Pacific Institute for the Mathematical Sciences

Annual Report 2003/04

The Pacific Institute for the Mathematical Sciences

Mission Statement

The Pacific Institute for the Mathematical Sciences (PIMS) was founded and is maintained by the five main universities in Western Canada (Simon Fraser University, University of Alberta, University of British Columbia, University of Calgary, University of Victoria) with the objectives of:

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

PIMS has a close partnership with the University of Washington and the Mathematical Sciences Research Institute (MSRI), and the Universities of Lethbridge and Northern British Columbia are affiliates.

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

Ivar Ekeland
Director, PIMS

From the Chair of the Board

Michael Boorman, Dean, Faculty of Science, University of Calgary

Michael Boorman, Chair of the Board

The year was a very eventful one in the history of PIMS since it saw the departure of Dr. Nassif Ghoussoub from the position of Director, a position that he had held since September 1996. Nassif's contribution and commitment to the creation, and running of the institute for its first seven years of existence were monumental, and we are all indebted to him for his vision and his ability to implement that vision. The contributions that PIMS has made under his leadership to the development of the mathematical sciences in Western Canada, and indeed beyond, have been remarkable to say the least.

PIMS has been extremely fortunate in being able to find someone with the appropriate qualities to succeed Dr. Ghoussoub, and Dr. Ivar Ekeland has taken over the reins with energy and new ideas to help us go to the next phase of our existence. One of our first items of business under our new Director was to re-establish the PIMS Board and ensure that we have input on a continuing basis from new members, as provided for in our constitution. We have also agreed to create a position for a Deputy Director, and we are indebted to the Provost of the University of British Columbia for his generous support in implementing this proposal. Indeed UBC has been generous in many other ways in providing space and financial help to PIMS in the past year. The year 2003–4 saw some additional progress in the plan to have the University of Washington become a full member of the institute, and these efforts are ongoing.

PIMS has continued to be involved in a broad range of programmes, as described in this report. The board has been delighted to see the success of these, and especially of the relatively new Collaborative Research Groups programme. Our involvement in the operation of BIRS continues to be a source of pride. The appointment of Dr. Nassif Ghoussoub to succeed the first Scientific Director of BIRS, Dr. Bob Moody, ensured that we keep the momentum going in the support of this truly world class enterprise.

I want to extend my personal thanks to Ivar Ekeland for his energetic contributions to the success of PIMS in the first year of his directorship, and to all the members of the PIMS staff for their efforts in ensuring we provide our member universities with a high level of service and commitment. Finally I want to pay tribute to the major contribution to PIMS made by Dr. Hugh Morris, who chaired the board with wisdom and unwavering dedication. Although Hugh has generously agreed to continue as a member of the Board, he stepped down as Chair. Filling his shoes as the Acting Chair this year has been a challenging task for me!

Overview

Ivar Ekeland, PIMS Director

This Annual Report serves as a reminder of everything the PIMS community has accomplished since Nassif Ghoussoub and the early PIMS supporters first conceived the idea of a distributed institute connecting science and industry through mathematics. There is now so much activity going on, and it has attracted many researchers to this part of the world. But there also remains so much to be done.

We must maintain the pioneer spirit that is so apparent in endeavours such as the *Industrial Problem Solving Workshop*, *Pi in the Sky*, and the *Banff International Research Station*. We have to ensure that the initial enthusiasm does not fade, and that the early expectations are fulfilled. We hope the Banff Station, for instance, will become an international reference so that the best mathematicians in the world will come to Western Canada on a regular basis, and our institute will become the hub of a major international scientific network. We want the quality of our scientific meetings and periods of concentration to continually rise and thereby promote training of younger researchers and encourage creativity of older ones: there must be substantial challenges if we aim for high accomplishments. We want our connections with industry to expand, because this is where many of our graduates will find jobs, and because this is where many interesting mathematical problems come from. We want our educational programmes and *Pi in the Sky* to capitalize on their experience and continue to improve in quality, so that younger generations and the public at large will become more familiar with mathematics and more curious about science.

As more scientists are attracted to PIMS, the range of disciplines we cover will expand, and so will our industrial connections. The structure of PIMS will change to accommodate these needs. UBC has created a position of Associate Director of PIMS within the Mathematics Department which we expect to fill by the summer of 2004. Until then, Manfred Trummer has agreed to serve as Deputy Director.

Ivar Ekeland, PIMS Director

The Board of Directors of PIMS is being recomposed, and we hope that the University of Washington will seize the opportunity to strengthen its formal ties to the organization. The mathematicians at UW have submitted a VIGRE proposal to NSF in which PIMS is heavily involved. If successful, this proposal would provide a sound financial basis for the cross-border exchange of students and researchers.

Visiting the various sites, I have found broadening interest in PIMS from previously unreached scientific communities, such as economics and health sciences. These are find new opportunities which we must be ready to seize. Doing all this while keeping up the momentum on earlier initiatives, such as the Postdoctoral Fellowships, the Banff Station, and the Collaborative Research Groups, is a huge challenge. PIMS will rise to it, as it has done in the past. It will be a proper and fitting tribute to the vision and dedication of Nassif and all those who have made PIMS what it is today.

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PIMS PERSONNEL

The staff from the PIMS sites together for a training meeting at UBC in November 2003.

PIMS Management

Board of Directors

The Board of Directors has final responsibility for all aspects of the PIMS' operation. In particular, the Board ensures fiscal accountability, monitors the operation of the PIMS, and advises the Executive Committee.

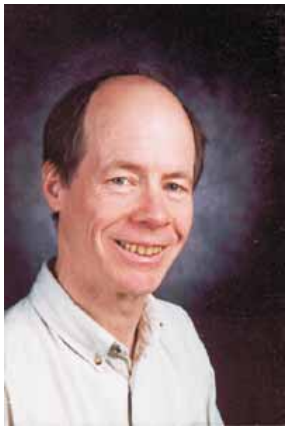
Chair of the Board: Dr. Michael Boorman received his Ph.D. from University of Nottingham in 1964 and is a professor in the Chemistry Department at the University of Calgary. Currently he is the Dean of Science at the University of Calgary. Dr. Boorman's research activities are in Inorganic Chemistry and in Heterogeneous Catalysis.

Michael Boorman.

Bruce Clayman.

Dr. Bruce Clayman received his Ph.D. in Physics from Cornell University in 1969. He is currently 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 of the Canadian Association of University Research Administrators. 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 90 papers in refereed journals and refereed conference proceedings.

Dr. James Delgrande is a Professor of Computing Science at Simon Fraser University and he is the former 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.



Jim Delgrande.

Dr. Don 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 Board Chair for 1999/2000.

Don has been with Syncrude for 24 years and is currently Manager, Process Automation Services providing process automation support to Syncrude's Mining, Extraction, Utilities and Upgrading operations in Fort McMurray, Alberta. Don's prior experience at Syncrude includes 10 years at Research developing On-Line Sensors and applying Pattern Recognition techniques to data analysis and 8 years as Manager Information Services. His current interest is applying mathematical techniques to determining process unit health and providing advanced warning to process operators to avoid downgrading incidents.

Don Denney.

Ivar Ekeland.

Dr. Ivar Ekeland is the Canada Research Chair in Mathematical Economics at the University of British Columbia. He is a former President of Universite Paris-Dauphine, and a former Director of the research centres CEREMADE and Institute Finance-Dauphine.

He has received prizes from the French Academy of Sciences, the French Mathematical Society, and the Belgian Academy of Sciences. He is a foreign member of the Norwegian Academy of Sciences and he holds honorary doctorates from UBC and from the University of Saint-Petersburg for Economics and Finance.

Dr. Ekeland is the founding editor of the "Annales de l'Institut Henri Poincare-Analyse nonlineaire" and he sits on the editorial board of many other publications.

He has also written several books which are reflections on, or popularization of, mathematics. For these contributions, Dr Ekeland was awarded the "Prix Jean Rostand" by the Association des Ecrivains Scientifiques de France and the "Prix d'Alembert" by the Societe Mathematique de France. He is also a regular contributor to the journal "Nature" as well as to the magazine "Pour la Science".

He has been a member of the PIMS Board of Directors since 2003 when he became PIMS Director.

Gary Kachanoski.

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

Gary continues to have a strong research program with main interests in the physics of water and chemical transport through soil. His past research contributions have been recognized by awards such as Fellow of Soil Science Society of America and Fellow of the Canadian Society of Soil Science. He was President of the Canadian Society of Soil Science in 2001. He has served on the Editorial Boards of the top peer reviewed research journals in his field including the Canadian Journal of Soil Science, Soil Science Society of America Journal, and the European Journal of Soil Science. He has authored over 80 scientific papers in referred journals and over 10 book chapters/sections. His research and technology transfer in soil and water conservation work have been recognized by industry and his peers through a nomination and induction into the Canadian Conservation Hall of Fame by Soil Conservation Canada.

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.

Barry McBride.

Dr. Barry McBride is currently the Vice-President, Academic and Provost at at the University of British. He received his Ph.D. from the University of Illinois (Urbana) in 1970. He was Department Head of the Microbiology Department at UBC from 1986 to 1989 and Department Head of the Oral Biology Department at UBC from 1981 to 1986. He was the Dean of Science at UBC from 1990 to 1998. He has consulted with Cominco, Energy Mines and Resources Canada, the National Institute of Health, USA and Ventures West. He is a

member of many Professional Committees including the Medical Research Council (where he is also on the Executive Committee), the Standing Committee on Manpower (MRC), Scientific Advisory Council - Alberta Council - Alberta Heritage Foundation for Medical Research and the Canadian Institute for Advanced Research - Research Advisory Council. His major area of research is in ecology and pathogensis of the microbial flora of man with specific reference to pathogens of the mouth.

Hugh Morris.

Dr. Hugh Morris holds a Ph.D. in Mining Geology from the University of Witwatersrand, Johannesburg, South Africa and has 44 years of experience in the mineral industry. He is a fellow of the Royal Society of Canada and is Chair of the Society's Canadian Global Change Programme.

From 1962 to 1979 he held a series of positions with Cominco Ltd. in its Exploration and Mining Departments in several Canadian locations, eventually becoming Director of Exploration for its worldwide activities. In 1979 Dr. Morris became associated with the E & B-Geomex Group of affiliated companies in Calgary, initially as President and Chief Operating Officer of Geomex Minerals Ltd., and in 1981, as President and Chief Executive Officer of E & B Canada Resources Ltd. Following the merger of the E & B-Geomex Group and Imperial Metals Corporation of Vancouver in May 1983, he was appointed Chairman and Chief Executive Officer of Imperial Metals and of three public companies within the Imperial Metals Group. He resigned from these positions in February 1993 to pursue other interests. Currently, he is a mineral industry consultant and board member of six Canadian public companies.

Dr. Morris has demonstrated special interest in national and international scientific and professional associations. He is a member of NSERC's Council, a member of the Standing Finance committee of ICSU, and Chairman of the Board of Directors of the Lithoprobe Project. He is past-president of both the Geoscience Council of Canada and the Geological Association of Canada, and was also Treasurer of the Canadian Geological Foundation from 1987 to 1996. He is a member of the Geological Society of London, the Institute of Mining and Metallurgy, 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. Edwin Perkins is Professor of Mathematics at the University of British Columbia where he was first appointed as a postdoctoral fellow in 1979. He did is his undergraduate degree at U. of Toronto and obtained his doctoral degree from the U. of Illinois. His research interests in probability include the general theory of processes, Brownian motion, stochastic differential equations and partial differential equations, interacting particle systems, measure-valued diffusions and stochastic models in population genetics.

Edwin Perkins.

He has won numerous awards for his research including the Coxeter-James Lectureship (1986), G. de B. Robinson Award (1996) and Jeffery-Williams Prize (2002) (Canadian Math. Society), the Rollo Davidson Prize (1983) (Cambridge U.) and a Steacie Fellowship (1992-93) (NSERC). He is a Fellow of the Royal Society of Canada and the Institute of Mathematical Statistics and presently sits on the editorial Boards of the Annales de l'Institut Henri Poincare, Stochastic Processes and Their Applications and the Electronic Journal of Probability. He has given several invited lectureships including an invited address at the 1994 International Congress of Mathematicians in Zurich.

Dr. Dennis R. Salahub assumed the position of is the Vice-President (Research & International) at the University of Calgary on July 1, 2002. Previously, 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 national and international scenes. His students are now occupying important positions in academia, industry and government in several countries. The computer code, deMon, developed in his laboratory is used by researchers around the world.

Dennis Salahub.

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 Insitute'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.

Indira V. Samarasekera.

Dr. Indira V. Samarasekera is vice president research at the University of British Columbia. She has been a professor in the Department of Metals and Materials Engineering and the Centre for Metallurgical Process Engineering at the University of British Columbia since 1980.

Dr. Samarasekera's expertise in heat transfer and stress analysis has led her to research a number of processes with a major emphasis on the continuous casting and hot rolling of steel, and the growth of single crystals for electronic devices. To facilitate knowledge-transfer to industry, Dr. Samarasekera has participated in short courses on the continuous casting of steel at companies in North and South America, Europe, Asia and South Africa. She was the first incumbent of the Dofasco Chair in Advanced Steel Processing at UBC. Dr. Samarasekera has received the Killam Prize and the McDowell Medal from the University of British Columbia 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, and has recently been invited to join the CBIN Board of Directors. She has served as a member of Council of the National Research Council of Canada, the Board of the Children and Women's Health Centre of BC, the BC Research Institute for Children and Women's Health and Aquanet-NCE. Dr. Samarasekera also served as president of the Metallurgical Society of CIM for a year and was on the board for six years. She was student affairs director for The Minerals, Metals and Materials Society of AIME in the U.S.

Dr. Samarasekera obtained a B.Sc. Honours degree in mechanical engineering from the University of Ceylon in 1974. She spent the following year as a mechanical engineer at the Refinery of the Ceylon Petroleum Corporation and then proceeded to the United States of America as a Hays-Fulbright Scholar, obtaining a M.S. degree in mechanical engineering from the University of California in 1976. She completed a doctorate degree at the University of British Columbia in 1980 under the supervision of Professor J. Keith Brimacombe, O.C.

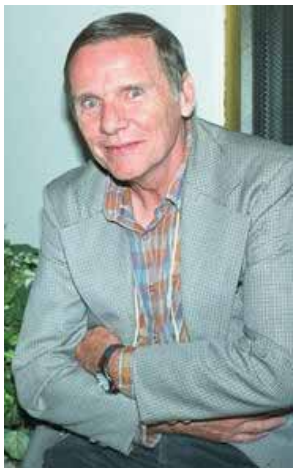
Martin Taylor.

Dr. Martin Taylor moved to the University of Victoria in July 1998 to be the University's first Vice President Research as well as being a full professor in the Geography Department. He has a BA in Geography from the University of Bristol (UK), and an MA and Phd from the University of British Columbia. He was appointed at McMaster in 1974. He was Chair of Geography (1991-1997), founding Director of the Institute of Environment and Health (1991-96), and Acting Vice President Research (1994-1995). 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 authoured one book and over 100 papers in peer-reviewed journals.

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

The members are:



David Brillinger.

Dr. David Brillinger's research is in statistical inference and applications to stochastic processes. In particular this involves him in statistical methods for random processes and in science and engineering. He has made contributions to the theory and application of statistics in subject areas including neurophysiology (the analysis of neural spike trains), seismology, and the modelling animal tracks. He is the author of Time Series Analysis: Data Analysis and Theory, former editor of the International Statistical Review, former President of the Institute of Mathematical Statistics and of the Statistical Society of Canada. He 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 and a D. Math. degree from the University of Waterloo in 2003.

David Brydges.

Dr. David Brydges received the PhD 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. In 2001 he was 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 lectures throughout the world including courses in the Troisiéme Cycle at Lausanne in 1992, Centre Emile Borel in 1998 and the NachDiplom program at ETH,Switzerland. He is the President of the International Association of Mathematical Physics.

His interests are centred in the renormalization group with applications to quantum field theory, statistical mechanics and probability.

Ivar Ekeland.

Dr. Ivar Ekeland is the Canada Research Chair in Mathematical Economics at the University of British Columbia. He is a former President of Universite Paris-Dauphine, and a former Director of the research centres CEREMADE and Institute Finance-Dauphine.

He has received prizes from the French Academy of Sciences, the French Mathematical Society, and the Belgian Academy of Sciences. He is a foreign member of the Norwegian Academy of Sciences and he holds honorary doctorates from UBC and from the University of Saint-Petersburg for Economics and Finance.

Dr. Ekeland is the founding editor of the "Annales de l'Institut Henri Poincare-Analyse nonlineaire" and he sits on the editorial board of many other publications.

He has also written several books which are reflections on, or popularization of, mathematics. For these contributions, Dr Ekeland was awarded the "Prix Jean Rostand" by the Association des Ecrivains Scientifiques de France and the "Prix d'Alembert" by the Societe Mathematique de France. He is also a regular contributor to the journal "Nature" as well as to the magazine "Pour la Science".

Randy Goebel.

Dr. 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.

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 know, 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.

Dr. Ronald Graham is the Irwin and Joan Jacobs Professor of Computer and Information Science in the Computer Science and Engineering Department of the University of California at San Diego. He is also currently President of the Mathematical Association of America and has served as the Treasurer of

Ronald Graham.

the National Academy of Sciences since 1996. He was also the President of the American Mathematical Society from 1993 to 1995, and served as Chief Scientist of AT&T Labs until 1999. Graham's academic awards include membership in the National Academy of Sciences, Foreign Honorary Member of the Hungarian Academy of Sciences, Fellow of the American Academy of Arts and Sciences, Fellow of the America Association for the Advancement of Science, Fellow of the Association of Computing Machinery, and recipient of the Polya Prize in Combinatorics, the Euler Medal in Combinatorics, a Lester Ford Award of the Math. Assoc. of America, a Carl Allendorfer Award of the Math. Assoc. of America, and the Leroy Steele Award for Lifetime Achievement from the American Mathematical Society in 2002. He has also served as President of the International Jugglers Association. Graham's current mathematical interests include combinatorics, number theory, graph theory, discrete and computational geometry, design and analysis of algorithms, and applications thereof.

Dr. 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. In 2002 he won a Killam prize for "outstanding career achievements".

Robert Moody.

Ian Putnam.

Dr. 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 Canada Research Chair in Operator Algebras and Dynamical Systems in the department of mathematics and statistics. He has received the Israel Halperin Prize and the Andre Aisenstadt prize. He is a Fellow of the Royal Society of Canada.

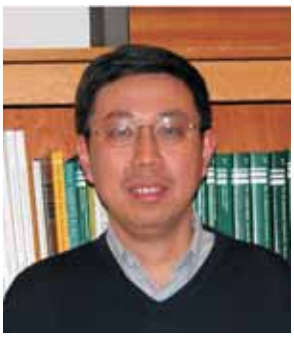
Dr. Bob Russell received the Ph.D. in 1971 at the University of New Mexico under the direction of Lawrence Shampine. In 1971 he became Assistant Professor at Colorado State University and in 1972 he moved to Simon Fraser University. He was promoted to Full Professor in 1981. He has held numerous visiting 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.

Dr. 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 an associate professor and became a full professor in 1992. He is currently a J. Simons professor at the Massachusetts Institute of Technology. Professor Tian is a recipient of the Alfred P. Sloan research fellowship (1991-1993). He presented a 45-minutes invited address at the International Congress of Mathematicians in Kyoto in 1990 and a plenary address at the International COmgress of Mathematics in Beijing in 2002. In 1994, he received the 19th Alan Waterman Award from the National Science Foundation. In 1996, Professor Gang Tian received the Veblen Prize of the American Mathematical Society.



Gang Tian.

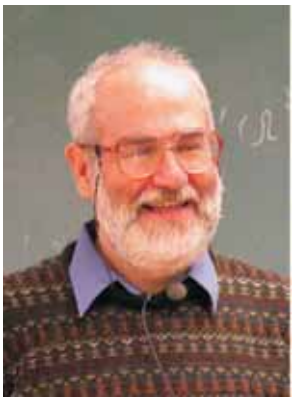
Elizabeth Thompson.

Dr. 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 1975-81 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.

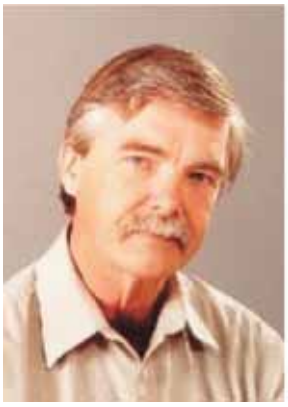
Dr. Gunther Uhlmann received the Ph.D. in 1976 at MIT under the direction of Victor Guillemin. He held postdoctoral positions at Harvard, Courant Institute and MIT. In 1980 he became Assistant Professor at MIT and in 1985 he moved to the University of Washington as an Associate Professor. He was promoted 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 was named Corresponding member of the Chilean Academy of Sciences 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 Non-Destructive Evaluation" in 1995, an invited lecture at the International Congress of Mathematicians in Berlin in 1998 and the PIMS distinguished lectures at UBC in 2002.

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.

Dr. 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.

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 Commitee

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: Ivar Ekeland (UBC, Math & Econ)
SFU Site Director and Acting Deputy Director: Manfred Trummer (SFU, Math)
UA Site Director.: Jim Muldowney (UA, Math)
UC Site Director.: Gary Margrave (UC, Math)
UVic Site Director: David Leeming (UVic, Math)
UW Site Director.: Gunther Uhlmann (UW, Math)

Education and Communication

Education Facilitator: Klaus Hoechsmann (UBC)
SFU Education Coordinator: Malgorzata Dubiel
UA Education Coordinator: Ted Lewis
UC Education Coordinator: Indy Lagu
UVic Education Coordinator: David Leeming
Publications and Communications Manager: Heather Jenkins
PIMS Website Manager: Kelly Choo

National Programme

PIMS has partnered with le Centre de Recherches Mathématiques (CRM) and the Fields Institute for Research in Mathematical Sciences (Fields) to support two national initiatives: a mathematics association for Atlantic Canada (AARMS), and the NPCDS statistics initiative. All geographical areas of the country now fall under the mandate of one of these groups.

The National Programme Committee of the Institutes now consists of the Directors of PIMS, the CRM and Fields (or their designates). Proposals for any part of Canada will be reviewed by this body. Please submit proposals to any of the Institutes, requesting review by the National Programme Committee.

PIMS Site Personnel

PIMS Central Office

Dr. Ivar Ekeland, Director
Dr. Manfred Trummer, Acting Deputy Director
Mrs. Shelley Alvarado, Chief Operations Officer
Ms. Andrea Hook, PIMS Administrator
Ms. Fanny Lui, Financial Clerk
Ms. Clarina Chan, MITACS Administrator for PIMS-UBC
Ms. Heather Jenkins, Communications and Publications Manager
Ms. Caitlin Shepard, Programme Coordinator
Dr. Klaus Hoechsmann, Education Facilitator
Mr. Brent Kearney, Manager Computer Systems
Mr. Kelly Choo, WebsiteManager
Mr. Shervin Teymouri, Computer Systems Administrator

Manfred Trummer, PIMS-SFU Site Director, 2001–04.

