Sachdev

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.

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, U. Alberta) who emphasized the important role that has been played in the mathematics community by PIMS and how meetings of this calibre wouldn't be possible without PIMS' support.



Colin Rogers (New South Wales) and T. Bryant Moodie (Alberta)

Plenary Speakers:

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

Jerry L. Bona (U. Texas, Austin): *Nearshore Zone Dynamics and Beach Protection*

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

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

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

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

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

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

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

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

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

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

A. Newell (Warwick): *Wave Turbulence and Intermittency*

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

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

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

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

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

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

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

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

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

A complete list of speakers together with their abstracts, contact information, and pictures can be found at <http://waves3.math.ualberta.ca>.

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

Organizers: Giovanni P. Galdi (Pittsburgh), John Heywood (UBC, Chair), 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 methods to problems for compressible and nonlinear fluids, and also to the modelling 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.

Main Speakers:

Herbert Amann (Institute for Mathematics, Zurich): *Navier-Stokes equations in spaces of low regularity*

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

Markus Bause (U. Erlangen): *Approximation schemes for stationary compressible viscous flow*

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

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

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

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

Reinhard Farwig (Inst. Tech. Darmstadt): *Maximal Regularity of the Stokes Operator in an Infinite Cylinder*

Robert Finn (Stanford): *Six remarkable properties of capillary surfaces*

Ian Frigaard (UBC): *Stability problems in parallel shear flows of visco-plastic fluids*

Hiroshi Fujita (Tokai U.): *Nonlinear Semi-group Theory and Nonstationary Stokes Flows under Boundary Conditions of Friction Type*

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

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

Ronald Guenther (Oregon State): *Hydrodynamic Forces and Torques on Submerged Rigid Bodies - Steady Flow*

Claus Heine (Inst. Tech. Aachen): *A Numerical Method for Shape and Stability of the Rotating Drop*

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

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

Reinhard Illner (U. Victoria): *Diffusive equilibria in granular flow*

Nicholas Kevlahan (McMaster): *An adaptive wavelet method for fluid-structure interaction*

Dietmar Kroener (Freiburg): *Transparent boundary conditions for compressible flows*

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

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

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

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

Wayne Nagata (UBC): *Bifurcations on spheres and hemispheres: convection in planets and branching of plant tips*

Jindrich Necas (Charles U., Prague): *Global Analysis for fluids with pressure dependent viscosities*

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

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

Mariarosaria Padula (Ferrara): *Stability of an isolated fluid drop rotating with finite angular velocity*

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

Olivier Pironneau (Montpellier II and Paris VI): *Optimal Shape Design with Turbulent flows*

Rolf Rannacher (Heidelberg): *Adaptive discretization in optimal control of flows*

Reimund Rautmann (Paderborn): *Navier-Stokes Approximations in Interpolation Spaces*

Niko Sauer (Pretoria): *A model for boundary permeation*

Okiihiro Sawada (Hokkaido): *Global existence of two-dimensional Navier-Stokes flow with nondecaying initial velocity*

Maria Schonbek (UC, Santa Cruz): *On zero mass solutions of viscous conservation laws*

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

David Siegel (Waterloo): *Equilibrium Configurations For A Floating Drop*

Ivan Straskraba (Math. Inst., Czech Academy of Sciences): *A brief summary of global properties of solutions to the compressible Navier-Stokes equations*

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

Stefan Turek (Dortmund): *On the next generation of CFD Tools*

Michael Wiegner (Inst. Tech. Aachen): *The Stokes Semi-group on an Infinite Layer*

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.
- *Asymptotic Combinatorics* including questions in Complexity Theory and Computational Geometry.
- Certain aspects of *Statistical Physics* that deal 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, University of Alberta)

Nassif Ghoussoub (PIMS and UBC)

Robert McCann (University of Toronto)

Gideon Schechtman (Weizmann Institute)

Programme

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

Conference on Phenomena of Large Dimension,
PIMS-UBC, July 14–23, 2002

Focused Research Groups on Random Methods and High Dimensional Systems,
PIMS-UBC, July 24–August 5, 2002

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

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

The goal of this thematic programme is to bring together some areas of Mathematics and Computer Science which are dealing with asymptotic behaviour of different parameters when the dimension, or a number of other relevant free parameters, increases to infinity.

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. This field is multidisciplinary in nature, typically combining geometric, analytic, probabilistic and combinatorial methods.



Fields medallist Jean Bourgain, IAS.

This Thematic Programme brought together over 220 senior experts, young researchers, post-docs and advanced Ph.D. students from mathematics and computer science. Represented among the programme of speakers were laureates of many different honours and prizes, such as the Fields Medal, Nevanlinna Prize, Wolf Prize, Salem Prize,

Ostrowski Prize, and many others. The flavour of the Workshop may be felt from the following examples of speakers and directions (in broad categories and listed in every group alphabetically). Many more talks in every direction were, in fact, given.

One-hundred and ten of the lectures in the programme were taped and are available in both streaming realvideo and MP3 format. This provided an online resource to conference participants, by allowing them to review previous lectures throughout the programme. To provide a resource to the mathematics community at large, we have now made entire collection of taped lectures available from the main Thematic Programme web page given above and from the PIMS online lecture archive, <http://www.pims.math.ca/video>.

For the complete list of participants and lectures please see the Thematic Programme web page, <http://www.pims.math.ca/aga>.

The main directions of study were convex geo-

metric 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. A number of lectures were also given on closely connected subjects in probability and nonlinear PDEs arising in convex analysis and geometric inequalities.

The programme was strongly connected thematically with many of the lectures illustrating the crossover between these fields. Most of the participants took advantage of this by attending a number of the sessions in the programme.



AGA participants enjoying a reception at PIMS.

Additional support for this Thematic Programme was provided by the CRC grant of Nicole Tomczak-Jaegermann, by the NSF conference grants of Erwin Lutwak and Ted Odell, and by Microsoft.

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).

The programme opened with the Conference on Convexity and Asymptotic Theory of Normed Spaces. Lasting one week, from July 1–5, this conference featured lectures on classical convexity theory, Radon transforms and Fourier methods in convexity, asymptotic theory of high dimensional convex bodies, geometric functional inequalities, probabilistic methods in Convexity, and isoperimetric-type inequalities

The following lectures in the conference were taped and are available from the web site <http://www.pims.math.ca/video>:

Keith Ball (U. College London): *Convolution Inequalities in Convex Geometry*

Mohammad Ghomi (U. South Carolina): *A Survey of Some Recent Convexity Results and Problems in Classical Differential Geometry*

Peter Gruber (Technische U.): *Optimal Quantization*

Erwin Lutwak (Polytechnic U.): *L_p -curvature*

Vitali Milman (Tel Aviv): *Are Randomizing Properties of any Two Convex Bodies Similar?*

Gideon Schechtman (The Weizmann Institute): *Non Linear Type and Pisier's Inequality*

Rolf Schneider (U. Freiburg): *Mixture of Convex Bodies*

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

Organizer: Robert McCann (U. Toronto).

The second week of the Thematic Programme was devoted to the Concentration Period on Measure Transportation and Geometric Inequalities. The focus was on transportation of measure methods and their applications, including concentration of measure phenomenon, geometric functional inequalities (Brascamp-Lieb, Sobolev, entropy, Cramer-Crao and the like), and probabilistic methods. This concentration period was organized with a slightly lighter lecture schedule to allow ample time for extensive informal discussions between lectures.

The following lectures were taped:

Shiri Artstein (Tel Aviv): *Entropy increases at every step*

Keith Ball (U. College London): *Entropy growth for sums of IID random variables*

Franck Barthe (U. Marne-la-Valle): *Optimal Measure Transportation**

Gordon Blower (Lancaster): *Almost sure weak convergence and concentration for the circular ensembles of Dyson*

Christer Borell (Chalmers U.): *On risk aversion and optimal terminal wealth*

Yann Brenier (CNRS): *Density and current interpolation*

Jose A. Carrillo (U. de Granada): *Asymptotic behaviour of fast diffusion equations*

Jochen Denzler (U. Tennessee): *Fast Diffusion to self-similarity: complete spectrum, long-time asymptotics and numerology*

Michel Ledoux (U. Toulouse): *Measure Concentration, Transportation Cost, and Functional Inequalities*

Robert McCann (U. Toronto): *Nonlinear diffusion to self-similarity: spreading versus shape via gradient flow*

Vitali Milman (Tel Aviv): *Geometric inequalities of hyperbolic type*

Assaf Naor (Microsoft Corporation): *Entropy jumps in the presence of a spectral gap*

Roland Speicher (Queen's): *Free probability and free diffusion*

Van Vu (UC, San Diego): *Concentration of non-Lipschitz functions and combinatorial applications*

Qinglan Xia (Rice): *Optimal paths related to transport problems*

Conference on Phenomena of Large Dimensions PIMS-UBC, July 14–23, 2002

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

The main topics covered in the lectures were different phenomena observed in complexity theory, asymptotic combinatorics, asymptotic convexity, statistical physics and other theories of very high parametric families (or large dimensional spaces).

The following lectures were taped:

Noga Alon (Tel Aviv U.): *(n, d, λ) -graphs in Extremal Combinatorics*

Imre Barany (U. College London): *Sylvester's Question, Convex Bodies, Limit Shape*

Franck Barthe (U. de Marne la Vallee): *Transportation versus Rearrangement*

Alexander Barvinok (U. Michigan): *How to Compute a Norm?*

Noam Berger (UC, Berkeley): *Phase Transition for the Biased Random Walk on Percolation Clusters*

Christian Borgs (Microsoft Research): *Phase Transition in the Random Partitioning Problem*

Jean Bourgain (IAS): *New Results on Green's Functions and Spectra for Discrete Schroedinger Operators*

Yann Brenier (CNRS): *On Optimal Transportation Theory*

Mei-Chu Chang (UC, Riverside): *Recent Results in Combinatorial Number Theory*

Jennifer Chayes (Microsoft Research): *Graphical Models of the Internet and the Web*

Marianna Csornyei (U. College London): *Structure of null sets and related problems of geometric measure theory*

Apostolos Giannopoulos (Crete): *Random Sections and Random Rotations of High Dimensional Convex Bodies*

Efim Gluskin (Tel Aviv U.): *On the Sections of Product Spaces and Related Topics*

Jeong Han Kim (Microsoft Research): *The Poisson Cloning Model for Random Graphs with Applications to k -core Problems, Random 2-SAT, and Random Digraphs*

Gil Kalai (Hebrew U.): *Results and Problems around Boruk's Conjecture*

Ravindran Kannan (Yale): *Random Submatrices of a Given Matrix*

Yoshiharu Kohyaku (U. San Paulo): *The Regularity Lemma for Sparse Graphs*

Michael Krivelevich (Tel Aviv U.): *Algorithmic Applications of Graph Eigenvalues and Related Parameters*

Izabella Laba (UBC): *Tiling Problems and Spectral Sets*

Rafal Latała (Warsaw U.): *Some Estimates of Norms of Random Matrices (non iid case)*

Laszlo Lovasz (Microsoft Research): *Discrete Analytic Functions and Global Information from Local Observation*

Colin McDiarmid (Oxford U.): *Concentration and Random Permutations*

Vitali Milman (Tel Aviv U.): *Some phenomena of large dimension in Convex Geometric Analysis*

Assaf Naor (Microsoft): *Metric Ramsey-Type Phenomena*

Krzysztof Oleszkiewicz (Warsaw U.): *On a Non-symmetric Version of the Khinchine-Kahane Inequality*

Leonid Pastur (U. Pierre & Marie Curie): *Some Large Dimension Problems of Mathematical Physics*

Bruce Reed (McGill U.): *Crayola and Dice: Graph Colouring via the Probabilistic Method*

Andrzej Rucinski (Adam Mickiewicz U.): *Ramsey Properties of Random Structures*

Mark Rudelson (U. Missouri): *Distances between Sections of Convex Bodies*

Shmuel Safra (Tel Aviv U.): *Probabilistically Checkable Proofs (PCP) and Hardness of Approximation*

Gideon Schechtman (The Weizmann Institute): *l_p^n , $1 < p < 2$, well embed in $l_1^{a^n}$, for any $a > 1$*

Miklos Simonovits (Hungarian Academy of Science): *Introduction to the Szemerédi Regularity Lemma*

Gordon Slade (UBC): *The Percolation Phase Transition on the n -cube*

Mikhail Sodin (Tel Aviv U.): *Zeroes of Random Analytic Functions*

Alexander Soshnikov (UC, Davis): *On the Largest Eigenvalue of a Random Subgraph of the Hypercube*

Benjamin Sudakov (Princeton U.): *On the Ramsey- and Turan-type Problems*

Stanislaw Szarek (U. Paris VI): *On Pseudorandom Matrices*

Nicole Tomczak-Jaegermann (U. Alberta): *Families of Random Sections of Convex Bodies*

Van Vu (UC, San Diego): *Divide and Conquer Martingales and Thin Waring Bases*

Avi Wigderson (IAS): *Expander Graphs - where Combinatorics and Algebra Compete and Cooperate*

Focused Research Groups on Random Methods and High Dimensional Systems PIMS-UBC, July 24–August 5, 2002

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

Participants took advantage of this period to discuss previous lectures in the programme and to work in new directions. Furthermore, Gideon Schechtman (Weizmann Institute) and Alexander Litvak (U. Alberta) each organized an informal series of lectures during this period.

The following lectures were taped:

Keith Ball (U. College London): *There are infinitely many irrational values of the zeta function at the odd integers*

Jean Bourgain (IAS): *New Results on Green's Functions and Spectra for Discrete Schroedinger Operators*

Yehoram Gordon (Haifa): *Applications of zonoids to Asymptotic Geometric Analysis*

Izabella Laba (UBC): *The Kakeya conjecture (Parts 1, 2)*

Rolf Schneider (Freiburg): *Stability of uniqueness results for convex bodies*

Rolf Schneider (Freiburg): *Minkowski's existence theorem and some applications*

Alexander Soshnikov (Davis): *Random Matrices: Gaussian Unitary Ensemble and Beyond (Parts 1–3)*

Conference 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 addressed in this conference related to the distribution of eigenvalues of random matrices, norms of such matrices, some aspects of free and quantum information theories, quantized functional analysis and operator spaces, and non-commutative L_p spaces.

The following lectures were taped:

David Blecher (Houston): *Noncommutative M -structure and the interplay of algebra and norm for operator algebras*

Edward Effros (UCLA): *Operator spaces as “quantized” Banach spaces*

Alexander Gamburd (Stanford): *Random Matrices and Magic Squares*

Kenley Jung (Berkeley): *Free Entropy Dimension and Hyperfinite von Neumann algebras*

Marius Junge (Urbana): *The central limit procedure for noncommuting random variables and applications*

Franz Lehner (Graz): *A Good formula for noncommutative cumulants*

Christian Le Merdy (Besançon): *Holomorphic functional calculus and square functions on non-commutative L_p -spaces*

Alexandru Nica (Waterloo): *A_2 -point functions for multi-matrix models, and non-crossing partitions in an annulus*

Eric Ricard (Paris 6): *Hilbertian Operator spaces with few completely bounded maps*

Haskell Rosenthal (Austin): *Can non-commutative L^p spaces be renormed to be stable?*

Zhong Jin Ruan (Urbana): *On Real Operator Spaces*

Mary Beth Ruskai (Lowell): *The Role of Maximal L_p Bounds in Quantum Information Theory*

Alexander Soshnikov (UC, Davis): *Determinantal Random Point Fields*

Roland Speicher (Queen's U., Kingston): *Maximization of free entropy*

Quanhua Xu (U. de Franche-Comté): *On the maximality of subdiagonal algebras*

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

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

The programme closed with the Conference on Banach Spaces. Unfortunately, personal circumstances required Bill Johnson to cancel his participation at the last minute and his presence was greatly missed. This conference focused on the asymptotic theory of Banach spaces and other applications of local theory to the geometry of infinite dimensional Banach spaces.

The following lectures were taped:

George Androulakis (U. South Carolina): *The method of minimal vectors*

Yoav Benyamini (Technion): *An introduction to the uniform classification of Banach spaces*

Vassiliki Farmaki (Athens U.): *Baire-1 functions and spreading models*

Tadek Figiel (Polish Academy of Sciences): *Selecting unconditional basic sequences*

Mark Hoffman (U. Missouri): *The Banach envelope of Paley-Wiener type spaces E_p for $0 < p < 1$*

Alexander Koldobsky (U. Missouri-Columbia): *Fourier analytic tools in the study of sections and projections of convex bodies*

Tamara Kuchurenko (U. Missouri): *Weak topologies and properties that are fulfilled almost everywhere*

Joram Lindenstrauss (Hebrew U.): *On Frechet differentiability of Lipschitz functions, parts I and II*

Narcisse Randrianantoanina (Miami U.): *Weak type inequalities for non-commutative martingales*

Thomas Schlumprecht (Texas A & M U.): *How many operators do there exist on a Banach space?*

Lior Tzafriri (Hebrew U.): *Λ_p sets for some orthogonal systems*

Vaclav Zizler (U. Alberta): *Sigma shrinking Markushevich bases and Corson compacts*

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, such as databases with outliers, gross errors or missing data. 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:

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

Programme:

International Conference on Robust Statistics (ICORS 2002)

UBC, May 12–18, 2002

3rd MITACS Annual General Meeting: Statistics for Large Scale Industrial Modelling

UBC, Vancouver, May 23–25, 2002

Design and Analysis of Experiments

Vancouver, July 14–18, 2002

PIMS-MITACS Workshop on Filtering Theory and Applications

Edmonton and Jasper, July 25–30, 2002

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

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

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

The conference touched upon many different aspects of data analysis in a fashion which integrates theoretical and applied statistics. One focus was the efficient computation of robust estimates using very large data sets.



The organisers of ICORS: Chris Field (Dalhousie), Luisa Fernholz (Temple) and Ruben Zamar (UBC). Missing from photo Ursula Gather (Dortmund).

Nearly 100 researchers from 10 different countries participated in ICORS 2002, which was hosted by PIMS and jointly sponsored by PIMS, MINERVA Research Foundation (USA) and SBF 475 at University of Dortmund (Germany).

ICORS 2002 was then followed up by a weekend Workshop on Computational Robustness hosted by PIMS and cosponsored by NSF.

The videos of the following lectures are available from <http://www.pims.math.ca/icors2002/>.

Claudia Becker (U. Dortmund): *Dimension Reduction and Nonparametric Regression: A Robust Combination*

Tadeusz Bednarski (U. Zielona Gora): *Robust Inference for the Cox Model*

Graciela Boente (U. Buenos Aires): *Robust Estimators in Partly Linear Models*

David Brillinger (UC, Berkeley): *John Tukey and "Troubled" Time Series Data*

Christophe Croux (U. Leuven): *On the Bianco-Yohai Estimator for High Breakdown Logistic Regression*

Laurie Davies (U. Essen): *Breakdown and Groups*

Peter Filzmoser (Vienna Tech): *Robust Factor Analysis*

Xuming He (U. Illinois at Urbana-Champaign): *Straight Talks about Robust Methods*

Karen Kafadar (U. Colorado): *Statistical Analysis of Microarray Data from Affymetrix Gene Chips*

Ricardo Maronna (U. Nacional de La Plata): *Approaches to Robust Multivariate Estimation Based on Projections*

Doug Martin (U. Washington and Insightful): *Robust Statistics in Portfolio Optimization*

Stephan Morgenthaler (École Polytechnique Fédérale de Lausanne): *The Multihalver*

Raymond Ng (UBC): *Robust Space Transformations for Distance-based Outliers*

David Rocke (UC, Davis): *Multivariate Outlier Detection and Cluster Identification*

Elvezio Ronchetti (U. Geneva): *Resistant Parametric and Nonparametric Modelling in Finance*

Peter Rousseeuw (U. Antwerp): *Robustness Against Separation and Outliers in Binary Regression*

Matias Salibian-Barrera (Carleton U.): *Estimating the p-values of Robust Tests for the Linear Model*

Arnold J. Stromberg (U. Kentucky): *Computational Issues in Robust Statistics*

David Tyler (Rutgers U.): *High Breakdown Point Multivariate M-Estimation*

Jane-Ling Wang (UC, Davis): *Semiparametric Random Effects Models for Longitudinal Data*

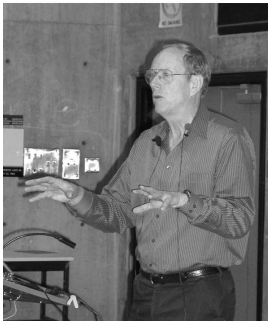
Doug Wiens (U. Alberta): *Robust, Sequential Design Strategies*

Victor Yohai (U. Buenos Aires): *High Breakdown Point Robust Regression with Censored Data*

Julie Zhou (U. Victoria): *Robustness Issues for Confidence Intervals*

3rd MITACS Annual General Meeting: Statistics for Large Scale Industrial Modelling, UBC, May 23–25, 2002

Conference Organisers: Arvind Gupta (MITACS), Nassif Ghoussoub (PIMS), Ken Davidson (Fields Institute) and Jacques Hurtubise (CRM).



Ron Graham (UC, San Diego)

exhibition and competition, administrative meetings and social gatherings.

The AGM Exhibition commenced on Thursday morning, when students and post-docs began mounting over 70 posters and demos. Eight posters earned prizes, which consisted of plaques and cash awards. Three companies generously sponsored the first place prizes: Object Technology International, Inc.; StemCell Technologies Inc.; and Alcatel.



Anil Jain (Michigan State)

Tondeur gave talks that emphasized the importance of mathematical research to society at large.

The plenary speakers were:

Ron Graham (UC, San Diego): *Guessing Secrets*

The 3rd MITACS Annual General Meeting brought together over 350 students, researchers and industrial representatives from across Canada and the United States. The participants enjoyed a range of activities that included lectures,



Gilbert Strang (MIT)

Indira Samarasekera (VP Research, UBC) gave the opening address of the welcoming reception at UBC's Museum of Anthropology. The conference banquet had in attendance Arthur Carty (President, NRC) and Philippe Tondeur (Director, Division of Mathematical Sciences, NSF). Both Carty and

Anil Jain (Michigan State): *Fingerprint Matching*

Gilbert Strang (MIT): *Filtering and Signal Processing*

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 followup 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 non-linear models or for computer modelling and finite element analysis.

The purpose of the PIMS Workshop on Design and Analysis of Experiments (DAE 1) was to begin a series of workshops to provide support and encouragement to junior researchers in the field of design and analysis of experiments, and to stimulate interest in topics of practical relevance to science and industry. In the summer of 2000, researchers from North America and abroad in the area of experimental design, including a large group of young talented new researchers, attended the First Midwest Conference for New Directions in Experimental Design in Columbus, Ohio organized by Angela Dean at Ohio State University, Kathryn Chaloner at the University of Minnesota, Dibyen Majumdar at the University of

Illinois Chicago and Dennis Lin at Penn State University. This workshop had a focus on applications of design in industry and was well received. It was sponsored by the National Science Foundation, the Ohio State University and Executive Jet Corp with a small award from Stat-Ease. A discussion group reached consensus that a series of similar workshops should be held every 2 or 3 years at different locations in North America. DAE 1 is the first workshop in this series in Canada. The bulk of its sponsorship came from PIMS with an additional contribution from Graduate Studies at SFU.

The next workshop in the series is being organized by Angela Dean, Kathryn Chaloner and Dibyen Majumdar and will be held in Chicago in 2003 (New Directions in Experimental Design, DAE2003, May 15-18, Chicago), with focus on medical applications. There was a roundtable discussion during the DAE 1 workshop in Vancouver to discuss general future structure and to determine interest among volunteers to host and organize the next in the series, following Chicago. This resulted in a commitment from researchers at Los Alamos National Laboratories to host DAE 3 in 2005 in Sante Fae, NM. Thus the PIMS support for this initial endeavour appears to have achieved its goal. An infrastructure and framework was established for a continuing such series at locations throughout North America to be held about every 2 years.

The DAE 1 workshop itself was a huge success. The invited speakers, the invited poster presenters and the attendees represented precisely the cross-section of young junior researchers and experienced world leaders in areas of both design and analysis of experiments that was hoped for. Visitors travelled from various sites in Canada and the US, as well as from Belgium, Sweden, Germany, the Netherlands, Italy, the United Kingdom, New Zealand and Taiwan; and represented both academia and industry. The talks and posters included such wide-ranging topics as Computer Intensive Methods for Design Selection, Design of Experiments in Bioinformatics, Drug Discovery and Marketing, Mathematical Theory of Design Construction and Bayesian Analysis of Designed Experiments, and represented leading research in these areas.

Invited Speakers:

Sabyasachi Basu (Boeing)
Scott Beattie (Eli Lilly)
Ching-Shui Cheng (UC Berkeley)
Shaowei Cheng (Academia Sinica, Taiwan)
Abdel El-Shawaari (National Water Research Institute)
Valeri Fedorov (Smith Kline)
Paul Green (Wharton School, Penn State)
Mike Hamada (Los Alamos National Labs)
Joel Huber (Wharton School, Penn State)
David Hunter (Penn State)
Stephen Jones (Boeing)
Abba Krieger (Wharton School, Penn State)
Warren Kuhfeld (SAS Institute)
Raymond Lam (GlaxoSmithKline)
Nhu Le (BC Cancer Agency)
Robert Mee (U. Tennessee-Knoxville)
Saumen Mandal (U. Manitoba)
Max Morris (Iowa State)
Bill Notz (Ohio State)
Greg Piepel (Pacific Northwest Labs-Battelle)
Giovanni Pistone (Politecnico di Torino)
Shane Reese (Brigham Young)
Louis-Paul Rivest (Laval U.)
Kirti Shah (U. Waterloo)
Bikas Sinha (U. Waterloo)
John Stufken (Iowa State)
Winson Taam (Boeing)
Boxin Tang (Memphis State)
Randy Tobias (SAS Institute)
Ben Torsney (University of Glasgow)
Joe Voelkel (Rochester Institute of Technology)
Marcia Wang (U. Waterloo)
C.F. Jeff Wu (U. Michigan)
Huaiqing Wu (Iowa State)
Don Ylvisaker (UCLA)
Kenny Ye (SUNY-Stony Brook)
Hongquan Xu (UCLA)
Hongtu Zhu (U. Victoria)
Lei Zhu (GlaxoSmithKline)
Jim Zidek (UBC)

PIMS-MITACS Workshop on Filtering Theory and Applications Edmonton and Jasper, July 25–30, 2002

Organisers: Robert Elliott (U. Calgary), Michael Kouritzin (U. Alberta), Tom Kurtz (U. Wisconsin-Madison) and Hongwei Long (U. Alberta).



Gopi Kallianpur (U. North Carolina)

Filtering theory is an active and current research field attracting many probabilists. In particular, there is increasing interest in applying filtering theory to real-world problems in areas such as mathematical finance, target detection and tracking, communication networks, pollution tracking, weather prediction, traffic management, and search and rescue. The main goal of the Conference was to bring current problems and theory together, benefiting all researchers, especially those new to filtering theory.

The four keynote speakers were:

Nick Duffield (AT&T): talk series entitled *Revealing the detail in network measurements*

Tyrone Duncan (University of Kansas): talk series entitled *Fractional Brownian motion and applications*

Gopi Kallianpur (U. North Carolina): talk series entitled *Lectures on nonlinear filtering theory*

Nicole El Karoui (Ecole Polytechnique): talk series entitled *Pricing and hedging financial products with partial information*

They are outstanding experts in their fields. Their lectures focused on the most recent development of filtering theory and applications to communication network and mathematical finance. There were many established researchers from five continents, who presented their recent and most exciting research

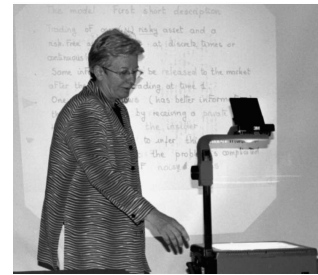


Tyrone Duncan (U. Kansas)

accomplishment in the conference and exchanged their ideas with other participants. The conference attracted students and postdoctoral researchers from universities across North America, which will encourage future research activity in Canada. The conference benefited from industrial participants including AT&T, Lockheed Martin and Raytheon, who showed great interests in the conference and indicated desire to have more interaction and collaboration with scientists from academic institutions. We believe that the conference helped to advance the scientific development of filtering theory and its applications as well as offer benefits to industry.

The meeting was held at the University of Alberta from July 25–27 and was concluded in Jasper, Alberta from July 28–30.

The conference was cosponsored with the University of Alberta and the Applied Mathematics Institute of the University of Alberta.



Nicole El Karoui (Ecole Polytechnique)

The Invited Speakers included:

D. Blount (Arizona State)

A. Budhiraja (U. North Carolina)

H. Chan (U. Alberta)

P. Del Moral (Toulouse)

R. Elliott (U. Alberta)

W. Engler (Vision Smart)

D. Kenway (Vision Smart)

V. Krishnamurthy (U. Melbourne)

H. Long (U. Alberta)

M. Kouritzin (U. Alberta)

M. Prefontaine (U. Alberta)

B. Remillard (HEC, Montreal)

W. Sun (U. Alberta)

A. Tsoi (U. Missouri, Columbia)

F. Viens (Purdue)

P. Wiebe (U. Alberta)

Xun Yu Zhou (Chinese U. Hong Kong)

Theme 2003 (A): Inverse Problems and Applications

Inverse problems are problems in which the goal is to find objects their material or biological properties or information about their surrounding environment which cannot be measured directly or it is not desirable to do so. These problems arise in many areas of applications including geophysics, medical imaging, remote sensing and nondestructive evaluation of materials.

During the last twenty years or so there has been remarkable developments in the mathematical theory of inverse problems. These developments together with the enormous increase in computing power and new powerful numerical methods has made possible to make significant progress on increasingly more realistic and difficult inverse problems. The purpose of the period of concentration is to bring together mathematicians and practitioners to work on these problems on these problem. During 2003 a series of workshops on inverse problems will be held at different locations emphasizing the wide range of applications. Gunther Uhlmann is the coordinator of the PIMS thematic year.