PIMS at Simon Fraser University

Dr. Manfred Trummer, Site Director
Ms. Olga German, Administrative Assistant
Ms. Andrea Kiefner, PIMS/MITACS Receptionist
Mr. Shahin Teymouri, Computer Systems Administrator
Dr. Malgorzata Dubiel, Education Coordinator
Dr. Grace Chiu, PDF
Dr. Russell Luke, PDF
Dr. Jan Manuch, PDF
Dr. Christopher Rowe, PDF (joint with UBC)
Dr. Jian-Jun Xu, PDF
Dr. Peter Berg, MITACS PDF
Dr. Ronald Ferguson, MITACS PDF

PIMS at University of British Columbia

Dr. Martial Agueh, PDF
Dr. Gregory Berhuy, PDF
Dr. Dominic Brecher, PDF
Dr. Ben Green, PDF
Dr. Xavier Granier, PDF
Dr. Jae-Hun Jung, PDF
Dr. Kyungkeun Kang, PDF
Dr. Freidrich Littmann, PDF
Dr. Kengo Maeda, PDF
Dr. Christopher Rowe, PDF (joint with SFU)
Dr. Ehud Schreiber, PDF
Dr. Jacob Shapiro, PDF
Dr. Zhenya Yan, PDF
Dr. Jianying Zhang, PIMS/MITACS PDF
Dr. Atife Caglar, MITACS PDF
Dr. Paul Chang, MITACS PDF
Dr. Rong Ding, MITACS PDF
Dr. Marek Labecki, MITACS PDF
Dr. Stan Maree, MITACS PDF
Dr. Nathaniel Newlands, MITACS PDF
Dr. Joern Sass, MITACS PDF
Dr. Rong Zhu, MITACS PDF

PIMS at University of Alberta

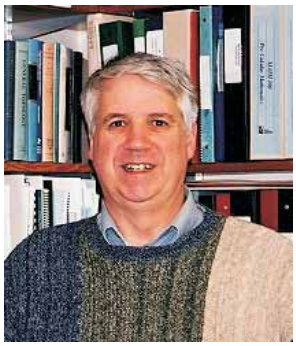
Dr. Jim Muldowney, Site Director
Ms. Shirley Mitchell, Administrative Assistant
Dr. Ted Lewis, Education Coordinator
Dr. Ariel Blanco, PDF
Dr. Dimitar Grantcharov, PDF
Dr. Frithjof Lutscher, PDF (joint with UC)
Dr. Eugene Radu, PDF
Dr. Joanna Renclawowicz, PDF (joint with UVic)
Dr. Chuong Tran, PDF
Dr. Suneeta Vardarajan, PDF

Jim Muldowney, PIMS-UA Site Director, 2001–04.

PIMS at University of Victoria

Dr. David Leeming, Site Director
Ms. Dil Bains, Admin. Assistant
Dr. David Leeming, Education Coordinator
Mr. Kelly Choo, Web Manager
Dr. Thomas Britz, PDF
Dr. Vladislav Panferov, PDF
Dr. Bahram Rangipour, PDF
Dr. Mario Roy, PDF
Dr. Joanna Renclawowicz, PDF (joint with UA)

David Leeming, PIMS-UVic Site Director, 2003–04.



PIMS at University of Calgary

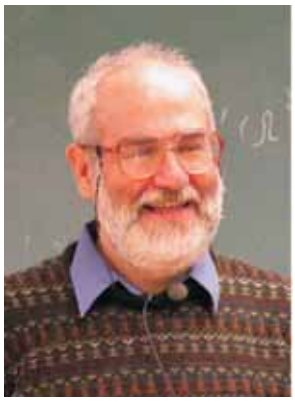
Dr. Gary Margrave, Site Director
Ms. Janice Deere, Administrative Assistant
Dr. Indy Lagu, Education Coordinator
Dr. Lyonell Boulton, PDF
Dr. Frithjof Lutscher, PDF (joint with UA)
Dr. Anne-Gaelle Rolland-Lagan, PDF
Dr. Tatjana Stykel, PDF
Dr. Hugh Geiger, MITACS-PDF
Dr. Peter Gibson, MITACS-PDF

Gary Margrave, PIMS-UC Site Director, 2001–04.

PIMS University of Washington

Dr. Gunther Uhlmann, Site Director
Ms. Mary Sheetz, Administrative Assistant

Gunther Uhlmann, PIMS-UW Site Director, 2003–04.



Banff International Research Station

Dr. Nassif Ghoussoub, BIRS Scientific Director
Mrs. Andrea Lundquist, BIRS Station Manager
Mrs. Amanda Kanuka, BIRS Programme Coordinator
Ms. Barbara Dempsey, BIRS Administrative Assistant
Mr. Brent Kearney, BIRS Systems Administrator

Brent Kearney, Robert Moody (former BIRS Scientific Director), Andrea Lundquist and Amanda Kanuka.

PIMS Scientific Personnel

PIMS Distinguished Chairs for 2003/04

Bryan Grenfell (University of Cambridge)
Site: Math Ecology CRG at University of Alberta
September 2003

Yuri Gurevich (Microsoft Research)
Site: Simon Fraser University
April, July 2003

Alexander Helemskii (Moscow State University)
Site: Dynamics CRG at University of Alberta
July - August 2003

Ashoke Sen (Harish-Chandra Research Institute)
Site: String Theory CRG at University of British Columbia
July 2003

Jeffrey D. Vaaler (University of Texas)
Site: Number Theory CRG at Simon Fraser University
June 2003

See page 45 for more information about the PIMS Distinguished Chairs for 2003/04.

PIMS PDFs for 2003/04

The review panel for the 2003/04 competition were Ivar Ekeland (Chair, UBC), Eric Woolgar (UA), Peter Zvengrowski (UC), Binay Bhattacharya (SFU), Julie Zhou (UVic), and Michael Doebeli (UBC).

Gregory Berhuy: *Algebraic Geometry.*
Supervised by Zinovy Reichstein (UBC).

Ariel Blanco: *Functional Analysis, Banach Algebras.*
Supervised by Anthony Lau (UA) and Nicole Tomczak-Jaegermann (UA).

Lyonell Boulton: *Spectral Theory of Linear Operators.*
Supervised by Paul Binding (UC).

Thomas Britz: *Applied Mathematics, Combinatorial Mathematics, Graph Theory .*
Supervised by Pauline van den Driessche (UVic) and Dale Olesky (UVic).

Dimitar Grantcharov: *Algebra, Lie Theory.*
Supervised by Arturo Pianzola (UA).

Jae-Hun Jung: *Theoretical Chemistry, Spectral Methods.*
Supervised by Bernie Shizgal (UBC).

Kyungkeun Kang: *Nonlinear PDEs.*
Supervised by Stephen Gustafson (UBC) and Tai-Peng Tsai (UBC).

Jan Manuch: *Computer Science, Communication Complexity.*
Supervised by Arvind Gupta (SFU).

Eugene Radu: *General Relativity, Quantum Field Theory in Curved Spacetime*
Supervised by Hans-Peter Künzle (UA).

Bahram Rangipour: *Algebraic Topology.*
Supervised by John Phillips (UVic).

Anne-Gaelle Rolland-Lagan: *Computer Science, Modelling and Simulation in Mathematical Biology.*
Supervised by Przemyslaw Prusinkiewicz (UC).

Jacob Shapiro: *Algebraic Geometry, Gromov–Witten Invariants.*
Supervised by Kai Behrend (UBC) and Jim Bryan (UBC).

Suneeta Vardarajan: *Theoretical Physics, Quantum Gravity.*
Supervised by Don Page (UA).

Approximately ten additional PIMS PDFs were assigned to the Collaborative Research Groups.

THE BANFF INTERNATIONAL RESEARCH STATION

The Banff Centre from the air. Photo courtesy of Robert Piché.

Nassif Ghoussoub, BIRS Scientific Director.

The Banff International Research Station is a collaborative effort between the Pacific Institute for the Mathematical Sciences (PIMS) and the Mathematical Sciences Research Institute (MSRI). Funding comes from the Canadian government through NSERC (grant to PIMS), the Alberta government through ASRA (grant to PIMS), the US government through NSF (grant to MSRI), and from MITACS. The administration of BIRS is performed by PIMS.

BIRS is located in Corbett Hall and the Max Bell Building of The Banff Centre in Banff, Alberta. More than 1700 researchers will attend 5-day workshops, 2-day workshops, research in teams, focused research groups and summer schools over 40 weeks of operation in 2003.

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 ans 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 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 looks 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

The BIRS Scientific Advisory Board

• **Nassif Ghoussoub** (Chair, UBC): *Non-linear Analysis, Partial Differential Equations*
• **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*
• **László Lovász** (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*
• **Ivar Ekeland** (Director, PIMS): *Mathematical Economics*
• **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*

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 (U. Toronto), Andreas Karch (U. Washington), K. Viswanathan (SFU)

Mar 22–27: **Scattering and Inverse Scattering**
Organizers: Richard Froese (UBC), Gunther Uhlmann (U. Washington)

Mar 29–Apr 3: **Commutative Algebra and Geometry**
Organizers: Mark Green (IPAM, UCLA), Jürgen Herzog (U. Gesamthochschule-Essen), Bernd Sturmfels (UC Berkeley)

Apr 5–10: **BIRS Workshop on Noncommutative Geometry**
Organizers: Alain Connes (IHES), Joachim Cuntz (U. Muenster), George Elliott (U. Toronto), Masoud Khalkhali (U. Western Ontario), Boris Tsygan (Penn State U.)

Apr 12–17: **Quantum Mechanics on the Large Scale**
Organizers: P.C.E. Stamp (UBC & U. Utrecht), G.A. Sawatzky (UBC), A.J. Leggett (U. Illinois), T. Havel (MIT), S.Popescu (HH Wills Lab, HP Lab), R. Gill (Utrecht U., Eurandom Inst.)

Apr 19–24: **Computational Fuel Cell Dynamics—II**
Organizers: John Kenna (Ballard Power Systems), Trung Van Nguyen (U. Kansas), Keith Promislow (SFU), Brian Wetton (UBC)

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

May 3–8: **Recent Advances in Algebraic and Enumerative Combinatorics**
Organizers: Richard Stanley, Sara Billey (MIT), Ian Goulden, David Jackson (U. Waterloo), Curtis Greene (Haverford College)

May 10–15: **Statistical Mechanics of Polymer Models**
Organizers: Christine E. Soteros (U. Saskatchewan), De Witt Sumners (Florida State U.), Stuart G Whittington (U. Toronto)

May 24–29: **Constraint Programming, Belief Revision, and Combinatorial Optimization**
Organizer: Randy Goebel (U. Alberta)

May 31–Jun 5: **Symmetry and Bifurcation in Biology**
Organizers: Martin Golubitsky (U. Houston), William F. Langford (U. Guelph), Ian Stewart (U. Warwick)

Jun 7–12: **Applicable Harmonic Analysis**
Organizers: Rong-Qing Jia (U. Alberta), Sherman D. Riemenschneider (West Virginia U.), M. Victor Wickerhauser (Washington U.)

Jun 14–19: **Integration on Arc Spaces, Elliptic Genus and Chiral de Rham Complex**
Organizers: Mikhail Kapranov (U. Toronto), Anatoly Libgober (U. Illinois), François Loeser (ENS)

Jun 21–26: **Point Processes—Theory and Applications**
Organizers: Peter Guttorp (U. Washington), Bruce Smith (Dalhousie U.)

Jun 28–Jul 3: **Joint Dynamics**
Organizers: Douglas Lind, Boris Solomyak (U. 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 (U. 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 U.), Peter J. Olver (U. Minnesota)

Jul 26–31: **Analysis and Geometric Measure Theory**
Organizers: Ana Granados (UBC), Hervé Pajot (U. Cergy-Pontoise), Tatiana Toro (U. Washington)

Aug 2–7: **Monge-Ampere Type Equations and Applications**
Organizers: Alice Chang, Paul Yang (Princeton), Pengfei Guan (McMaster U.)

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 (U. Utah), T. Hillen (U. Alberta), M. J. Ward (UBC), J. Wei (Chinese U., Hong Kong)

Aug 9–16: **Defects and their Dynamics** (1/2 workshop)
Organizers: Peter W. Bates (Brigham Young U.), Lia Bronsard (McMaster U.), Changfeng Gui (U. Connecticut, UBC)

Aug 16–21: **Current Trends in Arithmetic Geometry and Number Theory**
Organizers: Imin Chen (SFU), Brian Conrad, Chris Skinner (U. Michigan), Eyal Goren (McGill), Adrian Iovita (U. Washington), Nike Vatsal (UBC)

Aug 23–28: **Computational Techniques for Moving Interfaces**
Organizers: Randy LeVeque (U. Washington), Robert D. Russell, Steven Ruuth (SFU)

Aug 30–Sep 4: **A Scientific Creative Writing Workshop at BIRS**
Organizers: Marjorie Senechal (Smith College), Chandler Davis (U. Toronto)

Aug 30–Sep 4: **Locally Finite Lie Algebras** (1/2 workshop)
Organizers: Yuri Bahturin (Memorial U.), Georgia Benkart (U. Wisconsin), Ivan Penkov (UC Riverside), Helmut Strade (Hamburg U.), Alexander Zalesskii (U. East Anglia)

Sep 6–11: **Regularization in Statistics**
Organizers: Ivan Mizera (U. Alberta), Roger Koenker (Univ. Illinois-Urbana)

Sep 13–18: **Topology in and around Dimension Three**
Organizers: Steve Boyer (U. Quebec), Martin Scharlemann (UC Santa Barbara), Abigail Thompson (UC Davis)

Sep 20–25: **Structural and Probabilistic Approaches to Graph Colouring**
Organizers: Professor Bruce Reed (U. McGill), Paul Seymour (Princeton)

Sep 27–Oct 2: **Stochastic Partial Differential Equations**
Organizers: Martin Barlow, Edwin Perkins (UBC), Krzysztof Burdzy (U. 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 (U. Western Ontario), C. Riehm (McMaster U.)

Oct 11–16: **BANFF Credit Risk Conference 2003**
Organizers: Tom Astebro (U. Waterloo), Peter Beling (U. Virginia), David Hand (Imperial College), Robert Oliver (UC Berkeley), Lyn Thomas (U. Southampton)

Oct 18–25: **MITACS Theme and Consortia Meetings**
Organizers: MITACS, Peter Borwein, Evangelos Kranakis, Brian Alspach, Michael Mackey

Oct 25–30: **Current Trends in Representation Theory of Finite Groups**
Organizers: Jonathan L. Alperin (U. Chicago), Michel Broue (U. Paris VII), Gerald Cliff (U. Alberta)

Nov 1–6: **PIMS Hot Topic: Galaxy Formation; a Herculean Challenge**
Organizers: Arif Babul (U. Victoria), Julio Navarro (U. Victoria), Jeremiah Ostriker (Cambridge), Tom Quinn (U. Washington), Frank van den Bosch (U. Victoria), Neal Katz (U. Massachusetts)

Nov 8–13: **MSRI Hot Topic: Floer Homology for 3-manifolds**
Organizers: Yasha Eliashberg (Standford), Robion Kirby (UBC), Peter Kronheimer (Harvard)

Nov 15–20: **The Interaction of Finite Type and Gromov-Witten Invariants**
Organizers: Jim Bryan (UBC), David Auckly (Kansas State U.)

Nov 22–27: **Theory and Numerics of Matrix Eigenvalue Problems**
Organizers: J. W. Demmel (UC Berkeley), N.J. Higham (U. Manchester), P. Lancaster (U. Calgary)

Nov 29–Dec 4: **Nonlinear Dynamics of Thin Films and Fluid Interfaces**
Organizers: A. L. Bertozzi, R. P. Behringer, T. P. Witelski (Duke U.), R. Almgren, M. C. Pugh (U. Toronto), M. Shearer (NC State U.)

Dec 6–11: **Calabi-Yau Varieties and Mirror Symmetry**
Organizers: Victor Batyrev (U. Tübingen), Shinobu Hosono (Tokyo), James D. Lewis (U. Alberta), Bong H. Lian (Brandeis), S.-T. Yau (Harvard), Noriko Yui (Queen's U.), Don Zagier (Max Planck Institut)

Dec 13–18: **p-adic Variation of Motives** (1/2 workshop)
Organizers: Kevin Buzzard (Imperial College), Robert Coleman (UC Berkeley), Matthew Emerton (Northwestern U.), Eyal Goren (U. McGill)

Dec 13–18: **Coordinate Methods in Nonselfadjoint Operator Algebras** (1/2 workshop)
Organizers: Allan Donsig (U. Nebraska), Michael Lamoureux (U. Calgary)

2003 Programme for Focused Research Groups (FRG), Research in Teams (RIT), Summer Schools (SS) and 2-Day Workshops

Mar 27–29: **Northwest Functional Analysis Symposium** (2-day workshop)
Organizers: Michael Lamoureux (U. Calgary), Tony Lau (U. Alberta), Ian Putnam (U. Victoria), Nicole Tomczak-Jaegermann (U. Alberta)

Apr 3–6: **Restricting Syzygies of Algebraic Varieties** (RIT)
Organizers: David Eisenbud (MSRI), Sorin Popescu (SUNY at Stony Brook), Mark Green (IPAM, UCLA), Klaus Hulek (Fachbereich Mathematik Universitat, Hannover)

Apr 11–12: **Mathfair Workshop** (2-day workshop)
Organizers: Ted Lewis, Andy Liu (U. Alberta)

Apr 18–26: **Asymptotic Dynamics of Dispersive Equations with Solitons** (RIT)
Organizers: Tai-Peng Tsai (UBC), Kenji Nakanishi (Nagoya U., Princeton)

Apr 26–May 10: **Topological Orbit Equivalence for Dynamical Systems** (RIT)
Organizers: T. Giordano (U. Ottawa), C. Skau (Norwegian U. of Science & Technology), I. Putnam (U. Victoria)

Apr 26–May 10: **Field Theory & Cohomology of Groups** (RIT)
Organizers: A. Adem (U.Wisconsin-Madison), D. Karagueuzian (SUNY at Binghamton), J. Minac (U. Western Ontario)

May 10–24: **Regularity for Hypergraphs** (FRG)
Organizers: P. Haxell (U. Waterloo), V. Rodl (Emory U.), J. Skokan (U. Illinois, Urbana-Champaign), L. Thoma (U. Rhode Island)

May 15–17: **The Regression Discontinuity Method in Economics: Theory and Applications** (2-day workshop)
Organizer: Thomas Lemieux (UBC), David Card (Berkeley)

May 17–24: **PIMS Graduate Industrial Mathematics Modelling Camp** (SS)
Organizers: Rachel Kuske, Ian Frigaard (UBC), Fadil Santosa (IMA), Jack Maki (U. Alberta), Chris Bose (U. Victoria), Huaxiong Huang (York U.)

May 24–Jun 7: **Topology and Analysis: Complementary Approaches to the Baum-Connes and Novikov Conjectures** (FRG)
Organizers: N. Higson (Penn State U.), J. Kaminker (Indiana U.), S. Weinberger (U. Chicago)

Jun 7–21: **Quantum Algorithms & Complexity Theory** (FRG)
Organizer: Richard Cleve, John Watrous (U. Calgary), Umesh Vazirani (UC Berkeley)

Jun 21–27: **Preparatory Workshop for the 2003 AMS/MSRI von Neumann Symposium** (SS)
Organizer: R. Bryant (UC Berkeley)

Jun 28–Jul 10: **2003 Summer IMO Training Camp** (SS)
Organizer: B. Sands (U. Calgary)

Jul 12–26: **Problems in Discrete Probability** (FRG)
Organizers: R. Pemantle (Ohio State U.), Y. Peres (UC Berkeley), P. Winkler (Bell Labs, Lucent Technologies)

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 U.), S. Nayak (Harish-Chandra Research Inst.), P. Sastry (U. Toronto)

Aug 16–30: **Invariant Manifolds for Stochastic PDEs** (RIT)
Organizers: Tomas Caraballo (U. Sevilla), Jinqiao Duan (Illionois Inst. Tech.), Kening Lu (Brigham Young U.), Bjorn Schmalfuss (U. Appl. Sciences, Mereseburg, Germany)

Aug 16–Sep 6: **Local Uniformization and Resolution of Singularities** (RIT)
Organizers: S.D. Cutkosky (U. Missouri-Columbia), F.-V. Kuhlmann (U. Saskatchewan)

Aug 28–30: **Theoretical Physics Institute, University of Alberta Symposium** (2-day workshop)
Organizer: Helmy S. Sherif, Lee Grimard, Frank Marsiglio (U. Alberta)

Sept 4–6: **MITACS-PIMS Health Canada Meeting on SARS** (2-day workshop)
Organizer: Jianhong Wu (York U.)

Sep 6–20: **Arithmetic of Fundamental Groups** (FRG)
Organizers: D. Harbater (U. Pennsylvania), F. Pop (U. Bonn)

Sep 18–20: **Canadian Mathematics Chairs Meeting** (2-day workshop)
Organizer: Ted Bisztriczky (U. Calgary), Bob Erdahl (Queen's U.), Yvan Saint-Aubin (Montreal)

Sep 20–Oct 2: **Mathematical Models for Plant Dispersal** (FRG)
Organizers: M. Lewis (U. Alberta), J. Bullock (NERC Centre for Ecology and Hydrology)

Oct 3–18, 2003: **Modular invariants and NIM-reps** (RIT)
Organizers: Terry Gannon (U. Alberta), Matthias Gaberdiel (ETH Zurich, Switzerland)

Oct 16–18: **West Coast Operator Algebra** (2-day workshop)
Organizers: Berndt Brenken (U. Calgary), Bruce Blackadar (U. Nevada, Reno)

Oct 16–18: **The World Bank Thailand SEQI Project** (2-day workshop)
Organizers: Andy Liu (U. Alberta)

2003 BIRS Public Lecture Series

In 2003 the Pacific Institute for the Mathematical Sciences and the Banff Centre are pleased to announce the start of a series of free

public lectures hosted by the Banff International Research Station. These lectures will feature distinguished scientists, writers, and public speakers addressing developments, ideas, issues, and personalities in the world of the mathematical sciences, and more generally all of the sciences, as they relate to our times, our culture, and our society.

Sep 2: *Wings of Madness: Alberto Santos-Dumont and the Invention of Flight*
Organizer: Paul Hoffmann

Sep 28: *The Art and Mathematics of Star Polygons*
Organizers: Reza Sarhangi (Towson University)

BIRS Calendar for 2004

2004 Programme for 5-day Workshops

Mar 13–18: **Interactions between model theory and geometry**
Organizers: Deirdre Haskell (McMaster U.), Jan Denef (Leuven), Ehud Hrushovski (Hebrew U.), Angus Macintyre (Edinburgh), Anand Pillay (UIUC), Patrick Speissegger (Wisconsin & McMaster U.)

Mar 20–26: **Topology of Manifolds and Homotopy Theory**
Organizers: Ian Hambleton (McMaster U.), Erik Pedersen (SUNY Binghamton), Gunnar Carlsson (Stanford)

Mar 27–Apr 1: **Orthogonal Polynomials; Interdisciplinary Aspects**
Organizers: Jacek Szmigielski (U. Saskatchewan), Percy Deift (Courant Inst. of Mathematical Sciences), Lance Littlejohn, David Sattinger (Utah State U.)

Apr 3–8: **Model Reduction Problems and Matrix Methods**
Organizers: Anne Greenbaum (U. 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, London), Elton Hsu (Northwestern U.)

Apr 17–22: **BIRS Workshop in Creative Scientific Writing**
Organizers: Marjorie Senechl (Smith College), Chandler Davis (U. Toronto)

Apr 17–22: **Celestial Mechanics** (1/2 workshop)
Organizers: Florin Diacu (U. Victoria), Donald Saari (UC Irvine)

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 (U. Chicago)

May 1–6: **Singular Cardinal Combinatorics** (1/2 workshop)
Organizers: Claude Laflamme (U. Calgary), Matthew Foreman (UC Irvine), Stevo Todorcevic (U. Toronto & CNRS Paris)

May 8–13: **Knots and their Manifold Stories**
Organizers: Orr Kent (Indiana U.), Tim Cochran (Rice U.), Dale Rolfsen (UBC)

May 15–20: **New Developments on Variational Methods and their Applications**
Organizers: Kung-Ching Chang (Peking U.), Jingyi Chen (UBC), Changfeng Gui (U. Connecticut), Paul Rabinowitz (U. Wisconsin, Madison)

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 (U. Victoria), Boris Solomyak (U. Washington)

Jun 5–10: **Semimartingale Theory and Practice in Finance**
Organizers: Tom Hurd (McMaster U.), Thaleia Zariphopoulou (U. Texas, Austin), Philip Protter (Cornell U.), Lane Hughston (King's College London)

Jun 12–17: **New Horizons in String Cosmology**
Organizers: James Cline (McGill U.), Robert Brandenberger (Brown U.), Steve Giddings (UC Santa Barbara), Brian Greene (Columbia U.), Rob Myers (Perimeter Institute), Gordon Semenoff (UBC)

Jun 19–27: **PIMS-MITACS-MSRI Special Program on Infectious Diseases Summer School**
Organizers: Fred Brauer (UBC), Mark Lewis (U. Alberta), Pauline van den Driessche (U. Victoria), James Watmough (U. New Brunswick), Jianhong Wu (York U.), Ping Yan (Health Canada)

Jun 27–Jul 2: **PIMS-MITACS-MSRI Special Program on Infectious Diseases**
Organizers: Fred Brauer (UBC), Mark Lewis (U. Alberta), Pauline van den Driessche (U. Victoria), James Watmough (U. New Brunswick), Jianhong Wu (York U.), Ping Yan (Health Canada)

Jul 4–8: **Advances in Complexity Theory**
Organizers: Valentine Kabanets (SFU), Stephen Cook (U. Toronto), Arvind Gupta (SFU), Russell Impagliazzo (UC San Diego), Madhu Sudan (MIT), Avi Wigderson (Institute for Advanced Study, Princeton).

Jul 10–15: **Convex Geometric Analysis**
Organizers: Nicole Tomczak-Jaegermann (U. Alberta), Vitali Milman (Tel Aviv U.), Elisabeth Werner (Case Western Reserve U.)

Jul 17–22: **Modeling Protein Flexibility and Motions**
Organizers: Walter Whiteley (York U.), Michael Thorpe, Leslie Kuhn (Michigan State U.)

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 (U. Iowa), Michael Eastwood (U. Adelaide, Australia), McKenzie Wang (McMaster U.)

Aug 7–12: **Stochastic Processes in Evolutionary and Disease Genetics**
Organizers: Ellen Baake (U. Greifswald), Don Dawson (Carleton U.), Warren Ewens (U. Pennsylvania), Bruce Rannala (U. Alberta)

Aug 14–19: **Statistical Science for Genome Biology**
Organizers: Jennifer Bryan (UBC), Sandrine Dudoit, Mark van der Laan (UC Berkeley)

Aug 21–26 : **Dynamics, Control and Computation in Biochemical Networks**
Organizers: Brian Ingalls (U. Waterloo), Leon Glass (McGill U.), John Reinitz (The University at Stony Brook), Eduardo Sontag (Rutgers U.), Erik Winfree (Caltech)

Aug 28–Sep 2: **Combinatorial Hopf Algebras**
Organizers: Frank Sottile (U. Massachusetts), Nantel Bergeron (York U.), Louis Billera (Cornell U.), Stephanie van Willigenburg (UBC)

Sep 4–9: **Pluripotential Theory and its Applications**
Organizers: Len Bos, Alex Brudnyi (U. Calgary), Eric Bedford (U. Indiana), Al Taylor (U. Michigan)

Sep 11–16: **Commutative Algebra: Homological and Birational Theory**
Organizers: Ragnar-Olaf Buchweitz (U. Toronto), Paul Roberts (U. Utah), Bernd Ulrich (Purdue U.)

Sep 18–23: **Quantum Computation and Information Theory**
Organizers: John Watrous, Richard Cleve (U. Calgary), Umesh Vazirani (UC Berkeley)

Sep 25–30: **Interaction of Finite Dimensional Algebras with Other Areas of Mathematics**
Organizers: Vlastimil Dlab (Carleton U.), Claus Ringel (U. Bielefeld), Leonard Scott (U. Virginia)

Oct 2–7: **Self-Stabilizing Distributed Systems**
Organizers: Lisa Higham (U. Calgary), Anish Arora (Ohio State U.), Faith Fich (U. Toronto), Maurice Herlihy (Brown U.), Ted Herman (U. Iowa)

Oct 9–14: **Free Probability Theory**
Organizers: Alexandru Nica (U. Waterloo), Roland Speicher (Queen's U.), Dan Voiculescu (UC Berkeley)

Oct 16–21: **Braid Groups and Applications**
Organizers: Dale Rolfsen (UBC), Joan Birman (Columbia U.), Patrick Dehornoy (U. Caen), Roger Fenn (U. Sussex), Vaughan Jones (UC Berkeley)

Oct 23–28: **Mathematical Image Analysis and Processing**
Organizers: Mary Pugh (U. Toronto), Selim Esedoglu (UCLA), Sung Ha Kang (U. Kentucky), Jackie Shen (U. Minnesota)

Oct 30–Nov 4: **The Structure of Amenable Systems**
Organizers: George Elliott (U. Toronto), Andrew Dean (Lakehead U.), Thierry Giordano (U. Ottawa), Guihua Gong (U. Puerto Rico), Huaxin Lin, N. Christopher Phillips (U. Oregon)

Nov 6–11: **Functional Differential Equations** (1/2 workshop)
Organizers: Jianhong Wu (York U.), Hans-otto Walther (U. Giessen, Germany), John Mallet-paret (Brown U.)

Nov 6–11: **New Techniques in Lorentz Manifold**
(1/2 workshop)
Organizers: Virginie Charette (U. Manitoba), Todd Drumm (Swarthmore College), William Goldman (U. Maryland)

Nov 13–18: **Explicit Methods in Number Theory**
Organizers: Peter Borwein (SFU), H. W. Lenstra (UC Berkeley), P. Stevenhagen (U. Leiden), H. Williams (U. Calgary)

Nov 20–25: **Diophantine Approximation and Analytic Number Theory**
Organizers: Michael Bennett, Greg Martin (UBC), John Friedlander (U. Toronto), Andrew Granville (U. Montreal), Cameron Stewart (U. Waterloo), Trevor Wooley (U. Michigan)

Nov 27–Dec 2: **Mathematical Models for Biological Invasions**
Organizers: Mark Lewis (U. Alberta), Mark Kot (U. Washington), Pauline van den Driessche (U. Victoria)

Dec 4–9: **Generalizations of de Bruijn Cycles and Gray Codes**
(1/2 workshop)
Organizers: Brett Stevens (Carleton U.), Joe Buhler (Reed College), Persi Diaconis (Stanford), Fan Chung, Ronald Graham (UC San Diego), Frank Ruskey (U. Victoria)

Dec 4–9: **Numeracy and Beyond** (1/2 workshop)
Organizers: Klaus Hoechsmann (PIMS), Tony Gardiner (U. Birmingham), Yarom Sagher (U. Illinois), Guenter Toerner (U. Duisburg)

Dec 11–16: **Workshop on Resolution of Singularities, Factorization of Birational Mappings, and Toroidal Geometry**
Organizers: Kenji Matsuki, Jaroslaw Wlodarczyk (Purdue U.), Dan Abramovic (Boston U.), Edward Bierstone, Pierre Milman (U. Toronto), Steven Dale Cutkosky (U. Missouri)

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

Mar 13–27: **Cohomogeneity One Manifolds with Positive Sectional Curvature** (RIT)
Organizers: Wolfgang Ziller (U. Pennsylvania), Karsten Grove (U. Maryland), Burkhard Wilking (U. Muenster)

Mar 13–27: **Modular invariants and NIM-reps** (RIT)
Organizers: Terry Gannon, Matthias Gaberdiel (Kings College, London, UK)

Mar 18–20: **Human Infant Speech Perception and Language Acquisition** (2-day workshop)
Organizers: Janet Werker (UBC), Gary Marcus (NYU), Helen Neville (U. Oregon), Nuria Sebastian-Galles (U. Barcelona), Jacques Mehler (U. Trieste)

Mar 25–27: **Retreat on Mathematical Ecology and Evolution** (2-day workshop)
Organizers: Mark Lewis (U. Alberta), Ed McCauley (U. Calgary), Michael Doebeli (UBC), Thomas Hillen (U. Alberta), Mark Kot (U. Washington).

Apr 15–17: **PIMS PDF Meeting** (2-day workshop)
Organizer: Manfred Trummer (PIMS)

Apr 22–24: **Mathfair Workshop** (2-day workshop)
Organizers:Ted Lewis (U. Alberta), Andy Liu, Tom Holloway.

May 6–8: **Directions in Combinatorial Matrix Theory** (2-day workshop)
Organizers: Shaun Fallat, Steve Kirkland (U. Regina), Hadi Kharaghani (U. Lethbridge), Bryan Shader (U. Wyoming), Michael Tsatsomeros (Washington State U.), Pauline van den Driessche (U. Victoria)

May 13–15: **Decentralized Discrete Event Systems: Structure, Communication and Control** (2-day workshop)
Organizers: Peter Caines (McGill U.), Stephane Lafortune (U. Michigan), Laurie Ricker (Mount Allison U.), Karen Rudie (Queen's U.), John Thistle (U. Waterloo)

May 13–27: **Pi in the Sky Meeting** (RIT)
Organizer: Heather Jenkins (PIMS)

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 (U. North Carolina), Ian Graham (U. Toronto), Kang-Tae Kim (Pohang Institute, Korea)

Jun 3–5: **Adaptive Wavelet and Multiscale Methods for Partial Differential Equations** (2-day workshop)
Organizers: Tony Ware (U. Calgary), Manfred Trummer (SFU), Bin Han (U. Alberta), Michael Lamouroux (U. Calgary), Elena Braverman (U. Calgary)

Jun 3–10: **Geometry and Deformation Theory of Hyperbolic 3-manifolds** (RIT)
Organizers: Richard Canary (U. Michigan), Jeffrey Brock (Brown U./U. Texas), Kenneth Bromberg (U. Utah), Yair Minsky (Yale U.)

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)

Jul 15–17: **The Design and Analysis of Computer Experiments for Complex Systems** (2-day workshop)
Organizers: Derek Bingham (Canada Research Chair in Industrial Statistics), Randy Sitter (SFU).

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

Jul 24–Aug 14: **Study of Affine Surfaces with Self-maps of Degree > 1 and the Jacobian Problem** (RIT)
Organizers: R.V. Gurjar (Tata Inst. of Fundamental Research, India), M. Miyanishi (Osaka U.), D.-Q. Zhang (National U.), Peter Russell (Mcgill U.)

Aug 5–7: **Combinatorial and Algorithmic Aspects of Networking and the Internet** (2-day workshop)
Organizers: Angele Hamel (Wilfrid Laurier U.), Alex Lopez-Ortiz (U. Waterloo), Ian Munro (U. Waterloo), Rajeev Motwani (Stanford U.), Andrei Broder (IBM T.J. Watson), Srinivasan Keshav (U.Waterloo)

Aug 7–21: **Competing Species and Predator-Prey Models and Measure-valued Diffusions** (RIT)
Organizer: Edwin Perkins (UBC)

Aug 12–14: **Linear Operators: Theory, Applications and Computations** (2-day workshop)
Organizers: Paul Binding (U. Calgary), Peter Lancaster (U. Calgary).

Aug 23–Sep 5: **Kinetic Models for Multiscale Problems** (FRG)
Organizers: Peter Markowich (Wolfgang Pauli Institute Vienna), Lorenzo Pareschi (U. Ferrara, Italy), Jin Shi (U. Wisconsin), Reinhard Illner (U. Victoria)

Sep 2–4: **Theoretical Physics Institute, University of Alberta Symposium** (2-day workshop)
Organizer: Frank Marsiglio (U. Alberta)

Sep 4–18: **Geometry and Analysis on Cauchy Riemann Manifolds** (RIT)
Organizers: John Bland (U. Toronto), Tom Duchamp (U. Washington), Charlie Epstein (U. Pennsylvania), Jack Lee (U. Washington)

Sep 18–25: **Research on Stochastic Models for the Web Graph and Other Scalefree Networks** (RIT)
Organizers: Jeannette Janssen (Dalhousie U.), Anthony Bonato (Wilfrid Laurier U.)

Max Bell Building at the Banff Centre.

PIMS now has approximatiely 40 BIRS lectures available over the internet using on-demand streaming video and audio. See page 94 for a list.

BIRS website: **http://pims.math.ca/birs/**

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.

Areas of Concentration: 2003–05

String Theory

Scientific Computing

Number Theory

Mathematical Ecology and Evolution

Topological Dynamics

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 (POC) are designed to promote and support longer term, multi-event, multi-site coordinated activities of competitively selected Collaborative Research Groups (CRGs), in tandem with their national and international collaborators and visitors. Every year, the PIMS Scientific Review Panel will select, on a competitive basis, proposed POCs. 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. At any given time, it is expected that 5–8 CRGs will lead the PIMS scientific enterprise. Proposals can vary greatly according to the needs of the particular group and may combine a number of existing PIMS activities. During its period of concentration, a CRG can expect to receive priority for:

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

With this support, a CRG can plan to gather a significant portion of the world's experts in its scientific area of research 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.

Each CRG must have significant participation and leadership from at least two Canadian PIMS universities. Each CRG will designate a coordinator for its period of concentration. This coordinator must be based at a Canadian PIMS university; she/he will co-ordinate the various CRG activities, sign

off on all CRG events, and will be the CRG's liaison with the PIMS scientific and administrative personnel.

Each CRG designs its activities according to its specific needs within the guidelines provided by PIMS. Facilitating the training of highly qualified personnel has been identified as a priority for PIMS. Hence, CRGs are encouraged to take full advantage of the opportunities provided through the PIMS Postdoctoral Fellowship Programme, and to take a leadership role in the training of graduate and senior undergraduate students. PIMS encourages CRGs to develop innovative programmes in consultation with the Deputy Director. The proposed POC programme is evaluated by the PIMS Scientific Review Panel.

CRGs have priority access to the PIMS PDF programme. Individual PDF applications have to be submitted to the local PIMS site as part of the regular PIMS PDF competition.

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.

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.

Scientifc Activities 2003

Frontiers of Mathematical Physics Summer School on Strings, Gravity and Cosmology PIMS-UBC, July 14–25, 2003

See page 42 for a full report.

Ashoke Sen (Harish-Chandra Institute).

Ashoke Sen, PIMS Distinguished Chair, UBC

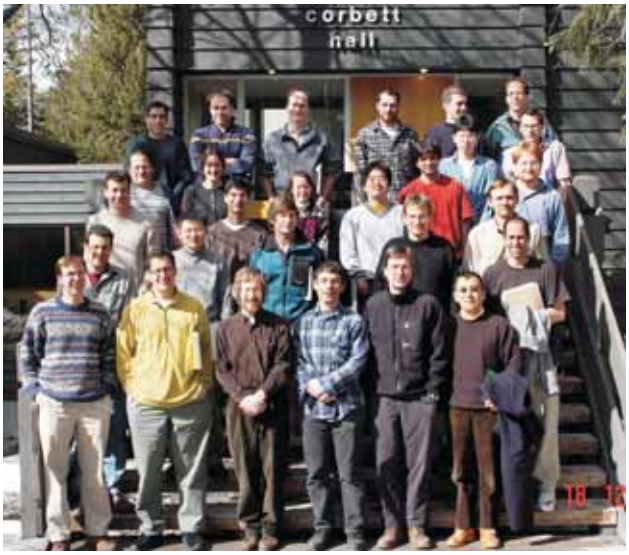
See page 47 for more information.

Pacific Northwest String Seminar PIMS-UBC, November 15–16, 2003

See page 50 for a full report.

PNW String Seminar on Mathematical Aspects of Open-Closed String Dualities U. Washington, December 4–5, 2003

See page 50 for more information.



Participants of the BIRS Workshop on Recent Developments in Superstring Theory.

BIRS Workshops

BIRS Workshop on Recent Developments in Superstring Theory, 5–Day Workshop, March 15–20, 2003

New Horizons in String Cosmology, 5–Day Workshop, June 12–17, 2004

String Field Theory Camp, Focused Research Group, July 10–25, 2004

Members of the CRG

PIMS PDFs of the CRG
UBC: Dominic Brecher, Kazuyuki Furuuchi and Ehud Schreiber

Faculty of the CRG
Leaders: Gordon Semenoff (UBC), Eric Woolgar (U. Alberta)
SFU: K. Viswanathan
U. Alberta: B. Campbell, V. Frolov, T. Gannon, D. Page
UBC: K. Behrend, J. Bryan, M. Choptuik, M. Van Raamsdonk, M. Rozali, K. Schleich, W. Unruh, D. Witt
U. Lethbridge: M. Walton
U. Toronto: A. Peet
U. Washington: A. Karch
Perimeter Institute: R. Myers, L. Smolin
APCTP: T. Lee

The String Theory CRG webpage is at **www.pims.math.ca/Collaborative_Research_Groups/PIMS_CRG_on_String_Theory:_2003-2005/**. Further information and a preliminary list of activities for 2004–05 may be found there.

Gordon Semenoff (UBC), co-leader of the CRG on String Theory.

Eric Woolgar (UA), co-leader of the CRG on String Theory.

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.

Scientific Activities 2003

Workshop on Numerical Linear Algebra and Applications PIMS-UBC, August 4–8, 2003

See page 61 for a full report.

Pacific Northwest Numerical Analysis Seminar U. Washington, October 4, 2003

See page 48 for more information.

PIMS Distinguished Series in Scientific Computing at UBC

This is a new distinguished speaker series, comprising five talks by world leading experts, and spanning a wide variety of topics in scientific computing.

For more information, including the list of lectures, see page 52.

BIRS Workshops

Computational Fuel Cell Dynamics, 5-Day Workshop, April 19–24, 2003

Computational Techniques for Moving Interfaces, 5–Day Workshop, August 23–28, 2003

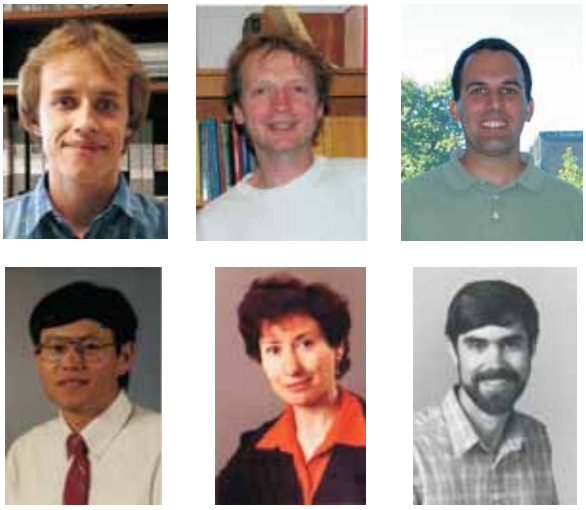
Mathematical Foundations of Scientific Visualization, Computer Graphics and Massive Data Exploration, 5–Day Workshop, May 22–27, 2004

Members of the CRG

PIMS PDFs of the CRG:
SFU: Jian-Jun Xu
UBC: Jianying Zhang

Faculty of the CRG:
Coordinator: Steve Ruuth (SFU)
CRG Leaders: Elana Braverman (U. Calgary), Chen Greif (UBC), Randy Leveque (U. Washington), Yanpin Lin (U. Alberta), Steve Ruuth (SFU), Manfred Trummer (SFU)
SFU: R. Choksi, M.C. Kropinski, T. Möller, D. Muraki, K. Promislow, B. Russell, S. Ruuth, L. Trajkovic, M. Trummer, J. Verner, R. Zahar.
U. Alberta: Y. Lin, J. Macki, P. Minev, Y.S. Wong
UBC: U. Ascher, O. Dorn, S. Dunbar, I. Frigaard, A. Peirce, B. Seymour, B. Shizgal, J. Varah, M. Ward, B. Wetton, M. Yedlin
U. Calgary: T. Ware, R. Westbrook
U. Victoria: P. van den Driessche, D. Olesky
U. Washington: L. Adams, C. Bretherton, J. Burke, D. Durran, A. Greenbaum, G. Hakim, N. Kutz, R. LeVeque, R. O'Malley, P. Schmid
Ballard Corp: R. Bradean, J. Kenna
Boeing Corp: M. Epton, S. Filipowski, J. Lewis
Quadrus Financial Technologies: S. Reddy

The Scientific Computing CRG webpage is **www.pims.math.ca/Collaborative_Research_Groups/PIMS_CRG_on_Scientific_Computing:_2003-2005/**. Further information and a preliminary list of activities for 2004–05 may be found there.



CRG on Scientifc Computing group leaders (clockwise from top left)*:* ***Steve Ruuth*** *(CRG Coordinator, SFU),* ***Manfred Trummer*** *(SFU),* ***Chen Grief*** *(UBC),* ***Randy Leveque*** *(U. Washington),* ***Elena Braverman*** *(U. Calgary) and* ***Yanpin Lin*** *(U. Alberta).*

Number Theory

Participants of the Computational Techniques for Moving Interfaces BIRS Workshop.

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.

Scientific Activities 2003

7th Annual PNW Number Theory Conference
U. Washington, April 5–6, 2003

See page 48 for a full report.

Mahler Measure of Polynomials
Simon Fraser University, June 2–29, 2003

See page 43 for more information.

Jeffrey Vaaler, PIMS Distinguished Chair, SFU

See page 46 for a full report.