Scientific Committee:

Gunther Uhlmann (Chair, U. Washington)
Richard Froese (UBC)
Nassif Ghoussoub (PIMS)
Michael Lamoureux (U. Calgary)
Gary Margrave (U. Calgary)
Jim Morrow (U. Washington)

Programme

Pan-American Advanced Studies Institute (PASI) on Partial Differential Equations, Inverse Problems and Nonlinear Analysis,

Centro de Modelamiento Matemático (CMM),
Universidad de Chile, January 6–19, 2003

BIRS workshop on Scattering and Inverse Scattering,

Banff Conference Centre, Banff, March 22–27, 2003

Summer School in Seismic Wave Simulation and Seismic Imaging

U. Calgary, July 14–18, 2003

PIMS-MITACS Workshop on Inverse Problems in Geophysics,

PIMS at the U. Calgary, July 21–26, 2003

Workshop on Inverse Problems and Medical Imaging,

UBC, August 4–8, 2003

Optimal Transportation and Nonlinear Dynamics

UBC, August 11–15, 2003

**Pan-American Advanced Studies
Institute (PASI) on PDEs, Inverse
Problems and Nonlinear Analysis,
Centro de Modelamiento Matemático,
Universidad de Chile,
January 6–19, 2003**

Organisers: Rafael Benguria (Pontificia U. Católica de Chile), Carlos Conca (U. de Chile), Nasif Ghoussoub (PIMS & UBC), Raul Manásevich (co-chair, U. de Chile), Wei-Ming Ni (U. Minnesota), Gunther Uhlmann (co-chair, U. Washington) and Michael Vogelius (Rutgers U.).

The PASI will consist of a series of intensive minicourses during the first week followed the second week by a workshop focused on latest developments. The minicourses will be given by L. Caffarelli, G. Ponce, F. Santosa, T. Toro and G. Uhlmann.

The PASI is sponsored by the US NSF, US Dept. of Energy, PIMS, Conicyt and the CMM. PIMS will be sponsoring the participation of Canadian students in PASI. Nomination letters for interested and qualified graduate students in Canadian universities should be sent by their supervisors to the PIMS Central Office at UBC. The deadline is October 15, 2002.

One of the main objectives of the PASI on PDE, IP and NA is to bring many of the recent developments to advanced graduate students, post-docs and other scientists in the Americas interested in these fields and their applications. Another important objective is to foster international cooperation throughout the Americas.

**BIRS Workshop on Scattering and
Inverse Scattering,
Banff, March 22–27, 2003**

Organisers: Richard Froese (Chair, UBC), Gunther Uhlmann (U. Washington).

The workshop will focus on recent developments in scattering and inverse scattering theory. In both these fields techniques of micro-local analysis, including the use of eikonal equations and of complex geometrical optics solutions to Schroedinger and other equations, has led to substantial progress in recent years.

Scattering theory seeks an understanding of spectral phenomena for noncompact manifolds. There

has been a recent focus in this subject on what is now termed geometric scattering, which amounts to the study of scattering on classes of noncompact complete manifolds with regular structures at infinity. Some of the questions asked here concern the smooth parametrization of the continuous spectrum by functions on some ideal boundary, the structure of the scattering matrix as an operator on this ideal boundary, and the study of resonances, which are poles of the meromorphic continuation of the resolvent. There are many subtle connections between these objects and the geometry of the underlying manifold.

**Summer School in Seismic Wave
Simulation and Seismic Imaging,
U. Calgary, July 14–18, 2003**

Organisers: Gary Margrave (U. Calgary) and Len Bos (U. Calgary).

The first part of this school will examine real seismic data and present several mathematical models for the forward problem: the simulation of seismic waves. Essential mathematical techniques such as Green's functions, Kirchhoff diffraction theory, and ray theory will be developed and examined. In the second part, these concepts and tools will be applied to develop the prototypical approaches to the seismic imaging problem. The Born and Kirchhoff approximations will be shown to lead to direct schemes for the estimation of subsurface reflectivity that are the basis for modern imaging techniques. The strengths and weaknesses of these techniques will be examined and a survey of more advanced, emerging methods will be presented. Emphasis will be placed upon understanding the assumptions and limitations of each technique. The successful student will obtain both an understanding of the basis and mechanics of the major imaging techniques and will appreciate the outstanding problems at the forefront of research.

This course is for the mathematically skilled physical scientist who is enrolled in a degree programme at a PIMS University. Students will be assumed to have previous exposure to elementary mathematical analysis (calculus, linear algebra, ordinary and partial differential equations, and Fourier analysis) as well as experience with basic physical theory.

PIMS-MITACS Workshop on Inverse Problems in Geophysics, PIMS, U. Calgary, July 21–26, 2003

Organisers: Maarted de Hoop (Colorado School of Mines), Gary Margrave (Chair, Calgary), Gunther Uhlmann (Washington) and William Symes (Rice).

Seismic imaging creates images of the Earth's upper crust using seismic waves generated by artificial sources and recorded into extensive arrays of sensors (geophones or hydrophones). The technology is based on a complex and rapidly evolving, mathematical theory that employs advanced solutions to a wave equation as tools to solve approximately the general seismic inverse problem. In the year 2000, nearly \$4 billion was spent worldwide on seismic imaging. The heterogeneity and anisotropy of the Earth's upper crust require advanced mathematics to generate wave-equation solutions suitable for seismic imaging. The workshop will bring together mathematicians familiar with these techniques and geophysicists familiar with the practical applications.

Workshop on Inverse Problems and Medical Imaging, UBC, August 4–8, 2003

Organisers: John Schotland (Chair), Richard Albanese (Armstrong Research Lab, Brooks AFB), Tom Budinger (Biomedical Engineering, Berkeley), David Isaacson (Courant), Amir Gandjbakhche (National Institute of Health) and Gunther Uhlmann (U. Washington).

This workshop will concentrate on recent developments in medical imaging including the advances in engineering and image processing mathematics which have allowed for significant enhancement of widely used imaging techniques like X-ray tomography, magnetic resonance imaging, single photon emission tomography, positron emission tomography and ultrasound. Of particular interest is recent progress in "elasticity imaging" which uses advances in the mathematical study of wave propagation in heterogeneous media for the evaluation of mechanical properties of tissue inaccessible to touch by a physician.

Optimal Transportation and Nonlinear Dynamics, UBC, August 11–15, 2003

Organisers: L. Caffarelli (U. Texas, Austin), M. J. P. Cullen (European Centre for Medium Range Weather Forecasts), L. C. Evans (UC, Berkeley), M. Feldman (U. Wisconsin, Madison) and W. Gangbo (Georgia Tech).

The theme around which this conference revolves is a transportation problem having its roots in economics, statistics, and geometry. Given two probability measures on a curved landscape, the problem is to determine the most efficient way to rearrange the mass of the first distribution to yield the second. Efficiency is measured against a function $c(x, y) \geq 0$ which specifies the cost per unit mass for transporting material from x to y on the curved landscape. After half a century of mathematical neglect, the past decade witnessed a revival of interest in optimal transportation, and watched as it blossomed into a fertile field of investigation as well as a vibrant tool for exploring diverse applications within and beyond mathematics. The transformation occurred partly because longstanding issues could finally be resolved, but also because unexpected connections were discovered which linked these questions to problems in physics, geometry, computer vision, partial differential equations, earth science and economics. Incarnations of this problem embed in current models for surprisingly diverse phenomena.

The research theme proposed for this meeting focuses on applications to models for atmospheric pressure fronts, the kinetic theory of gases, and geometric measure theory. This meeting is a natural follow up of the one, previously organized by the same research group, at the Fields Institute in Toronto, from August 20–25, 2001. That meeting gave an opportunity to experts of the Monge-Kantorovich theory to exchange knowledge, informations, and introduce other people from various background to the field. This second meeting is intended to help update the community on advances in this rapidly developing field, while at the same time focusing attention on key subjects which could not be covered in detail at the August 2001 meeting.

The aim is to bring together mathematicians working on transportation problems with a cross-section of scientists working in application areas.

Among our goals are to present and discuss new mathematical results and to introduce new problems in application areas that are ready for rigorous mathematical treatment. By inviting representatives from several application areas, it is expected that there will be cross-fertilisation of ideas between different applications, a fact that looks apparent from the August 2001 workshop. It is hoped to highlight some math-

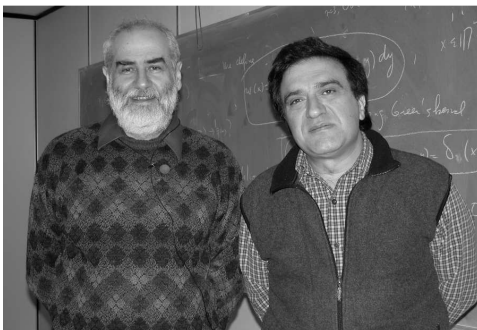
ematical and application areas which did not receive much emphasis in the first workshop, thus reaching a somewhat different audience. It is also hoped to emphasize the training element, both by providing mini-courses to introduce scientists to new areas of mathematics and new techniques, and by holding special contributed paper and tutorial sessions aimed at beginning researchers.

III. CORE SCIENTIFIC PROGRAMMES



The participants in the 2002 Frontier in Mathematical Physics Workshop on Brane Worlds and Supersymmetry.

The speakers at the Combinatorial Potlatch that took place at the University of Puget Sound on February 16, 2002: Jonathan Jedwab (SFU), Brett Stevens (Carleton) and Brian Alspach (Regina and SFU (Emeritus)).



Gunther Uhlmann and Nassif Ghoussoub. Gunther Uhlmann was a PIMS Distinguished Chair in November 2002 at UBC.

PIMS Mini-Programmes

Mini-programmes are more focused events than the thematic programmes and span a shorter period of time. They place the focus on having fewer formal lectures and more opportunities for active collaborative work between the participants, who typically stay for the duration of the programme.

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 (U. Seoul, Korea): *Noncommutative Supersymmetric Tubes*

Bruce Campbell (U. Alberta)

Steve Giddings (UC): *Strong Gravity at the TEV Scale*

Seungjoon Hyun (Seoul National U, Korea)

Y. Kitazawa (KEK, Japan)

Per Kraus (Enrico Fermi Institute)

Robert Leigh (U. Illinois): *D-branes on Orbifolds: The Standard Model*

Shiraz Minwalla (Harvard)

Rob Myers (McGill): *Dielectric Branes*

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

Mark Van Raamsdonk (Stanford)

Simon Ross (U. Durham)

Savdeep Sethi (U. Chicago)

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

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

Frontiers in Mathematical Physics on Workshop on Brane Worlds and Supersymmetry, UBC, July 22–August 2, 2002

Organizers: John Ng (TRIUMF, Chair), Andreas Karch (University of Washington), Taejin Lee (APCTP), Moshe Rozali (UBC), Alexander Rutherford (PIMS) and Gordon Semenoff (UBC).

Held at the Department of Physics and Astronomy, UBC, this two-week workshop featured a variety of talks on topics ranging from fundamental questions in superstring theory and supersymmetry to the cosmological implications of brane world models and higher dimensional physics. Brane world models suggest that the observable universe is a domain wall (the word brane derives from membrane) in a higher dimensional universe. These models have been proposed as a possible solution to the hierarchy problem, which asks why in the standard model of par-

particle physics the hierarchy of mass scales that is observed in nature can occur.

The standard model of particle physics is a complicated nonlinear dynamical system. In such systems, predictions of dimensional numbers like particle masses tend to be of the same size, the size of the largest input parameter. In nature, there is a distribution of different masses, from massless particles like the photon and the very light particles like the electron or neutrino to the mass scale which describes gravitational interactions, a factor of 10^{20} heavier. Previous to these new ideas, the only solution of this hierarchy problem was to invoke symmetries. In fact, supersymmetry—a hypothetical and as yet unobserved symmetry whose transformations mix fermionic and bosonic particles—was needed. These new ideas about extra dimensions give a radical new alternative solution of the hierarchy problem. This solution is so compelling that it has been the focus of intense theoretical particle physics research over the past few years.

The new ideas about extra dimensions have also led to a revolution in our thinking about the role of gravity in particle physics. Gravity was previously thought to be important to the interactions of elementary particles only at extremely short distance scales, 10–34 centimetres, or in processes involving extremely high energies, far beyond the reach of any conceivable experiments. In most of the extra dimension scenarios, gravity becomes an important player in particle physics modelling.

Some of the extra dimension scenarios use superstring theory to quantize gravity and predict that superstring excitations should be observable at much lower energies than was previously thought. The elementary particles seen so far would be the lowest energy excitations of superstrings. The next excited states would occur at energies not much higher than the masses of already observed particles. This has the exciting consequence that these new ideas are testable by present and imminent experiments. For example, the existence of extra dimensions modifies the gravitational interaction at short distances. If objects are close together, gravity would no longer have the Newtonian inverse square dependence on distance but would have a different power depending on the total number of dimensions of spacetime. There are now several new experiments dedicated to

testing the laws of gravity at the micron level.

Lectures were given by:

Alessandro D’Adda (INFN, Torino): *Gauge theories of the symmetric group in the large N limit*

Ignatios Antoniadis (CERN): *Physics with large extra dimension (2 lectures)*

Cliff Burgess (McGill): *Fixing runaway moduli*

Kiwoon Choi (KAIST): *Radius-dependent gauge coupling renormalization in AdS5*

Keith Dienes (Arizona): *Shape versus volume: rethinking the properties of large extra dimensions and Solving the hierarchy problem without SUSY or extra dimensions: an alternative approach*

Bogdan Dobrescu (Yale): *Universal extra dimension*

Andreas Karch (Washington): *Adding flavour to ADS/CFT*

Emanuel Katz (Washington): *Little Higgses*

Noboru Kawamoto (Hokkaido): *Twisted superspace and Dirac-Kaehler fermions*

Hyung Do Kim (KIAS): *Deconstructing warped gauge theory and unification*

C.S. Lam (McGill): *What can neutrino oscillation tell us about the possible existence of an extra dimension?*

Y.S. Myung (Inje University): *Limitation of Cardy-Verlinde formula on the holographic description of brane cosmology*

Erich Poppitz (Toronto): *Instanton effects in 5d theories and deconstruction*

Konstantin Savvidis (Perimeter Institute): *A new non-commutative field theory*

George Savvidy (National Research Center, Demokritos): *Conformal invariant string with extrinsic curvature action*

Gordon Semenoff (UBC): *Nonplanar corrections to PP-wave strings*

Mikhail Shifman (Minnesota): *Cosmological constant problem in infinite volume extra dimensions: a possible solution and Topological effects in our brane world from extra dimensions*

Henry Tye (Cornell): *Brane world cosmology: from superstring to cosmic strings*

Neal Weiner (Washington): *Supersoft supersymmetry breaking*

The programme was organized as that it allowed the opportunity for extensive discussion between the lectures. The lectures were videotaped and are available in realvideo and MP3 format from www.pims.math.ca/science/2002/fmp.

This workshop was the sixth of the annual workshops in the Frontiers in Mathematical Physics series. It was cosponsored by PIMS, the Perimeter Institute for Theoretical Physics and the Asia Pacific Center for Theoretical Physics.

**Upcoming Frontiers of
Mathematical Physics
Summer School on String Theory,
PIMS-UBC, July 14–25, 2003**

Organizing Committee: Taejin Lee (APCTP), John Ng (TRIUMF), Moshe Rozali (UBC), Alexander Rutherford (PIMS) and Gordon W. Semenoff (UBC).

The lecturers include:

V. Balasubramanian (Penn)
M. Berkooz (Weizmann)
R. Brandenberger (Brown)
M. Dine (UC Santa Cruz)
D. Kutasov (Chicago)
V. Schomerus (Saclay)
P. Yi (KIAS)

Frontiers of Mathematical Physics is part of the string theory CRG.

**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 (U. Calgary and Southern Illinois U.), F. Deloup (Universit e Paul Sabatier) and Victor A. Vassiliev (Steklov Mathematical Institute, Independent U. Moscow).

Organizers: D. Rolfen (UBC), V. Turaev (Universit e Louis Pasteur, CNRS Strasbourg) and P. Zvengrowski (U. Calgary).

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

The objective of the meeting was to develop a common framework for ideas coming from many important areas of mathematical research 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 homotopy quantum field theory. It also dealt with the study of the interaction between the representation theory of braids and other related subjects with tqft.



The participants of the NATO workshop.

Plenary Speakers:**D. Bar-Natan** (Hebrew University)**S. Bigelow** (U. Melbourne): *Homology and the Hecke algebra***J. Birman** (Columbia): *Knots and Contact Structures on the Three-Sphere***M. Karoubi** (U. Paris 7): *Braiding of Differential Forms and Homotopy Type***G. Masbaum** (U. Paris 7): *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. Bratislava): *Nonlinear Quantum Systems as Subsystems in Quantum Field Theory***J. Bryden** (U. Calgary & Southern Illinois U.): *Quantum Homotopy theory II***F. Cohen** (U. Rochester): *Braid Groups and Modular form***L. Crane** (Kansas State U.): *Mathematical Lessons from Quantum General relativity***C. Cunningham** (U. 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. 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. Natanson** (Moscow State U. & Independent U. 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. Moscow): *On the Homology of the Spaces of Long Knots***A. Tralle** (U. 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. Moscow): *New Invariants of Spaces of Knots***V. Vershinin** (Novosibirsk State U.): *Homological Properties of Virtual Braids*

Distinguished Chairs

PIMS has established a programme of Distinguished Chairs, which serves to host eminent 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 2001/02

Vladimir Turaev (CNRS Strasbourg VI)

Site: University of Calgary
July–August, 2001

Gang Tian (MIT)

Site: University of British Columbia
August 2001

Michael Shelly (Courant Institute)

Site: Simon Fraser University
November–December 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*.

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

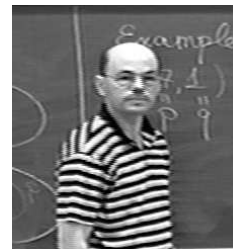
Reshetikhin proved that a system of topological invariants of 3-manifolds could be developed using the representation theory of quantum groups. In their work they exploited a relationship between the representation theory of quantum groups and

solutions of the Yang-Baxter equation of statistical mechanics. This allowed them to use the theory of representations of the quantum group $U_q(\mathfrak{sl}_2(\mathbb{C}))$ 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 development of a quantum theory of gravity.

PIMS hosted **Gang Tian** as a 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 gave 4 lectures on *Recent Progress in Complex Geometry* as part of the Geometric PDEs session of the PDE Thematic Programme and he also lectured at the Canada-China congress.

Gang Tian's research covers such diverse areas as



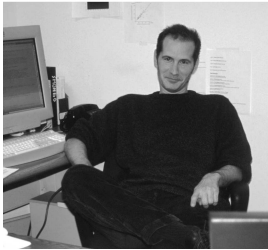
Vladimir Turaev



Gang Tian

differential geometry, algebraic geometry, geometric analysis and PDEs. 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 quantum cohomology ring is associative (joint with Y. Ruan) and for his work on higher dimensional gauge theory.

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



Mike Shelley

Michael Shelly is a Professor of Mathematics at the Courant Institute of Mathematical Sciences at New York University, where he is also Co-Director of the Applied Mathematical Laboratory, an experimental laboratory in fluid dynamics and related areas. Besides being interested in fluid dynamics and free-boundary problems, Dr. Shelley also works actively in the neuroscience of vision. He was the PIMS Distinguished Chair at SFU, November–December 2001. He gave 5 lectures with entitled *Computing Free Boundary Problems in Moving Fluids, Computing with Surface Tension, and Discovering Singularities, Pattern Formation in Fluid Dynamics: Fluid Dynamics meets Materials Science, Why do Flags Flap?* and *Bending in the Wind: Elasticity and Drag Reduction*.

PIMS Distinguished Chairs for 2002/03

Donald G. Saari (University of California, Irvine)
Site: University of Victoria
September 2002

Klaus Schmidt (University of Vienna and Director, Erwin Schrödinger Institute)
Site: University of Victoria
November 2002

Gunther Uhlmann (University of Washington)

Site: University of British Columbia
November 2002

In September 2002, **Donald Saari** delivered a series of five lectures at the University of Victoria as a PIMS Distinguished Chair. Don is a Distinguished Professor of Mathematics and Economics and Director of the Center for Decision Analysis at the University of California, Irvine, and the former Arthur and Gladys Pancoe Professor of Mathematics and Professor of Economics at Northwestern University. He is recognized for his important contributions to the theory of dynamical systems and to the social sciences.

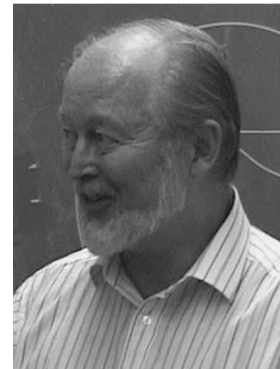
In his research Don uses mathematical models to analyze a wide variety of social phenomena: politics, markets, and intra-organizational behaviour. He made significant advances in celestial mechanics, in which Saari's conjecture—proposed in 1970 and now a landmark in the field—is still unsolved. Don is a member of the National Academy of Sciences.

His UVic lectures were intended to a broad general audience, showing how interesting mathematics is generated by questions coming from the social sciences.

Mathematical Social Sciences, an Oxymoron? presented how basic questions from the social sciences lead to new mathematics or new uses of mathematics. The talk emphasized how hidden symmetries influence everyday decision making.

Singularity Theory and Departmental Discussions dealt with simple models of basic decision theory, connecting it with singularity theory and with some unresolved questions from the n-body problem of celestial mechanics.

Evolutionary Game Theory; Examples and Dynamics explained why dynamical systems are becoming an important tool for handling the new area of evolutionary game theory. The conclusions for game theory can be surprising. The impact for dynamical systems is that new structures are found.

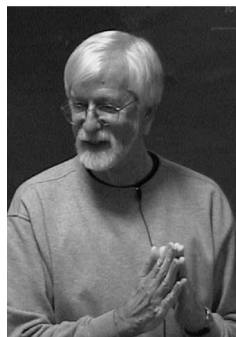


Donald Saari

Chaotic Dynamics of Economics refuted Adam Smith's invisible hand theory through a careful mathematical examination, which showed that chaos is more likely than stability in economics models.

Dynamics, Symmetry, and the Social Sciences concluded the lecture series by showing other uses of dynamics and symmetry in understanding basic concerns coming from the social sciences. One of the issues discussed was Arrow's theorem and a new way of interpreting it.

The lectures were widely attended by faculty, PDFs, graduate and undergraduate students from the mathematics and the economics departments, visitors from other universities, and several members of the general public. Long and interesting discussion followed after every talk. This has been a highly rewarding experience for all those who attended. A video recording of the lectures and a written version of the notes are available on PIMS's website.



Klaus Schmidt

During November 2002 **Klaus Schmidt**, who is a Professor at the Mathematics Institute of the University of Vienna, and the Director of the Erwin Schrödinger Institute for Mathematical Physics, gave series of five talks at the University of Victoria.

The talks were about Algebraic \mathbb{Z}^d -actions and covered the following topics: \mathbb{Z}^d -actions by automorphisms of compact abelian groups; general theory, higher order mixing, homoclinic points and the symbolic representations of algebraic \mathbb{Z}^d -actions, and rigidity properties.

Klaus Schmidt was the winner of the 1993 Ferran Sunyer i Balaguer Prize. He was a founding editor of the journal *Ergodic Theory and dynamical systems* and is a member of the Austrian Academy of Sciences.

At the start of November 2002 **Gunther Uhlmann** (University of Washington) gave three two-hour talks at UBC. The topics were *inverse boundary and inverse scattering problems*. Inverse boundary problems are a class of problems in which one seeks to determine the internal properties of a medium by performing measurements along the

boundary of the medium. These inverse problems arise in many important physical situations, ranging from geophysics to medical imaging to the non-destructive evaluation of materials. The appropriate mathematical model of the physical situation is usually given by a PDE (or a system of such PDEs) inside the medium. The boundary measurements are then encoded in a certain boundary map, usually called the Dirichlet-to-Neumann (DN) map. The inverse boundary problem is to determine the coefficients of the PDE inside the medium from knowledge of the boundary map. In inverse scattering problems, in which the observations are made far from the medium, the information is encoded in the scattering amplitude. The inverse scattering problem is to determine the medium properties from this information.

The first two lectures discussed the prototypical example of an inverse boundary problem, the inverse conductivity problem, also called electrical impedance tomography, whose mathematical formulation is due to A. P. Calderón. In this case the DN map is the voltage to current map; that is, the map assigns to a voltage potential on the boundary of a medium the corresponding induced current flux at the boundary of the medium. The inverse problem is to recover the electrical conductivity of the medium from the DN map. Gunther Uhlmann discussed the role of complex geometrical optics solutions in solving this inverse problem.

The first part of the last lecture described a solution of the inverse scattering problem at a fixed energy in dimension three or larger by reducing the problem to the study of the set of Cauchy data for the Schrödinger equation for a large ball. In the second half it was discussed recent progress on an inverse boundary problem arising in geophysics and rigidity questions in Riemannian geometry. The problem is to determine a Riemannian metric on a compact Riemannian manifold with boundary by measuring the lengths of geodesics (travel times) joining points of the boundary.

The lectures series by Vladimir Turaev, Gang Tian, Michael Shelley, Donald G. Saari, Klaus Schmidt and Gunther Uhlmann may be watched in real video format at www.pims.math.ca/video/mini/.

Distinguished Chairs for 2003

András Hajnal (Rutgers University)
Site of Chair: U. Calgary

Bryan Grenfell (Univ. of Cambridge)
Site of Chair: U. Alberta

**Ashoke Sen (Harish-Chandra Research
Institute)**
Site of Chair: UBC

Jeffrey Vaaler (University of Texas)
Site of Chair: SFU and UBC

Pacific Northwest Seminar Series

These are annual or biannual 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 PIMS, 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. The PNW meetings form the backbone of the PIMS Collaborative Research Groups.

Michael Thaddeus (Columbia): *Spaces of Higgs bundles as mirror partners*

Ravi Vakil (Stanford): *Vanishing of cohomology classes on the moduli space of curves*

October 20, 2002 at Western Washington U:
There were three speakers at this meeting:

Tom Graber (UC, Berkeley): *Generalizations of Tsen's Theorem*

Karen Smith (Michigan): *A non-vanishing conjecture of Kawamata and the core of an ideal*

Bill Fulton (Michigan):

PNW Algebraic Geometry Seminar

Organizers: Jim Bryan (UBC), James Carrell (UBC) and Sandor Kovacs (U. Washington).

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

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

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

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

February 9, 2002 at Western Washington U:
The following people spoke at the meeting:

Jim Bryan (UBC): *Gromov-Witten invariants of curves in Calabi-Yau 3-folds and Topological Quantum Field Theory*

Combinatorial Potlatches

Combinatorial Potlatches have been held for many years at various locations around Puget Sound and southern British Columbia, and are an opportunity for combinatorialists in the region to gather informally for a day of invited talks and conversation.

February 16, 2002 at University of Puget Sound:
The organizer of this meeting was **Nancy Neudauer** (U. Puget Sound). The invited speakers were:

Brian Alspach (U. Regina and SFU (Emeritus)): *Group Actions and Hamilton Decompositions of Complete Graphs*

Brett Stevens (Carleton University): *On Universal Cycles of k -sets of an n -set*

Jonathan Jedwab (SFU): *Combinatorial Design Theory and the IEEE 802.12 Transmission Code*

November 9, 2002 at University of Victoria: The organizers of this meeting were **Frank Ruskey** (chair), **Jing Huang**, **Gary MacGillivray** and **Wendy Myrvold** (U. Victoria). The speakers were:

Andrzej Proskurowski (U. Oregon): *Width parameters of graphs and discrete optimization problems*

Branko Grunbaum (U. Washington): *Polyhedra: Combinatorial and Geometric*

Jozef Siran (Slovak University of Technology): *Links between graph theory, group theory, geometry, Riemann surfaces, and Galois theory*

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 UBC, Oregon State U., U. Oregon, Portland State U., U. Utah and U. Washington.

October 27–28, 2001 at University of Oregon:

The organisers of this meeting were **Boris Botvinnik**, **Peter Gilkey**, **Jim Isenberg** (University of Oregon) and **Christine Escher** (Oregon State University). The speakers were:

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 (U. Bonn and OSU): *Spectral Sequences arising in Differential Geometry*

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

Joint Meeting of the PNW Geometry Seminar and the Cascade Topology Seminar, May 11–12, 2002 at U. Washington: Roughly 60 people attended this meeting, mostly from Washington, Oregon, and British Columbia. Individually, the PNW Geometry Seminar and the Cascade Topology Seminar are regular, regional meetings for geometers and topologists, respectively. This joint meeting provided a good setting for the usual interactions within each group, but also interactions between the groups. The meeting also received funding from the National Science Foundation. The talks were designed so as to be accessible to the entire audience, and they were

well-received. This was reflected in the broad participation in the problem sessions following the talks. Topics for talks included information theory, gauge theory, conformal field theory, and rational homotopy theory. The following people spoke:

John Baez (UC Riverside): *Categorified gauge theory*

Dan Christensen (Western Ontario): *Quantized geometry via representation theory*

Ralph Cohen (Stanford): *Duality phenomena in loop spaces and conformal field theory*

Megan Kerr (Wellesley): *A study of homogeneous Einstein metrics*

Laura Scull (UBC): *Rational Equivariant Homotopy*

Deane Yang (Polytechnic University): *Geometry, analysis, and information theory*

Western Canada Linear Algebra Meeting (W-CLAM)

Organizing Committee: Shaun Fallat, Steve Kirkland (U. Regina), Hadi Kharaghani (U. Lethbridge), Peter Lancaster (U. Calgary), Dale Olesky, Pauline van den Driessche (U. Victoria) and Michael Tsatsomeros (Washington State U.).