PIMS Number Theory Day
SFU Harbour Centre, December 5, 2003

See page 48 for more information.

BIRS Workshops

The Many Aspects of Mahler's Measure, 5–Day Workshop, April 26–May 01, 2003

Current Trends in Arithmetic Geometry and Number Theory, 5–Day Workshop, August 16–21, 2003

Explicit Methods in Number Theory, 5–Day Workshop, November 13–18, 2004

Diophantine Approximation and Analytic Number Theory, 5–Day Workshop, November 20–25, 2004

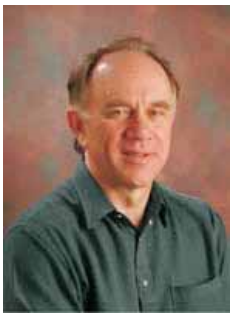
Members of the CRG

PIMS PDFs of the CRG:
SFU: Ron Ferguson, William Galway, Alexa van der Waall
UBC: Ben Green, Friedrich Littman, Christopher Rowe

Faculty of the CRG:
Group Leaders: Peter Borwein (SFU), David Boyd (UBC)
SFU: I. Chen, S. Choi, P. Lisonek
U. Alberta: J. D. Lewis
U. Calgary: R. Guy, J. P. Jones, R. Mollin, R. Scheidler, H. Williams

Peter Borwein (SFU), co-leader of the CRG on Number Theory.

UBC: M. Bennett, W. Casselman, R. Gupta, I. Laba, G. Martin, N. Vatsal
U. Washington: R. Greenberg, A. Iovita, N. Koblitz, B. Solomyak
Other institutions: A. Akbary (U. Lethbridge), E. Dobrowolski (College of New Caledonia), M. Klassen (DigiPen Inst. Tech.), K. Lauter (Microsoft)



David Boyd (UBC), co-leader of the CRG on Number Theory.

The Number Theory webpage is at **www.pims.math.ca/Collaborative_Research_Groups/PIMS_CRG_on_Number_Theory:_2003-2005/**. Further information and a preliminary list of activities for 2004–05 may be found there.

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.

Scientific Activities 2003

2nd Annual PIMS Mathematical Biology Summer Workshop University of Alberta, April 30–May 9, 2003

See page 73 for a full report.

Bryan Grenfell, PIMS Distinguished Chair

See page 45 for more information.

In November 2003 **Pauline van den Driessche** (U. Victoria) is visiting the Centre for Math Biology at U. Alberta. She will be doing research with PIMS PDF **Joanna Renclawowicz**.

BIRS Workshops

Mathematical Biology: From molecules to ecosystems; The legacy of Lee Segel, 5–day Workshop, July 5–10, 2003

Mathematical Models for Plant Dispersal, Focused Research Group, September 20–October 2, 2003

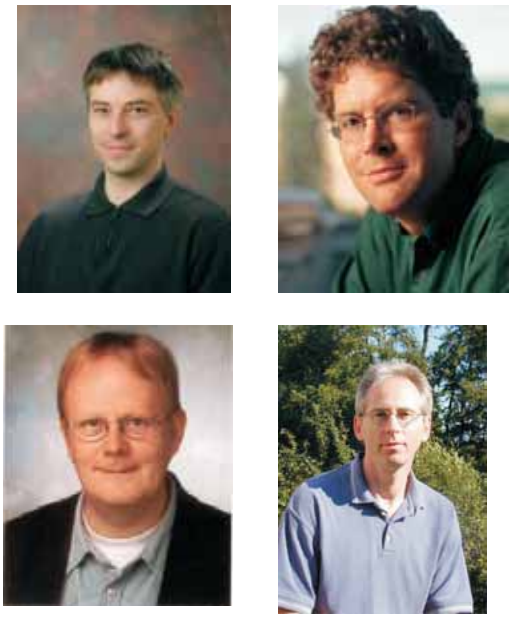
Retreat on Mathematical Ecology and Evolution, 2–day Workshop, March 18–20, 2004

Mathematical Models for Biological Invasions, 5-day Workshop, November 27–December 2, 2004

Members of the CRG

PIMS PDFs of the CRG:
U. Alberta & U. Calgary: Frithjof Lutschern
U. Alberta & U. Victoria: Joanna Renclawowicz

Participants of The legacy of Lee Segel Workshop at BIRS.



Clockwise from top left: Co-organizers of the Math Ecology and Evolution CRG Michael Doebeli (UBC), Mark Lewis (U. Alberta), Edward McCauley (U. Calgary), and CRG Co-ordinator Thomas Hillen (U. Alberta).

Faculty of the CRG:
Coordinator: Thomas Hillen (U. Alberta)
Co-organizers: Michael Doebeli (UBC), Mark Lewis (U. Alberta), Edward McCauley (U. Calgary)
SFU: E. Palsson, B. Roitberg
U. Alberta: M. Boyce, H. Freedman, S. Lele, M. Li, J. Roland, J. So
UBC: F. Brauer, L. Keshet, D. Schluter
U. Calgary: S. Richards
U. Victoria: P. van den Driessche
U. Washington: J. Anderson, C. Bergstrom, D. Grunbaum, R. Hilborne, M. Kot

The webpage for this CRG is at **www.pims.math.ca/Collaborative_Research_Groups/PIMS_CRG_on_Mathematical_Ecology_and_Evolution:_2003-2005/**. Further information and a list of activities for 2004–05 may be found there.

Dynamics and Related Topics

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.

Scientific Activities 2003

Alexander Helemskii, PIMS Distinguished Chair, University of Alberta

See page 46 for a full report.

BIRS Workshops

Northwest Functional Analysis Symposium, 2–Day Workshop, March 27–29, 2003

Coordinate Methods in Nonselfadjoint Operator Algebras, 5–Day Workshop, December 13–18, 2003

Aperiodic Order: Dynamical Systems, Combinatorics, and Operators, 5-Day Workshop, May 29–June 3, 2004

Members of the CRG

Faculty of the CRG:
Group Leaders: Douglas Lind (U. Washington), Ian Putnam (U. Victoria)
U. Alberta: A. Lau, R. Moody, V. Runde, A. Weiss
U. Calgary: B. Brenken, M. Lamoureux, I. Nikolaev
U. Victoria: C. Bose, R. Edwards, M. Laca, J. Phillips
U. Washington: M. Einsiedler, C. Hoffman, D. Lind, S. Rohde, B. Solomyak, S. Tuncel
Visitors and other contributors: M. Boyle (Maryland), C. Denninger (Muenster), W. Parry (Warwick), D. Rudolph (Maryland), K. Schmidt (Vienna)

Ian Putnam (U. Victoria), co-leader of the CRG on Dynamics and Related Topics.

Douglas Lind (U. Washington), co-leader of the CRG on Dynamics and Related Topics.

The Dynamics & Related Topics webpage is at **www.pims.math.ca/Collaborative_Research_Groups/PIMS_CRG_on_Dynamics_and_Related_Topics:_2003-2005/**. Further information and a preliminary list of activities for 2004–05 may be found there.

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.

Clockwise from top left: George Peschke (U. Alberta), Dale Rolfsen (UBC), Laura Scull (UBC), and Peter Zvengrowski (U. Calgary), the group leaders of the CRG on Topology and Knot Theory.

BIRS Workshops

Topology of Manifolds and Homotopy Theory, 5–day Workshop, March 19–24, 2004

Knots and their Manifold Stories, 5–day Workshop, May 7–12, 2004

Braid Groups and Applications, 5–day Workshop, October 15–20, 2004

Cascade Topology Seminar, 2–day Workshop, 2004

Members of the CRG

Faculty of the CRG:
Group Leaders: George Peschke (U. Alberta), Dale Rolfsen (UBC), Laura Scull (UBC), Peter Zvengrowski (U. Calgary)
U. Alberta: J. Timourian
UBC: J. Bryan, K. Lam, D. Sjerve
U. Calgary: K. Varadarajan
U. Washington: E. Babson, E. Devinatz, M. Freedman, S. Mitchell, J. Palmieri, J. Segal

The Topolgy & Knot Theory CRG webpage is at **www.pims.math.ca/Collaborative_Research_Groups/PIMS_CRG_on_Topology:_2004-2006/**.

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.

BIRS Workshops

BIRS Workshop on Statistical Mechanics of Polymer Models, May 10–15, 2003

Participants of the BIRS Workshop on Statistical Mechanics of Polymer Models.

BIRS Workshop on Stochastic Partial Differential Equations, September 27–October 2, 2003

BIRS Workshop on Analytic and Geometric Aspects of Stochastic Processes, April 10–15, 2004

Stability and Computations for Stochastic Differential Delay Equations, Research in Teams, July 24–August 7, 2004, BIRS

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

Competing Species and Predator-Prey Stochastic Models, Research in Teams, August 2004

Participants: Rick Durrett (Cornell U.), Leonid Mytnik (Technion), Ed Perkins (UBC)

Members of the CRG

Faculty of the CRG:
Group Leaders: David Brydges (UBC), Chris Burdzy (U. Washington), Ed Perkins (UBC), Byron Schmuland (U. Alberta)
U. Alberta: M. Kouritzin
UBC: M. Barlow, J. Feldman, A. Holroyd, V. Limic, G. Slade, J. Walsh
U. Saskatchewan: C. Soteros, R. Srinivasan
U. Washington: Z.-Q. Chen, B. Erickson, C. Hoffman, L. Korf, S. Rohde
Microsoft Research: C. Borgs, J. Chayes, O. Schramm, D. Wilson
Other Institutions: D. Dawson (McGill), R. van der Hofstad (Eindhoven)

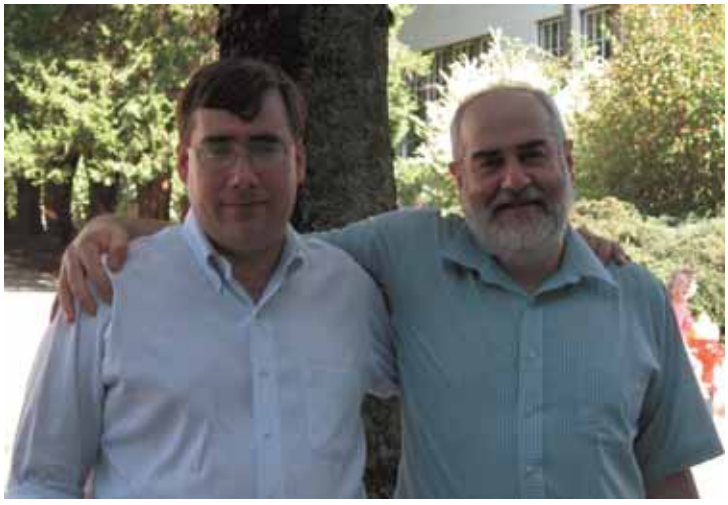
The Probability & Statistical Mechanics CRG webpage is at **www.pims.math.ca/Collaborative_Research_Groups/PIMS_CRG_on_Probability_and_Statistical_Mechanics:_2004-2006/**. Further information and a preliminary list of activities for 2004–05 may be found there.




Clockwise from top left: David Brydges (UBC), Chris Burdzy (U. Washington), Ed Perkins (UBC), and Byron Schmuland (U. Alberta), group leaders of the CRG on Probability and Statistical Mechanics.

II. THEMATIC PROGRAMME

Participants of the Workshop on Scattering and Inverse Scattering which took place at BIRS. This workshop was part of the 2003 PIMS Thematic Programme on Inverse Problems and Applications.



John Schotland (U. Penn) and Gunther Uhlmann (U. Washington), two of the organizers of the Workshop on Inverse Problems and Medical Imaging. Gunther Uhlmann was the coordinator of the 2003 PIMS Thematic Programme.

Wilfrid Gangbo (Georgia Tech), an organizer of the Optimal Transportation and Nonlinear Dynamics Workshop.

Theme 2003: Inverse Problems and Applications

Inverse problems are problems in which the goal is to find material or biological properties of objects or information about the objects' 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 imagining, remote sensing and non-destructive evaluation of materials. During the last twenty years or so there have 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 have made it possible to make significant progress on increasingly more realistic and difficult inverse problems. The purpose of the Thematic Programme was to bring together mathematicians and practitioners to work on these problems. A series of workshops on inverse problems were held at different locations, during the year 2003, emphasizing these different applications. Several of these activities were sponsored jointly by PIMS and the NSF.

Gunther Uhlmann was the coordinator of the PIMS thematic year.

Please see **www.pims.math.ca/inverse/** for more information.

Scientific Committee:

Gunther Uhlmann (Coordinator, 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 PDE, Inverse Problems and Nonlinear Analysis,
Centro de Modelamiento Matemático (CMM), Universidad de Chile, January 6–19, 2003

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

Seismic Wave Simulation and Seismic Imaging: A PIMS Summer School,
U. Calgary, July 14–18, 2003

PIMS Geophysical Inversion Workshop,
U. Calgary, July 20–25, 2003

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

PASI on PDE, Inverse Problems and Non-Linear Analysis

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

Organizers: Rafael Benguria (Universidad Católica de Chile), Carlos Conca (U. Chile), Nassif Ghoussoub (PIMS and UBC), Raul Manasevich (U. Chile), Wei-Ming Ni (U. Minnesota), Gunther Uhlmann (U. Washington) and Michael Vogelius (Rutgers)

The Pan-American Advanced Studies Institute (NSF) are funded by the US NSF and DOE. The PASI is modelled on the NATO Advanced Studies Institute. Canadian participation in the PASI in Chile was supported by PIMS.

The PASI on Partial Differential Equations (PDE), Inverse Problems (IP) and Non-Linear Analysis (NLA) was held at the Centro de Modelamiento Matemático (CMM), Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile. The interaction between PDE, IP and NLA has produced remarkable developments in the last couple of decades or so. One of the main objectives of the PASI was to bring many of these developments to advanced graduate students, postdocs and other scientists in the Americas interested in these fields and their applications. Another important objective of the PASI was to foster international cooperation throughout the Americas by bringing different areas of expertise in PDEs, IP and NLA in one event. More than 160 participants mainly from several countries of the Americas participated in this unique workshop.

During the first week of the PASI there were a series of minicourses given by **Jean-Bernard Baillon** (U. Chile), **Jerome Busca** (U. Paris IX), **Luis Caffarelli** (UT, Austin), **F. Alberto Grunbaum** (Berkeley), **Maarten de Hoop** (Colorado School of Mines), **Peter Kuchment** (Texas A&M), **Yan Yan Li** (Rutgers) and **Michael Vogelius** (Rutgers). During the second week the workshop focused on recent developments in the interaction between IP, NLA and PDE.

*Participants of the **PASI on PDEs, Inverse Problems and Non-linear Analysis** in Chile.*

BIRS Workshop on Scattering and Inverse Scattering

BIRS, March 22–27, 2003

Organizers: Richard Froese (UBC) and Gunther Uhlmann (U. Washington)

In the fields of scattering and inverse scattering theory techniques of microlocal analysis, including the use of eikonal equations and of complex geometrical optics solutions to Schrödinger and other equations, have led to substantial progress in recent years.

Despite close mathematical connections between the fields of scattering and inverse scattering there has not always been a strong interaction between these fields. Part of the rationale of this workshop was to bring together workers who might not ordinarily interact, but could benefit from sharing ideas. The 40 participants took full advantage of this opportunity.

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. Several of the lectures were concerned with questions about 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.

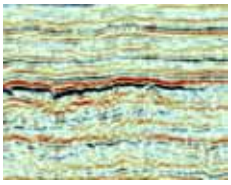
Inverse scattering is how we obtain a large part of our information about the

world. An everyday example is human vision: from the measurements of scattered light that reaches our retinas, our brains construct a detailed three-dimensional map of the world around us. Dolphins and bats are able to do the same thing from listening to scattered sound waves.

The inverse scattering problems discussed in the workshop included the determination of the interior structure of the Earth by measuring the travel times of seismic waves, and the inverse quantum scattering problem which attempts to determine the inner structure of the atom and its constituents from studying the scattering when materials are bombarded with particles. Another important inverse scattering problem discussed in the workshop is reflection seismology which uses the reflection of seismic waves to locate oil deposits. Inverse obstacle scattering is used in radar and sonar and several of the lecturers dealt with this topic.

Seismic Wave Simulation and Seismic Imaging: A PIMS Summer School

University of Calgary, July 14–18, 2003



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

The first part of this summer school examined real seismic data, and several mathematical models for the forward problem (the simulation of seismic waves) were presented. Wave equations and their solutions were explored. Essential mathematical techniques such as Greens functions, Kirchhoff diffraction theory, and ray theory were developed and examined.

In the second part, these concepts and tools were applied to develop the prototypical approaches to the seismic imaging problem. The Born and Kirchhoff approximations were 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 were examined and a survey of more advanced, emerging methods was presented. Emphasis was placed on understanding the assumptions and limitations of each technique.

The instructors at this summer school were:
Len P. Bos (Math & Statistics, U. Calgary)
Robert J. Ferguson (Jackson School of Geosciences, Geological Sciences, U. Texas, Austin)
Gary F. Margrave (Geology & Geophysics, U. Calgary)

PIMS Geophysical Inversion Workshop

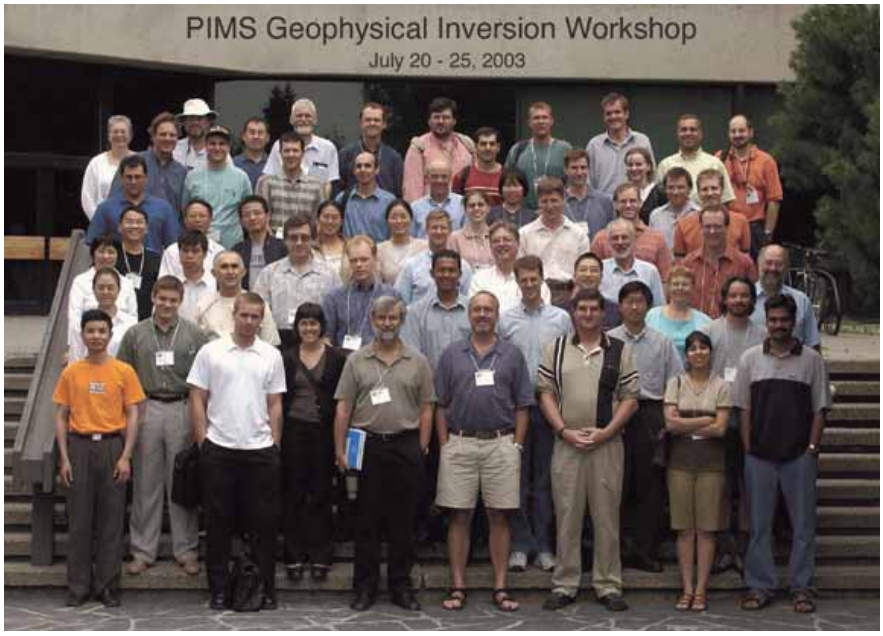
University of Calgary, July 20–25, 2003

Organizers: Gary Margrave (U. Calgary), Martijn de Hoop (Colorado State of Mines), and William (Bill) Symes (Rice U.)

The University of Calgary campus was the setting for more than eighty mathematicians, physicists, and geophysicists from around the world, who gathered to discuss geophysical inversion in theory and practise.

There were ten invited speakers and twenty-three contributed papers which made for a very full agenda. In addition, there were more than forty non-presenting registered attendees and many more people dropped in for the occasional presentation. The strong linkage between the subject matter and the business interests of the Calgary oil and gas exploration community bolstered workshop attendance. Though there were more geophysicists than mathematicians in attendance, there were some very well known people in the latter category, while many of the former were effectively applied mathematicians. Many graduate students were also present and some of these had stayed over from the Seismic Imaging Summer School of the previous week.

There were many presentations on the mathematics of wave propagation and the implied inverse problem, which is often called seismic imaging. Seismic imaging is a central theme in geophysical inversion and is a rapidly moving field. Fourier integral operators and pseudodifferential operators were found in numerous presentations suggesting that many researchers are finding these operators useful in seismic inversion. Another common theme in seismic inversion is the recognition that the inversion operation can also be formulated as a generalized Radon trans-



form. In addition to papers on the seismic reflection problem, there were also a variety of papers dealing with the inverse traveltime problem and other aspects of kinematics. Finally, there were several more general presentations on inverse theory that were not limited to seismological data.

The general atmosphere of the workshop was informal and congenial. Many presentations elicited a lively exchange of ideas. The two social events, an opening barbeque and a dinner in the latter part of the week, were well attended. In the end, there were many expressions of gratitude to PIMS for funding the event and a general desire to have another meeting in a few years.

Participants of the workshop on Inverse Problems and Medical Imaging at PIMS-UBC.

The invited speakers were:

Norman Bleistein (Colorado School of Mines): *Seismic Modelling, Migration and Inversion: From String Construction to Theory to Computer Implementation*

Michael Bostock (UBC): *Inverse scattering of teleseismic wavefields*

Hans Duistermaat (U. Utrect): *Fourier integral operators as a tool to take care of the high frequency part of waves*

Louis Fishman (MDF International previously at NRL): *One-Way Wave Equation Modeling in Seismo-Acoustic Wave Propagation and Inversion*

Rob van der Hilst (Massachusetts)

Larry Lines (U. Calgary): *Geophysical Inversion - Provehito in Altum!*

Doug Oldenburg (UBC): *Inversion for applied geophysics: Applications to mineral exploration*

Mauricio Sacchi (U. Alberta): *Regularized Least-squares Migration/Inversion*

Christiaan Stolk (Ecole Polytechnique): *The determination of medium discontinuities by migration: results from microlocal analysis*

Gunther Uhlmann (U. Washington): *The inverse kinematic problem*

Workshop on Inverse Problems and Medical Imaging

PIMS-UBC, August 4–8, 2003

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

This workshop was sponsored in collaboration with the US National Science Foundation.

The workshop focused on recent developments in medical imaging, particularly the advances in mathematics which have allowed for significant enhancement of widely used imaging techniques such as x-ray tomography, magnetic resonance imaging, and ultrasonic imaging. Mathematical developments in emerging medical imaging modalities were also surveyed. The more than 70 participants included physicians, physicists and mathematicians directly involved in the mathematical and practical aspects of medical imaging.

Several of the lectures described relatively recent medical modalities which might improve on the earlier detection and diagnosis of breast cancer. These new imaging methods are non-invasive and they all provide for more detailed information than given by standard x-ray mammography about different properties of breast tissue. For instance, electrical impedance tomography images the electrical conductivity of tissue by making voltage and current measurements at the boundary of the body. Breast tumours have a much larger conductivity than surrounding tissue. Transient elastography uses information given by shear ultrasound waves to measure the breast tissue hardness or elasticity. In optical tomography one sends infrared light through breast tissue to locate and quantify regions of oxygenated and deoxygenated hemoglobin. This might help detect early tumour growth and characterize the stage of a tumour by learning about its vascular makeup.