W-CLAM is a biannual 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 10–11, 2002 at University of Regina: This meeting received financial support from the National Programme Committee, the University of Regina Conference Fund, and the University of Regina Faculty of Science. WCLAM 2002 featured 18 talks by speakers from Canada, the United States and Germany. The lectures covered a range of research areas associated with linear algebra, include matrix theory, operator theory, graph theory, applied mathematics, numerical analysis and combinatorics. The list of speakers included two winners of the Hans Schneider prize, which is given out every three years by the

International Linear Algebra Society for outstanding contributions to research in linear algebra.

In addition to the contributed talks, the meeting featured lectures from three invited speakers:

Jane Day (San Jose State)

Ludwig Elsner (Universität Bielefeld)

Chris Godsil (Waterloo)

PNW Number Theory Seminar

January 13, 2001 at Western Washington University: The speakers were:

Michael Spiess (U. Nottingham): *Logarithmic differential forms on p -adic symmetric spaces*

Imin Chen (SFU): *On relations between induced representations for $GL_2(\mathbb{Z}/p^2)$ and applications to modular curves*

January 27, 2001 at SFU Harbour Centre: The speakers were:

Nils Bruin (PIMS, SFU, UBC): *Generalised Fermat equations*

Adrian Iovita (U. Washington): *Explicit description of the local Galois representations attached to modular forms*

Stephen Choi (SFU): *A Problem of Cohn on Classifying Characters*

February 24, 2001 at University of Washington: The speakers were:

Haruzo Hida (UCLA): *Arithmetic of p -adic Hecke L -functions*

Nike Vatsal (UBC): *Elliptic curves over anticyclotomic fields*

April 28, 2001 at Redmond, Washington: This was the 5th PNW Number Theory Seminar. It was organized by **Matt Klassen** (DigiPen Inst. Tech.), **Kristen Lauter** (Microsoft Research) and **Peter Borwein** (SFU). The speakers were:

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 (UBC): *Ergodic theory and Heegner points*

Trevor Wooley (U. Michigan): *Slim exceptional sets in Waring's problem*

July 5, 2001 at PIMS-SFU: The meeting was entitled "A Day of Number Theory at SFU." The speakers were:

Doug Bowman (U. Illinois): *Zeta Values: From Leibniz to Today*

David Bradley (U. Maine): *Research Update on Multiple Polylogarithms*

Nils Bruin (PIMS, SFU): *Skolem-Mahler-Lech and Chabauty-Coleman*

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

October 13, 2001 at Western Washington U: The speakers are this meeting were:

Glenn Stevens (Boston): *The eigencurve and p -adic L -functions*

Will Galway (PIMS, SFU): *The density of Pseudoprimes with Two Prime Factors*

November 17, 2001 at Western Washington U: The speakers are this meeting were:

Robert Pollack (U. Washington): *p -adic L -functions of elliptic curves at supersingular primes*

John Friedlander (U. Toronto): *The subconvexity problem for Artin L -functions*

December 1, 2001 at Western Washington U: The speakers are this meeting were:

Laurent Berger (Brandeis U.): *p -Adic Representations and Differential Equations*

Chris Smyth (U. Edinburgh): *Variations on the theme of Hilbert's Theorem 90*

Adrian Iovita (U. Washington): *A p -adic Shimura type construction for modular forms on quadratic imaginary fields*

February 23, 2002 at Western Washington U: There were three talks at this meeting:

Matt Baker (Harvard): *Canonical heights over abelian varieties*

Imin Chen (SFU): *Elliptic curves with non-split mod 11 representations*

Adrian Iovita (U. Washington): *Families of exponential maps attached to p -adic families of modular forms*

April 20–21, 2002 at PIMS-SFU: The sixth annual PNW Number Theory Meeting had about 40 participants primarily from Washington, Oregon, Alberta and BC. The invited speakers were:

Kristin Lauter (Microsoft): *Curves over Finite Fields and Applications to Cryptography*

Greg Martin (UBC): *Inequities in the Shanks-Rényi Prime Number Race*

Carl Pomerance (Bell Labs): *Mersenne numbers*

Mark Sheingorn: *Geometric Resonances in the Hall Ray of the Discrete Portion of the Markoff Spectrum*

Fernando Rodriguez Villegas (Texas, Austin): *Periods, L-functions and hyperbolic manifolds*

Hugh Williams (U. Calgary): *Computing Certain Invariants in Real Quadratic Number Fields*

November 2, 2002 at Western Washington U: The speakers at this meeting are:

Bisi Agboola (U. Santa Barbara): *Galois structure, Galois representations and metrised line bundles*

Will Galway (PIMS-SFU): *The pseudoprimes below 2^{64}*

Jim Mailhot (U. Washington): *Selmer Groups of Elliptic Curves with p -Isogenies*

PNW Numerical Analysis Seminar

September 29, 2001 at Western Washington U: The 15th annual PNWNAS. It was organized by **Tjalling Ypma** (Western Washington U). The speakers were:

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

Tim Chartier (U. Colorado, Boulder): *Multigrid*

Lisa Stanley (Montana State U.): *Sensitivity Computation*

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

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

September 28, 2002 at University of Victoria: This meeting was organised by **Dale Olesky** (U. Victoria). The speakers were:

Mike Foreman (Institute of Ocean Sciences, Victoria): *Modelling tidal resonance and tidal power around Vancouver Island*

John Fyfe (Canadian Centre for Climate Modelling and Analysis): *Numerical methods in climate research*

Joerg Gablonsky (Boeing): *Effective parallel optimization of expensive functions*

John Gilbert (MIT Laboratory for Computer Science and UC, Santa Barbara): *Graph algorithms in numerical linear algebra: past, present and future*

Chen Greif (UBC): *On the solution of indefinite linear systems*

Tom Hogan (Boeing): *Fitting position, direction and curvature with a C^2 Quartic Spline*

Volker Mehrmann (Technical University Berlin): *Numerical methods for model reduction and the control of partial differential equations*

West Coast Optimization Seminar

The West Coast Optimization Meeting takes place twice each year, and alternates between Vancouver and Seattle. In Vancouver, PIMS, CECM and the math departments at UBC and SFU 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 six PIMS partner sites and Washington State University; a featured guest from outside is also usually invited.

May 4–5, 2001 at PIMS-SFU: The speakers were:

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

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

Warren Hare

Lisa Korf (U. Washington): *Duality Theorems in Stochastic Programming*

Mason Macklem (SFU): *Current Models in Image Quality Evaluation*

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

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

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

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

May 3–4, 2002 at SFU: The spring session of the West Coast Optimization Meeting was well-attended, with over thirty participants. There were seven 45-minute technical presentations and a short theoretical talk, covering the full spectrum of theory, implementations, and applications of continuous optimization. The session concluded with a small group discussion, led by Tamas Terlaky, of the prospects for stimulating and structuring a nationwide collaboration in optimization. Speakers:

James V. Burke (UW): *Gauss's approach to the variational analysis of functions of the roots of polynomials*

Asen Dontchev (Mathematical Reviews): *The many faces of the condition number theorem*

Oliver Dorn (UBC): *A level set method for shape reconstruction in medical and geophysical imaging*

Marian Fabian (Czech Academy of Sciences): *Topological and Sequential Normal Compactness*

Gabor Pataki (North Carolina): *On the closedness of the linear image of a closed convex cone*

Tamas Terlaky (McMaster): *Interior Point Methods: Dynamic Update and Self-Regularity*

Paul Tseng (UW): *Signal denoising by maximum likelihood estimation with l_1 -penalty*

Jonathan Borwein (SFU): *Differentiability of Monotone Functions on Separable Banach Space*

PNW PDE Seminar

May 19, 2001 at University of Washington: This meeting was organized by **Richard Froese** (UBC), **Nassif Ghoussoub** (PIMS and UBC) and **Gunther Uhlmann** (U. 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 (U. 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*

May 23–25, 2002 at Washington State University, Pullman: This meeting was held in honor of John R. Cannon's 65th birthday. The invited speakers covered a wide range of topics including inverse and ill-posed problems, free boundary problems, PDEs arising in the life sciences, PDEs arising in financial mathematics and numerical analysis of PDEs.

It was organized by **Robert Dillon**, **Alex Kwapalov**, **V.S. Manoranjan** and **Hong-Ming Yin** (Washington State University).

The speakers were: Ralph Showalter (UT, Austin), Gary Lieberman (Iowa State), Thomas Seidman (U. Maryland, Baltimore), Zhilin Li (North Carolina State), Gunther Uhlmann (U. Washington), Kumud S. Altmayer (U. Wisconsin, Whitewater), Karthik Ramaseshan (U. Washington), Shuqing Ma (U. Alberta), Eduardo Chappa (U. Washington), Jim Douglas (Purdue), Emmanuele DiBenedetto (U. Vanderbilt), William Rundell (Texas A&M), Yanping Lin (U. Alberta), Paul DuChateau (Colorado State), David Wollkind (Washington State), Hong-Ming Yin (Washington State), Robert Dillon (Washington State), Takashi Suzuki (Osaka), Jodi Mead (Boise State), Emily Tian (Wright State), Long Lee (U. Washington), Sergei Avdonin (U. Alaska) and John Chadam (U. Pittsburgh).

PNW Probability Seminar

This seminar is organized by the probability groups at the UBC, U. Washington and Oregon State U. 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).

October 20, 2001 at University of Washington: The speakers were:

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

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

Christopher Hoffman (U. Washington): *Phase Transition in Dependent Percolation*

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

October 19, 2002 at University of Washington:
The speakers were:

Martin T. Barlow (UBC): *Random walks on supercritical percolation clusters*

Scott Sheffield (Microsoft Research): *Crystal facets and the amoeba*

Hao Wang (U. Oregon): *A class of interacting superprocesses*



Martin T. Barlow (UBC), Scott Sheffield (Microsoft Research) and Hao Wang (U. Oregon), PNW Probability Seminar speakers.

PNW Statistics Group

This is a biannual meeting.

March 16, 2001 at SFU: The speakers were:

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

Julia Wirth (SFU): *Coherent Risk Measures and Stochastic Dominance*

November 16, 2001 at University of Victoria:
The fall 2001 meeting had the following speakers:

Subhash Lele (U. Alberta): *The analysis of data that depicts the form of objects*

Jenny Bryan (UBC): *Finding Informative Genes based on Microarrays and Deletion Sets*

Subhash Lele showed that many commonly used methods base inference on non-identifiable parameters and he discussed the scientific implications of those methods. Throughout the presentation, he related the theoretical concepts to his projects on the shapes of skulls of children with Down's syndrome which motivated his theoretical work.

Jenny Bryan's work focuses on modelling gene expression data where it is informative to find sets of genes that exhibit interesting expression profiles or groups of genes that appear to be functionally related. In her talk, she discussed the research questions posed for such data and the challenges and opportunities they present for statisticians.

April 12, 2002 at UBC: The Spring 2002 meeting included 44 participants, with good representation from various institutions and excellent participation by graduate students. The main speaker was:

Ying MacNab (Health Care and Epidemiology, UBC and Centre for Community Health and Health Evaluation Research, BC Research Institute for Children's and Women's Health): *Statistical modeling issues in hospital performance comparison studies: the Neonatal Health Services in Canada Project*

PNW Seminar on String Theory

March 17, 2001 at UBC: This meeting was organized by **Konstantin Zarembo** (UBC), **Gordon Semenoff** (UBC) and **Sandy Rutherford** (PIMS). The speakers were:

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

Kostas Skenderis (Princeton): *Holographic renormalization*

Amanda Peet (U. Toronto): *String theoretic mechanisms for spacetime singularity resolution*

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

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

All these lectures were taped and are available from www.pims.math.ca/video/meetings/.

March 8–10, 2002, at PIMS-UBC: This seminar featured a series of talks on recent developments in string theory. This weekend meeting provides an opportunity for graduate students to interact with leading researchers in the field.

The organisers were **Kazuyuki Furuuchi** (PIMS & UBC), **Moshe Rozali** (UBC) and **Gordon Semenoff** (UBC), and the following people spoke:

Kazuyuki Furuuchi (PIMS & UBC): *Non-commutative Space And Chan-Paton Algebra in Open String Field Algebra*

Andreas Karch (UW): *Adding Flavor to AdS/CFT*

David Kutasov (Chicago): *Localized Closed String Tachyons*

Shin Nakamura (KEK): *Extension of Boundary String Field Theory on Disc and RP^2 Worldsheet Geometries*

Kazumi Okuyama (Chicago): *Comments on Vacuum String Field Theory*

Jan Plefka (AEI, Potsdam): *Wilson Loops in $N = 4$ Super Yang-Mills Theory*

Lisa Randall (Harvard): *The Hierarchy Unification and the Entropy of de Sitter Space*

Eva Silverstein (Stanford): *Nonperturbative Nonrenormalization in a Non-supersymmetric Nonlocal String Theory*

Matthias Staudacher (AEI, Potsdam): *Index Puzzles in SUSY Gauge Mechanics*

Leonard Susskind (Stanford): *Quantum Gravity dS Space*

All these lectures were taped and are available from www.pims.math.ca/video/meetings/.

Cascade Topology

This is a twice-yearly seminar which rotates among the universities of the US Pacific Northwest, and western Canada. Its purpose is to gather topologists of the region, and present lectures on recent progress in the field, at an informal weekend meeting. The meetings are informal and friendly, and a special effort is made to encourage participation by graduate students by providing their housing cost.

Joint Meeting of the PNW Geometry Seminar and the Cascade Topology Seminar, May 11–12, 2002 at U. Washington: See page 67.

November 2–3, 2002 at UBC: The 29th meeting of the Cascade Topology Seminar was organized by Kee Lam and Dale Rolfsen (UBC). Speakers:

David Gillman (UCLA): *The best picture of Poincare's homology sphere*

Ian Hambleton (McMaster): *Homotopy self-equivalences of 4-manifolds*

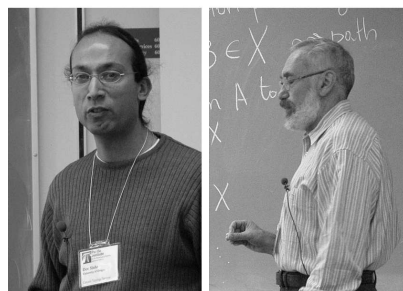
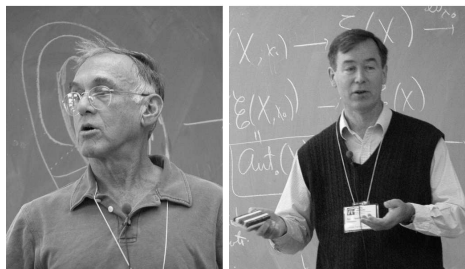
Vaughan Jones (UC Berkeley): *Skein theory in knot theory and beyond*

Dev Sinha (U. Oregon): *New perspectives on self-linking*

Catherine Webster (UBC): *Cryptography and the braid groups*

Sergey Yuzvinsky (U. Oregon): *Topological robotics; topological complexity of projective spaces*

All these lectures were taped and can be watched by going to www.pims.math.ca/video/meetings/.



Clockwise from top left: David Gillman (UCLA), Ian Hambleton (McMaster), Vaughan Jones (UC Berkeley), Sergey Yuzvinsky (Oregon), Dev Sinha (Oregon) and Catherine Webster (UBC).

PIMS Lecture Series

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

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 Caffisch (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

These lectures were taped and may be watched by going to www.pims.math.ca/video/dist/.

Planned 2002/03 Series

Gordon E. Swaters(University of Alberta): *Dynamics of Abyssal Ocean Currents*, October 7, 2002

David Chandler (University of California): *Transition pathways in complex systems: throwing ropes over rough mountain passes, in the dark*, October 28, 2002

Ulf Dieckmann (The International Institute for Applied Systems Analysis, Laxenburg): *Spatial complexity in ecology and evolution*, December 2, 2002

Parviz Moin (Stanford University): *Turbulence and its Computation*, January 13, 2003

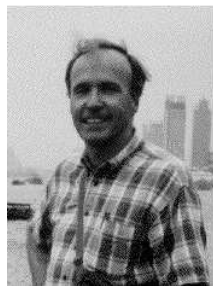
Leon Glass (McGill University): *Dynamics of Genetic Networks*. January 27, 2003

Lloyd N. Trefethen (Oxford University): *Fast accurate solution of stiff PDE*, March 17, 2003

These lectures are being taped and will be made available at www.pims.math.ca/video/dist/.

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 2001/02

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): *Computation of Hedging Portfolios for Options with Discontinuous Payoffs*, October 11, 2001

Joern Sass (UBC): *Maximizing the asymptotic growth rate under fixed and proportional transaction costs*, October 25, 2001

Robert Tompkins (Technische Universität Wien): *Pricing, no-arbitrage bounds and robust hedging of installment options*, December 10, 2001

Ulrike Reich (UBC): *Hedging in an international perspective*, January 24, 2002

Bo-Young Chang (UBC): *Introduction to Credit Derivatives*, February 28, 2002

Rik Blok (Centre for Applied Ethics, UBC): *Statistical properties of financial timeseries*, May 28, 2002

Joern Sass (PIMS and UBC): *Portfolio Optimization under Partial Information: The Drift Process as Continuous Time Markov Chain*, July 11, 2002

Satish Reddy (Quadrus Financial Tech. Inc.): *Introduction to Options and their Valuation*, September 20, 2002

Costis Skiadas (Northwestern U.): *Optimal Lifetime Consumption-Portfolio Strategies under Trading Cone Constraints and Recursive Preferences*, October 4, 2002

Gabriel Mititica (student): *Introduction to Collateralized Debt Obligations*, October 10, 2002

Gillian Clegg (UBC): *Introduction to Mortgage-Backed Securities*, October 24, 2002

Alex Schied (Humboldt U. & UBC): *Variational problems for capacities arising in risk theory*, November 13, 2002

Jean-Marie Dufour (U. Montreal): *Testing mean-variance efficiency in CAPM with possibly non-Gaussian errors: an exact simulation-based approach*, November 28, 2002

PIMS-Shell Lunchbox Lecture Series 2002

PIMS is presenting a series of lectures at the Shell Centre in downtown Calgary. These lectures, given by experts from the PIMS Universities, focus on mathematical techniques and applications relevant to the oil and gas industry and demonstrate the utility and beauty of applied mathematics. The talks are aimed at a general audience. Attendance may qualify for APEGGA Professional Development Hours.



Organizer: Gary Margrave (U. Calgary)

Michael Lamoureux (U. Calgary): *Wavelets in Industry*, February 12, 2002

Rita Aggarwala (U. Calgary): *Designing better industrial experiments*, April 16, 2002

Antonin Settari (U. Calgary): *Mathematics of coupled reservoir and geomechanical modeling*, May 21, 2002

Ian Frigaard (UBC): *Advances in understanding well-construction fluid mechanics: cementing flows and turbulence*, June 13, 2002

Richard Churchill (Hunter College, CUNY): *Fermat's Last Theorem*, August 6, 2002

Len Bos (U. Calgary): *Fitting Surfaces to Data*, September 23, 2002

Christian Jacob (U. Calgary): *Design by Evolution The Art and Science of Genetic Computer Programming*, October 22, 2002

Tony Ware (U. Calgary): *Changing your point of view: modern Fourier analysis and other techniques for seeing data in a new light*, November 18, 2002

Edward S. Krebes (U. Calgary): *Seismic Waves in a Layered Earth*, December 12, 2002

PIMS String Theory Seminar for 2001/02

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

Organizer: K. Zarembo (PIMS PDF, UBC)

Gordon Semenoff (UBC): *Strings in external electromagnetic fields*, January 22, 2001

Konstantin Zarembo (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): *Thermodynamics of Nongravitational String Theories*, March 5, 2001

Konstantin Zarembo (UBC): *Testing AdS/CFT correspondence with Wilson loops*, March 12, 2001

Jorgen Rasmussen (U. Lethbridge): *Superconformal algebras on the boundary of AdS₃*, 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. Strominger*, May 14, 2001

Emil Akhmedov (UBC): *On Unification of D-Brane Couplings to RR Fields*, May 28, 2001

Robert Brandenberger (Brown): *Review of approaches to string cosmology*, June 18, 2001

Robert Brandenberger (Brown): *Review of approaches to string cosmology (ctd)*, June 25, 2001

Robert Brandenberger (Brown): *Review of approaches to string cosmology (ctd)*, July 9, 2001

M. Rozali (UBC): *Strings on AdS₃*, October 22, 2001

S. Bal (Math Science, India): *Interaction of Fuzzy Spheres*, October 26, 2001

M. Rozali (UBC): *Strings on AdS₃*, October 29, 2001

Kristen Schleich (UBC): *Exotic differentiable structures in quantum gravity*, January 4, 2002

Aki Hashimoto (IAS): *Observables of String Field Theory*, January 18, 2002

Ben Sussman (UBC): *Kalb-Ramond Solitons in Bosonic String Theory*, January 25, 2002

Kazuyuki Furuuchi (UBC): *Non-Commutative Space and D-Branes in Open String Algebra*, February 1, 2002

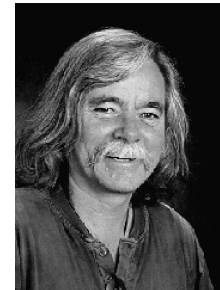
Jeremy Michelson (Rutgers): *Non-Commutative Field Theory from String Theory*, February 8, 2002

Kirk Buckley (UBC): *Superconducting strings in high density QCD*, November 8, 2002

Hong Liu (Rutgers): *Strings in Time-Dependent Orbifolds*, November 22, 2002

PIMS-MITACS Centre for Scientific Computing Seminar for 2001/02

Organizer: Bob Russell
(CSC Director)



Stephen Whitaker (UC Davis): *Coupled Transport During Drying in Porous Media*, January 5, 2001

Tom Manteuffel (U. Colorado): *Large 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** (Alberta): *A Statistical Description of Two and Three-Dimensional Turbulence*, February 16, 2001
- Lia Bronsard** (McMaster): *Phase Boundaries in Ginzburg-Landau Models of Materials Science*, February 19, 2001
- Bernard Deconick** (U. 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): *Stability and bifurcations of spiral waves*, March 16, 2001
- Chris Jones** (Brown): *Do Invariant Manifolds Hold Water?*, March 23, 2001
- Bengt Fornberg** (U. Colorado): *Radial Basis Functions - A future way to solve PDEs to spectral accuracy on irregular multidimensional domains?*, March 30, 2001
- Jane Wang** (Cornell): April 6, 2001
- Emily Stone** (Utah State) and **Abe Askari** (Boeing): *Non-linear 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 — $\text{div}k\text{grad} = f$ with discontinuous diffusion tensor k and source term f* , September 7, 2001
- Florin Diacu** (U. Victoria): *On the dynamics of Langmuir's Problem*, September 21, 2001
- Adrian Lewis** (SFU): *Optimization Problems Involving Pseudospectra*, September 28, 2001
- Claudio Fernandez** (Catholic U. Chile): *Lifetime in Quantum Mechanics*, October 5, 2001
- Uri Ascher** (UBC): *Multilevel Techniques for Large Scale Distributed Parameter Estimation in 3D*, October 12, 2001
- Xiaofeng Ren** (Utah State): *Analysis of Block Copolymer Morphology*, October 19, 2001
- Carson C. Chow** (U. Pittsburgh): *Collective dynamics of coupled neurons*, November 2, 2001
- Ricardo Carretero** (PIMS PDF): *Breathers in Bose-Einstein condensate lattices: from multi-soliton interactions to homoclinic tangles*, November 9, 2001
- Diana Allen** (SFU): *Applications of Numerical Modelling to Groundwater Flow*, November 16, 2001
- Oliver Dorn** (UBC): *A level set method for shape reconstruction in 3D Electromagnetic Induction Tomography*, November 23, 2001
- Gene H. Golub** (Stanford): *Solution of Non-Symmetric, Real Positive Linear Systems*, November 30, 2001
- K.K. Tung** (U. Washington): *Turbulent Energy Spectrum in the Atmosphere for Scales of Motion from 10^0 to 10^5 Kilometer*, January 4, 2002
- Thomas Hillen** (U. Alberta): *Pattern Formation in Chemotaxis Systems*, January 11, 2002
- Edward J. Kansa** (Lawrence Livermore National Lab): *Meshless, Radial Basis Function Collocation Methods for PDEs*, January 18, 2002
- Richard Bartels** (U. Waterloo): *Constructing multiresolutions from subdivisions*, February 1, 2002
- Peter Berg** (SFU): *Microscopic Parameters and Macroscopic Features of Traffic Flow*, February 15, 2002
- Professor Vladimir Dorodnitsyn** (Russian Academy of Sciences): *Lie Group Symmetries of Difference Equations: how to construct the invariant difference models*, March 7, 2002
- Philip Sharp** (U. Auckland): *Numerical challenges in long N-body simulations of the Solar System*, March 15, 2002
- Dale Durran** (U. Washington): *Wave Propagation in Quadratic-Finite-Element Approximations to Hyperbolic Equations*, April 5, 2002
- Dr. Koorosh Nikfetrat** (BCIT): *Three Dimensional Viscous Incompressible Flow Simulations Using Helmholtz Velocity Decomposition*, April 12, 2002
- Rajan Dassan and Brad Bondy** (Genus Capital Management): *Investment Problems: Mathematics and Computation*, April 19, 2002
- Alex Kurganov** (Tulane): *Smoothness Indicator for Adaptive Algorithms*, May 17, 2002
- Chris Budd** (U. Bath): *Can an adaptive method live with a symplectic method and still be friends?*, May 17, 2002
- Lubomir Bakule** (Academy of Sciences of the Czech Republic): *Decentralized Control of Large Scale Systems*, May 23, 2002
- Christopher P. Silva** (Academy of Sciences of the Czech Republic): *Chaos, Fractals, and Wavelets in Communications & Signal Processing*, June 7, 2002
- JF Williams** (U. Bath): *Exactly self-similar blow-up in higher order semilinear parabolic equations*, August 2, 2002
- Ioanis Nikolaidis** (U. Alberta): *On the use of transmission power control for energy-efficiency MANET services*, August 22, 2002
- Satish Reddy** (Quadrus Financial Tech. Inc.): *Introduction to Options and their Valuation*, September 6, 2002
- S. J. Paddison** (Los Alamos National Lab): *Multi-scale Modeling of Proton Conduction in the Electrolyte of a PEM Fuel Cell*, September 13, 2002
- Andrey Pavlov** (SFU): *Homeownership as a Constraint on Asset Allocation*, September 20, 2002

Dr. Jose-Leonel Torres (U. Michoacan): *Biological Power Laws and Darwin's Principle*, September 25, 2002

Dr. Michael Ward (UBC): *The Stability and Dynamics of Localized Patterns for a Reaction-Diffusion System*, September 27, 2002

Chen Greif (UBC): *On the solution of indefinite linear systems*, October 4, 2002

Eirikur Palsson (UBC): *Exploring the interplay of cell-adhesion and chemotaxis on cell sorting using a 3-D model*, October 11, 2002

Walter Craig (McMaster): *Traveling water waves*, October 21, 2002

Brad McNeny (SFU): *A stepwise procedure for detecting recombination breakpoints with application to HIV-1 molecular sequences from an individual*, October 25, 2002

Richard O. Moore (SFU): *Importance sampling applied to simulations in optical communications*, November 1, 2002

Bastiaan J. Braams (Courant): *The computational complexity of the Hartree-Fock approximation in quantum chemistry*, November 29, 2002

PIMS Centre for Mathematical Biology Seminar

Organizer: Mark Lewis
(University of Alberta)



Kerry Landman (U. Melbourne): *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'*, October 1, 2001

Hal Smith (Arizona State U.): November 1, 2001

Sebastian Schreiber (Western Washington U.): *Allee effects, chaotic transients, and extinction in simple population models*, November 19, 2001

Kevin Painter (Heriot-Watt U.): November 26, 2001

Brian Denis (U. Idaho): January 28, 2002

Leah Edelstein-Keshet (UBC): April 8, 2002

Alex Mogilner (UC Davis): *How nematode sperm crawl*, September 9, 2002

Rebecca Tyson (Okanagan University College): *How nematode sperm crawl*, November 4, 2002

IV. 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

Its unique structure allows PIMS 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 vigorous 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.

Design Theory: Resolvability and Parallelisms, PIMS-SFU, May 16–18, 2001

Organisers: Brett Stevens & 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, RRP's where every resolution class is made 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 uni-polar multi-user communication systems. These exciting recent developments prompted this mini workshop.

Speakers:

Charles Colbourn (U. Vermont): *Doubly resolvable Steiner triple systems*

Mark Chateauneuf (U. Waterloo): *Resolving to avoid parallelisms*

Izabella Adamczak (Michigan Technical University): *On the hole-size bound for incomplete block designs*

Myra Cohen (U. Auckland, 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 (U. 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 (SFU)

Alex Rosa (McMaster): *Upper Chromatic Index and Specialized Block Colourings of Steiner Triple Systems*

9th 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 (UC, Riverside): *New developments in canonical quantum gravity*

Dick Bond (CITA): *Cosmic Parameters from the CMB*

Viqar Hussain (U. New Brunswick): *Dualities and Wilson loops*

Amanda W Peet (U. Toronto): *Recent developments in string theory and applications to black holes*

Eric Poisson (U. Guelph): *Gravitational radiation reaction in strong fields*

Kristin Schleich (UBC): *Topological censorship*

Saul Teukolsky (Cornell): *Numerical simulations of black holes*

Kip S Thorne (Caltech): *Gravitational waves: A status report*

Virginia Trimble (UC, Irvine): *Looking into the potential wells: Observations of compact objects*

S-T Yau (Harvard): *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 (U. Victoria)

Speakers:

William Langford (U. 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 (U. Pernambuco): *Central Configurations for Charged Problems*

Hildeberto Cabral (Universidade Federal de Pernambuco): *Periodic solutions of perturbations of the Kepler problem*

Carmen Chicone (U. Missouri): *What are the classical equations of motion with radiation reaction taken into account?*

Daniel Offin (Queens University): *Stability of periodic solutions and the variational principle*

Christina Stoica (U. Victoria): *Classical Scattering and Block Regularization*

Mathematical Biology

Organizer: Pauline van den Driessche (Victoria)

Speakers:

Leah Keshet (UBC): *Modelling cell and chemical interactions in Alzheimer's Disease*

Michael Li (U. Alberta): *Mathematical Analysis of the Global Dynamics of a Model for HTLV-1 Infection and ATL Progression*

Mark Lewis (U. Utah): *How predation can slow, stop or reverse a prey invasion*

Mark Kot (U. 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 (U. Texas, San Antonio): *Modeling the Human Menstrual Cycle*

William Langford (U. Guelph): *Normal Form Analysis of Nayfeh's Abnormal Resonance*

Sally Blower (UCLA): *Live attenuated HIV vaccines: predicting the trade-off between efficacy & safety*

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 afternoon talks on individual papers.

Brian Alspach (U. Regina) gave a series of 3 instructional lectures on vertex-transitive graphs. **Charles Colbourn** (Arizona State) 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** (U. 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.



The Designs, Codes, Cryptography and Graph Theory group.

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. Manitoba): *Complementary Pairs of Sequences*

G. Hahn (U. Montreal): *Absorbing Sets in Coloured Tournaments*

S. Hedayat (U. Illinois, Chicago): *Adding More Runs to Saturated D-Optimal Resolution III Designs*

Y. Ionin (Central Michigan): *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. 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. Toronto): *The Number of Words in Certain Non-linear Codes*

R. Rees (Memorial): *On Holes in t -Wise Balanced Designs*

C. Rodger (Auburn U.): *A Very Basic Introduction to Error Correcting Codes, The Graph Theoretical Approach to Convolutional Codes, and Encoding on Compact Discs*

R. Safavi-Naini (U. Wollongong, Australia): *Error and Deletion Correcting c -Secure Codes*

P. Shiue (U. Nevada, Las Vegas): *On the Number of Primitive Polynomials over Finite Fields*

D. Stinson (U. 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. Manitoba): *Applications of a Numerical Sieving Device*

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): *Dynamic Chemical Process Optimization*

Kevin Burrage (U. Queensland): *An overview of numerical methods for stochastic ordinary differential equations*

Stephen Campbell (North Carolina State): *Optimization and Differential Equations*

Luca Dieci (Georgia Tech): *Some computational problems in dynamical systems*

Leslie Greengard (Courant Institute): *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 (Imperial College, London): *Conservative Methods for Wave and Fluid Dynamics*

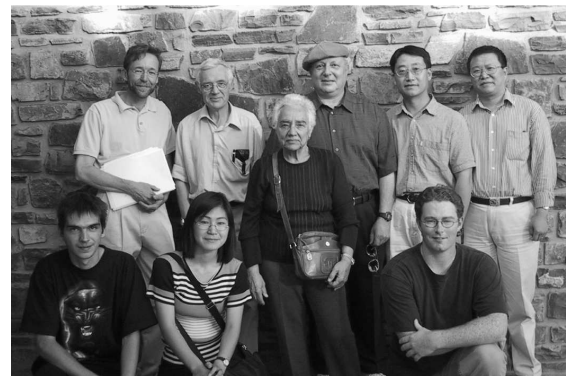
Gustaf Soderlind (Center for Mathematical Sciences, Lund University): *Digital Filters in Adaptive Time-Stepping*

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)

Speakers: **James Arthur** (U. Toronto), **Georgia Benkart** (U. Wisconsin), **Stephen Berman** (U. Saskatchewan), **H.S.M. (Donald) Coxeter** (U. Toronto), **Terry Gannon** (U. Alberta), **Victor Kac** (MIT), **Jeffrey Lagarias** (AT&T Labs-Research), **Ian Macdonald** (Oxford), **Kumar Murty** (U. Toronto), **Jiri Patera** (CRM), **Ian Putnam** (U. Victoria), **Peter Slodowy** (Universitat Hamburg), **Louis Solomon** (U. Wisconsin), **Boris Solomyak** (U. Washington), **Efim Zelmanov** (Yale) and **Andrei Zelevinsky** (Northeastern).



Maria's Group (all mathematical children and grandchildren of Maria). Top (l–r): A. Pianzola, R. Moody (U. Alberta), M. Wonenberger (Spain), S. Berman (U. Saskatchewan), K. Liu (UBC), Y. Gao (York). Bottom (l–r): N. Strungaru, J.-Y. Lee, S. Sullivan (U. Alberta).

Around Group Rings Seminar, Jasper, Alberta, February 18–21, 2002

Organisers: Gerald Cliff, Mazi Shirvani and Al Weiss (U. Alberta).

The conference was attended by 48 participants from North America (Canada, US), South Amer-

ica (Brazil), and Europe (Ireland, Italy, Poland, The Netherlands, Belgium, Germany) and Asia (Japan).

The speakers were: **Yuri Bakhturin** (Memorial and Moscow State), **Antonio Giambruno** (Palermo), **Jairo Goncalves** (Sao Paulo), **Narain Gupta** (Manitoba), **Martin Hertweck** (Stuttgart), **Ted Hurley** (Galway), **Eric Jespers** (Brussels), **Alexander Lichtman** (Wisconsin-Parkside), **Zbigniew Marciniak** (Warsaw), **Gabrielle Nebe** (Ulm), **Donald Passman** (Wisconsin-Madison), **David Riley** (Western), **Peter Roquette** (Heidelberg) and **Fernando Szechtman** (Waterloo).

A volume of proceedings will appear in the series Resenhas do IME published by the U. of Sao Paulo.



Participants of the Around Group Rings Seminar in Jasper.

Representations of Reductive p -adic Groups, Banff, Alberta, February 21–23, 2002

Organisers: Clifton Cunningham (U. Calgary) and Fiona Murnaghan (U. Toronto)

In February 2002 the Banff Centre hosted a small, focused, and very successful research workshop on Representations of Reductive p -adic Groups, bringing mathematicians from Canada, France, Germany and the US to the future site of the Banff International Research Station.

The workshop was organized around three mathematical themes reflecting recent progress in the field: The construction of types for admissible representations of reductive p -adic groups and applications to character theory; applications of rigid analytic geometry to p -adic group representation theory; results on L -packets.

Speakers and titles are listed below:

Jeffrey Adler (U. Akron): *Supercuspidal character germs for classical groups*

Anne-Marie Aubert (CNRS ENS): *Sheaves on adic spaces for p -adic group representation theory*

Stephen Debacker (Harvard): *Quixotic quests*

Laurent Fargues (Institut de mathématiques de Jussieu): *An introduction to Rapoport Zink spaces and their l -adic cohomology*

David Goldberg (Purdue): *The norm map and consequences*

Jeffrey Hakim (American University): *Supercuspidal Representations Attached to Symmetric Spaces*

Thomas Hales (Pittsburgh): *Motives and Representations of Reductive p -adic Groups*

Chris Jantzen (East Carolina): *Degenerate principal series for even-orthogonal groups*

Henry Kim (Toronto): *Application of Langlands' functorial lift of $SO(2n + 1)$ to $GL(2n)$*

Julee Kim (IAS, Princeton): *Dual blobs and Plancherel formula*

Peter Schneider (Universität Münster): *The algebraic theory of tempered representations*

Matthias Strauch (Universität Münster): *Representations on vanishing cycles, trace formulas and boundaries*

Jiu-Kang Yu (Maryland): *Integral schemes for Moy-Prasad filtrations*

Other participants appearing in the photograph are Peter Campbell (Alberta), Jason Levy (Ottawa) and Loren Spice (Chicago).



The participants of the Representations of Reductive p -adic Groups workshop.

2nd Canadian Conference on Nonlinear Solid Mechanics, SFU, June 19–23, 2002

Organisers: Elena M. Croitoro (Co-Chair, University of Victoria), Cecil Graham (Co-Chair, SFU), R. Choksi (SFU), M. Epstein (U. Calgary), M. S. Gadala (UBC), J. B. Haddow (U. Victoria), T. B. Moodie (U. Alberta), N. Rajapakse (UBC), P. Schiavone (U. Alberta) and D. J. Steigmann (UC, Berkeley).

Canadian Conferences on Nonlinear Solid Mechanics (CanCNSM) provide an international forum for communicating recent and projected advances in various areas of Nonlinear Solid Mechanics and Materials, to assemble researchers working on common themes from complementary perspectives, and to provide an opportunity for direct information exchange among delegates from academia, research laboratories, and industry. The framework of CanCNSM Conferences is truly multidisciplinary.

The plenary speakers were:

E. N. Dvorkin (Centre for Industrial Research, Buenos Aires): *Finite Element Models in the Steel Industry: Modeling of Production Processes*

R. Fosdick (University of Minnesota): *Steady, Structured Shock Waves: Thermoelastic Materials*

P. Podio-Guidugli (University of Rome Tor Vergata): *Concepts and Problems in Dynamic Micromagnetics*

A. P. S. Selvadurai (McGill University): *Second-Order Elasticity for Axisymmetric Torsion: A Spheroidal Coordinate Formulation*

J. R. Willis (University of Cambridge): *Some Recent Developments in the Analysis of Composite Materials*

Americas V Conference, Edmonton, July 7–12, 2002

Organisers: Michael Li (Co-Chair, Alberta), Kening Lu (Brigham Young), Konstantin Mischaikow (Georgia Tech.), James Muldowney (Co-Chair, Alberta) and Jianhong Wu (York).

The Americas Conference in Differential Equations and Nonlinear Dynamics is a biennial series that was established in 1994 as a joint initiative of four major research centres in South and North America:

The Center for Dynamical Systems and Nonlinear Studies (CDSNS) at Georgia Institute of Technology, USA, the Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas (IIMAS) at Universidad Nacional Autónoma de México (UNAM), México, the Instituto de Matemática Pura e Aplicada (IMPA), Brazil, and Fundayacucho, Venezuela, with an initial objective of fostering close collaborations and exchanges among researchers in this scientific field among the four countries.

The series was developed as a forum for the dissemination of scientific accomplishments in the Americas and for the creation of new opportunities for collaboration in dynamical systems. It has grown into one of the major international opportunities in this area. The first four conferences were held in Taxco, México (1994), Aguas de Lindoia, Brazil (1996), Atlanta, USA (1998) and Mérida, Venezuela (2000).

Americas V had 120 participants from 9 Americas countries (Canada, USA, México, Brazil, Venezuela, Colombia, Chile, Argentina and Peru) as well as from Asia and Europe. The conference was dedicated to Professor Shui-Nee Chow (Georgia Tech and University of Singapore) on his sixtieth birthday. Shui-Nee along with a handful of others such as Jack Hale (USA), Gilberto Flores (México) and Hildebrando Rodríguez (Brazil) have been active for many years in the development of scientific exchanges in the Americas especially at the graduate level.

The plenary lectures were delivered by: **Jorge Sotomayor** (Brazil), **Jack Hale** (USA), **Hildebrando Rodríguez** (Brazil), **Mark Lewis** (Canada), **Jianhong Wu** (Canada), **Raúl Manasevich** (Chile), **George Sell** (USA), **Alfonso Castro** (Colombia, USA), **Antonmaria Minzoni** (México), **Jorge Cosío** (Colombia), **Tomas Gedeon** (USA), **Robert Gardner** (USA), **Kening Lu** (USA), **John Mallet-Paret** (USA), **Peter Polacik** (USA), **Yingfei Yi** (USA) and **Hugo Leiva** (Venezuela).

An innovation at this conference was the PIMS Posters at Americas V which was a web-based poster session. A prize of \$1000 for the best graduate student poster was shared by Germán Jesús Lozada Cruz (from Peru, studying for his PhD at Universidade de São Paulo, Brazil) and Horacio Gómez-Acevedo (from México, studying for his PhD at U of

A, Canada). The Selection Jury for the graduate student posters was Ra'ul Manasevich (Chile), Gilberto Flores (Mexico) and Jianhong Wu (Canada).



Shui-Nee Chow with some of his former PhD students at the Americas V Conference.

Co-Sponsored Computer Science Conferences, Edmonton, July–August 2002

Over a three-week period in July–August 2002, PIMS, the University of Alberta together with the City of Edmonton had the honour of hosting the following eight prominent international conferences.

Each of these conferences represents a field with sophisticated mathematics and fascinating intellectual challenges. In addition, each is addressing useful, important real-world problems.

IDEAS'02, International Database Engineering and Applications Symposium, Edmonton, July 17–19, 2002

An international forum for discussion of the problems of engineering database systems involving not only database technology but the related areas of information retrieval, multimedia, human machine interface and communication. More information can be found on <http://database.cs.ualberta.ca/ideas02>.

CanDB'02, 3rd Annual Canadian Database Workshop, Edmonton, July 22, 2002

A biannual workshop grouping Canadian academics in databases to discuss their current research and re-

search issues. <http://db.cs.ualberta.ca/candb/>

KDD'02, The 8th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining Conference, Edmonton, July 23–26, 2003

The largest international conference in Knowledge Discovery and Data Mining, see www.acm.org/sigs/sigkdd/kdd2002/.

CG'02, 3rd International Conference on Computers and Games, U. Alberta, July 25–27, 2002

A major international forum for researchers and developers interested in all aspects of artificial intelligence in computer game-playing. For more information see www.cs.ualberta.ca/cg2002.

AAAI/IAAI'02, 18th National Conference on Artificial Intelligence, 14th Innovative Applications of AI Conference, Edmonton, July 28–August 1, 2002

The pre-eminent conference in Artificial Intelligence, for more information see www.aaai.org/Conferences/National/2002/aaai02.html.

UAI'02, 18th Conference on Uncertainty in Artificial Intelligence, U. Alberta, August 1–4, 2002

The primary international forum for presenting new results on the use of principled methods for reasoning under uncertainty within intelligent systems. For further information see www.cs.ucla.edu/uai02/.

SARA'02, Symposium on Abstraction, Reformulation and Approximation, Kananaskis, August 2–4, 2002

The fifth Symposium on Abstraction, Reformulation and Approximation (SARA) was held at Kananaskis Mountain Lodge, Kananaskis Village, Alberta (Canada), August 2–4, 2002. SARA's aim is to provide a forum for intensive interaction among researchers in all areas of AI with an interest in the different aspects of AR&A techniques.

SARA'02 was the most successful of the five meetings held so far. Fifty-one researchers attended from countries around the globe and twenty of the attendees were Ph.D. students. There were three invited technical talks, 14 technical presentations selected on a peer-review basis, and 14 presentations of "late breaking results" in a lively poster session. The proceedings of the meeting are published under the title *Abstraction, Reformulation and Approximation* as volume 2371 in Springer's LNAI series (Lecture Notes in Artificial Intelligence). Many details about the meeting, including some of the presentations made, are available through the conference's web page: <http://www.cs.ualberta.ca/holte/SARA2002/>

SARA-02 is an affiliate of the American Association for Artificial Intelligence (AAAI), and as such received free advertising through AAAI and a very generous grant for supporting student attendance. NASA's Ames Research Center provided financial support for two of the invited speakers. The University of Alberta provided a conference grant. PIMS handled the pre-registration of all attendees.

The next SARA will be run by Jean-Daniel Zucker of the Universite Paris VI (Pierre & Marie Curie) in Paris, France. For more information, contact Jean-Daniel.Zucker@lip6.fr.

See www.cs.ualberta.ca/holte/SARA2002.

**ISMB'02,
10th International Conference on Intelligent
Systems for Molecular Biology,
Edmonton, August 3–7, 2002**

The largest international conference in bioinformatics and computational biology. For more information see www.cs.ualberta.ca/ismb02/.

**Aperiodic Order, Dynamical Systems,
Operator Algebras and Topology,
U. Victoria, August 4–8, 2002**

Organisers: Jean Bellissard (Toulouse), Johannes Kellendonk (Cardiff), Ian Putnam (Victoria).

The workshop was devoted to recent developments in the area of aperiodic tilings and quasi-crystals. In particular, the participants discussed contributions from diverse fields such as operator algebras, topology, K-theory and foliated spaces, as well as ergodic

theory and diffraction. Experts from these different fields were brought together to share their knowledge.

The speakers and titles were:

Claire Anantharaman-Delaroche (Université d'Orléans): *Amenable groupoids. Examples and applications*

Michael Baake (Universität Greifswald): *Mathematical diffraction theory and model sets*

Marcy Barge (Montana State University): *The topology of one-dimensional tiling spaces*

Laurent Bartholdi (UC, Berkeley): *Tilings and Groupoids Acting on Rooted Trees*

Bob Burton (Oregon State): *A dynamical approach to constructing sequences in the unit cube which are well dispersed*

Thierry Fack (Université de Lyons I): *Introduction to cyclic cohomology*

Franz Gähler (ITAP, Universität Stuttgart): *Modelling Aperiodic Solids: Concepts and Properties of Tilings and their Physical Interpretation and Cohomology of Quasiperiodic Tilings*

Jean-Marc Gambaudo (Université de Bourgogne, Dijon): *Delone sets, tilings and solenoids: from finite translation type to finite isometry type*

Thierry Giordano (U. Ottawa): *Affable equivalence relations and orbit structure of Cantor minimal systems*

Chaim Goodman-Strauss (U. Arkansas): *Triangle Tilings and Regular Productions*

John Hunton (U. Leicester): *New Models and Methods for Tiling Spaces*

Jerry Kaminker (I.U.P.U.I.): *Index theory on foliated spaces and applications.*

Alex Kumjian (U. Nevada, Reno): *Actions of Z^k associated to higher rank graphs*

Jeong-Yup Lee (U. Alberta): *Consequences of Pure Point Diffraction Spectra for Discrete Point Sets*

Daniel Lenz (TU-Chemnitz): *Uniform ergodic theorems on Delone dynamical systems and applications*

N. Christopher Phillips (U. Oregon): *The structure of the C^* -algebras of free minimal actions of Z^d on the Cantor set*

Charles Radin (U. Texas, Austin): *Aperiodicity: lessons from various generalizations*

Lorenzo Sadun (U. Texas): *When size matters: the effect of geometry on $1 - D$ tiling dynamics*

Klaus Schmidt (U. Vienna):

Claude Schochet (Wayne State): *Life After K-theory*

Robert Williams (U. Texas, Austin): *Tiling spaces as Cantor set fiber bundles*

Physics Conference in Honour of K. S. Viswanathan's Contribution to Theoretical Physics, PIMS-SFU, September 19–20, 2002

Organisers: A. DeBenedictis (Langara), P. Matlock (SFU), W. Mueck (Naples), R. Parthasarathy (Chennai, India), R. Rashkov (Sofia, Bulgaria) and Y. Yang (SFU)

The speakers at this conference were:

R. Rashkov (Sofia University, Bulgaria): *On the static/time-dependent tachyon states in vacuum string field theory and their relevance to cosmology*

R. Parthasarathy (Institute of Mathematical Science, India): *Abelianisation of Wilson Loops of Non-Abelian Gauge Theory*

P. Matlock (SFU): *Butterfly Tachyons*

A. Das (SFU)

D. Horvat (U. Zagreb, Croatia): *Hypernuclear Potentials and Axial Vector and Vector Meson Degrees of Freedom*

Y. Yang (SFU)

T. Lee (Kangwon National University, Korea): *String Field Theory and Tachyon Condensation*

G. Semenoff (UBC): *Aspects of AdS/CFT*

Mathematical Prediction of Sound Transmission Through Composite Lightweight Walls Seminar, ATCO Noise Management, Calgary, November 7, 2002

Organisers: Daryl Caswell (University of Calgary), Liming Dai (U. Regina), Dave Nichols and Salem Hertel (ATCO Noise Management).

This seminar was conducted by **David Quirt** and **Alfred Warnock** (Acoustics, Institute of Research in Construction, NRC).

The seminar consisted of six presentations:

Airborne Sound Transmission Through Walls and Floors

Flanking Transmission—Typical performance, and concepts for modelling

Modelling Airborne Sound Transmission Through Walls and Floors

Floor and Wall Assemblies—Using Regression to Predict TL

Predicting Flanking Transmission in Wood Framed Construction

Sound Transmission Through Concrete Block Wall Systems

Co-Sponsored Computer Science Activities, Vancouver, November 16–23, 2002

Local Organizer: Arvind Gupta (MITACS)

Four premier events in theoretical computer science were held at the Delta Pinnacle hotel in Vancouver. In total more than 500 participants came from around the world took part in one or more activities.

Workshop on Algorithms and Models for the Web-Graph, November 16, 2002

Organisers: Bela Bollobas (Memphis and Cambridge), Andrei Broder (IBM T. J. Watson, Chair), Guido Caldarelli (U. di Roma), Fan Chung Graham (UC San Diego), Alan Frieze (CMU), Lee Giles (Penn State), Jon Kleinberg (Cornell), Ravi Kumar (IBM Almaden), Michael Mitzenmacher (Harvard), Christos Papadimitriou (UC Berkeley), Prabhakar Raghavan (Verity Inc), Andrew Tomkins (IBM Almaden) and Eli Upfal (Brown).

The 1st Workshop on Algorithms and Models for the Web-Graph (WAW) took place was very successful. There were 9 contributed talks, 3 invited talks, and a panel, and the final tally was 76 participants, probably half of which were students.

The invited speakers were:

F. Chung, L. Lu and **V. Vu** (UC, San Diego): *Eigenvalues of random power law graphs*

R. Stata (UC, Santa Cruz): *Building Web-scale Web graphs from real data*

M. Mitzenmacher (Harvard): *A brief history of generative models for power law and lognormal distribution*

The event was co-sponsored by MITACS, PIMS, IBM, and Overture.

Foundations of Computer Science Tutorial, November 16, 2002

This tutorial attracted 200 participants. The three speakers that were chosen to present tutorials on topical issues were:

Oded Goldreich (Weizmann Institute of Science): *Zero-Knowledge*

Eva Tardos (Cornell): *Approximation Algorithms*

Salil Vadhan (Harvard): *Randomness Extractors*

IEEE Foundations of Computer Science (FOCS) Conference, November 16–19, 2002

Programme Committee: Dorit Aharonov (Hebrew U), Maria Luisa Bonet (UPC, Barcelona), Bernard Chazelle (Chair, Princeton & NEC Research), Edith Cohen (AT&T Labs), Lance Fortnow (NEC Research), Anna Gal (UT Austin), Venkatesan Guruswami (UC Berkeley & U Washington), Piotr Indyk (MIT), Ravi Kannan (Yale), Claire Kenyon (U Paris-Sud), Yuval Rabani (Technion), Tal Rabin (IBM Research), Omer Reingold (AT&T Labs), Ronitt Rubinfeld (NEC Research), David B. Shmoys (Cornell), Dan Spielman (MIT) and Emo Welzl (ETH, Zürich).

The 43rd Annual Symposium on Foundations of Computer Science (FOCS 2002) had close to 350 participants, much higher than the usual 200–250 at past FOCS conferences. More than 250 papers were submitted out of which 74 were selected for presentation. The highlight was a traditional Chinese banquet at the Imperial Chinese Restaurant.

The IEEE Computer Society Technical Committee on Mathematical Foundations of Computing, MITACS, SFU, PIMS, Microsoft Hewlett-Packard and QCI were all sponsors of the event.

International Symposium on Symbolic and Algebraic Computation (ISAAC), November 20–23, 2002

Organizers: Binay Bhattacharya (SFU), Prosenjit Bose (Carleton), Arvind Gupta (SFU) and Tiko Kameda (SFU).

The 13th Annual International Symposium on Algorithms and Computation (ISAAC) attracted 120 par-

ticipants with substantial representation from Asian countries. There were 54 papers presented from 164 submissions.

The three plenary speakers were:

Luc Devroye (McGill): *Random Tries*

János Pach (Courant Institute): *Monotone drawings of planar graphs*

Nicholas Pippenger (UBC): *Expected Acceptance Counts for Finite Automata with Almost Uniform Input*

The sponsors of ISAAC were MITACS, PIMS, SFU, HP, QCI, and Bajai.

Alberta Conference on Industrial Organization, U. Calgary, November 29–30, 2002

Organisers: Aidan Hollis (U. Calgary) and Andrew Eckert (U. Alberta).

Competition policy is the means through which national governments control the behaviour of firms to ensure that consumers receive a low price and yet investors receive a fair return on their investment. This workshop explored several different aspects of competition policy by drawing on examples from specific industries (such as gasoline and automobiles) in which there is systematic useful data, and by theoretical modelling applied to explore problems such as competition in the patent system and competition in industries with upgrades.

The speakers at this conference were:

John Boyce (U. Calgary): *Novelty and Usefulness in Patents*

Jeffrey Church (U. Calgary): *Competitive Upgrades*

Andrew Eckert (U. Alberta): *Retail Gasoline Price Cycles and Cross-Sectional Price Dispersion*

Robin Lindsey (U. Alberta): *Predatory Pricing in Differentiated Products Retail Markets*

Moez Kilani (Universite du Centre a Sousse, Tunisia): *Price and product line competition in automobile markets*

A Glimpse at 2003

**Special Functions in the Digital Age,
Simon Fraser University,
January 23–24, 2003**

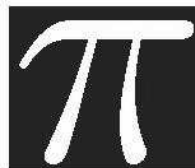
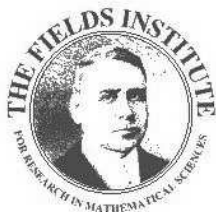
**Graph Theory of Brian Alspach,
Simon Fraser University,
May 25–29, 2003**

**4th Geoffrey J. Butler Memorial
Conference,
University of Alberta
June 17-21, 2003**

**Banach Algebras and their Applications,
University of Alberta
July 27–August 9, 2003**

**Workshop on Optimal Transportation
and Nonlinear Dynamics,
University of British Columbia,
August 11–15, 2003**

**PIMS Sessions at the CMS Winter 2003
Meeting,
Simon Fraser University,
December 6–8, 2003**



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 programmes 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 programme rotates between the three Institutes on an annual basis. Submissions are made to the Deputy Director of the institute admin-

istering the programme in that year. In 2001–02 the Committee approved the following slate of scientific activities:

Activities 2001/02:

Novel Approaches to Hard Discrete Optimization

University of Waterloo, April 26–28, 2001

Contact: Henry Wolkowicz (U. Waterloo)

Canadian Annual Symposium on Operator Algebras,

MSRI, Berkeley, California, April 26–May 2, 2001

Contact: George Elliott (U. Toronto)

Black Hole, III Conference

Kananaskis, Alberta May 19–23, 2001

Organizer: A. Frolov (U. 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 (U. Saskatchewan)

Summer Meeting 2001 CAIMS

University of Victoria, June 7–9, 2001

Organizer: Reinhard Illner (U. Victoria)

Joint meeting of SSC, IMS and WNAR,

SFU, June 10–14, 2001

Contact: Mary Lesperance (U. 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. Waterloo)

Second Gilles Fournier Memorial Conference

University of Sherbrooke, August 13–15, 2001
 Contact: Tomasz Kaczynski (U. Sherbrooke)

Second Workshop on the Conley Index and Related Topics

University of Sherbrooke, August 15–18, 2001
 Contact: Tomasz Kaczynski (U. Sherbrooke)

Aspects of Symmetry on the occasion of the 60th birthday of Robert Moody

Banff, Alberta, August 26–29, 2001
 Contact: Arturo Pianzola (U. 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 U.)

Western Canada Linear Algebra Meeting

University of Regina, May 10–11, 2002
 Contact: Steve Kirkland (U. Regina)

PIMS Sessions at the SSC Annual Meeting

Hamilton, Ontario, May 26–29, 2002
 Contact:

5th Americas Conference on Differential Equations and Nonlinear Dynamics

University of Alberta, July 07–12, 2002
 Contacts: Michael Li and James Muldowney (U. Alberta)

Formal Power Series and Algebraic Combinatorics 2002

University of Melbourne, July 8–12, 2002
 Organizer: Nantel Bergeron (York U.)

Nonlinear Dynamical Systems with Applications

Memorial U. Newfoundland, July 15–18, 2002
 Organizers: H. Brunner and X. Zhao (Memorial U.)

AARMS Summer School

Memorial University of Newfoundland,
 July 22–August 16, 2002
 Organizer: Hermann Brunner (Memorial U.)

14th Annual Canadian Conference on Computational Geometry (CCCG02)

University of Lethbridge, August 12–14, 2002
 Contact: Stephen Wismath (U. Lethbridge)

International Workshop on Polynomial Identities in Algebra

Memorial University of Newfoundland,
 August 29–September 3, 2002
 Organizer: Hermann Brunner (Memorial U.)

APICS 2002 Special Session on Ring Theory

Mount Allison University, October 18–20, 2002
 Organizers: M. Beattie (Mount Allison U.),
 M. M. Parmenter (Memorial U.) and R. J. Wood
 (Dalhousie U.).

Numerical Analysis, Scientific Computing and Computational Applied Mathematics

St. Francis Xavier University, October 20–21, 2002
 Organizer: Hermann Brunner (Memorial U.)

CMS Winter Meetings

Ottawa, December 8–10, 2002
 Organizer: Graham Wright (CMS)

International Initiatives

Second Pacific Rim Conference on Mathematics, Taipei, Taiwan, January 4–8, 2001

Organizing Committee: Shui-Nee Chow (National U. Singapore), Craig Evans (UC, Berkeley), Fon-Che Liu (Academia Sinica, Taiwan), Masayasu Mimura (Hiroshima U.), Robert Miura (PIMS), Ian Sloan (U. 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 Non-linear 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): *Cellular neural Networks: Pattern and Waves*

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 Poincaré'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.

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.



From left: Robert Moody, Arvind Gupta, Tom Brzustowski, Nassif Ghoussoub, Mark Lewis, Jacques Hurtubise and Hugh Morris at the Canada-China banquet at UBC.