The invited speakers were:

Simon Arridge (UCL): *Reconstruction Methods in Optical Tomography and Applications to Brain Imaging*

Yoram Bresler (UIUC): *Fast Hierarchical Algorithms for Tomography*

Thomas Budinger (UC Berkeley): *How Medical Science will Benefit from Mathematics of Inverse Problems*

Emmanuel Candes (Cal Tech): *New Multiscale Thoughts on Limited-Angle Tomography*

Scott Carney (UIUC): *Computed Imaging for Near-Field Microscopy*

Anna Celler (UBC): *Inverse Problems and Nuclear Medicine*

Rolf Clackdoyle (U. Utah): *Reconstruction from Truncated Fanbeam and Parallel-Beam Projections*

Mathias Fink (ESPCI): *Transient Elastography and Supersonic Shear Imaging*

Amir Gandjbakhche (NIH, USA): *Effects of Target Non-localization on the Contrast of Optical Images: Lessons for Inverse Reconstruction*
Frederick Greensite (UC Irvine): *Multivariate Inverse Problems*
David Isaacson (RPI): *Progress and Problems in Electrical Impedance Imaging*
Matti Lassas (Rolf Nevalinna Institute, Finland): *Inverse scattering problem with a random potential*
Brian Litt (UPenn): *Predicting Epileptic Seizures From Intracranial EEG*
Joyce McLaughlin (RPI): *Interior Elastodynamics Inverse Problems: Recovery of Shear Wavespeed in Transient Elastography*
Michael Miller (Johns Hopkins University): *Image Analysis Models in Computational Anatomy*
Frank Natterer (U. Muenster): *3D Emmission Tomography Via Plane Integrals*
Joseph O'Sullivan (Washington U., St. Louis): *Information Geometry, Alternating Minimizations, and Transmission Tomography*
George Papanicolau (Stanford): *Imaging in Clutter*
Sarah Patch (GE Medical Systems): *Thermoacoustic Tomography - An Inherently 3D Generalized Radon Inversion Problem*
Todd Quinto (Tufts): *Limited Data Tomography in Science and Industry*
Yoram Rudy (Case Western Reserve U.): *ECGI : A Noninvasive Imaging Modality for Cardiac Electrophysiology and Arrhythmias*
John Schotland (UPenn): *Tomography and Inverse Scattering with Diffuse Light*
Meir Shinnar (UMDNJ): *Inversion of the Bloch Equation*

Some of the talks were videotaped and may be watched in RealVideo format from the web page **www.pims.math.ca/science/2003/inverse/.**

Optimal Transportation and Nonlinear Dynamics Workshop

PIMS-UBC, August 11–15, 2003

Organizers: Michael Cullen (UK Meteorological Office), Lawrence C Evans (UC, Berkeley), and Wilfrid Gangbo (Georgia Tech) and cosponsored by their NSF Focused Research Group.

The conference commenced with an survey lecture by **Robert McCann** (U. Toronto) on *Optimal Transportation: The Lay of the Land*, and featured special sessions organized by **Felix Otto** (U. Bonn) about *Analyzing Gradient Descent Models in Physical Systems* and **Michael Cullen** on *Atmospheric Dynamics* and *Scientific Computation* problems from optimal transport theory.

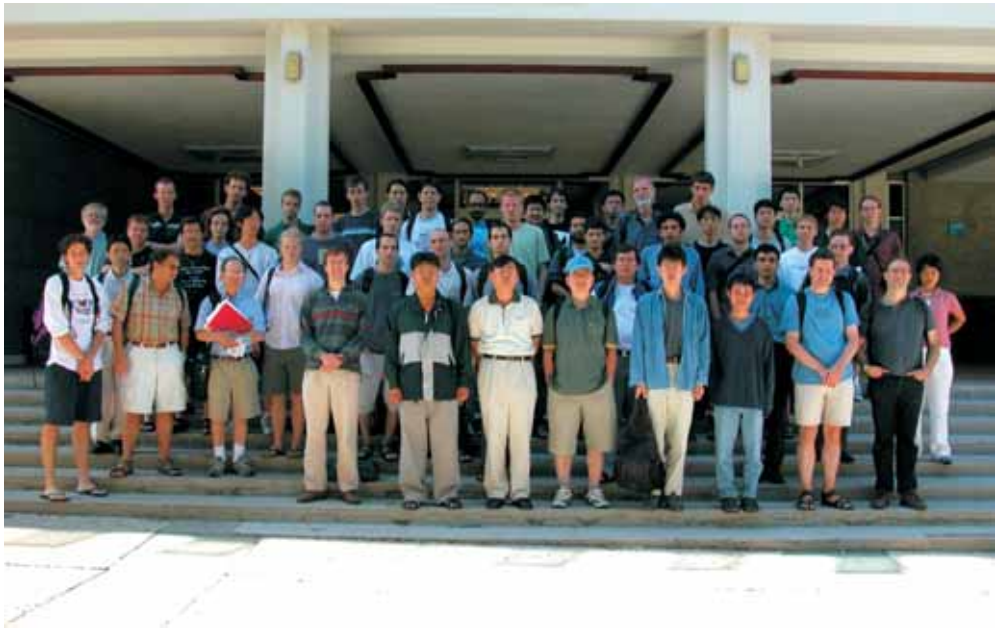
A minicourse on *Hessian and Curvature Equations* was given by **John Urbas** (Australian National University). These second-order elliptic PDEs arise in geometric and optimization problems, but are fiendishly difficult to analyse due to nonlinearities which result from replacing the Laplacian operator in Poisson's equation with the Hessian determinant or (in 3 dimensions and higher) other elementary symmetric functions of the Hessian's eigenvalues.

The conference was a successful sequel to the *Transport me to Toronto!* workshop held at the Fields Institute in August 2001.

The invited lecturers were:
Jean-David Benamou (INRIA)*: Numerical Resolution of an "Unbalanced" Mass Transport Problem*
Guy Bouchitte (U. Toulon et du Var)*: Asymptotic of Optimal Location Problems*
Yann Brenier (U. Nice Sophia-Antipolis)*: Displacement of 2D Vector Fields and 3D Electromagnetism*
Peter Constantin (U. Chicago)*: Diffusive Lagrangian Transformations*
Mike Cullen (U. Reading)*: Fast Algorithm for the Monge-Kantorovich Problem (joint work with Purser)*
Jean Dolbeault (U. Paris IX - Dauphine)*: Direct Entropy Methods*
Mikhail Feldman (U. Wisconsin)*: Lagrangian Solutions of 3D Semigeostrophic Equations in Physical Space*
Jim Feng (U. Massachusetts Amherst)*: Large Deviations, Hamilton-Jacobi and Mass Transport*
Nassif Ghoussoub (UBC, PIMS)*: A Unifying Framework for Geometric Inequalities*
Lorenzo Giacomelli (U. di Roma "La Sapienza")*: A Variational Approach to Lubrication Approximation*
Bernd Kawohl (U. Köln)*: Symmetries in Anisotropic Media*
David Kinderlehrer (Carnegie Mellon U.)*: Diffusion Mediated Transport: Can We Understand Motion in Small Systems?*
Robert McCann (U. Toronto)*: Optimal Transportation: The Lay of the Land*
John Norbury (Oxford)
Adam Oberman (U. Texas)*: Exact Solution to the Semigeostrophic Equations in Elliptical Domains*
Vladimir Oliker (Emory U.)*: Fermat's Principle and Mass Transport Problem*
Felix Otto (U. Bonn)*: A Transportation Problem in Type I Superconductors*
Max von Renesse (U. Bonn)*: Robust Lower Ricci Bounds by Optimal Transportation*
Ian Roulstone (U. Reading)*: Semigeostrophic Theory on The Sphere*
Giuseppe Savaré (U. degli Studi Pavia)*: Gradient Flows in Wasserstein Spaces*
Andrei Sobolevskii (Observatoire de la Cote D'Azur)*: Reconstruction of the Early Universe by a Monge-Ampere-Kantorovich Mass Transportation Method*
John Urbas (Australian National U.)*: Minicourse on Regularity and Estimates for Hessian and Curvature Equations*
Xu-Jia Wang (Australian National U.)*: Light Reflection and Optimal Transportation*

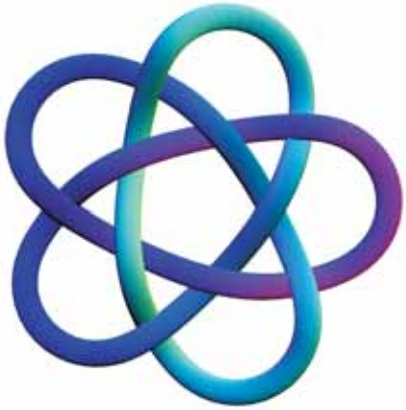
Some lectures were videotaped and may be watched in RealVideo format from the web page **www.pims.math.ca/science/2003/inverse/**.

III. CORE SCIENTIFIC PROGRAMMES



Participants of the 2003 Frontiers in Mathematical Physics Summer School on Strings, Gravity and Cosmology outside the Henry Angus Building at UBC.

PIMS held 15 Pacific Northwest Seminars in 2003–04. One of these was the Cascade Topology Seminar.



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 of Mathematical Physics Summer School on Strings, Gravity and Cosmology

PIMS-UBC, July 14–25, 2003

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

Frontiers in Mathematical Physics was organized as a summer school this year. The school was concentrated on the interface between gravity, cosmology and string theory. This is an active research area in string theory, and the school was designed to prepare the students for active research in this field. By choosing a particular section of string theory, the school was fairly comprehensive in the topics covered, providing both elementary introduction to the subject matter and ending with reviews of recent literature.

The first week of the school was dedicated to introducing the basic tools of string theory. Those include the basic technical tools of (perturbative and non-perturbative) string theory and quantum field theory, and some of their applications. Basics of cosmology were covered in preparation for the second week. The second week of the school covered more advanced topics, by and large developments of the last year or two (or in some cases the last week or two). These included recent developments in matrix models, Liouville theory, cosmic singularities and much more. Among those were the excellent lectures of **Ashoke Sen**, PIMS distinguished speaker, on *Tachyon Dynamics in Open String Theory*.

The full list of speakers is:
Vijay Balasubramanian (UPenn): *Time and String Theory*
Micha Berkooz (Weizmann Institute): *Cosmic Singularities in General Relativity and String Theory*
Robert Brandenberger (Brown): *Basics of Cosmology for String Theorists*
Michael Dine (UC, Santa Cruz): *String Phenomenology*
Simeon Hellerman (Stanford): *Supersymmetric Gauge Theories*
David Kutasov (U. Chicago): *Little String Theory*
Yuri Makeenko (ITEP, Moscow): *Large N Gauge Theories*
Volker Schomerus (Saclay): *Strings in Exact Non-Compact Backgrounds*
Ashoke Sen (Harish-Chandra Institute): *Tachyon Dynamics in Open String Theory*
Matthew Strassler (U. Washington): *Confinement and String Theory: The Duality Cascade and its Applications*
Leonard Susskind (Stanford): *deSitter Space*
Richard Szabo (Heriot-Watt): *Perturbative String Theory*
Mark Van Raamsdonk (Standford/UBC): *Introduction to AdS/CFT*
Don Witt (UBC): *QFT in Curved Space*
Piljin Yi (KIAS): *Low Energy Dynamics of Unstable D-Branes*

Vijay Balasubramanian (U. Pennsylvania).

David Kutasov (U. Chicago).

Leonard Susskind (Stanford).

We were fortunate to have a large group of very enthusiastic and dedicated students, 88 in all. Student seminars were given at the end of the day, and were well-attended. The lectures were very interactive, resulting in interesting discussions during the breaks. It is our hope the students are now able to start making their own contributions to our field.

The next Frontiers in Mathematical Physics Summer School will be on Particles, Fields and Strings, and it will be held in early August 2004.

Mahler's Measure of Polynomials

Simon Fraser University, June 2–29, 2003

Organisers: Stephen Choi (SFU, chair), Peter Borwein (SFU), Imin Chen (SFU), Ron Ferguson (PIMS)

The PIMS summer programme on *Mahler Measure* was funded by PIMS with support from Simon Fraser University. There were a total of 50 faculty members, postdoctoral fellows, graduate and undergraduate students from various universities and countries including Canada, US, France, Italy, Australia, Austria and Greece. The keynote speaker for this program was **Jeffrey Vaaler**, a PIMS Distinguished Chair visiting Simon Fraser University. Before his lectures series, there was a short graduate course, taught by **Stephen Choi** (SFU) and **Mike Mossinghoff** (Davidson College), serving as a preparation for the lecture series and later talks in the program. **David Boyd** (UBC) gave two talks on *Multivariable Mahler measure*. The program ended with a workshop in the last week of June. In the workshop 18 speakers gave talks on different aspects of Mahler measure. A student session was also organized throughout the whole program to encourage graduate students to present current work to the participants. Almost all the participating students gave talks in this student session. Most of the slides and notes of the talks from this programme are on the PIMS website **http://www.pims.math.ca/science/2003/mahler/**.

The Invited Speakers were:

Iskander Aliev (Technische U. Wien): *Decompositions of Integer Vectors and Some Related Problems*
Arthur Baragar (UNLV): *Vector Heights on Surfaces*
Jason Bell (U. Michigan): *Cohen-Macaulay Rings and Polynomials with Real Zeros*
Marie José Bertin (U. Paris, Pierre et Marie Curie): *Mahler's Measures of Calabi-Yau's Varieties: Examples*
David Boyd (UBC): *Explicit Formulas for Multivariable Mahler's Measure; Mahler's Measure and Hyperbolic Manifolds*
Edward Dobrowolski (The College of New Caledonia)
Tamas Erdelyi (Texas A & M)
Lenny Fukshansky (U. Texas, Austin): *Small Zeros of Quadratic Forms with Linear Conditions*
Kevin Hare (UC, Berkeley): *Gaps in the Spectra of Pisot Numbers*
Angel Kumchev (U.T, Austin): *On Waring-Goldbach Problem*
Matilde Lalin (U. Texas, Austin): *Examples of Mahler Measures as Special Values of the Riemann Zeta Function and L-Series*
Friedrich Littmann (UIUC, UBC, SFU): *Entire Extremal Majorants*
Michael Mossinghoff (Davidson College): *Computational Aspects of Problems on Mahler's Measure; Mahler's Measure of Polynomials with Odd Coefficients*
Nathan Ng (U. Montréal): *Mean Values of L-functions*
Clay Petsche (U. Texas, Austin): *The Height of Algebraic Units in Local Fields, and Lehmer's Problem; The Quantitative Distribution of Galois Orbits of Small Height*
Chris Pinner (Kansas State U.): *Some Bounds for Complete Exponential Sums*
Igor E. Pritsker (Oklahoma State U.): *Gelfond-Schnirelman Method in Prime Number Theory*
Georges Rhin (U. Metz): *Integer Transfinite Diameter and Polynomials of Small Mahler Measure*
Chris Sinclair (U. Texas, Austin): *Heights of Polynomials, Asymptotic Estimates and the Mellin Transform; The Distribution of Mahler's Measures of Reciprocal Polynomials*
Jeff Vaaler (U. Texas, Austin): *Mahler's Measure and the Number of Irreducible Factors of a Polynomial, Mahler's Measure and the ABC Inequality, The Distribution of Values of Mahler's Measure, Estimates for the Number of Algebraic Numbers of Fixed Degree and Bounded Height*
Carlo Viola (U. Pisa): *Birational Transformations and the Arithmetic of Euler's Integrals*
Qiang Wu (U. Metz): *An Effective Algorithm to Compute the Integer Transfinite Diameter and Some Applications*

Banach Algebras and their Applications

U. Alberta, July 27-Aug. 9, 2003

Organisers: **Anthony To-Ming Lau** and **Volker Runde** (University of Alberta).

It was the sixteenth in a series of conferences on Banach algebras that started 1974 in Los Angeles. The organizers of the first meeting, **Wiliam G. Bade** of Berkeley and **Philip C. Curtis, Jr.**, of UCLA, were among the 136 participants from all continents (except Antarctica) at the Edmonton conference.

In addition to the regular conference programme, there were five workshops on the following topics, each of which was chaired by an internationally recognized specialist in the respective area:

Joachim Cuntz (U. Münster): *K-theory for Banach and Locally Convex Algebras*
Alexander Ya. Helemskii (Moscow State U, and PIMS Distinguished Chair): *Topological Homology*
Anthony To-Mig Lau (U. Alberta): *Banach Algebras in Abstract Harmonic Analysis*
Michael M. Neumann (U. Saarbrücken): *Banach Algebras in Operator Theory*
Z.-J. Ruan (U. Illinois, Urbana-Champaign): *Banach Algebras and Operator Spaces*

The workshop on harmonic analysis was held in the honour of **Eberhard Kaniuth of Paderborn**, Germany, who retired this year.

The mathematical highlights included a solution — by **Viktor Losert** of Vienna, Austria — of the so-called inner derivation problem of the late B. E. Johnson: "Every derivation on the group algebra of a locally compact group is an inner derivation implemented by a measure." This problem had been open for more than three decades.

There will be conference proceedings published by the AMS in their Contemporary Mathematics series.

Please see **http://www.math.ualberta.ca/~ba03/**.

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 2003/04

Bryan Grenfell (University of Cambridge)
Site: Math Ecology CRG at University of Alberta
September 2003

Yuri Gurevich (Microsoft Research)
Site: Simon Fraser University
April, July 2003

Alexander Helemskii (Moscow State University)
Site: Dynamics CRG at University of Alberta
July - August 2003

Ashoke Sen (Harish-Chandra Research Institute)
Site: String Theory CRG at University of British Columbia
July 2003

Jeffrey D. Vaaler (University of Texas)
Site: Number Theory CRG at Simon Fraser University
June 2003

Bryan Grenfell (U. Cambridge).

Bryan Grenfell of the University of Cambridge was the PIMS Distinguished Chair in Mathematical Ecology in September 2003. He gave five lectures with two at the University of Alberta, one overview lecture at UBC, and two more lectures at the University of Calgary. These lectures were videotaped and will be made available on the web. Notes from his talks will also be made available.

His talks were entitled:

- *Comparative dynamics of childhood microparasitic infections and the impact of vaccination*
- *Waves, sparks and wavelets: measles in space and time*
- *Childhood infections in space and time*
- *Dynamics and evolution of pathogens*
- *Dynamics and control of foot and mouth disease*

For more information please see **www.pims.math.ca/science/2003/distchair/grenfell/**.

Yuri Gurevich (Microsoft Research).

Yuri Gurevich was a PIMS Distinguished Chair at Simon Fraser University in 2003. In April he gave one lecture on *Executable Specifications: The Abstract State Machine Approach* and in July he spoke twice about *The Theory of Abstract State Machines*.

Yuri Gurevich is Senior Researcher at Microsoft Research in Redmond, WA. He heads the group on Foundations of Software Engineering. Dr. Gurevich started his career as an algebraist. Later he became a logician. Then

he moved to computer science, where his main projects have been Abstract State Machines, Average Case Computational Complexity, and Finite Model Theory. Dr. Gurevich has been honored as Dr. Honoris Causa of the University of Limburg, Belgium (1998), a Fellow of the Association for Computing Macinery (1996), as well as a Fellow of the John Simon Guggenheim Memorial Foundation (1995).

These lectures were organized by Alistair Lachlan, Uwe Glässer and Evgenia Ternovska (SFU).

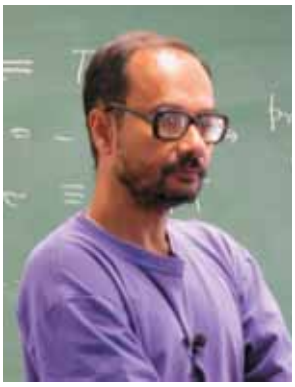
For more information or to watch his lectures please see **www.pims.math.ca/science/2003/distchair/gurevich/**.

The 2003 holder of the PIMS Distinguished Chair in Dynamics at the University of Alberta was **Alexander Ya Helemskii** of Moscow State University. He arrived in Edmonton on July 11 and stayed until August 13. Besides giving a series of four lectures as PIMS Distinguished Chair, he participated in the 16th international conference on Banach Algebra (Banach Algebras and their Applications, July 27 to August 9 — another PIMS sponsored event), where he chaired a workshop on his speciality: topological homology.

Alexander Yakovlevich Helemskii is a professor of the Chair of Function Theory and Functional Analysis at Moscow State University in Russia. Among his many results, one of the most notable is his global dimension theorem: A commutative Banach algebra with infinite character space has global homological dimension at least two. He is the author of more than fifty research papers and of two books, as well as the editor of a third one.

His lecture notes may be downloaded from **www.pims.math.ca/science/2003/distchair/helemskii/**

As part of the summer programme in string theory, UBC hosted **Ashoke Sen** as PIMS distinguished speaker. Professor Sen is one of the most influential string theorists in the world, leading the recent effort aimed at understanding tachyon dynamics in open string theory, one of the most active research areas in string theory. This was the topic of his 5 lectures in Vancouver.



Ashoke Sen (Harish-Chandra Institute).

Professor Sen was educated in India, and Obtained his PhD from State University of New York at Stony Brook. He completed postdoctoral appointments in SLAC (Stanford) and Fermilab (Chicago). He joined the faculty of the Tata institute in Mumbay in 1988, and the Harish-Chandra research institute in Allahabad in 1995.

Professor **Jeffrey Vaaler** from the University of Texas at Austin Prof. Vaaler was a PIMS Distinguished Chair at Simon Fraser University in 2003. During his time there he was the keynote speaker for the PIMS summer programme on *Mahler Measure.* During the programme, Prof. Vaaler gave four very stimulating talks in his distinguished lectures series. Before his lectures series, there was a short graduate course, taught by Stephen Choi (SFU) and Mike Mossinghoff (Davidson College), serving as a preparation for the lecture series and later talks in the programme.

Jeffrey D. Vaaler (University of Texas).

Prof. Vaaler's lecture series has been videotaped and will be put on the PIMS website in the near future.

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.

Western Algebraic Geometry Seminar (WAGS)

September 13–14, 2003 at UBC

Organizers: Jim Bryan (UBC), James Carrell (UBC) and Sandor Kovacs (U. Washington).

The September 2003 Western Algebraic Geometry Seminar (WAGS) speakers were:
Dan Abramovich (Brown U): *Valuative criteria for stable complexes*
Gavril Farkas (U. Michigan): *The Mori cones of moduli spaces of pointed curves*
Sándor Kovács (U. Washington): *Recent advances in the Minimal Model Program, after Shokurov, I*
James McKernan (UC, Santa Barbara): *Recent advances in the Minimal Model Program, after Shokurov, II*
Alexander Polishchuk (Boston University): *A-infinity homogeneous coordinate rings*
Bernd Sturmfels (UC, Berkeley): *Tropical Algebraic Geometry*
Ravi Vakil (Stanford U): *A geometric Littlewood-Richardson rule*

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.

November 8, 2003 at U. Victoria

Organizers: Frank Ruskey (chair), Jing Huang, Gary MacGillivray and Wendy Myrvold (U. Victoria).