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, Math Centre of Chinese Education Ministry)
- **Wang Jie** (Vice director, Chinese NSF)
- **Zhiming Ma** (President, Math Society of China)
- **L.Z. Peng** (Secretary, Math 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)

Plenary Speakers:

- **Robert Moody** (U. 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** (U. Alberta): *Realistic models for biological invasion*
- **Jie Xiao** (Tsinghua), *Hall Algebras and Quantum Groups*
- **Yiming Long** (Director, 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** (Courant): *The Dynamics of Vortices*
- **Peter Greiner** (Toronto): *Subelliptic PDEs and Subriemannian Geometry*
- **Gordon Semenov** (UBC): *Boundary states for background independent string field theory*
- **Izabella Łaba** (UBC): *Spectral Measure*
- **Jiquang Bao** (PIMS): *Local Estimates for Special Lagrangian 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): *Microlocal Analysis with Tight Multiwavelet Frames*

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 Postprocessing 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. 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. 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): *On Automorphisms of Belyi Surfaces*
- **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 Schrodinger 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 Homogeneous 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. 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. 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. Oregon): *Ordered K -theory for crossed products of the Cantor set by free minimal actions of \mathbb{Z}^d*
- **Sam Walters** (UNBC): *The structure of the Fourier transform on the rotation algebra*
- **Qing Lin** (U. Victoria and Ericsson): *Some thoughts from my recent work with Chris Phillips*
- **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 Stability Conditions for Orbital Stability of Almost Periodic Solutions*
- **Christiane Rousseau** (Montréal): *Finite cyclicity of graphics of planar vector fields and Hilbert's 16th problem for quadratic vector fields*

VIII. Mathematical Finance:

- **Abel Cadenillas** (Alberta): *Executive Stock Options with Effort Disutility 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*

Upcoming International Events:

**Pan American Advanced Studies
Institute on Inverse Problems and
Nonlinear Analysis,
Santiago, Chile, January 6–19, 2003**

**3rd Pacific Rim Conference on
Mathematics,
Vancouver, Canada, 2004**

V. INDUSTRIAL PROGRAMME



Participants of the 6th annual PIMS Industrial Problem Solving Workshop beside the PIMS facility at UBC.

PIMS/MITACS Industrial Partners

Advanis	ICBC	Prestige Telecommunications
Amber Computer Systems	Imperial Oil	Progas
APPEGA	In Silico	Quatronix Media
Ballard Power Systems Inc.	Insightful	Searle
Barrodale Computing	Itres Research Ltd.	Shaw Cable
Bayer Inc.	Kinetek Pharmaceuticals Inc.	Siemens Research
BC Cancer Research Center	Lockheed Martin Tactical Defense Systems	Simons International Copr.
BC Hydro	Math Resources Inc.	SmithKline BeeCham Pharma
BioTools	MathSoft	Sperry-Sun
Canadian Cable Labs	MacMillan Bloedel Ltd.	Soundlogic
Canadian Marconi	McMillan-McGee	StemCell Technologies Inc.
Charles Howards & Associates	MDSI	StemSoft Software Inc.
Chemex Labs	Menex Technologies	Stentor
Computer Modeling Group	Merak	Stern Stewart & Co.
Corel Corporation	Michelin	Sun Microsystems
Crystar Research Inc.	NALCO Canada Inc.	Syncrude
Diagnostic Engineering Inc.	NORTEL Networks	Telecom Research Labs
Dynapro	Novacor	Telus
Eastman Kodak	Pacific Forestry Centre	TransAlta
Enbridge	PanCanadian Petroleum Ltd.	Veritas DGC
FinancialCAD Corporation	Petro Canada	VisionSmart
Firebird Semiconductors	Progas	Vortek Industries Ltd.
Galdos Systems	Powerex	Waterloo Maple Inc.
Hughes Aircraft	Powertech Labs Inc.	Worker's Compensation Board
Husky Oil	Precision Biochemicals	
IBM T. J. Watson Research Center		

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.

5th 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

6th PIMS Industrial Problem Solving Workshop (IPSW 6)

University of British Columbia, May 27–31, 2002

Organizers:

Jack Macki (U. Alberta)
Chris Bose (U. Victoria)
Randy LeVeque (U. Washington)
Huaxiong Huang (York U.)
Marc Paulhus (U. Calgary)
Manfred Trummer (SFU)
Ian Frigaard (UBC)

Industrial Participants:

Capital Health
McMillan-McGee Corp
Precix Advanced Cutting Technologies
RBC Financial Group
Semiconductor Insights
Shell Canada
Talisman Energy

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).

Last 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.

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 Micklethwiate** of **Firebird Semiconductors**, 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.

PIMS Industrial Problem Solving Workshop (IPSW 6), University of British Columbia, May 27–31, 2002

Organizers: Jack Macki (U. Alberta), Chris Bose (U. Victoria), Randy LeVeque (U. Washington), Huaxiong Huang (York U.), Marc Paulhus (U. Calgary), Manfred Trummer (SFU) and Ian Frigaard (UBC).

About 100 people registered for this year's **Industrial Problem Solving Workshop (IPSW)**, including the 60 graduate students who had taken part in the graduate modeling camp the week before. Faculty from as far away as South Africa, Finland and China 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 found on the website, www.pims.math.ca/industrial/2002/ipsw/, and proceedings papers are now being written by each group.

Workshop Problems:

Mathematically Surface Matching of Maps of the Human Torso: **Edmond Lou** represented **Capital Health** of Edmonton and brought a problem involving automating the process of analysis data from a 3D laser scanner that is used to diagnose patients with scoliosis. The current process, although good, relies on many manual user steps to complete the analysis. The team was able to show how some standard (and some not so standard) image processing techniques could be used to fully automate the data analysis process. Further, Capital Health was interested in knowing if it was necessary to use the physical marker points that they currently place on the patient's back before the scanning process. The team was convinced, after looking at a large amount of sample data, that the information given by the marker points could not be retrieved mathematically from the data, and hence are necessary.

Combined Inversion of Seismic and Magnetotelluric for Gas Exploration in the Canadian Foothills: **Kai Meunzer** from **Shell Canada** came to the workshop with an inverse problem: Given seismic and magnetotelluric data, can we determine geological properties of the Canadian foothill? After some discussion on the background materials of both seismic and magnetotelluric methodologies, the team realized that the best approach was to construct a simple one-dimensional 3-layer model to test a hybrid seismic-magnetotelluric approach by minimizing the weighted least square errors of both seismic and magnetotelluric data. Even though the team worked on this project was the smallest, each participant brought considerable expertise from various areas. With the help of Doug Oldenburg, (an expert in geophysical inverse problems), Yongji Tan, (an expert in inverse problems), and with the help of two graduate students, it was found that the hybrid method works better than either seismic or magnetotelluric approaches. This was only true if appropriate weight functions were chosen. Kai Meunzer was very satisfied with the progress made during the workshop and some follow-up work after the workshop has provided further insight into the problem.

How to create the composite image of an integrated circuit: **Edward Keyes of Semiconductor Insights** was interested in an algorithm to automatically stitch a large number of images of an integrated circuit together in order to reconstruct the image of the entire circuit itself. This problem attracted a large number of participants who quickly broke into teams to test the many different approaches that were suggested. The most straightforward approach, based on least-squares was implemented and tested during the week and was found to be a significant improvement over the current method. Other approaches, based on graph theory, simulated annealing and linear programming also showed a great deal of promise. It is clear that once the smoke clears the company will have an algorithm that is a significant improvement over the current techniques.

Resistance Monitoring: Appearing in his second IPSW, **Bruce McGee** of **MacMillan-McGee** presented the following scenario. One method of recovering soil contaminants is to electrically heat the soil with various electrodes inserted into wells in the ground. By injecting water into certain electrode locations and pumping fluids out of the remaining locations, the contaminants are slowly removed. If the contaminants are actually removed, as is intended, this process should change the resistivity of the soil as it progresses. For this reason, departures from the characteristic evolution of resistivity are of particular interest.

The workshop participants were given the inverse problem of find the actual resistivity, given the response curve of the current, (or indeed any other measurable data). Failing this, was it possible to localize where in the domain any changes in resistivity occurred? Because of the size of the group (7 faculty and 9 graduate students), various aspects of the problem were investigated. To understand the forward problem a sequence of one and two-dimensional models were constructed to determine (i) the time evolution of the temperature field when cold water is injected and (ii) the sensitivity of the model to small localized changes in the resistivity. These preliminary investigations illustrated that an internal transition layer is generated during the propagation of the shock of injecting cold water, which persists in the steady state. Furthermore, the measured voltage between the electrodes is much more sensitive than the outflow fluid temperature to localized resistivity changes. Using these forward models as justification, the temperature field was neglected for the inverse problem and an attempt was made to implement the generalized sensitivity theorem in a square domain with a localized resistance anomaly at its centre. By combining the computed voltage field in the domain without the anomaly with a series of voltage measurements obtained with the anomaly in place, a picture of where the anomaly was located was built up. Work continues on the problem specifically in extending the analysis of the inverse problem to a simple layered medium. Investigations to increase the resolution of the inverse problem using an analytic Green's function and finite difference rather than finite element methods are ongoing. Bruce McGee was quite pleased with the progress made on the problem and anticipates a predictive model that can be used onsite. In Bruce's words, "It's all good!"

Price Pseudo-Variance, Pseudo-Covariance, Pseudo-Volatility, and Pseudo Correlation Swaps—In Analytical Close Forms: **Ritchie He** of the **RBC Financial Group** presented a challenge to compute the closed form solutions to some very complex "pseudo" statistics. The team for this problem consisted almost entirely of graduate students, most of whom were new to financial mathematics. Nevertheless, the result was achieved and we look forward to seeing the full solution presented in the report.

Seismic inverse problem in anisotropic, inhomogeneous media: In the areas of petroleum exploration and reservoir engineering, geoscientists use concepts from seismology to image the subsurface and determine essential rock-physics properties. Experimental conditions are typically in the form of a seismic survey whereby measurements are made of a seismic wave traveling between source and

receiver. **Talisman Energy** presented an inverse seismic ray problem that sought to incorporate recent technological advances in the determination of elastic moduli. In particular, with the development of three-component geophones it is now possible to measure particle displacement associated with a seismic wavefront at depth. Such an experiment, whereby sources are located at the surface and geophones are placed within the earth, is called a VSP, (vertical seismic profile). It was hoped that pairing particle displacement (i.e., polarization angle) with recorded traveltimes would lead to an in situ inversion for elastic moduli requiring only a single source/receiver pair. Using concepts of asymptotic ray theory and continuum mechanics the team was able to formulate a system of eight non-linear equations that could be solved for the elastic moduli that were sought. Unfortunately, with the introduction of experimental errors, the system proved highly unstable and had to be abandoned. However, with the introduction of

some further, yet not overly restrictive, assumptions, the team went on to formulate a new system of four non-linear equations. Initial follow up work suggests the new formulation is reasonably stable under experimental conditions.

A Glimpse at 2003

**7th PIMS Industrial Problem Solving
Workshop,
University of Calgary,
May 24–30, 2003**

**Workshop on Facility Location
Problems,
SFU, June, 2003**

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 Industrial Problem Solving Workshop:

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 Mathematics 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-COE 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.

4th PIMS Graduate Industrial Math Modeling Camp
University of Victoria, June 11–15, 2001
Coordinator: Chris Bose (U. Victoria)

5th PIMS Graduate Industrial Math Modeling Camp
SFU, May 18–23, 2002
Coordinator: Marc Paulhus (U. Calgary)

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)

4th PIMS Fluid Dynamics Summer School
PIMS at U. Alberta, July 28–August 9, 2002
Organizer: B. R. Sutherland (U. Alberta)

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop
PIMS-UBC & PIMS-SFU, February 17–18, 2001
Organizers: R. Russell (SFU) & B. Shizgal (IAM)

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop
PIMS-UBC & PIMS-SFU, February 16–17, 2002
Organizers: R. Russell (SFU) & B. Shizgal (IAM)

Statistical Genetics and Computational Molecular Biology Workshop
U. Washington, December 16–18, 2001
Organizer: Elizabeth Thompson (UWashington)

1st PIMS Mathematics of Biological Systems Summer Workshop
University of Alberta, May 11–19, 2002
Organizer: Mark Lewis (U. Alberta)

PIMS-MITACS-COE Undergraduate Industrial Case Study Workshop
COE at UBC, May 25–27, 2002
Organizers: M. Puterman (Commerce and Business Admin, UBC) and Stephen Jones (COE, UBC)

Month of Industrial Math at PIMS: A wealth of opportunities for Canadian & 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 workshops.

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.

4th PIMS Graduate Industrial Math Modeling Camp, University of Victoria, June 11–15, 2001

Organizers: Chris Bose (U. Victoria), Randy LeVeque (U. Washington), Huaxiong Huang (York University), Mark Paulhus (U. Calgary), Keith Promislow (SFU) and Ian Frigaard (UBC).

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 Bepamyatnikh (UBC)

John Chadam (U. Pittsburgh)

Ian Frigaard (UBC)

Lisa Korf (U. Washington)

Hedley Morris (San Jose State)

Tim Myers (U. Capetown)

Miro Powojowski (Algorithmics Corp.)

Moshe Rosenfeld (U. 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



Sergei Bepamyatnikh (UBC)

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.

**5th PIMS Graduate Industrial Math Modeling Camp,
Simon Fraser University,
May 18–23, 2002**

Organizers: Jack Macki (U. Alberta), Chris Bose (U. Victoria), Randy LeVeque (U. Washington), Huaxiong Huang (York U.), Marc Paulhus (U. Calgary), Manfred Trummer (SFU) and Ian Frigaard (UBC).

At the **5th Annual Graduate Industrial Math Modelling Camp** (GIMMC) camp 60 graduate students from all over Canada, the US and even some from as far as Europe cut their teeth on some problems in Industrial Mathematics presented by prestigious academic mentors.

Brett Stevens (Carleton University) presented a problem in software testing. The idea was to apply combinatorics and statistical design to devise the best possible set of tests for a piece of abstract software. The students worked very hard devising combinatorial coverings of the space of possible input parameters.

Tim Myers (University of Cape Town) presented a problem on heating an airplane wing in order to evaporate water before it freezes. His students made great progress in modelling and solving this challenging thin film problem.

Chris Budd (University of Bath) presented a problem where you use a prod to test for the freshness of fish. His students were challenged into building a mathematical model the fish prods response and attempting to infer what information on the freshness of the fish could be retrieved from the data.

Yongji Tan (Fudan University, Shanghai) presented a problem applicable to the oil and gas industry. The students were asked to investigate the results of a well log tool that measures the resistivity in the surrounding structure. The students learned a great deal about finite element methods.

Alexander Melnikov (University of Alberta) came with some problems in financial mathematics. His problem attracted the largest number of students who were interested in learning about hedging and option in both complete and incomplete market settings.

Petra Berenbrink (SFU) brought her students right to the very edge of research in the complex area of routing in ad-hoc networks. The students came up with many new approaches and some counterexamples to this very difficult problem.

Brian Wetton (UBC) challenged the students with a very complex problem in modelling a protein membrane of a fuel cell. His students did an excellent job of solving some very difficult mathematics.

This year the students had a unique opportunity to present the results of the week's work in the form of a poster at the MITACS-AGM.

**3rd PIMS Fluid Dynamics Summer School, PIMS-U. Alberta,
May 27–June 8, 2001**

Organizers: B. R. Sutherland (U. Alberta) and T. B. 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** (U. Alberta), *Turbulence Modelling*;

Andrew B. G. Bush (U. Alberta), *Climate Modelling*; **Peter Minev** (U. Alberta), *Computational Fluid Dynamics*; **T. Bryant Moodie** (U. Alberta), *Wave Theory*; **Bruce R. Sutherland** (U. Alberta), *Stratified Flows* and **Gordon E. Swaters** (U. Alberta), *Physical Oceanography*.

4th PIMS Fluid Dynamics Summer School, PIMS-U. Alberta July 28–August 9, 2002

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

A knowledge of the dynamics of fluids is the starting point to understanding such diverse fields of study as aerodynamics, weather forecasting, ventilation, lubrication and turbulence. Fluid flows can be described by mathematical equations but these cannot be solved except in special circumstances. Instead scientists solve the equations numerically or use the results of laboratory experiments to guide their intuition in finding solutions.

In its dedication to the training of highly qualified personnel, each year the PIMS sponsors a fluid dynamics summer school at the University of Alberta. The two week long event is attended by graduate students and senior undergraduates from around the world. Each morning the participants attend lectures on a broad range of topics including waves and turbulence, convection, physical oceanography and climate modelling. The afternoons are spent gaining hands-on experience running numerical simulations and performing laboratory experiments which are designed to complement the lectures and which are adapted from the lecturers' current research. At the end of the school the students give presentations based on the results of their work.

There are two other annual fluid dynamics summer schools in the world, one at the University of Cambridge, England and the other at Woods Hole Oceanographic Institution, MA, USA. The PIMS Fluid Dynamics Summer School is unique in its emphasis on computational fluid dynamics and computer-aided laboratory measurements. Indeed, with its modern computational resources and its concentration of expertise in experimental and numerical fluid dynamics, the U. Alberta is one of the few

institutions in the world capable of running a school which simultaneously exposes participants to theory, numerical and experimental methods.

The summer school was fully attended by eighteen participants from Canada, England, Germany and the United States. Core lectures were given by **John Bowman** (Turbulence Modelling), **Andrew Bush** (Climate Modelling), **Peter Minev** (Computational Fluid Dynamics), **Bryant Moodie** (Wave Theory), **Bruce Sutherland** (Stratified Flows) and **Paul Myers** (Physical Oceanography).

The four invited lecturers were:

John Allen (U. Oregon): *Coastal Oceanography*

John Bush (MIT): *Geophysical Plumes*

Jean-Luc Guermond (LIMSI, U. Paris, Orsay): *Large Eddy Simulations*

Peter Rhines (U. Washington): *Overtuning Circulations in the Oceans and Atmospheres and Mountainous Flows in Rotating Fluids: Vorticity Dynamics, Form Drag and Induced Circulation*

Please see <http://fdss.math.ualberta.ca>.



2002 Fluid Dynamics Summer School participants.

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.

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop, PIMS-UBC and PIMS-SFU, February 16–17, 2002

Organizers: Bernie Schizgal (UBC) and Bob Russell (SFU)

The PIMS along with the Institute of Applied Mathematics (IAM) at the University of British Columbia and the Centre for Scientific Computing (CSC) at Simon Fraser University sponsored an undergraduate workshop on problems in applied mathematics for senior undergraduate students.

The workshop ran for two days with the first day at UBC and the second day at SFU.

Faculty mentors outlined each of the applied problems to all the participants. The students then

chose one of the problems to work on each day. The mentors presented lectures in which the tools for the modelling and analysis of the problem were developed. The mentors then helped groups of approximately 8 students to develop the models and to 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 are accessible to 3rd and 4th year undergraduates in mathematics, applied mathematics, physics and applied science. The workshop is an opportunity to meet students from across Canada.

The Student Committee of the Canadian Mathematical Society sponsored Saturday's reception, the Department of Mathematics at SFU sponsored Sunday's dinner.

The problems discussed included:

Setting Stable Cement Plugs in Oil Wells, Mentor: **Ian Frigaard** (UBC)

Characterization of Internet Traffic and its Impact on Network Performance, Mentor: **Ljiljana Trajkovic** (SFU)

Finding the tumor, Mentor: **Anthony Peirce** (UBC)

Scientific Visualization of Large Data Sets, Mentors: **David Muraki** and **Torsten Möller** (SFU)

For further details, please see the webpage www.pims.math.ca/industrial/2002/summw.



Participants in the IAM-CSC-PIMS Senior Undergraduate 2002

Statistical Genetics and Computational Molecular Biology, University of Washington, December 16–18, 2001

Organizer: Elizabeth Thompson (U. Washington).

This successful three-day workshop was 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. It was organised by the programmes in Statistical Genetics and Computational Molecular Biology at the University of Washington.

PIMS awarded a total of 13 travel scholarships to students from SFU, UBC and U. Calgary.

The following people spoke at the workshop:

David Baker (UW): *Protein Structure Prediction*

Jenny Bryan (UBC): *Finding Informative Subsets of Genes*

Joe Felsenstein (UW): *Trees of genes within and between species: molecular biology meets population biology*

Jinko Graham (SFU): *Testing and Estimation of Recombination Breakpoints in a Set of Aligned Sequences*

Phil Green (UW): *Analyzing Genome Sequences*

Kathleen Kerr (UW): *Gene Expression Microarrays: Classical Statistics and Modern Genomics*

Charles Kooperberg (FHCRC): *Sequence analysis using logic regression*

Leonid Kruglyak (FHCRC):

John Mittler (Microbiology, UW): *Population genetics and dynamics of HIV-1 infection*

Stephanie Monks (Biostatistics, UW): *Studying the Genetics of Gene Expression*

Maynard Olson (Genome Center, UW): *Resequencing Segments of the Human Genome: Experimental and Statistical Considerations*

Ram Samudrala (Microbiology, UW): *Modelling genome structure and function*

Elizabeth Thompson (Statistics, UW): *Inferring Gene Locations from Genetic Data on Pedigrees*

Martin Tompa (Computer Science and Engineering, UW): *Discovering Regulatory Motifs in DNA Sequences*

Ellen Wijsman (Division of Medical Genetics, School of Medicine, UW): *Gene finding in human populations*

1st PIMS Mathematics of Biological Systems Summer Workshop University of Alberta, May 11–19, 2002

Organizers: Mark Lewis (U. Alberta)

From May 11–19, 2002, the Centre for Mathematical Biology (CMB) offered the 1st annual PIMS Mathematics of Biological Summer Workshop entitled **Mathematics of Biological Systems**. Our aim was to intro-

duce undergraduate mathematics students to mathematical modeling and analysis applied to real biological systems. Instructors were Gerda de Vries, Thomas Hillen, Mark Lewis, and Michael Li, all from the University of Alberta. There was further assistance provided by volunteer graduate students, postdoc fellows, and staff (Robert Bechtel, Andrew Beltaos, Gustavo Carrero, Christina Cobbold, Tomas de Camino-Beck, Lisa Haraba, Annemarie Pielaat, Shirley Mitchell).

We received applications from almost 40 students from all over North America. In the end, 26 students came to the workshop from 14 different Universities across Canada and the United States, many on their own funding. More than half of the attendees were women.

The workshop was 8 days in length and was a combination of classroom instruction, computer lab instruction and exercises, guided group project work, and project presentations.

The extremely positive feedback that was received, in combination with the large number of applicants and participants, has led us to pursue the workshop as an annual event. We strongly believe the exchange of ideas and knowledge that occurred between students will be carried back to their home universities and that the program will grow in popularity over the years to come.



The participants.

PIMS-MITACS-COE Undergraduate Industrial Case Study Workshop, Centre for Operations Excellence, UBC, May 25–27, 2002

Organizers: Martin Puterman and Stephen Jones (UBC)

Sixteen undergraduate students in commerce, engineering, business, physics, mathematics, statistics, and computer science were invited from across Canada to meet industry executives and renowned academics, and to explore graduate study opportunities, and to work in teams to solve challenging business problems.

The focus of the workshop was a real-world case study competition, culminating with teams presenting their findings to industry executives and academics on May 27.

Universities represented in the workshop were UBC, SFU, U. Alberta, U. Calgary, McGill and Mount Allison. Workshop judges Glen Darou (COE Director, Industry), Carol Leacy (Vice President, Systems and Process Integration, Mark Anthony), Bernard Lamond (Professor and Director, Department of Operations and Systems, Universit Laval) and Maurice Queyranne, (COE Director, Academic) were presented with outstanding presentations from the workshop teams. All participants were awarded with certificates and COE sweatshirts for their excellent work over the weekend. Team four, composed of Derrick Chung (McGill), Amir Motamedi (McGill), Igor Naverniouk (UBC), and Philip Seo (UBC), was honored with the prize for “Best Overall Case Analysis and Presentation”.

This workshop was 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 see the web page www.pims.math.ca/industrial/2001/uicsw.

A Glimpse at 2003

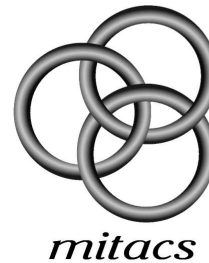
IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop, UBC and SFU, February 15–16, 2003

6th PIMS Graduate Industrial Math. Modelling Camp, BIRS, May 17–22, 2003

2nd PIMS-MITACS-COE Undergraduate Industrial Case Study Workshop, UBC, May 2003

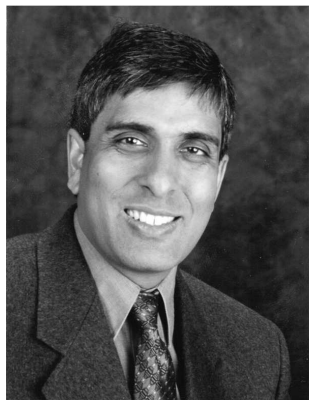
2nd PIMS Mathematics of Biological Systems Summer Workshop, U. Alberta, May 2003

MITACS: A Network of Centers of Excellence in the Mathematical Sciences



Mathematics of Information Technology and Complex Systems (MITACS) is one of the three 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.

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

**3rd MITACS Annual General Meeting:
Statistics for Large Scale Industrial
Modelling, UBC, May 23–25, 2002**

This meeting was part of the **PIMS Thematic Programme on Selected Topics in Mathematical and Industrial Statistics**.

See the chapter on *Thematic Programmes*.

MITACS Projects at PIMS

There are 31 ongoing MITACS projects across the country in five themes: Biomedical Research, Commercial Research, Information Technology Research, Manufacturing Research, and Trading and Finance Research. Here are the currently 14 projects coordinated by PIMS:

Biomedical Research

Biomedical Models of Cellular and Physiological Systems in Health and Disease

Leader: Dr. 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 (Ophthalmology, UBC), Dr. Y. Xian Li (Math, UBC) Dr. M. Mackey (Math, McGill)

Industrial Affiliates: Bayer Inc., InSilico Biosciences, Kinetek Pharmaceuticals, Precision Biochemicals, Stem-Cell Technologies, SmithKline Beecham, BC Cancer Research Center.

Mathematical Modelling 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. Michael J. Ellison (Institute for Biomolecular Design), Dr. John Samson (MACI and Physics, U. Alberta), Dr. W. de Brouwer (Starlab, Belgium)

Other Affiliates: 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)

Commercial Research

Facility Location Optimization

Leaders: Dr. Binay Bhattacharya (CS, SFU) and Dr. David Kirkpatrick (CS, UBC).

Members: P. Bose (CS, Carleton U.), J. Han (CS, SFU), P. Hansen (Ecole des Hautes Etudes Commerciales/GERAD), J. M. Keil (CS, U. Saskatchewan), R. Ng (CS, UBC), T. Shermer (CS, SFU), J. Snoeyink (CS, UBC), G. Toussaint (CS, McGill U.)

Industrial Affiliates: Webdispatchers.

The Mathematics of Resource Allocation and Scheduling

Leader: L. Hafer (CS, 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), P. Hell (CS and Math & Stats, 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), H. Chen (Commerce, UBC), M. Gendreau (Université de Montréal), S. Jones (Commerce, UBC), B. Lamond (Université Laval), T. McCormick (Commerce, UBC), J. McGill (Queen's U.), M. Queyranne (Commerce, UBC).

Industrial Affiliates: TELUS, Canadian Airlines International, Workers Compensation Board of BC.

Searching Networks

Leader: Dr. Brian Alspach (U. Regina)

Members: Gena Hahn (Montreal), Denis Hanson (Regina), Richard Nowakowski (Dalhousie)

Information Technology Research

Mathematical Methods for Modeling, Verification and Testing in Information Technology

Leader: Dr. Bruce 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 (PINTS)

Leader: Dr. Mike Kouritzin (Math, U. Alberta)

Members: D. Blount (Math, Arizona State University), J. Bowman (Math, U. Alberta), P. Del Moral (Universite Paul Sabatier, France), D. Dawson (Fields), E. Gombay (Math, U. Alberta), A. Heunis (Engineering, Waterloo), T. Kurtz (Math, Wisconsin-Madison), J. Macki (Math, U. Alberta), L. Miclo (Universite Paul Sabatier, France), B. Remillard (École des Hautes Études Commerciales), J. Xiong (Math, U. Alberta)

Industrial Affiliates: Acoustic Positioning Research Inc., Lockheed Martin Canada, Lockheed Martin Naval Electronics & Surveillance Systems, VisionSmart

Quantum Computing

Leader: Dr. Richard Cleve (UBC)

Members: M. Mosca (C&O, Waterloo), J. Watrous (CS, Calgary), C. Crapeau (CS, McGill), R. Flamme (Physics, Waterloo), D. Lidar (Chemistry, Toronto) A. Tapp (CS, McGill), W. Unruh (Physics, UBC)

Symbolic Analysis

Leader: Dr. Peter 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

Towards Interactive Data Mining

Leader: Dr. Raymond Ng (UBC)

Members: L. Lakshmanan (CS, UBC) A. Wagner (CS, UBC) R. Zamar (Stats, UBC) R. Miller (CS, Toronto) J. Rosenthal (Stats, Toronto) K. Sevcik (CS, Toronto)

Manufacturing Research

Mathematical Modeling and Scientific Computation

Leader: B. Wetton (Math, UBC),

Members: R. Bradean (PDF, Math, SFU) L. Bridge (Graduate student, Math, UBC) R. Choksi (Math & Stats, SFU), R. Haynes (Graduate student, Math, SFU) H. Huang (Math, York U.), N. Kouzniak (PDF, Math, UBC) M. C. Kropinski (Math & Stats, SFU), D. Liang (PDF, Math, York) M. Liang (Graduate student, Math, UBC) A. Novruzi (PDF, Math, UBC) A. Peirce (Math, UBC), K. Promislow (Math & Stats, SFU), B. Russell (Math & Stats, SFU), S. Ruuth (Math, SFU) B. Seymour (Math, UBC), J. Stockie (PDF, Math, SFU) M. Ward (Math, UBC), R. Westbrook (Math & Stats, U. Calgary)

Industrial Affiliates: Ballard Power Systems, Powertech Labs, Vortek Industries

Pseudo-differential Operator Theory in Seismic Imaging

Leaders: Dr. Michael Lamoureux and Dr. Gary Margrave (University of Calgary)

Members: R. Aggarwala (Math, U. Calgary), W. Alegretto (Math, U. Alberta), J. Bancroft (Geophysics, U. Calgary), P. Binding (Math, U. Calgary), K. Bude (Math, Washington), A. Calvert (Earth Sciences, SFU), P. Lancaster (Math, U. Calgary), L. Lines (Geophysics, U. Calgary), E. Nyland (Physics, U. Alberta), M. Sacchi (Physics, U. Alberta), M. Slawinski (Mechanical Eng, U. Calgary), J. Sniatycki (Math, U. Calgary), G. Uhlmann (Math, Washington), D. R. Westbrook (Math, U. Calgary)

Industrial Affiliates: Chevron Petroleum Technology Company, Veritas DGC Inc, Consortium for Research in Elastic Wave Exploration Seismology

Trading and Finance Research

Modeling, Trading and Risk in the Market

Leader: U. Haussmann (Math, UBC)

Members: M. Barlow (Math, UBC), J. Friedman (Math, UBC), A. Lari-Lavassani (Math, U. Calgary), A. Peirce (Math, UBC), J. Walsh (Math, UBC)

Industrial Affiliates: Financial CAD, Powerex Corporation, Transalta

**PIMS affiliated MITACS
Postdoctoral Fellows 2002**

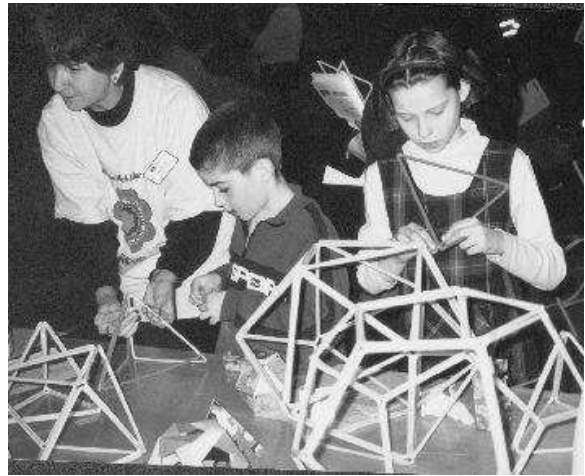
1. Janez Ales, Simon Fraser University
2. Peter Berg, Simon Fraser University
3. Edgardo Cheb-Terrab, Simon Fraser University
4. Ronald Ferguson, Simon Fraser University
5. Daya Gaur, Simon Fraser University
6. Alexander Kononov, Simon Fraser University
7. Stefan Langerman, Simon Fraser University
8. Snezana Mitrovic-Minic, Simon Fraser University
9. Andrew Solomon, Simon Fraser University
10. Bettina Speckmann, Simon Fraser University
11. Brett Stevens, Simon Fraser University
12. Rong Ding, University of British Columbia
13. Marek Labecki, University of British Columbia
14. Stan Maree, University of British Columbia
15. Joern Sass, University of British Columbia
16. Rong Zhu, University of British Columbia
17. Hugh Geiger, University of Calgary
18. Peter Gibson, University of Calgary
19. Julien Arina, University of Victoria

A Glimpse at 2003

**4th MITACS Annual General
Meeting,
Ottawa, May 8–11, 2003**

VI. MATHEMATICS EDUCATION PROGRAMME

Students at Sir James Douglas enjoy
Math Mania in 2001.



Students discuss math with Akbar Rhemtulla (University of
Alberta) during the 2001 PIMS Graduate Information Week.

The participants of the Esso-CMS-PIMS
Summer Math Camp for High School
students outside East Academic Annex
at SFU.



Initiatives for K–12 Students

PIMS continues to provide fun and innovative education activities for elementary and high school students. These include mathematics competitions and math fairs.

Activities for Elementary Schools

The following four activities took place for elementary schools students in 2001/02.

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,

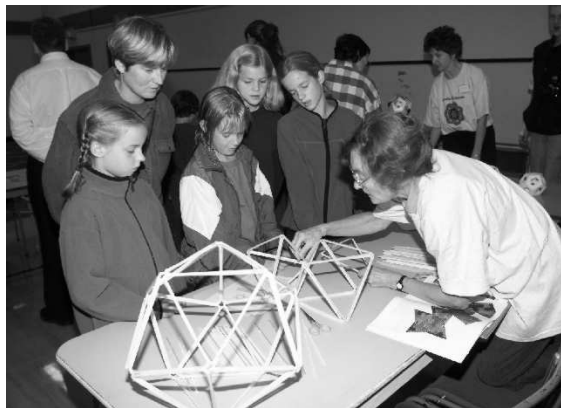


Photo courtesy of *Victoria Times Colonist*.

Pauline van den Driessche (PIMS-UVic) holds the attention of some Cordova Bay Elementary students.

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.

The Math Mania events in 2001/02 were:

- February 28, 2001: **Sir James Douglas Elementary School, Victoria**
- October 2, 2001: **Sooke Elementary School, Victoria**
- January 30, 2002: **Oaklands Elementary School, Victoria**
- May 28, 2002: **Lampson Street Elementary School, Victoria**
- October 9, 2002: **Happy Valley Elementary School, Victoria**

The enthusiastic volunteers who participated in these events included 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 Marilyn Hewgill, Elies Hoepner, Reinhard

Illner, David Leeming, Shaun Pack, Jan and Paul Nienaber, Elena Prieto, Geoff Schmidt, Pauline van den Driessche and Julie Zhou.



Making bubbles with Dr. Denny Hewgill.

Mathematics Unplugged

This annual event is a Student Mathematics Conference which takes place at Westwood Elementary School, a school of approximately 250 students in Coquitlam BC. 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.

The main goal of this event is to lay an enjoyable and fun foundation for further mathematical awareness and engagement, which can last a lifetime. The other goals of the conference are to:

- utilize expertise from the community
- show students that Mathematics occurs in all aspects of everyday life, and in 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)

Six sessions of Mathematics Unplugged have been held to date. PIMS has supported this event since it began.

Mathematics Unplugged VI 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.

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 automata may be included.

The success of these evenings can be directly attributed to the enthusiasm and skill of the volunteers: Rob Petzold, Jean Springer, Laura Marik, Peter Zizler, Scott Carlson, and Sharon Friesen.

The Elementary Math Nights took place on:

- February 13, 2001: **Science Alberta School, Calgary**
- February 22, 2001: **Sunnyside Community School, Calgary**
- May 15, 2001: **Westmount Elementary School, Strathmore**

MathClick Workshops

In the summer of 2001, PIMS organized and hosted two MathClick Workshops for children at PIMS-UBC. On August 28 and August 31, 2001, thirty-two grade 5–7 students attended these full-day mathematics immersion experiential events. MathClick workshops are not only for the mathematically talented; in fact, the main intention is to awaken children’s latent talent and interest by showing them that mathematics can be also playful and intriguing. Students in these workshops engaged in a genuine mathematical inquiry in a very encouraging environment that promoted a feeling of surprise and ample opportunity for success.

Klaus Hoechsmann (PIMS Education Facilitator) and one of the workshop instructors co-authored the mathematical content for the workshop programme. The workshops were taught by Edel Vo and Natasa Sirotic from Collingwood School and assisted by Wendy Dorn from the Burnaby School District and Janet Martin, a graduate student at the UBC Faculty for Education.

Judy Dalling, the parent of MathClick participant Eleanora, attests that this single-day workshop can be truly transformational and can dazzle a child to the extent of completely reconditioning her or him for success in mathematics. She wrote, “*Last August I enrolled my 10 year-old daughter Eleanora in the one day MathClick workshop. Her record at elementary school was poor in all areas. In Grade 5 math, socials and science she had a C average, and getting her to complete assignments was impossible. After taking the MathClick workshops her attitude completely changed. She realized that she was capable of much greater things. She has not missed one day of school this year, and she has replaced the C’s on her report card with A’s. When asked, Eleanora credits these changes to your encouragement in the workshop. Thanks you for helping her realize her potential. What a difference a day can make!*”



Participants in one of the 2001 MathClick Workshops.

PIMS has continued these highly successful workshop in 2002, with workshops taking place on August 27 and 30. This year all the students went home with certificates of participation.

Activities with High School Students

The PIMS education panel organizes a number of events aimed at high school students. Here we describe one such event. The two sections that follow this one, Mathematics Competitions and PIMS Math Fair Programme, highlight many other PIMS activities for high school students.

Junior High Math Nights

These biannual events are organised by **Dr. Peter Zizler** of Mount Royal College, Calgary. From January–March, 2002 on six consecutive Mondays, students, parents and teachers at Mount Royal College are provided with the opportunity to engage in mathematical exploration. The event took place again in October 2002, this time on six consecutive Tuesdays. The emphasis of these evenings was to dispel 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: This evening was a potpourri of topics about the number five, including 5 by 5 magic squares, Pentagonal numbers, Tessellation of the plane using various polygons including pentagons, compass and straightedge 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.

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 international competitions.

CMS Regional Math Camps

To identify and nurture future members of the Canadian team for the International Mathematical Olympiad, the CMS, Esso and PIMS sponsor this yearly event to which students in grades 8–10, 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.

2001 Esso-CMS-PIMS Summer Math Camp, SFU, June 25–29, 2001

This camp 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.

The activities consisted of talks and problem sessions given by the SFU Mathematics and Statistics faculty and graduate students, a Campus tour, and a visit to the SFU Engineering labs. Twenty-four students from 16 schools participated in the camp.

The following sessions were offered:

Len Berggren: *Lessons from the History of Mathematics*

Jonathan Borwein: *Exploring Math on the Internet*

Peter Borwein: *Much Ado about Pi*

Imin Chen: *Cryptography*

Luis Goddyn: *The Lonely Runner and Other Problems*

Mary Catherine Kropinski: *Swimming in Syrup*

Petr Lisonek: *Mathematics with Maple*

Carl Schwarz: *One Fish, Two Fish, Red Fish, Blue Fish*

Petr Lisonek: *Putnam Competition Problems*

Ronald Haynes: *An Algorithm to Compute the Roots of Polynomials?*

Mahdad Khatirinejad Fard: *Inequalities*

The session leaders also gave daily problems to the participants. The best solutions were rewarded with prizes.

The camp was supported by grants from the Canadian Mathematical Society, the Imperial Oil Charitable Foundation, PIMS and the SFU Department of Mathematics.

2002 Esso-CMS-PIMS Summer Math Camp, SFU, July 2–5, 2002

The second Esso-CMS-PIMS Summer Math Camp for High School students took place July 2–5, 2002, at the SFU-PIMS Site in the East Academic Annex.

Twenty-five students from schools across the Lower Mainland were selected to participate in the camp, out of almost 50 nominations sent by their teachers. For four days, they participated in exciting and challenging activities organized by the SFU faculty and graduate students. Two guest speakers were invited as well: **Lily Yen** (Capilano College) and **Branko Curgus** (Western Washington University).

2002 Esso-CMS-PIMS Summer Math Camp, U. Alberta, August 14–20, 2002

The annual Alberta Math Camp alternates between the U. Alberta and U. Calgary. This is the second time that it was held at the U. Alberta. The event is sponsored by ESSO and CMS, with additional support from the Faculty of Science at the U. Alberta, PIMS, the Edmonton Public School Board, and the Mathematical Council of the Alberta Teachers Association. The camp organizers were **Ted Lewis** and **Andy Liu**.

The camp is intended for students from grades 7–10. Twenty-four campers from Alberta and two campers from outside the province stayed in the Lister Hall Residence Complex for its duration. There were also three day students from Edmonton who attended.

The morning programme consisted of a three-hour workshop centered on a lecture. **Andy Liu** gave a lecture on *Coding*, **Hans Brungs** spoke about

The History of Mathematics, **Edit Gombay** talked about *Probability*, **Sudarshan Sehgal** gave a lecture on *Number Theory*, **Dragos Hrimiuc** spoke about *Diophantine Equations*, and **Volker Runde** gave a lecture on *The Banach-Tarski Paradox*.

The afternoon programme was a mixture of academic and extracurricular activities. On Sunday, the students wrote a three-hour contest. On Monday, the camp visited the Odysium, the former Edmonton Space Science Centre. The students were divided into groups for a team contest on Tuesday. On Wednesday, the camp visited a cornfield maze just outside Edmonton. Prof. Andy Liu offered an exhibition of part of his puzzle collection on Thursday. On Friday, the well-known magician, Jon Charles, gave a special performance at the camp.

The evenings were largely spent in the residence for social activities. The students were supervised by Mr. Gilbert Lee and Mrs. Joyce Pon, the mother of one of the campers. On Wednesday, after the cornfield maze, the camp visited West Edmonton Mall. On Thursday, the students had an eat-in consisting mainly of pizzas. On Friday, a banquet was held at the China Palace Seafood Restaurant.

Alberta High School Mathematics Competition

The Alberta High School Mathematics Competition is an annual two part competition taking place in November and February of each school year. There are book prizes for the first part, and cash prizes and scholarships for the second part.

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.

The 2001–2002 season marked the 46th year of the Alberta High School Mathematics Competition. In this two part competition, part I, with 1093 participants, occurred on November 20, 2001, and part II, with the top 69 competitors from part I, took place on February 6, 2002. The major prize winners attended the 2002 PIMS awards dinner, which was held in Calgary. The awards dinner will be held in Edmonton next year.

PIMS Elementary Grades Mathematics Contest

The annual **PIMS Elementary Grades Math Contest (ELMACON)** is open to students in Grades 5–7. It provides an opportunity for them to experience mathematics as an exciting sport. The contest is modelled after the successful *MathCounts* competitions. 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 2001 and 2002 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. 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 events.

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. The top 10 from the first two rounds went on to the Countdown round where the students “duelled” starting with the 9th and 10th. The winner of that contest then went on to “duel” with the 8th place holder. So the person who ranked 10th had the potential of winning the contest by beating the 9 people ahead of him/her one by one. The duelling consisted of answering math questions against the clock and sounding a buzzer. 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.

3rd ELMACON, UBC, May 26, 2001

Last year, 223 students participated in the third ELMACON, with 73, 80 and 70 students in grades 5, 6 and 7 respectively. It was a substantial increase from the previous year.

While the markers were ranking the kids in preparation for the countdown round Cary Chien gave a talk on strategies and common mistakes. A video tape of his talk and other parts of the contest will soon be available at www.pims.math.ca/elmakon/.

The top 10 winners of ELMACON 2001 were:

Grade 5: 1. Jimmy He, 2. Sherwin Kwan, 3. Aram Ebtekar, 4. David Lam, 5. Bryan Huang, 6. Simon T.H. Tseng, 7. Christin Chan, 8. Sara Hyunjung Kim, 9. Alan Tung, 10. Tiffany Le Gentil.

Grade 6: 1. Steven Karp, 2. Arthur Yip, 3. Arthur da Silva, 4. Jason Ng, 5. Connor Joseph Wagner, 6. Serena Ip, 7. David Di, 8. Rickey Tam, 9. Nestor Choi, 10. Sviatoslav Moldavanov.

Grade 7: 1. Sam Wang, 2. William Wanki Kim, 3. Diane Wu, 4. Steven Hermann, 5. Yoshiaki Sono, 6. Howard Yan, 7. Carter (Wan Jae) Lee, 8. Fanhao Meng, 9. Jeffrey Nguyen, 10. Isaac Tang.

4th ELMACON, UBC, May 25, 2002

The fourth annual ELMACON had a total of 229 competitors. There were 67, 80 and 82 children in grades 5, 6 and 7 respectively. The top 10 winners for 2002 were:

Grade 5: 1. Juno Jung (Nelson), 2. Aram Ebtekar (Glen), 3. Jeffrey Choi (John T Errington), 4. Karen Bennie Ho (Oppenheimer), 5. Nikita Zouev (Lynn Valley), 6. Jeffrey Yeh (Vancouver Montessorri), 7. Sophie Ji-Soo Kwalk (Canyon Heights), 8. Veronika Dikoun (Maywood Community), 9. Phil

Chang (Simon Fraser), 10. Yanga Zhu (Eric Langton).

Grade 6:

1. Alarica Tang (Kitchener),
2. Jimmy He (Pinewood),
3. Daniel Park (Kwayhquitlum Middle),
4. Bryan Huang (Osler),
5. Yuan Liang (Pitt River Middle), 6. Silviu Toderita,
7. Sherwin Kwan (Seaforth), 8. Jonathan Zhang (Oppenheimer), 9. Hank Duan (Maple Creek Middle), 10. Simon T. H. Tseng (Chantrell Creek).



2002 Grade 6 winners (l-r): Daniel Park, Jimmy He, Alarica Tang.

Grade 7: 1. James Chen (John T Errington), 2. Arthur da Silva (St. Paul's), 3. Anthony Chuang (Maple Lane), 4. Sebastian Crema (Boundary Community), 5. Jerome Li (Kwayhquitlum Middle), 6. Steven Karp (Kitchener), 7. Jeffrey Hsiung (Emily Carr), 8. Kevin Xiao (Confederation Park), 9. Mulin Yang (University Hill), 10. Javin Chen (Thunderbird).



Left photo: 2002 Grade 5 winners (l-r) Jeffrey Choi, Aram Ebtekar, Juno Jung. Right photo: 2002 Grade 7 winners (l-r) Anthony Chuang, Arthur da Silva, James Chen.

PIMS Math Fair Programme

Math Fairs are particularly suitable for students in Grades 7–12 who are looking for longer term projects to get a feel for the adventure of a self-directed exploration.

PIMS supports math fairs as part of the Greater Vancouver Regional Fair and the Calgary Youth Science Fair, as well as running its own Forever Annual Mathematics Exhibition in Vancouver and numerous math fairs in Alberta.

The Concept of a Math Fair

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 to 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, homespun 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.

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 the others were all mathematical.

In terms of the grade-level distribution, there were 10 junior (grades 7, 8), 10 intermediate (grades 9, 10), and 6 senior (grades 11, 12) projects. 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.



Gabrielle Arden with her project, *Forecasting Weather with Neural Networks*.

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.

The 2002 Math Fair project took place this year amidst the teachers' job action. Despite this obstacle, ten projects were entered in the Computational and Mathematical Sciences category at the 2002 Greater Vancouver Regional Science Fair (GVRSF) and of these, two were selected to attend the Canada-Wide Science Fair held in Saskatoon, Saskatchewan in May 2002. These students were **Gabrielle Arden**

of Burnaby South Secondary School and **Rochelle Leung** of York House School (pictured).

PIMS presented the following awards.

First: Rochelle Leung (York House): *Decrypting the math behind cryptography and its ciphers*

Second: Gabrielle Arden (Burnaby South Secondary): *Forecasting weather with neural networks*, **Frank Sun** and **Winnie Ho** (Windermere Secondary): *Matrices and cryptology*, **Harvey Zhang** (Burnaby North Secondary): *Inscribed triangles in circles and ellipses*

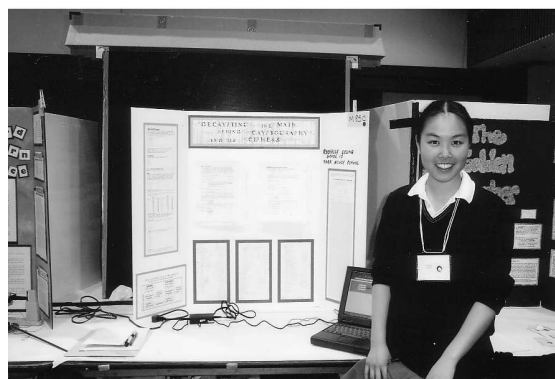
Third: Pearly Trinh and **Elaine Lee** (Windermere Secondary): *RSA algorithm cryptology*, **Galina Meleger** and **Kathryn Cheng** (York House): *The golden number*

The first prize winner received \$200, the second prize winners \$100 each, and the third prize winners \$50 each.

Considering there were only ten projects entered in the Computational and Mathematical Sciences category, it is noteworthy that the GVRSF judges selected two of these projects as part of the top ten projects at the entire science fair.

PIMS contributed \$2500 travel money to send the two winners to Saskatoon.

At the Canada-Wide Science Fair, Gabrielle Arden won a Gold Medal and a \$2000 scholarship to the University of Western Ontario in the Intermediate Computational and Mathematical Sciences category, and Rochelle Leung won a Bronze Medal and a \$1000 scholarship to the University of Western Ontario in the same category.



Rochelle Leung with her project, *Decrypting the Math Behind Cryptography and its Ciphers*.

Calgary Youth Science Fair

In 2001 and 2002 PIMS provided a prize at the Calgary Youth Science Fair. The prize consisted of \$100 and a plaque awarded for *Secondary project making major use of mathematics in the project.*

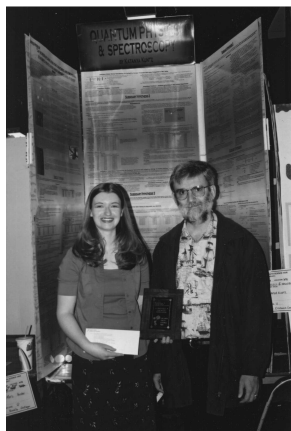


Michael Lamoureux (PIMS Deputy Director) presenting the plaque to the 2001 winner, Jonathan Sick.

On April 7, 2001 the winner was Jonathan Sick, a grade 9 student as Queen Elizabeth Junior High School. The project was *Sunspot Morphology and 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. Jonathan went on to win the Intermediate

level at the National Youth Science Fair.

At this year's Calgary Youth Science Fair, which took place on April 10–13, 2002, the PIMS award went to **Katanya Kuntz**, a grade 11 home schooler from Alberta Distance Learning. Her project was called *Quantum Physics and Spectroscopy*. The objective of the project was to learn more about Quantum Physics and to test mathematical models of the atom (the Bohr theory and the Quantum theory) for their accuracy in predicting and explaining the atomic universe. Her Unified Hypothesis was "Spectroscopic signatures,



Katanya Kuntz & Gary Margrave (PIMS Site Director, U. Calgary) in front of her project.

other atomic characteristics, and atomic phenomena can be accurately predicted and explained by a mathematical model of the atom." She concluded that the Quantum theory is the best known model (so far) that is extremely accurate in predicting and explaining the atomic universe.

Forever Annual Mathematics Exhibition (FAME)

Students in the Greater Victoria School District took part in the fourth annual **FAME**, the **Forever Annual Mathematics Exhibition**, at S.J. Willis School on April 21, 2001. Last 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 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.

The fifth Annual FAME took place at S.J. Willis Educational Centre on April 10, 2002. A total of 120 students participated in the events, with 20 elementary entries, 13 junior entries and 20 senior entries. Twelve students won Distinction Awards (score 90+/100). The winning schools (in terms of scores for the top 3) were Fairburn (elementary) and Lansdowne (junior and senior).

Some of the topics chosen this year were: *Optical illusions*, *Tower of Hanoi*, *The average sleeper*, *Numbers that make you go hmm*, *History of math in South America*, *Codes and ciphers*, and *Catapults and What is the fourth dimension?*

Fame is sponsored by PIMS, BCAMT, Greater Victoria Teacher Association and School District #61. The event was organized by mathematics teachers Betty Doherty of Lansdowne and Wendy Swonnell of Lambrick Park.

Elementary Math Fairs in Alberta

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. Last year, Clara Tyner and Terrace Heights Elementary Schools were involved.

The Edmonton Math Fairs are unique in that all students in the school participate. This event is about problem solving, not winning and losing. 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 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 tabletop 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.

PIMS/U. Alberta Math Fair, March 21, 2002

How often do you find grade school students happy to spend two and a half hours doing mathematics? This is what happened for about 450 students from elementary and junior-high schools in the Edmonton area on Thursday, March 21, at the PIMS/U. Alberta Math Fair. There were actually two parts to the activities—the fair itself, which was presented by the students of the Math 160 class, and a problem solving session conducted by Andy Liu.

The math fair was non-competitive, and presented mathematical puzzles for the visitors to try. The puzzles were very diverse, from river-crossing problems to the towers of Hanoi.

The math fair is part of the curriculum for Math 160 and has significantly revitalized the course. This

is the first time that the math fair took place on campus instead of at individual schools. Moving the fair here was prompted by both the popularity of the fairs and associated logistical problems of taking a Math 160 class to a school away from the campus. Holding it here solved some problems but raised several others. Renee Polziehn from the university outreach centre provided many useful suggestions.

PIMS/U. Alberta Math Fair, November 5, 2002

Just under seven hundred elementary and junior high students from twenty-five schools visited the PIMS/U. Alberta Math Fair on Tuesday November 5, 2002. This all day event was sponsored by PIMS and presented by the Math 160 students of Venera Hrimiuc and Ted Lewis, and was held in Dinwoodie Lounge in the Student Union Building. At the same time, Andy Liu ran a problem solving session for the children (which he dubbed the “math unfair”). The students spent about 2–2.5 hours at the event, splitting their time between the math fair and the problem solving session.

That’s a Good Problem!, Math Fairs in Calgary

That’s a Good Problem! is a collaborative project of PIMS, the Galileo Educational Network (GENA), and Mount Royal College in Calgary. It is based on the highly successful math fairs organised by Ted Lewis (PIMS Education Coordinator, University of Alberta). Teams of teachers from several Calgary-area schools were invited to a half-day workshop. The focus of the workshop was on teaching mathematics through explorations and investigations by working through a number of mathematical explorations, suggestions for introducing explorations to other teachers, organising and promoting a school math fair.

The teachers returned to their schools armed with Ted Lewis’ excellent booklet on how to run a math fair. Sharon Friesen of GENA and Indy Lagu (PIMS Education Coordinator, Calgary) made visits to the schools to work with the teachers and students before the math fairs.

After the math fairs, the teachers were invited for another half-day workshop to talk about problem solving, what worked and what did not with their

fairs, and future steps. Many of the teachers admitted that they were worried about how successful their math fair would be, but none were disappointed, and all thought of the math fair as an unqualified success. The many parents who attended the math fairs were also quite impressed. In all, seven schools participated, and all expressed an interest in repeating a math fair.

The math fairs took place as follows:

- February 28, 2002: **Pineridge Elementary School**
- March 19, 2002: **Strathmore High School**
- April 19, 2002: **C. Ian McLaren School, Black Diamond**
- May 16, 2002: **Glendale Elementary School**
- May 22, 2002: **Nellie McClung Elementary School**
- June 6, 2002: **Red Deer Lake Elementary School**

Half-day workshops were also held with teachers about the math fairs.

More information about the math fairs (including lots of photographs) can be found at www.galileo.org/math/sumtalk/index.html.

Dr. Friesen and Dr. Lagu are planning to involve 10 or 12 new schools in the project next year.

A Glimpse at 2003

**Math Mania Night,
George Jay Elementary School,
Victoria, January 28, 2003**

**Alberta High School Mathematics
Competition:
Part II of the 2002–2003 Season,
February 5, 2003,
Part I of the 2003–2004 Season,
November, 2003**

**PIMS Elementary Grades Math
Contest,
UBC, May 24, 2003**

**ESSO–CMS–PIMS Math Camp for
High School Students,
SFU, June 23–27, 2003**

**Summer Institute in Mathematics for
High School Students,
University of Washington,
July 22–August 2, 2003**

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 IV, SFU Harbour Center, May 11, 2001

The Fourth Annual Changing the Culture Conference, brought together mathematicians, mathematics educators and school teachers from all levels to work together towards narrowing the gap between mathematicians and teachers of mathematics.

The 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 language, mathematics and literature, and how we can use language to teach mathematics.

There were two plenary talks:

Brett Stevens (PIMS/IBM PDF, SFU): *Mathematics and Literature: Cross Fertilization*

John Mighton (NSERC PDF, Fields Institute): *Breaking the Cycle of Ignorance*

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 Trilog*y; about Euler's work on Latin Squares and its 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 programme for students who are doing badly in mathematics in school. This programme 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 General's 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. Leaders: 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.

Changing the Culture V, SFU Harbour Center, April 26, 2002

The Fifth Annual Changing the Culture conference took place April 26, 2002 at the SFU Harbour Centre campus. The conference was attended by 78 participants: Teachers from all levels, from elementary through university; student teachers and graduate students in mathematics and math education.

The theme of this year's conference was *Rigour and Intuition in Mathematics*. Two plenary speakers: **Ed Barbeau**, a mathematician from the University of Toronto, and **Brent Davis**, a Canada Research Chair in Education at the University of Alberta in Edmonton, presented their views on understanding mathematics and the respective roles of intuition and logic in the process of achieving it.

A lively panel discussion, chaired by **Klaus Hoehsman** (PIMS), addressed the topic in the afternoon. **Lin Hammill** (Kwantlen University College), **Christine Stewart** (SFU), **Günter Börner** (German Mathematical Society, DMV) and **Kirsten Urdahl-Serr** (School District 42, Maple Ridge), presented their views on the subject.

The participants were offered a choice of 3 workshops to enrich their experiences:

Sue Haberger (Centennial Secondary School): *The Moment of Proof*, which described methods and tricks she has developed and successfully used over the years to make students appreciate the need for rigour.

Natasa Sirotic (Collingwood School): *"Proofs" of Fallacies, or how to spot problems in seemingly flawless reasoning*.

David Lidstone (Langara College): *Intuition in Problem Solving*, which invited participants to test their mathematical intuition in a series of challenging problems.

PIMS Technology Workshops

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 the "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 coauthor (with C.J.Sangwin) of a book, "Mathematics Galore!" recently published by the Oxford University Press, containing material for workshops designed to generate enthusiasm for mathematics in students from the age 11 through to high school age. His talk was about his work with high school students and about how his workshops for students are organized.

Teacher Association Meetings

Annual meetings of teacher associations provide an important venue for connections between PIMS researchers and school teachers. PIMS participated in the big 2001 and 2002 October meetings of the British Columbia Association of Mathematics Teachers (BCAMT). PIMS had a display table there which was organised by Janet Martin in 2001, and by Janet Martin and Wendy Nielsen in 2002.