The speakers were:
Steph van Wilgenburg (UBC): *Enumerative Properties of Ferres Graphs*
Peter Horak (U. Washington): *Graph Theory as an Integral Part of Mathematics*
Rick Brewster (University College of the Cariboo): *Categorical Aspects of Graph Homomorphins*
Zdenek Ryjacek (U. of Western Bohemia): *Closure Concept, Contractible Subgraphs and Hamiltonian Properties of Line Graphs*

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.

April 26-27, 2003 at PIMS-UBC

This meeting drew over 30 participants from other participating PNGS institutions, including Oregon State University, University of Oregon, and University of Washington.

Parts of S.-T. Yau's lecture were filmed by a TV crew and may appear in an upcoming documentary about the Fields medallist!

The five speakers were:
Tobias Colding (Courant Institute)
Jim Isenberg (U. Oregon)
Michael Kapovich (U. Utah)
Jun Li (Stanford)
S.-T. Yau (Harvard)

October 25-26, 2003 at Portland State University

There were five speakers at this meeting:
Michael Anderson (SUNY, Stony Brook): *Surgery construction of Einstein metrics*
Christine Escher (Oregon State): *The topology of manifolds with nonnegative sectional curvature*
Victor Guillemin (MIT): *Signature quantization*
Matthew Gursky (U. Notre Dame): *A notion of maximal volume in conformal geometry and some applications*
Rafe Mazzeo (Stanford): *Positive Scalar Curvature and Poincaré-Einstein Fillings*

PNW Number Theory Seminar

April 5–6, 2003 at U. Washington

The 7th Annual PNW Number Theory Seminar was organized by **Ralph Greenberg** and **Joe Buhler** with support from the University of Washington Milliman Fund, the Number Theory Foundation, Reed College, and PIMS.

About 40 people attended the conference, including graduate students and faculty members from universities in the Pacific Northwest and as far as the University of Chicago. The lectures covered a diverse set of topics in number theory.

The speakers were:
Michael Bennett (UBC): *Perfect Powers from Progressions*
Joe Buhler (Reed College): *The Probability that a p-adic Polynomial Splits*
Cheewhye Chin (UC, Berkeley): *Lafforgue's Work on the Langland's Correspondence over Function Fields*
Stephen Choi (SFU): *Small Prime Solutions for Quadratic Equations with Five Variables*
Henry Cohn (Microsoft): *Horosphere Packings*
Karl Rubin (Stanford): *Kolyvagin Systems*

PIMS Number Theory Day December 5, 2003 at SFU

Organizers: Michael Bennett (UBC), Peter Borwein (SFU), David Boyd (UBC), Imin Chen (SFU), Stephen Choi (SFU)

The invited speakers were:
Valentin Blomer (University of Toronto)
Alina Cojocaru (Princeton University)
Benjamin Green (PIMS)
Friedrich Littmann (PIMS)
Nathan Ng (University of Montreal)
Robert Osburn (Queen's University)
Christopher Rowe (PIMS)

PNW Numerical Analysis Seminar

October 4, 2003 at U. Washington

The Seventeenth Annual Pacific Northwest Numerical Analysis Seminar was hosted by the University of Washington.

Organizers:Randy LeVeque, Anne Greenbaum, and Loyce Adams (U. Washinton)

The speakers were:
Jonathan Goodman (NYU): *Accuracy Measures for Discretizations of Stochastic Differential Equations*
Marsha Berger (NYU): *Time-Dependent Methods for Cartesian Grids with Embedded Geometry*
Yun-Qiu Shen (WWU): *Solving Nonlinear Algebraic Systems Using the Singular Value Decomposition*
Ian Mitchell (UBC): *Level Set Methods for Contrained Path Planning and for Reachable Sets*
Boualem Khouider (UVic): *Asymptotic Modeling for Large Eddy Simulations of Turbulent Premixed Flames*
Michel Pettigrew (UW): *Stochastic Modeling of Signal Transduction in T Cells*
William Ferng (Boeing): *Matrix Eigen Formulation for Model Correlation*

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 9–10, 2003 at U. Washington

The Spring West Coast Optimization meeting was a great success bringing together over 40 researchers in optimization and variational analysis. The Spring meeting was a particularly memorable occasion since it coincided with **R. Tyrrell Rockafellar**'s retirement from the University of Washington. It was only fitting that the meeting was dedicated in honour of Professor Rockafellar's lifelong seminal contributions to the subject. Each of the invited speakers reminisced about the formative impact of Terry's research on their past and current research.

It was a truly joyous and inspiring event full of lively mathematical discussion as well as personal recollections of intellectual as well as wilderness explorations and adventures with Terry. Many of those in attendance recalled the thrill of collaborating with Terry while kayaking, x-country skiing, or trekking in the wilderness. Now that Terry is retired one can be sure that these mathematical back-country trips will be occurring with greater frequency. It must be something about intimately experiencing mountain passes and riptides that inspires a deeper insight into minimax theory and non-smooth analysis.

Asen Dontchev (U. Michigan, AMS) kicked off the morning session talks with a discussion of his joint work with Terry on metrically regular mappings and some recent work on selection theorems for such mappings.

Then **Mirjam Duer** (Darmstadt U. Technology) described a new probabilistic branch and bound method for solving non-convex optimization problems and its convergence theory.

Lucien Polak (UC, Berkeley) followed by describing the use of augmented Lagrangian techniques in the solution of generalized semi-infinite optimization problems.

Jong-Shi Pang (Johns Hopkins) began the afternoon session by discussing the connections between optimization and the theory and interpolation of continuous M-estimators.

Roger Wets followed by analyzing various notions of convergence for bi-variate functions giving examples from game theory.

Boris Mordukhovich (Wayne State U) then spoke on subdifferential and superdifferential optimality conditions in non-smooth optimization.

Ivar Ekeland (UBC & PIMS) concluded the programme by discussion the duality theory for functions of the determinant at one point producing his notes of a lecture given by Terry in 1968. The notes were still relevant to the topic at hand.

October 3–4, 2003 at SFU

The speakers were:
Jonathan Borwein (SFU): *CoLab One function variational principles*
Ian Coope (U. Canterbury, NZ): *NZ Grids and Frames in Computational Optimization*
John Dennis (Rice University): *Mesh Adaptive Direct Search Algorithms*
Rafal Goebel (UC, Santa Barbara): *Optimality, stability, and duality of value functions for convex control problems*
Chris Hamilton (SFU CoLab): *Symbolic (Computational) Convex Analysis*
Adrian Lewis (CECM, SFU): *The structured distance to ill-posedness for conic systems*
Terry Rockafellar (U. Washington): *Regularity and Conditioning of Solution Mappings in Variational Analysis*

PNW PDE Seminar

PDEfest, June 17, 2003 at PIMS-UBC

The speakers were:
Jingyi Chen (UBC): *Moving lagrangian submanifolds by mean curvature*
Richard Froese (UBC): *Some new examples of discrete Schrödinger operators with absolutely continuous spectrum*
Nassif Ghoussoub (PIMS & UBC): *The mother of many geometric inequalities*
Changfeng Gui (UBC): *Symmetry of minimizers*
Tai-Peng Tsai (UBC): *Asymptotic Stability and Completeness in Energy Space of Nonlinear Schrödinger Equations with Small Solitary Waves*

Cascade Topology Seminar

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 theire housing cost.

May 17–18, 2003 at Portland State University

The speakers were:
Marta Asaeda (U. Maryland, College Park)
Dan Dugger (U. Oregon): *Motivic Cell decompositions*
Jens Harlander (U. Frankfurt): *Finiteness properties of groups*
Uwe Kaiser (Boise State U.): *Skein theory and the topology of mapping spaces*
Justin Roberts (UC, San Diego)

November 1–2, 2003 at University of Oregon, Eugene

The speakers were:
Kristine Baxter (U. Calgary): *Classifications of Degree N Functors*
Gunnar Carlsson (Standford): *Derived Completion and Representation Varieties*
Gregor Masbaum (Paris VII): *Integral Structures in TQFT*
Jack Morova (John Hopkins U.): *Two-Categories and Four Manifolds*
Julia Pevtsova (U. Oregon): *Rank Varieties and Classification of Thick Subcategories for Finite Dimensional Hopf Algebras*
Peter Teichner (U. California): *Embedding N-Complexes into 2n-Space*

PNW String Seminar

November 15–16, 2003 at PIMS-UBC

The meeting is cosponsored by PIMS and the Pacific Institute for Theoretical Physics.

The speakers were:
Dominic Brecher (UBC)
Michael Gutperle (UCLA)
Shamit Kachru (Stanford University)
Andreas Karch (University of Washington)
Albion Lawrence (Brandeis University)
Hirosi Ooguri (Caltech)
Stephen Shenker (Stanford University)
Matthew Strassler (U. Washington)

December 4–5, 2003 at U. Washington

Organizers: Mina Aganagic, Charles Doran, Andreas Karch and Matthew Strassler (U. Washington).

This seminar was supported by PIMS, the Milliman Fund at the UW Department of Mathematics, the U.S. Department of Energy, and the Dean of the UW College of Arts and Sciences.

The theme was *Mathematical Aspects of Open-Closed String Dualities.*

The speakers included:
Mina Aganagic (UW): *Topological Strings and Integrable Hierarchies*
Adrian Clingher (Stanford): *Mathematics Underlying the F Theory/Heterotic String Duality in Eight Dimensions*
Charles Doran (UW): *Integral Structures, Toric Geometry, and Homological Mirror Symmetry*
Ezra Getzler (Northwestern): *Moduli Spaces of Riemann Surfaces with Boundary and Gromov-Witten Invariants*
Sergei Gukov (Clay/Harvard): *Topological Gravity in Various Dimensions*
Kentaro Hori (Toronto): *Orientifolds of Gepner Models*
Ken Intriligator (UCSD): *$U(1)_R$ and flavor charges, and open-closed string dualities*
Amer Iqbal (Harvard): *Quantum Foam and Topological Strings*
Melissa Liu (Harvard): *Formulas of one-partition and two-partition Hodge integrals*

Alberta IO Conference

October 24–25, 2003 at U. Alberta

Organisers: Andrew Eckert (U. Alberta) and Douglas S. West (U. Alberta).

The second Alberta Conference on Industrial Organization focused on experimental studies of game theory, the theory of the firm, and the effect of exchange rate movements on the survival and productivity of firms.

The speakers were:
John Boyce (U. Calgary): *Learning to Play Nash: The Case of Unstable Equilibria (with Rob Oxoby)*
Sungchul Choi (U. Alberta): *Unpredictability and Mixed-Strategy Pricing: An Experimental Study of Competitive Price Promotional Strategies (with Paul R. Messinger)*
Greg Dow (SFU): *Appropriation, Information, and the Structure of the Firm*
Curtis Eaton (U. Calgary): *Reciprocal Altruism and the Theory of the Family Firm*
Loretta Fung (U. Alberta): *Large Real Exchange Rate Movements, Firm Dynamics, and Productivity Growth*

PIMS Lecture Series

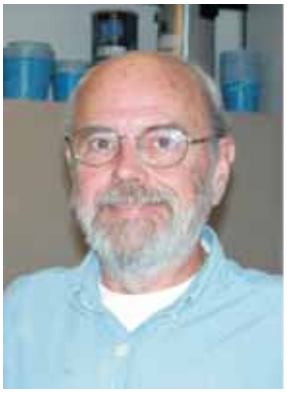
PIMS lectures series include:
- PIMS Algebraic Geometry Seminar at UBC
- PIMS Algebraic Topology Seminar at UBC
- PIMS Distinguished Lecture Series at PIMS Sites
- PIMS Distinguished Series in Scientific Computing at UBC
- PIMS-MITACS Math Biology Seminar at U. Alberta
- PIMS Number Theory Seminar at UBC and SFU
- PIMS PDE/GEOMETRY Seminar at UBC
- PIMS Problems In Discrete and Combinatorial Math Seminar at UBC
- PIMS String Theory Seminar at UBC
- PIMS-Shell Lunchbox Lecture Series at Shell Centre, Calgary
- IAM-PIMS Joint Distinguished Colloquium Series at UBC
- PIMS-MITACS Financial Seminar Series at UBC
- PIMS/MITACS Mathematical Biology Seminars at UBC
- Centre for Scientific Computing Seminar—A PIMS/MITACS Event at SFU
- SFU-UBC Biannual Distinguished Series in Scientific Computing

PIMS Algebraic Geometry Seminars, UBC

Organisers: Andrei and Anca Mustata (Math, UBC)

The 2003/04 seminars included:
Andrei Mustata (UBC): *Intermediate Moduli Spaces and Stable Maps*, September 18, 2003
Lawrence Ein (University off Illinois at Chicago): *Multiplier Ideals and their Applications*, September 23, 2003
Jacob Shapiro (UBC): *A Study of the Gopakumar-Vafa Conjecture for Local K3-Survaces*, September 25, 2003
Zinovy Reichstein (UBC): *Cayley Maps for Algebraic Groups*, October 2, 2003
Kiumars Kaveh (UBC): *Carrell-Lieberman Theorem and the Cohomology Ring of Toric Varieties*, October 16, 2003
Ajneet Dhillon (UBC): *Cohomology of the Moduli of Stable Bundles*, October 23, 2003
Jaydeep Chipalkatti (UBC): *Degenarcy Loci of Transvectant Morphisms,* October 30, 2003
Jim Carrell (UBC): *Singularities of Schubert Varieties*, November 6, 2003
Kai Behrend (UBC): *Using Vector Fields to Compute Cohomology of Stable Map Spaces II,* November 27, 2003

PIMS Algebraic Topology Seminars, UBC



Organizer:
Dale Rolfsen (Math, UBC).

The 2003/04 seminars included:
Bert Wiest (University of Rennes): *Relaxation Algorithms in Braid Groups: A Linear Bound*, April 30, 2003
Kee Y. Lam (UBC): *PNonsingular Bilinear Mass Near the Hurwitz-Radon Range*, September 17, 2003
Dale Rolfsen (UBC): *Knot Theory and 3-Dimensional Manifolds,* September 24, 2003
Denis Sjerve (UBC): *Symmetries of Surfaces*, October 1, 2003

PIMS Distinguished Lecture Series, PIMS Sites

Organisers: PIMS Site Directors

The 2003/04 lectures included:
Klaus Schmidt (University of Vienna and Director of the Erwin Schroedinger Institue for Mathematical Physics): *Mahler Measure, Factors of Markov Shifts and Symbolic Representations of Group Automorphisms*, May 8, 2003
Stephen Cook (University of Toronto): *The P vs. NP Problem and its Place in Complexity Theory*, October 17, 2003

PIMS Distinguished Series in Scientific Computing, UBC

***Organizers**: Uri Ascher and Chen Greif (Computer Science, UBC), l–r.*

Additional support was provided by the NSERC grants of the organizers and by the Institute of Applied Mathematics at UBC.

The 2003/04 lectures were:
Heinz W. Engl (Industrial Mathematics Institute, Johannes Kepler Universität, Austria): *Iterative Regularization of Nonlinear Inverse Problems*
Pat Hanrahan (Computer Science, Stanford U.): *Why is Graphics Hardware so Fast? Implications for Scientific Computing*
Tom Hou (Applied Mathematics, CalTech): *Multiscale Modelling and Computation of Flow in Heterogeneous Media*
Jorge Nocedal (Electrical & Computer Engineering, Northwestern U.): *The New Faces of Nonlinear Optimization*
Andy Wathen (Oxford U. Computing Lab): *Preconditioning in Scientific Computation*

PIMS-MITACS Math Biology Seminar, U. Alberta

Organizer:
Mark Lewis
(Math, University of Alberta).

The 2003/04 PIMS funded seminars were:
Dr. Bryan Grenfell (PIMS Distinguished Visitor, Zoology, Cambridge U.): *Comparative dynamics of childhood microparasitic infections and the impact of vaccination*, September 11, 2003
Dr. Bryan Grenfell (PIMS Distinguished Visitor, Zoology, Cambridge U.): *Waves, sparks and wavelets: measles in space and time*, September 15, 2003
Bo Deng (University of Nebraska-Lincoln): *Ecological Time Scales, Stability and Chaos*, October 24, 2003
Dr. Bernard Roitberg (Biological Sciences, SFU): *The importance of behavior to malaria epidemiology*, November 24, 2003
Dr. James Watmough (Mathematics and Statistics, U. New Brunswick): *Disease transmission in human populations: simple models of a complex system*, December 9, 2003
Dr. Dan Coombs (UBC): *Chirality Inversions Propagating on Bacterial Flagella*, January 26, 2004
Dr. Troy Day (Mathematics & Biology, Queen's University): *Modeling the Evolutionary Dynamics of Pathogen Virulence*, February 23, 2004
Dr. Michael Doebeli (Mathematics, UBC): *Adaptive speciation: theory and experiments,* Joint seminar with DE&DS, March 24, 2004
Dr. Christina Cobbold (Mathematics, University of Glasgow): *Modelling population cycles of insect assemblages in spatially structured habitat*, March 29, 2004
Dr. Birgitt Schoenfisch (Lehrstuhl Biomathematik University of Tuebingen): *Model-based analysis of proteasomal cleavage data*, April 5, 2004

PIMS Number Theory Seminar, UBC and SFU

Organisers:
Greg Martin (Math, UBC) and Stephen Choi (Math, SFU, picutred).

The 2003/04 seminars included:
Chris Skinner (University of Michigan): *p-adic L-functions for Unitary Groups and Stable/Endoscopic Congruences,* September 4, 2003
Chris Rowe (PIMS/SFU/UBC): *Coates-Wiles Towers for CM-Abelian Varieties,* September 4, 2003
Friedrich Littman (PIMS/SFU/UBC): *An extremal problem in Fourier analysis*, September 18, 2003
Ben Green (PIMS/SFU/UBC): *Roth's theorem in the primes*, September 18, 2003
Jozsef Solymosi (UBC): *Sums, products, and convexity*, October 2, 2003
Michael Bennett (UBC): *Euler's equation $x^y=y^x$ revisited*, October 2, 2003
Idris Mercer (SFU): *Probabilistic methods for unimodular polynomials*, October 16, 2003
Peter Borwein (SFU): *The Identify function in Maple IX: What is 8.5397342226?* (computer demonstration), October 16, 2003
Stephen Choi (SFU): *Quadratic equations with five prime unknowns*, October 16, 2003
Alexa van der Waall: *A demonstration of computations with differential rings and operators in Magma*, October 30, 2003
Nils Bruin (SFU): *Arithmetic Geometry with Magma*, October 30, 2003
Patrick Ingram (UBC): *Diophantine approximation and rational points on elliptic curves*, November 13, 2003
Keshav Mukunda (SFU): *Pisot numbers that are roots of Littlewood polynomials*, November 13, 2003
Ron Ferguson (MITACS/SFU/UBC): *Zeros of finite Dirichlet sums*, November 27, 2003
Imin Chen (SFU): *Diophantine equations and elliptic curves*, November 27, 2003
Mark Watkins (Penn State): *Solving Systems of Polynomial Equations via Multidimensional p-adic Newton iteration*, January 15, 2004
Igor Shparlinski (Macquarie University, Sydney, Australia): *Character sums and congruences with n!*, February 12, 2004
Kevin O'Bryant (University of California, San Diego): *A one-dimensional tiling problem,* February 12, 2004
Andy Pollington (Brigham Young University): February 27, 2004
Peter Borwein (SFU): *The Mahler measure of polynomials with odd coefficients*, March 11, 2004
Nicholas Ramsey (Harvard University): *Geometric and p-adic modular forms of half-integral weight,* March 11, 2004
David Grant (University of Colorado, Boulder): *On almost rational torsion points*, March 25, 2004
Ravi Ramakrishna (Princeton): *Constructions of Semisimple p-adic Galois Representations with prescribed properties*, March 25, 2004

PIMS PDE/Geometry Seminar, UBC

Organiser:
Tai-Peng Tsai (Math, UBC).

The 2003/04 seminars included:
Francois Hamel (Universite of Aix-Marseille III): *Nonlinear Propagation of Fronts in Reaction-Diffusion Equations*, April 15, 2003
Robert Finn (Stanford University): *Unusual Comparison Properties of Capillary Surfaces*, May 8, 2003

PIMS Problems in Discrete and Combinatorial Math Seminar, UBC

Organisers: Stef Van Willingenberg (Math, UBC)

The 2003/04 seminars included:
Petr Lisonek (Simon Fraser University): *Caps in Binary Projective Spaces*, April 9, 2003
William Evans (UBC): *Scheduling to Minimize Video-on-Demand Delay*, September 9, 2003
William Evans (UBC): *Scheduling to Minimize Video-on-Demand Delay II*, September 30, 2003
Ben Green (UBC): *An Arithmetic Version of Szemeredi's Regularity Lemma*, October 7, 2003
Laura Chavez (Simon Fraser University): *Circular Chromatic and Flow Numbers of Matroids*, October 21, 2003
Kalle Karu (UBC): *Polytopes and Toric Varieties*, November 4, 2003
Gabor Tardos(Renyi Institute, Budapest): *Optimal Probabilistic Fingerprint Codes,* November 25, 2003

PIMS String Theory Seminar, UBC

Organizer:
Mark Van Raamsdonk (Physics, UBC).

These seminar continued to take place in 2003/04. The list of speakers is unavailable.

PIMS/Shell Lunchbox Lecture Series, Shell Centre, Calgary

Organizer:
Gary Margrave (U. Calgary).

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.

The 2003/04 seminars included:
Florin Diacu (University of Victoria): *The Birth of Chaos*, April 8, 2003
Hugh Cowie Williams (University of Calgary): *Cryptography, Psueudosquares and Number Sieves*, October 6, 2003
Jedrzej Sniatycki (University of Calgary): *SPurposefulness and Determinacy in Mechanics*, November 5, 2003
Donald M. Henderson (University of Calgary): *Dinosaurs and Differentials: Using Mathematics to Study Ancient Life*, November 12, 2003
Gerald Cole (University of Calgary): *Application of Forward Dynamics Simulation to the Study of Human Movement*, December 5, 2003
Karoly Bezdek (University of Calgary): *Densest Sphere Packings*, March 11, 2004
Ben D. Aggarwala (University of Calgary): *HIV/AIDS, A Comparison Between Canada and the United States*, March 19, 2004

IAM-PIMS Joint Distinguished Colloquium Series, UBC

Organizer:
Michael Ward (Director, IAM).

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

The 2003/04 seminars included:
Jorge Nocedal (Northwestern University): *The New Faces of Nonlinear Optimizations*, September 22, 2003
Harry Swinney (University of Texas Austin): *Spatial Patterns and Shock Waves in Sand*, October 6, 2003
Chris Bretherton (University of Washington): *Understanding the Circulation of the Tropical Atmosphere Using Simple Mathematical Models*, November 3, 2003
Mary Pugh (University of Toronto): *The Richness of Thin Films*, January 19, 2004
Stephen Boyd (Stanford University): *Recent Advances in Convex Optimization*, March 15, 2004

These lectures were taped and are available at **www.pims.math.ca/industrial/2003/iampims_lect/**.