A Glimpse at 2003

Changing the Culture VI,
SFU Harbour Centre, May 2, 2003

Initiatives for Undergraduate Students

PIMS Graduate Weekends

This annual PIMS programme is unique in Western Canada, providing a forum in which talented undergraduates can preview and select the speciality which best suits their interests and ability. The payoff is many-faceted: Groups and laboratories are populated with better-matched students, students get the programmes they really want, and the strength of Western Canada's mathematical sciences is promoted.

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 to a full programme of presentations about graduate studies at the U. Calgary, including talks by research groups in discrete math, analysis, industrial and collaborative mathematics, math finance, computer graphics, quantum computing, and several others.

The Dean of Graduate Studies, James Frideres, outlined some of the many attractions of studying at Calgary, while the PIMS Deputy Director, Michael Lamoureux, described the advantages of joining the PIMS team of western universities. The department's Director of Graduate Programs, John Collins, detailed the scholarship possibilities and amenities of each of the programmes. Gary MacGillivray gave a presentation on programmes 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 Sjerne (UBC), Randy Sitter (SFU), Lorna Stewart (U. Alberta) and Jim Muldowney (U. Alberta).

After a lunch with local CS and MathSci faculty



Visiting students attend a talk at the University of Alberta.

and grad 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 Avenue.

Financial support for the seminar was provided by PIMS and each of the two host universities.

PIMS Graduate Information Weekend, SFU and UBC, January 12–13, 2002

On the weekend of January 12–13, PIMS together with SFU and UBC, hosted the Sixth Annual Graduate Information Weekend.

Twenty-eight potential graduate students with exceptional undergraduate records were invited from across Canada for a weekend in Vancouver, in order to be introduced to graduate programmes at UBC, SFU, U. Victoria, U. Alberta, and U. Calgary.

The result was two long but fruitful days of contact and information for the students, and unequalled opportunities for various groups in the Mathematical Sciences to present their programmes.

The programme at UBC started with introductions by George Bluman, the head of the Mathematics Department at UBC, and Dale Rolfsen, the UBC site director for PIMS. Ed Perkins gave an address relating his experiences as a graduate student.

The remainder of the day was filled with presentations from various research groups at UBC: Alan Wagner for Computer Science, Bertrand Clarke for Statistics, Jim Bryan representing algebraic geometry, David Brydges representing mathematical physics, Ian Frigaard representing applied mathematics, Izabella Laba representing analysis, Greg Martin representing number theory, and Laura Scull representing topology. During the afternoon there were campus tours and a chance for students and faculty to meet one-on-one.

On the social side there was a Saturday afternoon lunch at Hillel House on the UBC campus and in the evening there was a reception at the Graduate Student Centre, hosted by the graduate students in the UBC math department.

At SFU the following groups were represented. Applied and Computational Mathematics, Comput-

ing Science, Mathematics and CECM, and Statistics.

Presentations were made by Manfred Trummer (PIMS Site Director, SFU), Jonathan Driver (Dean of Graduate Studies, SFU), Dave Muraki (Applied Math), Imin Chen (Pure Math), Jon Borwein (CECM), Carl Schwarz (Statistics & Actuarial Sciences) and Torsten Möller (Computer Science).

The students were given tours of labs in Computing Science, Statistics and the Centre for Experimental and Constructive Mathematics, with plenty of time for informal contact between the students and potential programme advisors or supervisors.

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop, PIMS-UBC & PIMS-SFU, February 17–18, 2001

Organizers: R. Russell (SFU) and B. Shizgal (IAM).
(See *Industrial & Scientific Training Programme* chapter.)

IAM-CSC-PIMS Senior Undergraduate Math Modelling Workshop, PIMS-UBC & PIMS-SFU, February 16–17, 2002

Organizers: R. Russell (SFU) and B. Shizgal (IAM).
(See *Industrial & Scientific Training Programme* chapter.)

Statistical Genetics and Computational Molecular Biology Workshop, University of Washington, December 16–18, 2001

Organizer: Elizabeth Thompson (U. Washington)
(See *Industrial & Scientific Training Programme* chapter.)

1st PIMS Mathematics of Biological Systems Summer Workshop, University of Alberta, May 11–19, 2002

Organizer: Mark Lewis (U. Alberta)
(See *Industrial & Scientific Training Programme* chapter.)

PIMS-MITACS-COE Undergraduate Industrial Case Study Workshop, Centre for Operations Excellence at UBC, May 25–27, 2002

Organizers: M. Puterman (Commerce and Business Admin, UBC) and Stephen Jones (COE, UBC).
(See *Industrial & Scientific Training Programme* chapter.)

A Glimpse at 2003

**5th PIMS Graduate Information
Weekend,
U. Alberta and U. Calgary,
January 7–11, 2003**

**IAM-CSC-PIMS Senior
Undergraduate Math Modelling
Workshop,
UBC and SFU, February 15–16, 2003**

**2nd PIMS-MITACS-COE
Undergraduate Industrial Case
Study Workshop,
UBC, May 2003**

**2nd PIMS Mathematics of Biological
Systems Summer Workshop
U. Alberta, May 2003**

Initiatives for Graduate Students

Graduate Industrial Math Modelling Camps

Each spring PIMS sponsors a five-day workshop for graduate students on industrial mathematical modelling. The goal of the **Graduate Industrial Math Modelling Camp** (GIMMC) is to provide experience in the use of mathematical modelling as a problem solving tool for graduate students in mathematics, applied mathematics, statistics, and computer science.

GIMMC 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 Modelling 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 modelling 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 levels in the fields of mathematics, applied mathematics, statistics, and computer science, or related disciplines, are invited to apply.

4th PIMS Graduate Industrial Math Modelling Camp,
University of Victoria,
June 11–15, 2001

Organizer: Chris Bose (U. Victoria)
(See chapter on *Industrial Training Programme*.)

5th PIMS Graduate Industrial Math Modelling Camp,
Simon Fraser University,
May 18–23, 2002

Organizer: Mark Paulhus (U. Calgary)
(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*.)

**4th PIMS Summer School in Fluid Dynamics,
PIMS at the University of Alberta,**
July 28–August 9, 2002

Organizers: B. R. Sutherland (U. Alberta) and
T. Bryant Moodie (U. Alberta)
(See chapter on *Industrial Training Programme*.)

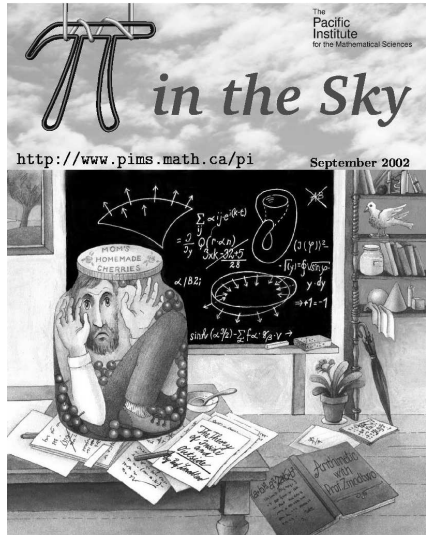
A Glimpse at 2003

**6th PIMS Graduate Industrial Math.
Modelling Camp,**
BIRS, May 17–22, 2003

VII. COMMUNICATION OF THE MATHEMATICAL SCIENCES

Calendar 2001

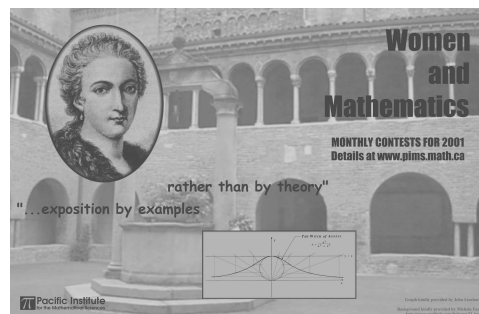
The 2001 PIMS Calendar which featured the *Mathematics is Everywhere* posters.



While studying the work of Möbius, Prof. Zmodtwo discovers the importance of signs.

The fifth issue of *Pi in the Sky* magazine. The cover was specially created by Czech artist Gabriela Novakova according to an original idea by George Peschke, and the meaning of the scene is explained in the article "Oops!!! Just what happened to Prof. Zmodtwo?"

The December poster in the 2001 *Women and Mathematics* campaign featuring Maria Gaetana Agnes.



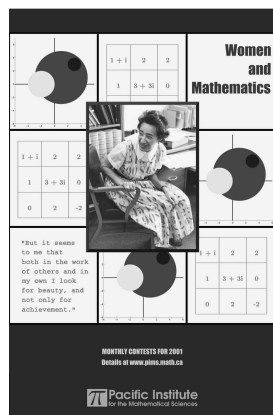
Women & Mathematics

Coordinators: Krisztina V'as'arhelyi and Heather Jenkins (PIMS).



PIMS Calendar for 2002 which features the *Women and Mathematics* posters.

Building on the momentum of the *Mathematics is Everywhere* poster campaign, PIMS continued the project in 2001 with a new theme and format. Klaus Hoechsmann's innovative poster series has demonstrated that given the right approach, it is possible to rouse interest in the "terminally unpopular".



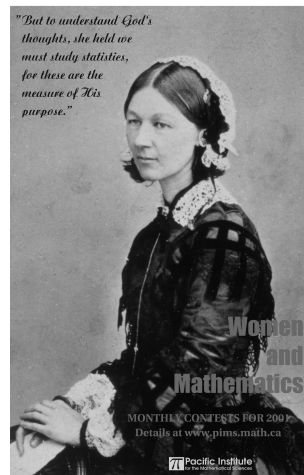
Olga Taussky-Todd from April.

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 presented 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 endeavours. The last point is aptly illustrated by the



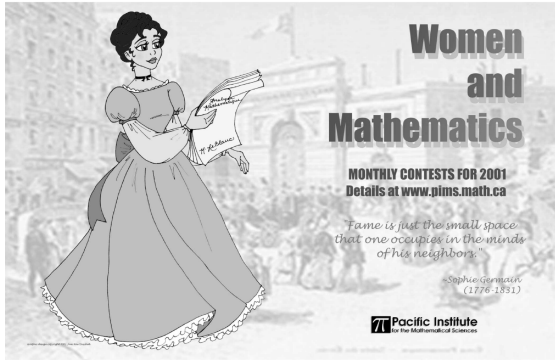
Florence Nightingale from July.

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 accomplishments.

The target audience for this project included 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.

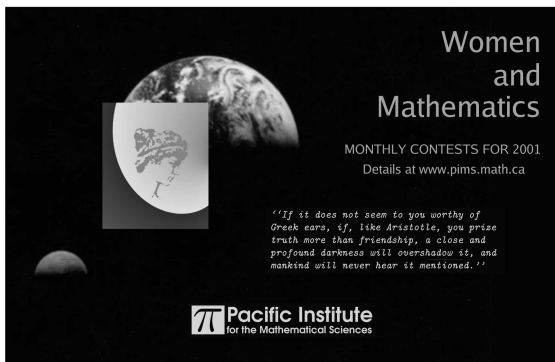
The contest itself promoted internet-based biographical research in addition to problem-solving. A set of quiz questions will be posted on the contest website. One of the questions was a mathematics problem, highlighting the field of involvement of the featured individual. Answers to the remaining biographical 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.

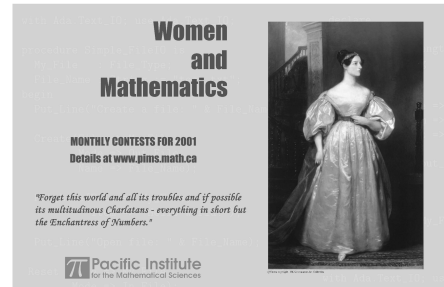


The May poster designed by Jeni Rae Duschak.

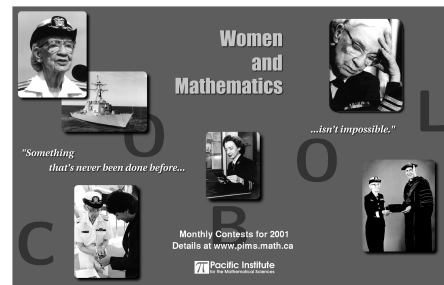
Her life might have been the subject of a storybook: **Sophie Germain** dressed up as a man to be admitted to the École Polytechnique where her mathematical genius was discovered, and she was the secret saviour of Gauss, whose life was threatened during Napoleon's invasion. In May, PIMS was treated to 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.



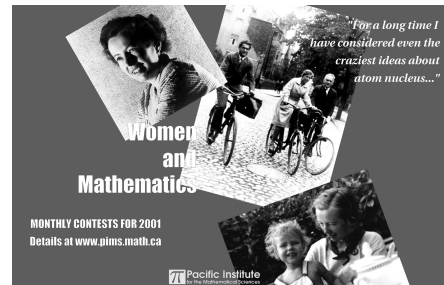
The February poster featuring Hypatia of Alexandria, last of the Alexandrian scholars.



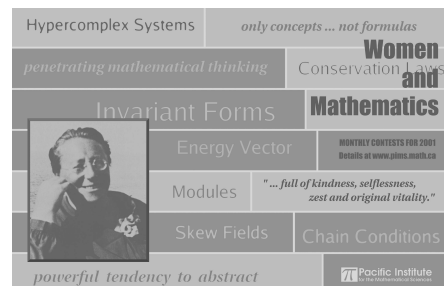
Ada Lovelace, namesake of the computer language Ada from March.



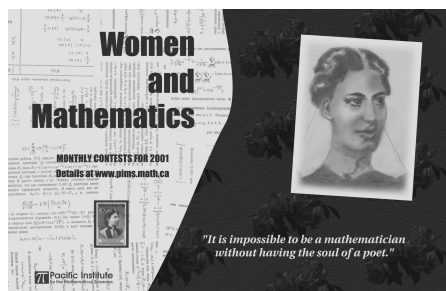
Grace Hopper developed the computer language COBOL and featured on the June poster.



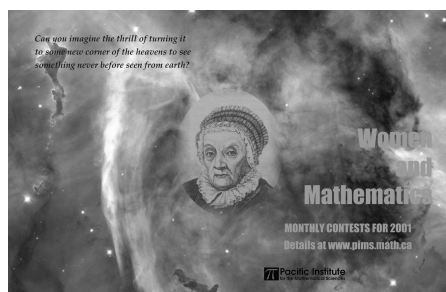
Nobel Prize winning theoretical physicist Maria Goeppert-Mayer in August.



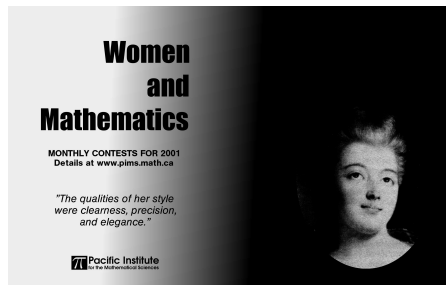
Emmy Noether one of the great mathematical minds of this century featured in September.



October's poster featuring Sofi a Kovalevskaya.



Observational astronomer Caroline Herschel featured in November.



Emilie de Breteuil who featured in January 2002.

Pi in the Sky

Pi in the Sky is a mathematical magazine 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, Alberta and Washington State. This popular semi-annual publication promotes all aspects of the mathematical sciences. The first 5 issues are available online through the PIMS website. The Editors in Chief are Nassif Ghoussoub (PIMS Director) and

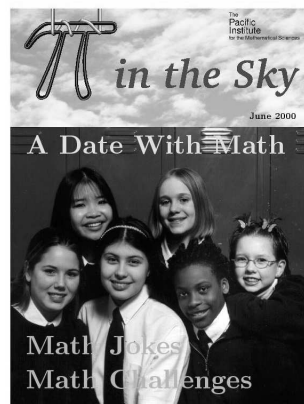
Wieslaw Krawcewicz (U. Alberta). John Bowman, also from U. Alberta, is the Associate Editor. The rest of the editorial Board consists of Peter Borwein (SFU), Florin Diacu (U. Victoria), Klaus Hoechsmann (UBC), Michael Lamoureux (U. Calgary) and Ted Lewis (U. Alberta).

The purpose of Pi in the Sky is to promote mathematics, establish direct contact with teachers and students, increase the involvement of high school students in mathematical activities, and promote careers in the mathematical sciences.

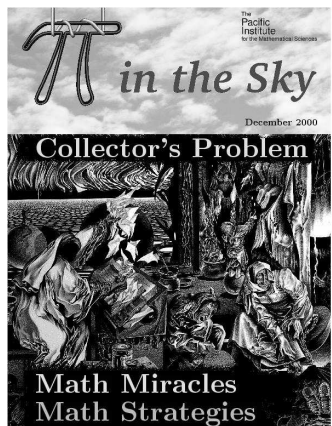
This journal, aimed at an average student, has the following objectives:

- 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*.

The second issue of *Pi in the Sky*.

The cover shows a fragment of a painting by prominent Russian mathematician Anatoly T. Fomenko which was inspired by mathematical ideas.

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.

The fourth issue of the *Pi in the Sky* features students from Tempo School in Edmonton on the cover. These students were visited by five University of Alberta mathematicians in October 2001. The students were shown how mathematics can be fun and interesting at the same time. They also learned all about

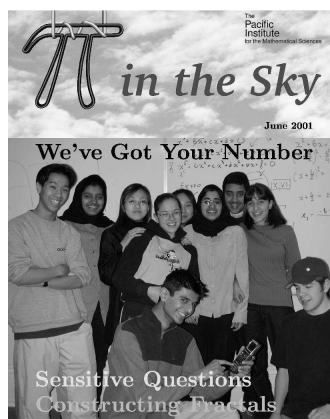
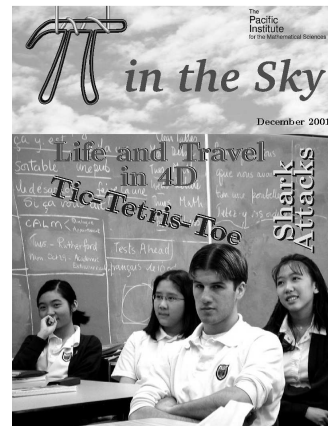
In the second issue of *Pi in the Sky* Akbur Rhemtulla writes about *Counting with Base Two and the Game of Num*, and Byron Schmuland about the *Collector's Problem*. Readers learn about π in *The Number π and the Earth's Circumference*

by Wieslaw

the *Pi in the Sky* magazine. This issue also includes the game *Tic-Tetris-Toe* by Andy Liu, a biography of *Karl Weierstraß* by Volker Rundle, insight into *Life and Travel in 4D* by Tomasz Kaczynski, an explanation of *Shark Attacks and the Poisson*

Approximation by Bryron Schmuland, and *The Rose and the Nautilus: A Geometric Mystery Story* by Klaus Hoechsmann. There is also the usual wealth of math jokes and challenges.

The fifth issue of the *Pi in the Sky* came out in September 2002. The Math & Astronomy section features *Solar Eclipses: Geometry, Frequency, Cycles* by Hermann Koenig. Read a biography of female mathematician *Emmy Noether* by Volker Runde. *From Rabbits to Roses: A Geometric Mystery Story* by Klaus Hoechsmann is the continuation of the mystery series *The Rose and the Nautilus*. Other article include *Student's Workshop: Polyhedra with Six Vertices* by Richie Ng, *Mathematics of the Past* by Garry Kasparov, and *Decoding Dates from Ancient Horoscopes* by Wieslaw Krawcewicz. Another article is about *Gibbon, Malthus, and the Ancients*.

The third issue of *Pi in the Sky*.The fourth issue of *Pi in the Sky*.

The PIMS Math Fair Booklet

PIMS published the math fair booklet by **Ted Lewis** (PIMS Education Coordinator, U. Alberta) in the Spring. This is a major new resource for teachers and others interested in math fairs for schools. It is based on the experience of the author and his colleagues over the past few years. It is a rich source of guidelines to organizing math fairs, and to finding suitable problems puzzles and challenges.

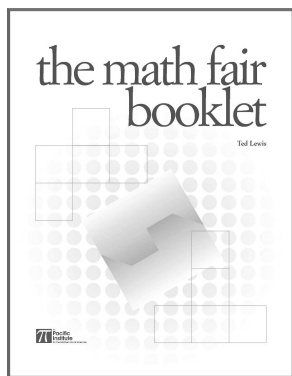
The booklet is available for free download in pdf format suitable for laser printing. Hard copies may

be purchased from PIMS University of Alberta for a nominal fee (US\$10.00 for shipping and handling in North America, US\$15.00 elsewhere).

From the Introduction: the math fair booklet by Ted Lewis

Everybody knows what a science fair is. Students find projects to work on, they prepare posters and demonstrations, the public is invited to come and see what they have done, and a panel of judges awards prizes for projects that are deemed to be the best.

A math fair is similar, but two important differences set our concept apart. Although mathematics is extremely diverse, our math fairs concentrate on just one aspect of the subject, namely problem solving, and our fairs are officially non-competitive, so there are no awards or prizes. We have chosen to focus on problem solving for several reasons. It is one activity that is common to most of mathematics, it is frequently an explicit part of the mathematics curriculum and it encourages skills in students that can be applied in all areas of their lives.



The problems in this booklet are ones that young students can solve and truly understand with a reasonable amount of work. They will not need a broad educational background, but the problems are not simple and most will have to think before solving them.

The same is true about the people who visit the math fair even though they may be adults or students from higher grades. When the participants present their problems, they will discover that the visitors need help to work through the solutions, and the presenters will gain the satisfaction and confidence that comes from helping more talented or older persons.

The interaction between the participants and the viewers at a problem-based math fair can have a profound effect on the poise, confidence, communication skills and patience of the participants. The rea-

son for our second difference, that the math fair be officially non-competitive, is so that all students are encouraged to participate and benefit. If some students feel they have little chance of winning they may decline to join in or not put in a full effort.

Even if a math fair is officially non-competitive, informal competition does occur. The participants quickly recognize who among them are good problem solvers, who can explain things well, whose presentations have the best artwork, and which displays attract the most visitors. But this sort of competition is friendly and constructive, and frequently leads to co-operative efforts among the participants. The focus on problem solving and the lack of formal awards are the key parts to our concept of a math fair for children, but otherwise there are many opportunities to creatively adapt the concept to a particular situation. We hope you will find this booklet useful in organizing your own math fair and are looking forward to hearing from you about your experiences.

The PIMS Newsletter/Magazine

Scientific Articles that have appeared in the PIMS Newsletter

- Volume 4.2: *A Brief Survey of Braid Groups* by **Bert Wiest** (PIMS PDF)
- Volume 4.3: *Constructing Fractals in Geometer's SketchPad™* by **Michael Lamoureux** (PIMS Deputy Director and Site Director U. Calgary)
- Volume 5.1: *Strings and D-branes* by **K. Zarembo** (PIMS-PDF)
- Volume 5.1: *The Mathematics of Voting* by **Florin Diacu** (PIMS Site Director, U. Victoria)
- Volume 5.1: *The Amazing Number π* by **Peter Borwein** (SFU)
- Volume 5.2: *The Fascinating Predator-Prey Equation and Development of HIV/AIDS in Canada* by **B. D. Aggarwala** (U. Calgary)
- Volume 6.1: *Computing Free Boundary Problems in Moving Fluids* by **Michael Shelley** (Courant)
- Volume 6.2: *Is Economic Theory True?* by **Ivar Ekeland** (U. Paris-Dauphine)

Pacific Institute for the Mathematical Sciences Newsletter

A VISION OF PROPOSED INITIATIVE

A Morning In the Life, 1999

at the Pacific Institute for the Mathematical Sciences

The proposed Pacific Institute for the Mathematical Sciences (PIMS) will primarily be a research institute in the mathematical sciences. The founding Universities of western Canada will offer faculty to the annual communication...

The Pacific Institute will create its own research and development centre...

- 1. Victoria, B.C., S.F.U., Prince George, Colangelo, Estimation
2. The Fields Institute, Toronto
3. The Centre for Dynamic Modelling in Computer Science (DMACS), University of Waterloo...

Pacific Institute for the Mathematical Sciences Newsletter

for the Mathematical Sciences Feb. 1998 Vol. 2 Issue 1

PIMS, Fields and the CRM invited to develop NCE in the mathematical sciences

Canada's three mathematical sciences centres have cleared the final hurdle in their application to the prestigious National Centres of Excellence program...

PIMS Graduate Week-end
As a new initiative, the Pacific Institute for the mathematical sciences will be offering the PIMS GRADUATE WEEK-END to members of the community...

PIMS to celebrate James Mirreles'
The main theme would be a lecture series at the 4th anniversary meeting of the Society for Social Choice and Welfare...

PIMS and CIRS launch the Industrial Working Seminar Series
As a part of PIMS and CIRS' Centre for Integrated Computer Systems Research initiative...

Dr. Hugh Morley, FRS: New Chair of PIMS Board of Directors (Page 2)

The Pacific Institute for the Mathematical Sciences Newsletter, Feb. 1998

Pacific Institute for the Mathematical Sciences Newsletter

for the Mathematical Sciences March 1999 Vol. 2 Issue 4

PIMS: Base Funding From NSERC For 1999-2003

The Mathematical Information Technology and Computer Systems Networks (MITACS), a new Canadian mathematical network, will benefit from a federal investment of close to \$4.5 million over the next four years...

The 3x3 Canada-China Mathematics Initiative
The 3x3 Canada-China Convention is an exciting initiative of UBC, McGill, and the University of Toronto...

MITACS: One of Three New Networks in NCE Program
The Mathematical Information Technology and Computer Systems Networks (MITACS), a new Canadian mathematical network...

BC and Alberta math NSERC's funding for PIMS
NSERC's \$800K annual support for PIMS will be matched by a cash contribution of \$300K per year from B.C. and Alberta sources...

What's inside...
PIMS calendar of scientific events for 1999 (Page 4)
Indexed contents (Page 2)
Report on recent scientific activities (Page 3)
The Mathematics Education Page (Page 7)
PIMS Council (Page 8)

The Pacific Institute for the Mathematical Sciences, December 1998

Pacific Institute for the Mathematical Sciences Newsletter

June 1997 Vol. 1 Issue 1

NSERC Supports Pims Outreach Activities

Pims received \$400,000 of funding for the next two years from NSERC's Research Partners Program under the University-Industry collaborative activities component...

Pims Organises Oxford Study Program July 1-August 31, 1997
Pims will be holding an Oxford study program in the summer of 1997 to develop a study program model in Canada based on the highly successful Oxford model...

Fields and Pims launch a National Research Network
In collaboration with the Centre for Integrated Computer Systems Research (CICRS) and Communications and Information Technology Ontario (CITO), PIMS is launching a National Research Network...

PIMS thematic summer 1998: Math Economics and Finance
This is a planning a group of activities dealing with mathematical problems arising in economic and financial contexts...

The Pacific Institute for the Mathematical Sciences Newsletter
for the Mathematical Sciences May 1998 Vol. 2 Issue 2

Alberta Government Supports PIMS Industry and Educational Programs

The Alberta Government, through its Alberta Research Authority, has committed \$1.05M for the 1998-99 fiscal year to support PIMS' industry and educational programs...

NSERC's President on "Mathematics and PIMS"
NSERC's President, Dr. David Lewis, has written a foreword to the Pacific Institute for the Mathematical Sciences Newsletter...

BC Government Renews Its Support for PIMS Industrial Program
In its speech during the biennial ceremony of the PIMS sponsored UBC-SusTech Summit, Stuart Callaghan, BC Advanced Technology and Technology Development Minister...

NCE: PIMS plays a Pivotal Role in Formulating the Vision of the MITACS Network
On May 1, 1998 the three major Canadian mathematical sciences initiatives (PIMS, CRM, and Fields) jointly submitted a proposal to a new Network of Excellence (NCE) in Mathematics of Information Technology and Computer Systems (MITACS)...

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The Pacific Institute for the Mathematical Sciences, May 1998

Pacific Institute for the Mathematical Sciences Newsletter

December 1997 Vol. 1 Issue 2

BC Government Supports Pims Industry Liaison Programs

Following the decision of NSERC to support Pims with \$200,000 for each of the next two years, the BC government provided to award Pims \$70,200 for 1997-1998 from the Science and Technology Branch of the BC Innovation, Science and Technology Agency...

Pims Form on industrial mathematics, SFU-UC
Following on the heels of its highly successful Industrial Problem Solving Workshop (PWS), Pims has recently announced an annual forum in Industrial Mathematics to take place May 25-26, 1998...

The CRM and the Fields Institutes pledge \$100,000 in support of PIMS
Dr. David Lewis, director of the CRM will provide financial support of \$50,000 each to PIMS to be disbursed over the period from the next NSERC competition...

PIMS thematic summer 1998: Math Economics and Finance
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The Pacific Institute for the Mathematical Sciences Newsletter, Dec. 1997

Pacific Institute for the Mathematical Sciences Newsletter

for the Mathematical Sciences Sept. 1998 Vol. 2 Issue 3

PIMS 1999 Thematic Programs: Math Biology & Experimental Mathematics

Reflecting the overwhelming enthusiasm and success of the last two thematic programs, PIMS is now aiming to foster such programs year after year...

NSERC Visits PIMS on September 14
The long awaited visit to determine PIMS' NSERC grant will take place on September 14 at the University of British Columbia...

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PIMS calendar of scientific events for 1999 (Page 4)
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The Pacific Institute for the Mathematical Sciences, Sept. 1998

Pacific Institute for the Mathematical Sciences Newsletter

for the Mathematical Sciences Spring 1999 Vol. 3 Issue 2

NSERC's President Leads 60 Canadian Mathematicians to China

More than 60 Canadian mathematical scientists will participate in the First 2 x 3 Canada-China Mathematics Convention, which will be held August 21-28 at the Campus of Tsinghua University in Beijing...

Third Annual PIMS Industrial Problem Solving Workshop: A Continuing Success
From October 1996 to this year, the Pacific Institute for the Mathematical Sciences has been providing a three-day industrial problem solving workshop...