PIMS-MITACS Financial Seminar Series, UBC

Organizer:
Ulrich Haussmann (Math, UBC).

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

The 2003/04 seminars included:
Emmanuel Gobet (Ecole Polythechnique): *Monte Carlo Methods in Finance*, April 1, 2003
Emmanuel Gobet (Ecole Polythechnique): *Monte Carlo Methods in Finance II*, April 3, 2003
Emmanuel Gobet (Ecole Polythechnique): *Application of Malliavin Calculus to the Computation of Greeks in Finance*, April 9, 2003
Emmanuel Gobet (Ecole Polythechnique): *Dynamics of a Two-Dimensional Continuum Model for Swarming*, April 10, 2003
Emmanuel Gobet (Ecole Polythechnique): *Approximation of Stochastic Processes: Beyond Markovian Techniques,* April 23, 2003
Florina Halasan (UBC): *Interest Rate Dynamics and Consistent Forward Rate Curves*, September 18, 2003
Ivan Bandic (UBC): *Princing Mortgage-Backed Securities and Collateralized Mortgage Obligation*, October 2, 2003
Ulrich Horst (Humboldt University, Berlin): *The Mathematical Modelling of Market Microstructure*, January 26, 2004
Ulrich Horst (Humboldt University, Berlin): *Probabilistic Interaction Systems in Economics and Finance*, January 28, 2004
Gordan Zitkovic (Carnegie Mellon University): *Optimal Consumption, Bipolar Theorems and Finitely-Additive Probability*, February 5, 2004
Gordan Zitkovic (Carnegie Mellon University): *Maximizing Utility in Financial Markets*, February 6, 2004
Adam Oberman (University of Texas): *Convergent Difference Schemes for Nonlinear PDEs from Mathematical Finance*, February 10, 2004
Professor Tom Hurd (McMaster University): *Indifference Pricing for Reciprocal Affine Stochastic Volatitily Models,* February 19, 2004
Dr. L. Luo (Financial CAD): *Credit Derivatives and their Implementation in FincadXL*, March 4, 2004
Erik Taflin (EISTI Paris): *Optimal Management of Bond Portfolios*, March 25, 2004

PIMS/MITACS Mathematical Biology Seminars, UBC

Organiser:
Leah Keshet (Math, UBC).

The 2003/04 seminars included:
Dr. Daniel Promislow (University of Georgia): *A Network Perspective on the Evolutionary Genetics of Aging*, April 3, 2003
Dr. Chad Topaz (Duke University): *Dynamics of a Two-Dimensional Continuum Model for Swarming*, April 10, 2003
Dr. Nathaniel Newlands (UBC): *Fishery-Independent Abundance Estimation of Atlantic Bluefin Tuna (Thannus Thynnus) in the Gulf of Maine: Integrating Tracking, Tagging and Aerial Survey Data*, April 17, 2003
Carol Huang, Adriana Dawes, Clive Glover (UBC): *Project Presentations,* May 1, 2003
Professor Linghai Zhang (Lehigh University, Pennsylvania): *On the Stability of Traveling Wave Solutions of Integral-Differential Equations Arising from Synaptically Coupled Neuronal Networks,* May 22, 2003
Leah Edelstein-Keshet (UBC): *Mathematical Biology of Cellular and Biomedical Problems*, June 5, 2003
Ross Cressman (Wilfred Laurier University): *Coevolution and the Stationary Density Surface*, June 10, 2003
Leonardo Huato (Vancouver, BC): *Predicting Migratory Route and Behaviour of Migratory Fieshes: A Fitness-Based Approach to the Modelling of the Juvenile Migration of Sockeye Salmon*, June 19, 2003
Fred Brauer (UBC): *Population Harvesting*, June 24, 2003
Ryan Gutenkunst (Cornell University): *Analysis of Movement Pattern of Bluefin Tuna in Homogeneous and Hetergeneous Environments*, August 18, 2003
Laurent Pujo-Menjouet (Centre for Nonlinear Dynamics, McGill): *Analysis of Cell Kinetics Using a Cell Division Marker: Mathematical Modeling of Experimental Data*, August 21, 2003
Eiwoo Lee: *Singular Perturbation Methods in Bursting Phenomenon*, August 26, 2003
Brian Grenfell (University of Cambridge, UK): *Childhood Infections in Space and Time*, September 17, 2003
Thomas Hillen (University of Alberta): *L^2-Movement Closure of Transport Equations and Applications in Biology*, October 8, 2003
Roy Adler (IBM Thomas Watson Research Lab, New York): *Scoliosis*, October 15, 2003
David Brian Walton (University of Washington): *Using Hidden*

Markov Models to Analyze Single-Molecule Motor Protein Experiments, October 29, 2003
Elena Braverman (University of Calgary): *Logistic Equations with Harvesting,* November 5, 2003
Fred Brauer (UBC): *Some Simple Models for Disease Outbreaks*, November 12, 2003
Dr. Daniel Pauly (Fisheries Center, UBC): *Turning Fisheries Statistics into Insights: The Global Impact of Fisheries on Marine Ecosystems*, November 18, 2003
Viktoria Hsu (University of Washington): *Mechanistic Modeling of Cell Membrane Potentials Via a Quasi Steady State Approximation*, November 19, 2003
Peter Cripton (UBC): *Kinematics of the Human Spine*, December 3, 2003
Ridgway Scott (University of Chicago): *Simulating Novel Materials*, December 10, 2003
Robert M. Miura (New Jersey Institute of Technology): *Spreading Depression: A Paradigm for Understanding Basic Brain Mechanisms*, January 15, 2004
Eric Cytrynbaum (UC Davis & UBC): *Experimental and Computational Studies of Mitotis Spindle Morphorphogenesis*, January 28, 2004
Judith Miller (Georgetown University): *A Finite Locus Effect Diffusion Model for the Evolution of a Quantitative Trait*, February 4, 2004
Adriana Dawes (UBC): *The Establishment of Cell Polarity in the Early C. Elegans Embryo,* February 11, 2004
Rachel Bearon (University of Washington): *Swimming Micro-Organisms: From Individual Trajectories to Population Distributions,* February 25, 2004
Colin Clark (UBC): *Fisheries Management: The Problem of Excess Capacity*, March 3, 2004
Andrew MacDougall (UBC): *Predictable Unpredictability in a Disturbance-Dependent Ecosystem*, March 10, 2004
Carlos Castillo-Chavez (Arizona State University): *Cross-Immunity as a Mechanism for Multiple Strain Co-Existence: The Case of Influenza A*, March 17, 2004
Michael Gilchrist (University of New Mexico): *Modelling Host-Parasite Coevolution and Intra vs. Inter-Host Selection Through the Use of Nested Models*, March 24 2004
Yue Xian Li (UBC): *Models of Ideal Schooling Behaviour*, March 31, 2004

Organizer:
Bob Russell
(CSC Director).

Tobias Schaefer (University of North Carolina): *Nonlinear Pulse Propagation in Optical Fibers*, May 15, 2003
Charles Hansen (University of Utah): *Leveraging PC Graphics Cards for Advanced Visualization*, May 16, 2003
Tamara Munzner (UBC): *TreeJuxtaposer: Scalable Tree Comparision Using Focus+Context with Guaranteed Visibility,* June 27, 2003
Michiel van de Panne (UBC): *Control for Simulation Human and Animal Motion*, July 11, 2003
Arnold Kim (Stanford): *Light Propagation in Biological Tissues*, September 19, 2003
Bruce Sutherland(University of Alberta): *Gravity Wave Tunnelling*, October 10, 2003
David Muraki (Simon Fraser University): *Tales of the Nonlinear: A Simple Illustration of a Spectral Cascade*, October 31, 2003
Dominik Schoetzau (UBC): *Mixed Discontinuous Galerkin Methods for Saddle Point Problems*, November 7, 2003
Ian Mitchell (UBC): *Level Set Methods for Contrained Path Planning and for Reachable Sets*, November 14, 2003
Alla Sheffer (UBC): *Mapping Textures to Model*, November 21, 2003
Anna Celler (Vancouver Hospital and Health Sciences Centre): *Quantitative and Dynamic SPECT Imaging*, January 16, 2004
Mario Szegedy (Rutgers University, New Brunswick): *Quantum in Computer Science*, January 16, 2004
Sarah Mitchell (UBC): *Application of the Box Scheme to Reactive Transport Problems*, February 20, 2004
Robert Bridson (UBC): *Scalable Collision Resolution in Computer Animation*, March 12, 2004
Anja Sturm (UBC): *Family Ree of Genes Under the Influence of Selection and Mutation,* March 19, 2004

Centre for Scientific Computing Seminar, a PIMS/MITACS Event, SFU

The 2003/04 seminars included:
Peter Palffy-Muhoray (Kent State University): *Phase Separation in Binary Liquid Crystal Mixtures*, April 4, 2003
Edward J. Kansa (Laurence Livermore National Laboratory): *A Volumetric Radial Basis Function Formulation for the Time Dependent Solution of Partial Differential Equations*, April 25, 2003

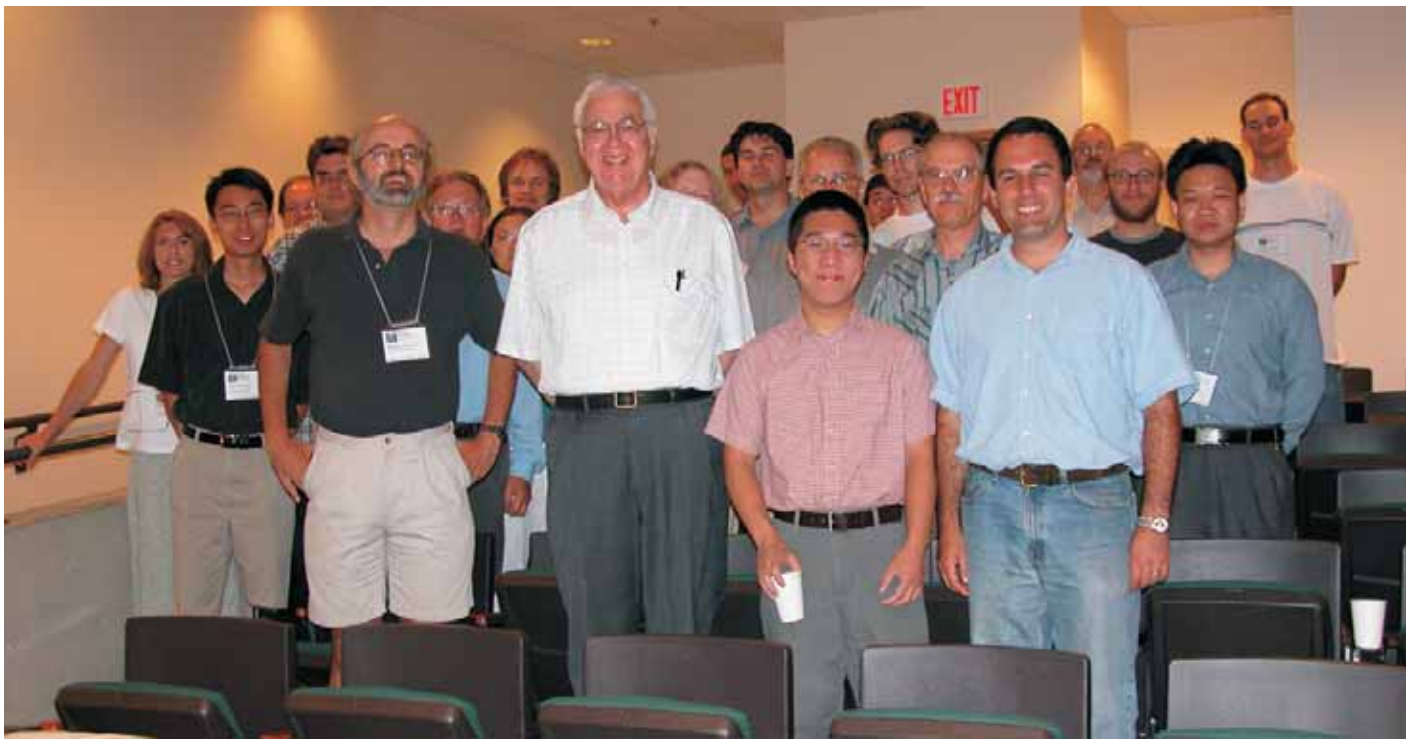
SFU-UBC Biannual Distinguished Series in Scientific Computing

Funding for this new event is provided by PIMS, MITACS and the SFU Centre for Scientific Computing (CSC).

The 2003/04 speaker was:
Barry Merriman (UCLA): *Biological Molecular Algorithms—A Mathematicians Perspective on Molecular Biology*, March 5, 2004

III. GENERAL SCIENTIFIC EVENTS

The Crystal Group who held their second workshop at PIMS-UBC on January 3–4, 2004: Standing, from left-right, are Naveen Vaidya (York), Shuqing Liang (York), Mike Ebbehoj (UBC), Thomas Brakel (UBC/Cape Town), Colin Carrew (Firebird Semiconductors), Ian Frigaard (UBC). Sitting are C. Sean Bohun (Penn State) and Bill Micklethwaite (Firebird Semiconductors). Missing are Huaxiong Huang (York), Tim Myers (Cape Town) and Yuri Skrynnikov (UBC).



Participants of the Workshop on Numerical Linear Algebra and Applications which was held at UBC, August 4–8, 2003.

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 vigourous dialogue between the mathematical sciences and the other disciplines.

This section describes the extra-thematic scientific activities of the institute. Each workshop has its own organizing committee and they are mostly held in the various PIMS sites. The selection and funding decisions are made by the Scientific Review Panel.

Graph Theory of Brian Alspach

SFU, May 25–29, 2003

Organisers: Pavol Hell (SFU, chair), Gena Hahn (U. Montréal, cochair), C-Q Zhang (West Virginia U, cochair), Luis Goddyn (SFU), Wolf Holzmann (U. Lethbridge), Hadi Kharaghani (U. Lethbridge), Jiping Liu (U. Lethbridge) and Joy Morris (U. Lethbridge).

This special event was held in honour of the 65th birthday of **Brian Alspach**. There were twenty invited plenary talks spread over the five days, in addition to daily sessions of contributed talks. Many of the talks focused on areas of research in which Brian's own work has been particularly influential, including graph decomposition problems, hamilton cycles, Cayley graphs and vertex-transitive graphs.

Brian Alspach (SFU).

The invited speakers ranged from some of the best-known, most respected mathematicians in graph theory, to mathematicians still establishing their careers; but they all clearly shared a deep admiration and respect for Brian's work, and many anecdotes throughout the week described his impact on the lives and research of everyone present. In keeping with Brian's tradition of encouraging and helping promising young mathematicians, graduate students were welcomed to the conference, and most talks were pitched at a suitable level for their comprehension. There were 103 registered participants at the conference, 21 of whom were graduate students. Mathematicians came from more than 10 countries around the world, including France, England, Germany, Slovenia, New Zealand, Puerto Rico, Spain, Japan, India and the United States, demonstrating the widespread influence that Brian has had on graph theory. The invited talks generally provided some history and an overview of work on a particular problem, leading up to some of the speaker's recent research. In this way, current cutting-edge research and open problems were presented without an excess of technical detail. The background provided by these presentations often proved useful in some of the shorter, more technical contributed talks. The focus of the conference, on Brian's work, gathered a group of mathematicians who are not often brought together. This provided an exciting, dynamic environment where many ideas were exchanged, acquaintances renewed, and new collaborative relationships were formed that may last for many years. Despite the demanding schedule, participants enjoyed themselves, and left with a much better understanding of many research problems.

The Invited Speakers were:
J. Adrian Bondy (U. Lyon 1 and U. Paris 6): *The Erdos-Posa property for long circuits*
Ted Dobson (Mississippi State U): *On groups of odd prime-power degree that contain a full cycle*
Luis Goddyn (SFU): *Explaining Youngs' bimodality phenomenon for embedded graphs*
Chris Godsil (U. Waterloo): *Colouring interesting graphs*
Gena Hahn (U. Montréal): *And now for something somewhat different (what you may not know about Brian Alspach)*
Pavol Hell (SFU): *Homomorphisms of graphs with bounded degrees*
Bill Jackson (Queen Mary, U. London): *Connected rigidity matroids and unique realizations of graphs*
H.A. Jung (TU Berlin): *Degree estimates for the circumference of graphs*
Curt Lindner (Auburn U): *A brief history of embedding partial 4-cycle systems*
Jim Liu (U. Lethbridge): *A characterization of pancyclic complements of line graphs*
Dragan Marusic (U. Ljubljana): *Symmetry in graphs - some open problems*
Joy Morris (U. Lethbridge and Oklahoma State U.): *Hamiltonian paths and cycles in vertex-transitive graphs and di-graphs, On automorphisms of circulant graphs*
Brooks Reid (California State U, San Marcos): *Tournaments in which every arc is in a Hamiltonian path*
Alex Rosa (McMaster U):
Moshe Rosenfeld (U. Washington, Tacoma): *Variations on Hamiltonian themes*
Gert Sabidussi (U. Montréal): *Subholomorphic Cayley graphs*
Mateja Sajna (U. Ottawa): *Cycle decompositions: the past, present, and future*
Wal Wallis (Southern Illinois U): *Totally magic graphs*
Cun-Quan Zhang (West Virginia U): *Chords of longest circuits in 3-connected graphs*

11th Annual Conference of the CFD Society if Canada
Vancouver, May 28–30, 2003

Organisers: Carl Ollivier-Gooch (UBC, chair), Susan Allen (UBC), Luc Bauwens (U. of Calgary), Eric Bibeau (American Flow Technology), Todd Chisholm (U. of Toronto), Ned Djilali (U. of Victoria)

The invited speakers were:
Andre Garon (Ecole Polythechnique): *CFD Design and Optimization of Heart Pumps*
Greg Flato (Victoria): *The Developement and Application of Global Climate Models*
Hongtan Liu (U. of Miami): *Application of CFD in PEM Fuel Cell Modeling*

PIMS-MITACS Summer School on Quantum Information Science
U. Calgary, June 23–27, 2003

Organizers: Richard Cleve, Peter Høyer and John Watrous (U. Calgary).

The goal of the PIMS-MITACS Summer School on Quantum Information Science is to introduce a general audience of computer scientists, physicists, and mathematicians with little or no background in quantum information science to this exciting field. The school will consist of five days of talks that will cover the basics of quantum computation and information as well as several advanced topics.

Specific topics to be covered included:
• quantum algorithms: quantum Fourier transforms and Shor's algorithm
• quantum algorithms: amplitude amplification and continuous time paradigms
• quantum information theory and entanglement
• quantum cryptography
• quantum error correcting codes
• fault-tolerant quantum computation
• physical implementations of quantum information processing devices
• non-locality and quantum communication complexity
• quantum complexity theory

The speakers included:
Andrew Childs (MIT): *Continuous-time quantum paradigms*
Richard Cleve (U. Calgary): *Introduction to Quantum Information; Quantum communication complexity*
Ronald de Wolf (CWI): *Quantum lower bounds*
Peter Høyer (U. Calgary): *Quantum Fourier Transforms and Shor's Algorithm; Amplitude amplification*
Brian King (McMaster U.): *Physical Implementations of quantum computer*
Raymond Laflamme (U. Waterloo & Perimeter Institute): *Quantum computing by linear optics*
Michele Mosca (U. Waterloo and Perimeter Institute): *Basic Quantum Algorithms;* Quantum Searching
John Preskill (Caltech): *Quantum error correcting codes and quantum cryptography*
Alain Tapp (U. Montreal): *Nonlocality; Quantum complexity theory*
John Watrous (U. Calgary): *Open problems; Mathematical foundations of quantum information; Quantum complexity theory*

For more information and registration please see **www.pims.math.ca/industrial/2003/ssqis/**.

Workshop on Structural Graph Theory
PIMS-UBC, July 9–19, 2003

In July 2003, a small group of researchers gathered together for 10 days at the PIMS UBC facility to work together on a number of problems in structural graph theory. The main focus was on parity minors and generalizations to Matroid theory. The collaboration was fruitful and at least five papers will result from work carried out during the meeting. PIMS was a perfect location for such a meeting. The staff arranged the housing, computers accounts, rooms in which to work, and coffee breaks. We enjoyed the stunning landscape on and around the campus and the glorious weather. The participants initially focused on the *odd path packing* problem: "How many odd-length disjoint paths having endpoints in a prespecified set of vertices, exist in a given undirected graph?" They solved a generalization of this problem concerning "non-zero" paths in graphs whose arcs have group-valued weights. For example, one can substitute "noncontractible" for "odd-length" in the case of embedded graphs. Additionally, one can substitute "nonmonochromatic" for "odd-length" in the case of coloured graphs. Progress was also made on problems related to perfect graphs, matroids, and the structure theory of signed graphs. For more information please see **www.pims.math.ca/science/2003/structural/**.

CECM 2003: Computational Mathematics
SFU, July 31, 2003

The Centre for Experimental and Constructive Mathematics (CECM) hosted this summer workshop. The talks and poster session covered diverse topics in mathematics with an emphasis on computation. This event was co-sponsored by PIMS, Maplesoft, the developer of Maple, and MITACS.
The speakers were:
Jonathan Borwein (SFU): *On the AG fraction of Ramanujan*
Edgardo Cheb-Terrab (MITACS, SFU and Maplesoft): *Special Function solutions to linear ODEs and new facilities in Maple 9*
Adrian Lewis (SFU): *Components of pseudospectra and controllability*
Michael Overton (Courant Institute): *Semi-definite and Semistable Programming*
Austin Roche (SFU): *Computing all Roots of an Analytic Function*
Ladislav Stacho (SFU): *Spanning Spiders and Light-splitting Switches*
Allan Steel (University of Sydney): *The Magma Computer Algebra System: A Demonstration*

Fourth Geoffrey J. Butler Memorial Conference
University of Alberta
June 17–21, 2003

Organizing and Scientific Committee: Walter Allegretto (U. Alberta), Lynn Erbe (University of Nebraska), Herbert Freedman (U. Alberta), Mark Lewis (U. Alberta), Yanping Lin (U. Alberta), Jack Macki (U. Alberta), James Muldowney (U. Alberta), Hal Smith (Arizona State University), Joseph So (U. Alberta).

This conference was a gathering for researchers and students in Differential Equations and Mathematical Biology. It was in honor of the memory of our former colleague Geoff Butler. It also celebrated the career and retirement of Paul Waltman of Emory University.