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The Pacific Institute for the Mathematical Sciences, Spring 1999

Pacific Institute for the Mathematical Sciences Newsletter

for the Mathematical Sciences March 1999 Vol. 3 Issue 1

Alberta Science and Research Authority Awards \$800K to PIMS

On November 21, the Alberta Science and Research Authority (ASRA) announced it is awarding \$800K to PIMS program. The support is for the PIMS industrial program...

UBC and SFU Provide Research Facilities for PIMS and MITACS
Through the support of Barry McBride (VP Academic and Provost, UBC), the PIMS Central Office has been provided with a 4,800 sq. ft. office facility for UBC campus...

What's inside...
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The Pacific Institute for the Mathematical Sciences, Spring 1999

Pacific Institute for the Mathematical Sciences Newsletter

for the Mathematical Sciences May 1999 Vol. 3 Issue 1

MITACS Board Approves 21 Projects

The MITACS (Mathematics of Information Technology and Computer Systems) Network Agreement became official on February 22, 1999. The MITACS network comprises a collaboration involving 17 PIMS researchers from 21 universities, 34 external and many other organizations...

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The Pacific Institute for the Mathematical Sciences, Spring 1999

PIMS Offers Lectures via Streaming Video over the Internet

PIMS now has over 2002 lectures available over the internet using on-demand streaming video and audio. The lectures are available at www.pims.math.ca/video. There are both videos of the lectures in Realvideo format and high resolution JPEG images of the speaker's slides, when possible. MP3 files are also available for listening to for many of the lectures. The library is divided into five main sections:

Ceremonies and Meetings
Seminar Series and Distinguished Lectures
Thematic Programmes, Conferences and Workshops
Minicourses
Educational Activities

Ceremonies and Meetings

PIMS Awards Ceremony 2001, Vancouver, BC, December 1, 2001

The ceremony where the three PIMS prizes for research, education and industrial outreach were awarded.

Announcement Ceremony for BIRS, The Banff Centre, Alberta and The NSF, Washington, DC, September 24, 2001

This ceremony includes speeches by: **Rita Colwell** (Director, NSF), **Tom Brzustowski** (President, NSERC), **Robert Church** (Chair of Board, Alberta Science and Research Agency), **Philippe Tondeur** (Director of Division for the Mathematical Sciences, NSF), **Hon. Cindy Ady** (MLA for Calgary Shaw), **Mary Hofstetter** (President and CEO of The Banff Centre) and **Raul E. Chavera** (US Consul General in Calgary).

Opening Ceremonies and Banquet of the 2001 Canada-China Mathematics Congress, UBC, August 20, 2001

This initiative built on the success of the first Canada-China 3x3 Congress held at Tsinghua University in August 1999.

Opening Ceremonies of the 1999 Canada-China Mathematics Congress, Tsinghua University, Beijing, August 23–28, 1999

On August 23–28, 1999, **Tom Brzustowski** (President of NSERC) led a delegation of more than 60 Canadian mathematical scientists to Beijing who took part in a high-level Canadian-Chinese Mathematics Congress.

PIMS Opening Meeting, University of Victoria, October 4, 1996

The following talks are available:

- **David Brillinger** (UC, Berkeley): *Studying the tracks of Elephant Seals*
- **Katherine Heinrich** (SFU): *PIMS and Mathematics Communication*
- **Richard Karp** (U. Washington): *Combinatorial Optimization as a Tool for Molecular Biology*
- **Donald Saari** (Northwestern): *The Chaotic Complexity of Economics and the Social Sciences*

Seminar Series and Distinguished Lectures

IAM-PIMS 2002–03 Joint Distinguished Colloquia, UBC

All the talks from this series will be taped. The talks by **Gordon E. Swaters** (U. Alberta), **David Chandler** (UC, Berkeley) and **Ulf Dieckmann** (International Institute for Applied Systems Analysis, Laxenburg) are available at the time of publication.



David Chandler
(UC, Berkeley)

MITACS Annual General Meeting, UBC, May 23–25, 2002

The talks by **Gilbert Strang** (MIT), **Ron Graham** (UC, San Diego) and **Anil K. Jain** (Michigan State U.) are available.

IAM-PIMS 2001–02 Joint Distinguished Colloquia, UBC



Eva Tardos (Cornell)

The six talks from this series were given by: **Eva Tardos** (Cornell University), **Adam Arkin** (UC, Berkeley), **Russel Caffisch** (UCLA), **Joel H. Ferziger** (Stanford University), **David Gottlieb** (Brown University) and **Philippe R. Spalart** (Boeing Corporation).

IAM-PIMS 2000–01 Joint Distinguished Colloquia, UBC

Talks by **Bengt Fornberg** (U. Colorado), **Gunther Uhlmann** (U. Washington), **David Baillie** (SFU) and **Linda Petzold** (UC, Santa Barbara) may be viewed.

PIMS-MITACS Seminars on Computational Statistics and Data Mining, UBC, 2001–01

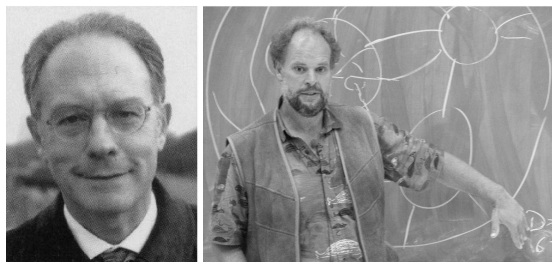
John Rice (UC, Berkeley) and **R. Douglas Martin** (University of Washington) from the series can be watched.

Distinguished Lectures

Talks by the following people may be viewed:

- **Vaughan Jones** (UC, Berkeley): *Skein theory in knot theory and beyond*, UBC, November 4, 2002
- **Ivar Ekeland** (Université Paris-Dauphine): *Systems of Nonlinear PDEs arising in economic theory*, UBC, March 22, 2002
- **David Gillman** (UCLA): *Odd embeddings on lens spaces*, UBC, May 31, 2001
- **Douglas Arnold** (Director, IMA, Minnesota): *Colliding Black Holes and Gravity Waves: A new Computational Challenge*, UBC, May 16, 2001
- **David Eisenbud** (Director, MSRI): *Chow Forms and Resultants - old and new*, UBC, April 12, 2001

- **Tudor Ratiu** (École Polytechnique Fédérale de Lausanne): *Variational Principles, Groups and Hydrodynamics*, U. Victoria, January 12, 2001
- **Robert Devaney** (Boston University): *The Mandelbrot Set, the Farey Tree, and the Fibonacci Sequence*, U. Victoria, October 20, 2000
- **Beno Eckmann** (ETH Zürich): *Idempotents in Group Algebras, Traces, and Geometry of Groups*, U. Calgary, September 21, 2000
- **Beno Eckmann** (ETH Zürich): *Projections, Group Algebras, and Geometry of Groups*, UBC, September 14, 2000
- **Beno Eckmann** (ETH Zürich): *The Euler Characteristic - Some Variations and Ramifications*, UBC, September 13, 2000
- **Sir Christopher Zeeman**: *Geometric Unfoldings of a Difference Equation*, U. Victoria, March 21, 2000
- **Israel Gohberg** (Tel Aviv University): *Infinite Systems of Linear Equations*, U. Calgary, September 30, 1999
- **Richard Karp** (U. Washington): *The Design of Molecular Bar Codes: A Combinatorial Problem from Molecular Biology*, SFU, May 13, 1999
- **Mitchell Luskin** (U. Minnesota): *Modelling, analysis and computation of crystalline microstructures*, UBC, September 10, 1998
- **Avi Wigderson** (Hebrew University): *A Computational View of Randomness*, UBC, April 6, 1998



Ivar Ekeland (Université Paris-Dauphine) and Vaughan Jones (UC, Berkeley) who both gave talks as a PIMS Distinguished Lecturers in 2002.

Thematic Programmes, Conferences and Workshops

Thematic Programme on Asymptotic Geometric Analysis, PIMS at UBC, July 1–August 15, 2002

110 lectures are available.

International Conference on Robust Statistics, UBC, May 13–17, 2002

23 lectures are available.

Pacific Northwest String Theory Seminar, PIMS at UBC, March 8–10, 2002

10 lectures are available.

Thematic Programme on Nonlinear Partial Differential Equations, PIMS at UBC, July–August, 2001

38 lectures are available.

Pacific Northwest String Theory Seminar, PIMS at UBC, March 17, 2001

5 lectures are available.

Conference on Biophysics and Biochemistry of Motor Proteins, Banff, AB, August 27–September 1, 2000

2 lectures are available.

Thematic Programme on Graph Theory and Combinatorial Optimization, PIMS at U. Victoria and SFU, June–July, 2000

9 lectures are available.

Thematic Programme on Mathematical Biology, PIMS at UBC, June–August, 1999

A lecture by **Sir Andrew Huxley** (Trinity College, Cambridge) is available.

Cascade Topology Seminar, PIMS at UBC, November 2–3, 2002

6 lectures are available.

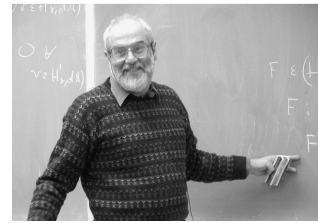
Minicourses

Minicourses at the Thematic Programme on Nonlinear PDEs, PIMS-UBC, July–August, 2001

Minicourses given by **Gang Tian** (MIT), **Richard Schoen** (Stanford), **Eric Séré** (Université Paris IX), **Yann Brenier** (Université Paris VI), **Maria Esteban** (Paris-Dauphine), **Fang Hua Lin** (Courant), **Changfeng Gui** (UBC), **Wei-Ming Ni** (U. Minnesota), **Michael Struwe** (ETH Zurich), **Henri Berestycki** (Université Paris VI) and **Panagiotis Souganidis** (U. Texas, Austin). are available.

Minicourses by PIMS Distinguished Chairs

Gunther Uhlmann
(U. Washington)



- **Gunther Uhlmann** (U. Washington): PIMS Distinguished Chair, UBC, November, 2002. 3 lectures are available on *The Dirichlet to Neumann Map and Inverse Problems*.
- **Klaus Schmidt** (University of Vienna and Schrödinger Institute): PIMS Distinguished Chair, U. Victoria, November, 2002. 5 lectures are available on *Algebraic \mathbb{Z}^d -actions*.
- **Donald G. Saari** (UC, Irvine): PIMS Distinguished Chair, U. Victoria, September, 2002. 5 lectures are available with titles: *Mathematical Social Sciences, an oxymoron?*, *Singularity theory and departmental discussions*, *Evolutionary game theory; examples and dynamics*, *Chaotic dynamics of economics* and *Economic and Dynamics*.
- **Michael Shelley** (Courant Institute): PIMS Distinguished Chair, SFU, November–December, 2001. 5 lectures are available with titles: *Computing Free Boundary Problems in Moving Fluids*, *Computing with Surface Tension*, and *Discovering Singularities, Pattern Formation in Fluid Dynamics: Fluid Dynamics meets Materials Science, Why do Flags Flap? and Bending in the Wind: Elasticity and Drag Reduction*.

- **Vladimir Turaev** (National Center of Scientific Research, France): PIMS Distinguished Chair, U. Calgary, July–August, 2001. 5 lectures are available with titles: *Torsion of chain complexes*, *Mehler's Formula and the Renormalization Group*, *Euler structures and refined torsions*, *The torsion function of 3-manifolds* and *Properties of the torsion function*.
- **David Brydges** (University of Virginia): PIMS Distinguished Chair, UBC, September–October, 2000. 4 lectures are available on *Self-Interacting Walk and Functional Integration*.
- **Yuri Matiyasevich** (Steklov Institute of Mathematics): PIMS Distinguished Chair, U. Calgary, March 9, 2000. A lecture is available on *How to draw a tree correctly*.
- **Yuri Matiyasevich** (Steklov Institute of Mathematics): PIMS Distinguished Chair, U. Calgary, February, 2000. 5 lectures are available on *On Hilbert's Tenth Problem—What can we do with Diophantine Equations?*

Educational Activities

PIMS Changing the Culture 2002, SFU at Harbour Centre, April 26, 2002

Talks by **Ed Bareau** (U. Toronto) and **Brent Davis** (Faculty of Education, U. Alberta) were taped.



Ed Bareau (U. Toronto)

PIMS Changing the Culture 2002, SFU at Harbour Centre, May 11, 2001

John Mighton (Fields Institute) and **Brett Stevens** (PIMS, SFU) spoke at this conference and their talks are on the web page.

PIMS Changing the Culture 2002, SFU at Harbour Centre, April 28, 2000

A talk by **H.S.M Coxeter** (U. Toronto) is on-line.

VIII. PIMS PRIZES:

2001

Ken Foxcroft (TD Securities), Research Prize Winner
Kai Behrend (UBC), and Ron Graham (San Diego).



Dick Peter (Dean of Science, U. Alberta) and Education Prize
Winner Wieslaw Krawcewicz (U. Alberta). The Education
Prize was awarded jointly to Klaus Hoechsmann (UBC) and
Wieslaw Krawcewicz.

Ken Foxcroft (TD Securities), Michael Boorman
(Dean of Science, U. Calgary), Industrial Prize
Winner Martin Puterman (UBC) and Arvind Gupta
(MITACS). Martin Puterman shared the prize with
Michael Kouritzin (U. Alberta).



Three PIMS Prizes for research, education and industrial outreach were awarded at the PIMS Banquet held at SFU's Harbour Centre Campus on December 1, 2001.

The **PIMS Research Prize** is selected by the Institute's Scientific Review panel which consisted of: David Boyd, Gordon Slade, Nick Pippenger (UBC), Alistair Lachlan (SFU), Bob Moody (U. Alberta), Ian Putnam (UVic), Ron Graham (San Diego), Bernie Matkowski (Chicago), David Brillinger (Berkeley) and Gang Tian (MIT).

The 2001 PIMS Research prize has been awarded to **Kai Behrend**. Dr. Behrend studied mathematics at the University of Hamburg graduating in 1983. After a masters degree at the University of Oregon and a Diploma at the University of Bonn, he received his Ph.D. at the University of California at Berkeley in 1991, under Arthur Ogus. His thesis was on the "Lefschetz Trace Formula for the Frobenius Morphism of an Algebraic Stack". He was a Moore Instructor at MIT from 1991–1994 after which he joined UBC.

Yuri Manin writes: "*Partly in collaboration with Barbara Fantechi, Kai produced the first ever algebraic geometric construction of the Kontsevich virtual fundamental class and general Gromov-Witten invariants for arbitrary smooth projective algebraic manifolds.*"

Dr. Behrend's construction has provided a key step in the understanding of Gromov-Witten invariants and made possible some of the deepest work so far in enumerative algebraic geometry.

He is also regarded as one of the world's top experts in the burgeoning area of algebraic stacks. Fields medallist Maxim Kontsevitch writes: "*The work of Kai Behrend is of the highest level and is absolutely fundamental in algebraic geometry.*"

Kai Behrend has also received the 2001 Coxeter-James prize of the Canadian Mathematical Society.

The **PIMS Education Prize** for 2001 is awarded jointly to two very dedicated individuals: **Wieslaw Krawcewicz**, Professor at the University of Alberta and **Klaus Hochsmann**, Professor Emeritus at UBC. The PIMS Education prize committee, consisting of the six Site Directors, was unanimous in choosing these two from a field of seven nominees, who were all very deserving individuals in their own right.

Wieslaw Krawcewicz is the creator and moving force behind the highly successful new magazine "Pi in the Sky", which was launched two years ago under PIMS sponsorship. This magazine, devoted to improving awareness of mathematics among high school students, has been distributed free of charge to all high schools in Alberta and British Columbia, as well as selected sites throughout North America.

It has an attractive format, lots of jokes and cartoons, as well as articles written on mathematical topics, often with an angle of relevance to teenage life. For example, the first issue had its lead article entitled *A Date with Math* and had five enthusiastic schoolgirls on the cover. The magazine is also available online.

As one of his colleagues commented, "*At the beginning I was skeptical. I did not believe that such a project could be finalized. Wieslaw was extremely active in convincing and encouraging people, including myself, to participate. He did all kinds of work from editing and writing articles to making cartoons and math jokes. He had long discussions with high school students, undergraduates, teachers and other people involved in education. Wieslaw's enthusiasm is contagious.*"

The director of curriculum and programmes in the Edmonton public school system remarked, "*Our high school mathematics department heads all look forward to the magazine and frequently utilize its contents to enrich the math programme for their students. This publication has certainly helped to increase interest in mathematics. The contributions of Dr Krawcewicz to the students in Edmonton Public Schools have been and continue to be significant in helping to raise the bar in mathematics education. He is a most deserving candidate for the PIMS Education award.*"

One of Wieslaw's colleagues noted that "*the University of Alberta (and I expect other PIMS universities as well) is seeing the positive effect of Dr. Krawcewicz's efforts. Since the introduction of the magazine, enrolment in the first-year Honours Calculus classes at UA has approximately doubled; enrolment in our second year class has actually tripled. The magazine has made many students aware that mathematics can be interesting.*"

Sharing this year's prize is another person who has worked far beyond the call of duty in math

education and increasing public awareness and appreciation of mathematics, Professor Klaus Hoechsmann. Even before PIMS existed, he has been devoted to the cause of mathematics education. At UBC he developed, and was the first teacher of, the course “Mathematics by Inquiry” (Math 336), which has become the centrepiece of the new Certificate Programme for Mathematics Teachers, cosponsored by the Mathematics department and the Curriculum Studies department of the Education Faculty. It is a course designed to provide hands-on mathematical experience to educators. One of his former students—now teaching mathematics at a BC high school—remarked “*Using the principles he teaches, mathematics, like singing, is for everyone—not only the three tenors.*” Klaus inspires teachers to love and understand mathematics.

Upon becoming Chair of the PIMS Education Committee, Klaus truly went into high gear, putting tremendous enthusiasm into PIMS’ educational and outreach programmes. He co-organized the innovative Changing the Culture conferences, a BC forum for elementary, high school, and postsecondary math educators. Klaus was instrumental in creating the PIMS Elementary School Mathematics Contest (ELMACON) in partnership with the BC Association of Mathematics Teachers. He has spent countless hours with BCAMT people and individual teachers, made presentations at schools and conferences, and completely revamped PIMS’ activities in K-12 education. Many contributions to “Pi in the Sky” were authored by Klaus.

To celebrate the year 2000, the International Mathematics Year, Klaus designed and executed the hugely successful “Mathematics is Everywhere” poster campaign. Each month of the year a new poster would appear on buses in the lower mainland, with an attractive graphic and a mathematical problem, offering a \$100 prize for its solution, along with a web address for further information. The enthusiastic response of the public was beyond anyone’s expectations. These posters also became the basis for the first PIMS calendar, which is now becoming a collector’s item. A sequel to this poster campaign, celebrating Women in Mathematics, was developed by staff in the PIMS office, with Klaus’ encouragement.

The most innovative and ambitious of Hoechsmann’s contributions, perhaps, is the full-length play “Hypatia’s Street Theatre.” This is a dramatization based on the life of an early woman mathematician and philosopher in Alexandria, and is unique in that it actually teaches mathematical concepts within the play. It was performed in December 2000 to a full house in the Frederic Wood theatre on the UBC campus. Klaus not only wrote the script (with the assistance of professional playwright Ted Galay), but worked with the professional actors and stage crew throughout the rehearsals. He also paid for the production, devoting all of his (modest) stipend as a PIMS employee to the cause. Because of this, the nominators argued that there was really no conflict in awarding the PIMS Education prize to one of our own employees. Indeed the prize is richly deserved for all the effort Klaus has devoted over the years to mathematical education and public awareness.

This year the committee of Dr. Arvind Gupta (Chair, MITACS), Dr. Shahid Hussein (Telus), Mr. Randy Savoie (Ballard Powersystems), Mr. Jack Fujino (Stantec), Dr. Bryant Moodie (University of Alberta), and Dr. Chris Bose (University of Victoria), received seven nominations for the **PIMS Industrial Prize**. They were impressed by the significant contributions made by all the candidates. It is clear that industrial-university research programmes are thriving across the country.

The committee felt that two nominations stood out from the others. After considerable debate, they chose to recommend that **Michael Kouritzin** (University of Alberta) **Martin Puterman** (University of British Columbia) share this year’s industrial prize.



Ken Foxcroft (TD Securities), Industrial Prize Winner Michael Kouritzin (U. Alberta), Michael Boorman (Dean of Science, U. Calgary), and Arvind Gupta (MITACS).

The committee was very impressed that so early in his career, Dr. Kouritzin has established a strong and well-known industrial research programme. He founded the PINTS Centre (Predictions in Interacting Systems), which is supported by MITACS and PIMS. The centre focuses on novel filtering theory to track various types of objects from lost ships to pollution. His industrial partners unanimously agreed that Michael's research is having a significant impact on their own business plans.

It is difficult to imagine anyone who has put more time and energy into establishing close university-industry collaborations than Dr. Puterman. Dr. Puterman has a long and distinguished research career, most recently winning the Lancaster Prize. He was also an early advocate of industry-university research as pivotal to operations research. This led to the creation of the Centre for Operations Excellence (COE) at UBC. COE receives support from MITACS, PIMS, and a significant number of partner companies. Dr. Puterman's vision of giving students high-level research training in an industrial-university setting is a model that is a testament to what can be accomplished through vision and hard work.

The keynote address at the ceremony was given by **Philippe Tondeur**, Director of the Division of Mathematical Sciences at the National Science Foundation and Professor of Mathematics at the Uni-

versity of Illinois in Urbana-Champaign.

During his years at NSF Dr Philippe Tondeur has become an articulate voice for the role of the Mathematical Sciences in the U.S. Science and Engineering enterprise. It is worth noting that even after the tragic events of September 11th the NSF has received an 8.4% increase for Fiscal Year 2002. Closer to home, the birth of BIRS will always be connected to the leadership of Philippe Tondeur at the NSF. There is no doubt that the world mathematical community owes much to the clarity of vision and to the farsightedness of Philippe Tondeur in the development of BIRS.



Nassif Ghoussoub (PIMS) and Philippe Tondeur (NSF).

Appendix:

Financial Report

The PIMS fiscal year runs from April 1, 2001 to March 31, 2002. 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 (Simon Fraser University, University of Alberta, University of British Columbia, University of Calgary, University of Victoria, University of Washington) and the affiliated Institutions (University of Lethbridge and University 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 ministry of Competition, Science and Enterprise (formerly Science and Information Technology Agency).

PIMS also received substantial contributions from 57 industrial partners (to March 31, 2002) for its industrial programmes and for the PIMS-affiliated MITACS industrial collaborative research projects.

Income for 2001–02

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 scientific leadership to 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. 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, 2001-March 31, 2002

Source	Carry-forward	Income 01/02	Operating Funds	In-Kind Support
NSERC	\$76,505	\$630,000	\$706,505	
BC (CSE/ISTA)	\$22,142	\$197,500	\$219,642	
BC (NCE)	\$0	\$100,000	\$100,000	
Alberta (ASRA)	\$583	\$200,000	\$200,583	
Universities	(\$24,077)	\$0	(\$24,077)	
SFU		\$75,000	\$75,000	\$150,000
UAlberta		\$70,000	\$70,000	\$60,000
UBC		\$115,000	\$115,000	\$180,000
UCalgary		\$61,000	\$61,000	\$60,000
UVictoria		\$60,000	\$60,000	\$60,000
ULethbridge		\$5,000	\$5,000	
UNBC		\$5,000	\$5,000	
UWashington*		\$0	\$0	\$25,000
MITACS	\$29,928	\$157,000	\$186,928	
Other**	\$68,295	\$198,047	\$266,342	
Total	\$173,376	\$1,873,547	\$2,046,923	\$535,000

* The University of Washington contribution of \$74446 CAD for FY2001 and FY2002 was received in FY2001 and reported in the 2000-01 PIMS Annual Report.

** Does not include industrial contributions to PIMS activities or PIMS/MITACS projects.

Total Operating Funds	\$2,046,923
Reserve Fund	\$75,000
Industrial Funds Received (PIMS/MITACS)	\$781,448
Total Funds At-Hand	\$2,903,371
Total In-Kind Support	\$535,000

Industrial funding

PIMS receives substantial industrial funding in support of its programmes: The PIMS prizes, various industrial workshops, PIMS seminar series and industrial postdoctoral fellows. It also manages the in-

dustrial funds provided by various companies to the 12 MITACS collaborative projects associated with PIMS. (See list below)

PIMS/MITACS Industrial Funds

Project	Company	Before March/01	April/01-March/02	Total to March/02
Project 1	IBM	\$30,000	\$0	\$30,000
	MDSI	\$25,000	\$0	\$25,000
	StemSoft	\$34,500	\$0	\$34,500
Project 2	Quatronix	\$15,000	\$0	\$15,000
	Sound Logic	\$25,000	\$0	\$25,000
	Webdispatchers.com	\$20,000	\$5,000	\$25,000
Project 3	Waterloo Maple	\$85,000	\$54,750	\$139,750
	Workfire Development Corp.	\$20,000	\$0	\$20,000
Project 4	FinancialCAD	\$64,000	\$24,750	\$88,750
	Powerex	\$52,000	\$10,000	\$62,000
	TransAlta	\$42,000	\$0	\$42,000
Project 5	CREWES	\$10,000	\$0	\$10,000
	Imperial Oil	\$0	\$15,000	\$15,000
	C&C Systems Limited	\$0	\$10,000	\$10,000
Project 6	NORTEL	\$120,000	\$0	\$120,000
Project 7	Kinetek	\$15,000	\$0	\$15,000
	SmithKline Beecham	\$10,000	\$150,000	\$160,000
	In Silico	\$77,556	\$0	\$77,556
	StemCell	\$5,000	\$0	\$5,000
Project 8	Bayer	\$10,000	\$0	\$10,000
	VisionSmart	\$7,473	\$0	\$7,473
	Lockheed Martin	\$48,665	\$50,124	\$98,789
	Acoustic Positioning Research	\$8,000	\$12,000	\$20,000
	Canadian Airlines	\$87,000	\$0	\$87,000
Project 9	BCTel	\$43,500	\$0	\$43,500
	Telus	\$43,500	\$0	\$43,500
	Workers' Compensation Board	\$87,000	\$47,750	\$134,750
	Vancouver International Airport	\$0	\$53,875	\$53,875
Project 10	Powertech	\$20,000	\$0	\$20,000
	Ballard Power System Inc.	\$186,000	\$180,000	\$366,000
Project 11	Organon Canada	\$20,000	\$0	\$20,000
	Starlab	\$8,141	\$0	\$8,141
	Kinetana	\$8,000	\$27,400	\$35,400
	National Institute of Health	\$5,941	\$0	\$5,941
	Cybercell	\$0	\$20,000	\$20,000
Project 12	Monsanto Company	\$2,920	\$0	\$2,920
	Merak	\$2,000	\$0	\$2,000
	Charles Howard & Associates	\$1,000	\$0	\$1,000
Project 13	Imperial Oil	\$2,000	\$2,000	\$4,000
	McMillan-McGee	\$2,000	\$0	\$2,000
	Michelin	\$2,889	\$0	\$2,889
	Stern Stewart & Co.	\$2,889	\$0	\$2,889
Project 14	Firebird Semiconductors	\$0	\$2,000	\$2,000
	Algorithmics	\$0	\$2,000	\$2,000
	IBM	\$0	\$1,974	\$1,974
	Microsoft	\$0	\$3,011	\$3,011
	Dept. of National Defence (CSE)	\$0	\$2,000	\$2,000
	AEC Oil & Gas	\$0	\$2,000	\$2,000
Project 15	Insightful	\$0	\$23,814	\$23,814
Project 16	Firebird Semiconductors	\$0	\$23,000	\$23,000
Project 17	Toronto Dominion	\$10,000	\$10,000	\$20,000
Project 18	MathSoft	\$21,708	\$0	\$21,708
Project 19	Vortek	\$10,000	\$0	\$10,000
Project 20	Schlumberger (Etudes & Productions)	\$24,000	\$24,000	\$48,000
Project 21	Schlumberger (Cambridge)	\$10,000	\$10,000	\$20,000
Project 22	NORTEL/StatCar	\$12,604	\$0	\$12,604
Project 23	Galdos Systems	\$0	\$15,000	\$15,000
	Total	\$1,337,286	\$781,448	\$2,118,734

Other Contributions

In the table below, we have outlined only 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 post-

doctoral 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 16 PIMS postdoctoral fellows (\$18,000 each) have been at least matched (minimum \$18,000 contribution) 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 *Esso-CMS-PIMS Summer Math Camps*, the *Workshop on Designs, Codes, Cryptography and Graph Theory* (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 2001/02

Expense Category	Budgeted	Actuals	Over/Under
Site Offices	\$177,310	\$169,655	\$7,655
Scientific Personnel	\$120,000	\$120,409	(\$409)
Central Office	\$289,000	\$268,537	\$20,463
Special Events	\$90,000	\$96,149	(\$6,149)
Industrial Outreach*	\$373,700	\$307,228	\$66,472
Education Programmes	\$148,025	\$121,988	\$26,037
Scientific Activities	\$630,372	\$582,046	\$48,326
PIMS Postdoctoral Fellows**	\$288,000	\$281,965	\$6,035
Total Expenses	\$2,116,407	\$1,947,977	\$168,430

* Figures include neither industrial funds nor MITACS projects

** Figures include neither industrial PDFs nor matching funds

Source	Operating Funds	Budgeted	Actuals	Carry-forward
NSERC	\$706,505	\$713,100	\$630,967	\$75,538
BC (CSE/ISTA)	\$219,642	\$192,000	\$205,684	\$13,958
BC (NCE)	\$100,000	\$100,000	\$74,786	\$25,214
Alberta (ASRA)	\$200,583	\$188,000	\$188,000	\$12,583
Universities	\$366,923	\$444,060	\$423,593	(\$56,670)
MITACS	\$186,928	\$205,700	\$180,065	\$6,863
Other	\$266,342	\$273,547	\$244,702	\$21,640
Total Expenses	\$2,046,923	\$2,116,407	\$1,947,797	\$99,126



The Max Bell Building and Corbett Hall, Banff Centre, the location of BIRS.

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