G.J. Butler Speaker : **Gail Wolkowicz** (McMaster University): *Competition-Mediated Coexistence*

Invited Speakers :
Emmanuele DiBenedetto (Vanderbilt University): *Homogenized and Concentrated Limited in Visual Transduction*
Gerda deVries (U. Alberta): *Bursting Electrical Activity in Pancreatic Beta Cells*
Odo Diekmann (Universiteit Utrecht): *How to construct steady states of structured population models?*
Karl-Peter Hadeler (Universtaet Tuebingen): *Differential Equations of Granular Matter*
Thomas Hillen (U. Alberta): *The story of chemotactic blow-up*
Yang Kuang (Arizona State University): *Biodiversity and Stoichiometry: Models and Analyses*
Michael Li (U. Alberta): *How to Do Phase-Plane Analysis in Higher Dimensions?*
Konstantin Mischaikow (Georgia Institute of Technology): *Dispersal, Competition, and Spatially — Temporally Heterogeneous Environments*
Wei Ming Ni (University of Minnesota): *Recent Progress in Diffusion and Cross-Diffusion Systems*
Horst Thieme (Arizona State University): *Infectious disease models with re-infection dependent latent periods*
Jianhong Wu (York University): *Delayed Reaction and Retarded Diffusion: Hyperbolic/Neutral Systems of FDEs and Their Dynamics*

The conference was co-sponsored by G. J. Butler's Memorial Fund, PIMS, National Programme Committee (CRM, Fields & PIMS), Applied Mathematics Institute (U. Alberta), Faculty of Science (U. Alberta), Department of Mathematical and Statistical Sciences (U. Alberta), and U. Alberta Conference Fund.

For more information see **www.pims.math.ca/science/2003/butler/.**

Workshop on Numerical Linear Algebra and Applications
UBC, August 4–8, 2003

This workshop was organized by **Chen Greif** (UBC). It featured two short courses, and a mixture of survey talks and advanced talks.

The short courses were accessible to non-experts, and slides from these courses are available on the web page.

Alison Ramage (Strathclyde).

The short course speakers were:
Alison Ramage (Strathclyde University): *An Introduction to Iterative Solvers and Preconditioning Techniques*
Eldad Haber (Emory U): *PDEs and Optimization*

The other speakers were:
Uri Ascher (UBC): *On the modified conjugate gradient method in cloth simulation*
Xiao-Wen Chang (McGill U.): *Numerical linear algebra in the Global Positioning System*
Edmond Chow (Lawrence Livermore National Lab): *A survey of incomplete factorization preconditioners*
Iain Duff (RAL and CERFACS): *The symbiosis of direct and iterative methods for solving large sparse systems & Solving large industrial problems in electromagnetics at CERFACS*

Eldad Haber (Emory).

Gene Golub (Stanford): *Numerical Solution for Solving Least Squares Problems with Constraints*
Anne Greenbaum (U. Washington): *Polynomial Numerical Hulls of Jordan Blocks and Related Matrices*
Chen Greif (UBC): *Techniques for solving indefinite linear systems*
Misha Kilmer (Tufts U.): *Numerical Methods for Ill-Posed Problems*
Scott MacLachlan (U. Colorado): *Solving PDEs with Multigrid Methods*
Carl Meyer (North Carolina State U.): *Updating Markov Chains*
Peyman Milanfar (UC, Santa Cruz): *Applications of Numerical Linear Algebra to Imaging Inverse Problems*
Esmond Ng (Lawrence Berkeley National Lab): *Computational Challenges in Electron Microscopy of Macromolecules*
Michael Overton (NYU): *Optimizing Matrix Stability*
David Watkins (Washington State U.): *Hamiltonian and Symplectic Lanczos Processes*

Please see **www.pims.math.ca/science/2003/numerical/.**

Workshop in Statistical Genetics and Computational Molecular Biology
September 21–23, 2003

The workshop is aimed at students from the mathematical, computational, and statistical sciences who may be considering graduate study and research in statistical genetics or mathematical and computational biology.

The speakers included:
David Baker (UW Department of Biochemistry)
Jenny Bryan (UBC, Statistics)
Anne Condon (UBC, Computer Science)
Mary Emond (UW Biostatistics)
Joe Felsenstein (UW Genome Sciences)
Jinko Graham (SFU, Statistics and Actuarial Sciences)
Phil Green (UW Genome Sciences)
Kathleen Kerr (UW Biostatistics)
Charles Kooperberg (Fred Hutchinson Cancer Research Center)
Stephanie Monks (UW Biostatistics)
William Noble (UW Genome Sciences)
Maynard Olson (UW Genome Sciences)
Larry Ruzzo (UW Computer Science)
Ram Samudrala (UW Microbiology)
Matthew Stephens (UW Statistics and Genome Sciences)
Elizabeth Thompson (UW Statistics)
Martin Tompa (UW Computer Science)
Wyeth Wasserman (Center for Molecular Medicine and Therapeutics, UBC)

For more information see **www.pims.math.ca/science/2003/statgen/.**

2nd PIMS Crystal Growth Workshop
PIMS-UBC, January 3–4, 2004

In January PIMS hosted the Second PIMS Crystal Growth Workshop at UBC. The mandate of the group is to improve semiconductor manufacturing through scientific modelling. Since the inaugural meeting in May 2002, advances have been made in three specific areas: 1) Modelling the crucible fluid flow; 2) Analysis of the gas flow and heat transfer; and 3) Understanding the crystal stress, shape and growth dynamics. Research is ongoing and the industrial partner is beginning to implement some of the suggested changes to the growing environment identified by the modelling team. The crystal group consists of researchers from across Canada, the United States, and South Africa.

Atlantic Association for Research in the Mathematical Sciences

The Atlantic Association for Research in the Mathematical Sciences (AARMS) was founded in 1995 at a time when the National Network for Research in the Mathematical Sciences was being discussed and planned. AARMS exists to encourage and advance research in all mathematical sciences, including statistics and computer science, in the Atlantic region. In addition, AARMS acts as a regional voice in discussions of the mathematical sciences on a national level. Since its inception, AARMS has played an important role in the research activities in the Atlantic region, sponsoring or cosponsoring numerous meetings and workshops. In the summer of 2002, AARMS initiated an annual Summer School for graduate students and promising undergraduates. Please write to us for information about the next AARMS Summer School.

AARMS activities are funded by Canada's three mathematical institutes, the Fields Institute, the Centre de Recherches Mathématiques, and the Pacific Institute for Research in the Mathematical Sciences as well as Acadia University, Dalhousie University, Memorial University, and the University of New Brunswick (Fredericton).

For further information please see the AARMS link at **www.pims.math.ca/Scientific_Programme/.**

AARMS Scientific Review Panel

The AARMS Scientific Review Panel members are:

Hermann Brunner (Chair of Panel, Director of AAMRS, Memorial University of Newfoundland)
Christian Léger (Directeur, Centre de Recherches Mathématiques)
Ken Davidson (Director, Fields Institute)
Ivar Ekeland (Director, PIMS)
Uri Ascher (University of British Columbia)
Eric Aubanel (University of New Brunswick)
Yuri Bahturin (Memorial University of Newfoundland)
Margaret Beattie (Mount Allison University)
Richard Charron (Guigne International)
John Clements (Dalhousie University)
Nassif Ghoussoub (University of British Columbia)
Lisa Jeffrey (University of Toronto)
Dan Kucerovsky (University of New Brunswick)
Francois Lalonde (CRC, Université de Montréal)
Bruce Smith (Dalhousie University
Catherine Sulem (University of Toronto)
Mary Williams (Director General, NRC Institute for Marine Dynamics)
Jianhong Wu (CRC, York University)

Activities 2003/04:

31st Annual Canadian Operator Theory and Operator Algebra Symposium

University of New Brunswick, Fredericton, May 20–24, 2003

Organizer: **Dan Kucerovsky** (University of New Brunswick)

Workshop on Combinatorial Designs and Related Topics

Memorial University, July 14–18, 2003

Organizers: **Rolf Rees** and **Nabil Shalaby** (Memorial)

Second Annual Summer School
Memorial University,
July 21–August 15, 2003

Organizers: **Edgar Goodaire** and **Hermann Brunner** (Memorial)

Workshop on Financial Mathematics
Memorial University, August 17–20, 2003

Organizers: **Robert Elliott** (Calgary), **Edgar Goodaire** (Memorial) and **John van der Hoek** (Adelaide)

International Workshop on Locally Finite Lie Algebras and Related Topics
Banff International Research Station,
August 30–September 5, 2003

Organizers: **Yuri Bahturin** (Memorial University), **Georgia Benkart** (Wisconsin, USA), **Ivan Penkov** (University of California, Riverside), **Helmut Strade** (Hamburg), **Alexandre Zalesski** (University of East Anglia, UK)

AARMS Research Session in Linear Algebra
University of Prince Edward Island,
October 17–19, 2003

Organizers: **Gordon MacDonald** (Prince Edward Island) and **Heydar Radjavi** (Dalhousie)

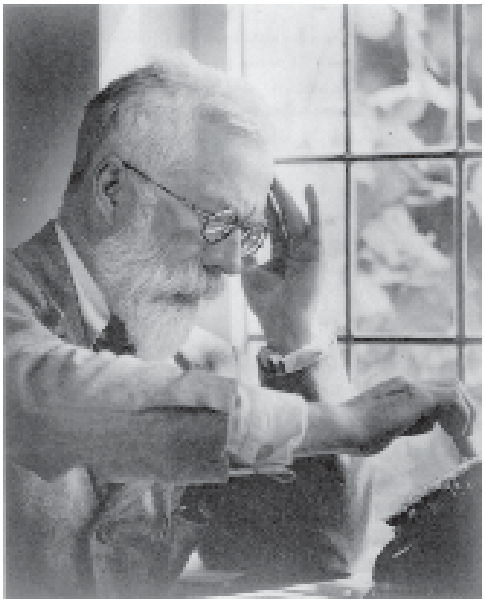
15th Canadian Conference on Computational Geometry
Dalhousie University,
August 11–13, 2003

Organizer: **Michael McAllister** (Dalhousie University)

The National Program on Complex Data Structures

The National Program was conceived as a model for a national network in the Statistical Sciences in partnership with Canada's three Mathematical Sciences Institutes. The program was funded by NSERC during the recently completed reallocations exercise and received funding for four years for a total of $687,000 with an additional $200,000 committed to the program by the Institutes. **Jamie Stafford** (U. Toronto) is the Director of the National Program and chairs its Scientific Committee. The Scientific Committee and the Institute Directors are working intensively to establish what is expected to be a very successful program.

The broad goal of the program is to foster nationally coordinated projects with substantial interactions with the large community of scientists involved in analysis of complex data sets, and to establish a framework for national networking of research activities in the statistical community. The original proposal targeted the development and application of statistical methods for the analysis of data obtained from complex survey sample designs and longitudinal biological, epidemiological and medical studies. More specific objectives of the program include the development of collaborations between university and extra-university researchers, and the provision of training for graduate students in important scientific areas through these collaborations.



Fisher, the father of modern statistics.

Jamie Stafford, NPCDS Director.

The working plan for 2003 is to promote collaborative research opportunities in thematic areas through two inaugural workshops/projects. One is in complex survey data analysis for population health and social science, and the other is in statistical genomics/bioinformatics. In partnership with the National Program and Statistics Canada, the project on complex survey data has successfully sought further support from MITACS and has established research positions for students.

The National Program is a unique opportunity to advance the statistical sciences in Canada and its success depends crucially on the active involvement of statisticians and scientists from a variety of sectors across the country. Those interested in providing input on important directions for the program are welcome to do so by contacting Jamie Stafford. Information about the program may be found at the NPCDS link at **www.pims.math.ca/Scientific_Programme/.**

Members of the Program Committee

Jamie Stafford (Director of the NPCDS, U. Toronto)
David Bellhouse (University of Western Ontario)
Richard Cook (University of Waterloo)
Paul Gustafson (UBC)
Mike Hidiroglou (Statistics Canada)
Nancy Reid (University of Toronto)
Randy Sitter (Simon Fraser University)
Ed Susko (Dalhousie University)
Louis-Paul Rivest (Universite Laval)

Activities 2003/04

Workshop on Statistical Methods for Complex Survey Data

Centre de Recherches Mathématiques, April 30–May 2, 2003

Survey data are now being collected and analyzed by many government, health and social science organizations with subsequent analysis being used to identify the determinants of health and to influence public policy. Surveys used have increasingly complex structures in both longitudinal and cross-sectional forms, and new statistical methods are needed to make the best use of this data. Canada is a world leader in sample survey methodology and many of Canada's top researchers in this area are on this team. The researchers on this team have partnered with Statistics Canada, and their affiliated Research Data Centres across the nation, the Toronto Rehabilitation Institute, UNESCO and WestStat. They carry out research in the general areas of modelling of survey data, missing data in the survey response file, and variance estimation under complex survey designs. One of the team's activities is the placement of ongoing PhD and postdoctoral students in collaborative research positions at Statistics Canada and at the Toronto Rehabilitation Institute. The students are supervised jointly by researchers at these institutions and by professors at universities throughout Canada. The team has successfully sought further support from MITACS and held an inaugural workshop hosted and supported by the Centre de Recherches Mathématiques.

David Bellhouse leads an NPCDS project on Complex Survey Data.

Workshop on Statistical Genomics

Fields Institute, September 3–5, 2003

Rafal Kustra is heading activity in Statistical Genomics.

The fields of Genetics and Molecular Biology are undergoing an unprecedented revolution triggered by mappings of the genomes of various organisms, including humans. While sequencing the genome is aimed at answering the questions "What?" and "Where?", functional genomics addresses the important questions of "Why?" and "How?". Modern functional genomics utilizes biochips and other high-throughput modalities in increasingly large experiments generating huge quantities of data. These data is quite varied depending on modality and technology used or the nature of experiments carried out. It also presents many broad statistical challenges, which together represent a unique set. The field of Statistical Genomics is being born to work with molecular biologists, geneticists and bioinformaticians to answer these challenges. To this end NPCDS and the Fields Institute hosted the First Canadian Workshop on Statistical Genomics Sept 3–5, 2003, which was attended by leaders in these various fields. The availability of travel awards for students met with a tremendous response with 40 students from across the nation receiving support. A proposal for a national project in this area is being drafted by a subset of the participants and progress is being made in seeking partnerships in industry and at various research institutes.

Participants of the First Canadian Workshop on Statistical Genomics.

V. INDUSTRIAL PROGRAMME

Participants of the 2nd Annual PIMS Mathematical Biology Workshop which was held at the University of Alberta, April 30–May 9, 2003.

PIMS/MITACS Industrial Partners:

Advanis
Amber Computer Systems
APPEGA
Ballard Power Systems Inc.
Barrodale Computing
Bayer Inc.
BC Cancer Research Center
BC Hydro
BioTools
Canadian Cable Labs
Canadian Marconi
Charles Howards & Associates
Chemex Labs
Computer Modeling Group
Corel Corporation
Crystar Research Inc.
Diagnostic Engineering Inc.
Dynapro
Eastman Kodak
Enbridge
FinancialCAD Corporation
Firebird Semiconductors
Galdos Systems
Hughes Aircraft
Husky Oil
IBM T. J. Watson Research Center
ICBC
Imperial Oil
In Silico
Insightful
Itres Research Ltd.
Kinetek Pharmaceuticals Inc.
Lockheed Martin Tactical Defense Systems
Math Resources Inc.
MathSoft
MacMillan Bloedel Ltd.
McMillan-McGee
MDSI
Menex Technologies
Merak
Michelin
NALCO Canada Inc.
NORTEL Networks
Novacor
Pacific Forestry Centre
PanCanadian Petroleum Ltd.
Petro Canada
Progas
Powerex
Powertech Labs Inc.
Precision Biochemicals
Prestige Telecommunications
Progas
Quatronix Media
Searle
Shaw Cable
Siemens Research
Simons International Copr.
SmithKline BeeCham Pharma
Sperry-Sun
Soundlogic
StemCell Technologies Inc.
StemSoft Software Inc.
Stentor
Stern Stewart & Co.
Sun Microsystems
Syncrude
Telecom Research Labs
Telus
TransAlta
Veritas DGC
VisionSmart
Vortek Industries Ltd.
Waterloo Maple Inc.
Worker's Compensation Board

Industrial Problem Solving Programme

The format of the **Industrial Problem Solving Workshops** is mainly based on the Oxford Study Group Model, in which problems of relevant and current interest to the participating companies are posed to the workshop participants by experts from industry. The participating graduate students and academics will spend five days working on the problems and the results will be published in the workshop's proceedings. The advantages for participating students and academics are:

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

7th PIMS-IMA Industrial Problem Solving Workshop

University of Calgary,
May 25–29, 2003

Organizers:

Rachel Kuske (University of British Columbia)
Fadil Santosa (Institute for Mathematics nnd its Applications)
Jack Macki (University of Alberta)
Chris Bose (University of Victoria)
Huaxiong Huang (York University)
Ian Frigaard (University of British Columbia)
Tony Ware (University of Calgary)

Academic Experts

Rita Aggarwala (University of Calgary)
Sean Bohun (Penn State University)
Huaxiong Huang (York University)
Mike Kouritzin (University of Alberta)
Jack Macki (University of Alberta)
Nilima Nigam (McGill University)
Robert Piché (Tampere UT, Finland)
Juan Restrepo (University of Arizona)
Fadil Santosa (University of Minnesota)
Rex Westbrook (University of Calgary)

Industrial Participants:

Schlumberger
Lucent Technologies
McMillan-McGee Corp.
Lockheed Martin
Orisar (formerly Semiconductor Insights)
Cargill
Manifold Data Mining Inc.

The 7th Industrial Problem Solving Workshop was co-sponsored by the **Institute for Mathematics and its Applications** (IMA) at the University of Minnesota. Approximately 55 people registered for the event, including the 34 graduate students who attended the GIMMC the previous week.

The participants divided into seven groups to work on the industrial problems which are described below.

Lalitha Venkataramanan (Schlumberger): *Solving Fredholm integral of the first kind in two dimensions*

One problem of interest to Schlumberger, which provides a wide range of products and services for the energy industry, is the determination of average rock pore size through spectral analysis by Nuclear Magnetic Resonance (NMR). Mathematically, the problem presented is an inversion of a 2-D Fredholm Integral of the first kind in order to solve for the underlying relaxation density. The problem is ill-posed in the classical sense both in continuous and discrete formulation. The group focused on three directions of attack. Since the problem is ill-posed, regularization methods are natural. They studied both SVD truncation and Tikhonov regularization with good success, significantly reducing data size by using factored form rather than the Kronecker product form. The group also investigated the possibility of higher order regularization in the Tikhonov problem. Solution of this problem was achieved only for the Kronecker form as the factorization did not appear to be consistent with the higher order regularization. A number of other investigations were initiated, including the Galerkin method and an analysis of the Butler, Reeds and Dawson (1981), with some limited success.

Lalitha Venkataramanan of Schlumberger Doll Research explains NMR remote sensing to graduate students Ying Han, Lin Zhou, Quingguo Li, Qian Wang and Xinghua Deng.

Veena B. Mendiratta (Lucent): *Modelling Quality and Warranty Cost*

The main aim of this project was to begin a modelling effort directed at optimizing the warranty and quality costs associated with the production of a system with both hardware and software components. This optimization is constrained by the need to maintain reliability of the product, while staying within an operational budget. The aim was to identify important aspects of the modelling, focusing on identifying the major quality-related attributes of interest, modelling the key reliability indicators (failure rate and the severity level) and modelling the building and warranty costs for a product with a certain quality level. The optimization model then minimizes the sum of the quality and warranty costs over the entire class of admissible quality-related attribute vectors. The project focused on the modelling function, and it was run on test data. Progress relied heavily on communication between the team and Dr. Mendiratta, in order to model reality as closely as possible without being able to compare with real data.

Bruce McGee (McMillan-McGee Corp): *The Thermodynamic Bubble Problem for the In-Situ Thermal Remediation of Contaminated Soils*

In the remediation process used by McMillan-McGee, over a period of several weeks electrical energy is introduced to the contaminated soil using a multitude of finite length cylindrical electrodes. Current is forced to flow through the soil by the voltage differentials at the electrodes. Water is also pumped into the soil via the injection well and out of the ground at the extraction well. The soil is heated up by the electrical current and the contaminated liquids and vapours are produced at the extraction well. The reason for using the electrical current is that "flushing" the soil using water alone is not effective for removing the contaminants. By heating up the soil and vaporizing the contaminated liquid, it is anticipated that rate of extraction will increase as long as the recondensation is not significant.

In the two-phase zone, since vapour bubbles tend to rise due to the buoyancy force, and the temperature decreases along the vertical path of the bubbles out of the heated region, it is possible that the bubbles will recondense before reaching the extraction well. The main objective of this modelling exercise is to determine the necessary vacuum pressure (pressure drop from the electrodes to the extraction well) so that the chemical bubbles are removed at the extraction well before they rise too high and condense to the liquid state.

John R. Hoffman (Lockheed-Martin): ***Problems associated with the Probability Hypothesis Density Function approach for multi-target tracking***

The team focused on the state estimation problem for tracking single and multiple targets. The Probability Hypothesis Density (PHD) makes the tracking problem computationally feasible by propagating only the first-order multi-target statistical moments by using a particle filter implementation for the PHD. The problem then becomes one of estimating the targets' state based on the output of the PHD when using a particle filter implementation. The approach used in this paper, based on the Expectation-Maximization (EM) algorithm, views the PHD distribution as a mixture distribution, and the particles as an i.i.d. sampling from the mixture distribution. Using this, a maximum likelihood estimator for the parameters of the distribution can be generated.

"Handwaving explanations" in a conversation between Carlos Tolmasky (Cargill) and Rachel Kuske (UBC).

Edward Keyes (Orisar, formerly Semiconductor insights): ***Methods to localize inadvertent power and ground connections on integrated circuits***

Orisar Inc. (formerly SemiConductor Insight) provides reverse engineering services to integrated circuit IC manufacturers. The process produces a circuit diagram from a chip and allows the manufacturer to learn about a competitor's product or to determine if intellectual properties infringements have been committed by their competitor. Reverse engineering of integrated circuits is made difficult by the shrinking form factor and increasing transistor density. Electron microscope photography captures a detailed image of each IC layer. A noise removal algorithm is then applied to the pictures, which are then passed to pattern recognition software in order to transfer the layer design into a polygonal representation of the circuit.

In the current work-flow, workers at Orisar Inc. visually inspect the polygonal representation of the circuit in order to find errors. However this process, performed manually, is very time consuming. The team proposed a method which can do better by automating it and thus saving valuable workers time and accelerating the process of reverse engineering.

Carlos Tolmasky (Cargill): ***Correlation structures corresponding to forward rates***

While it has become common to model a single stock using the Black-Scholes formulation, the modelling of bond prices requires simulations of the change of interest rates as a function of their maturity, and thus the entire yield curve. The spectral decomposition of the correlation matrix for the spot rates from this curve shows that the top three components can explain nearly all the data. Similar structure is observed for bonds and commodities. As suggested by Lekkos, instead the forward rates should be analyzed. The team performed a spectral analysis of the forward rates, and investigated a model for the associated structure. Prinicipal component analysis together with yield curve modelling formed the basis of this study.

Wei Lu (Manifold Data Mining Inc.): ***Product-Driven Data Mining***

Understanding how complicated and interrelated factors drive the consumer is the primary goal of Manifold Data Mining. They have developed innovative demographic and household spending pattern databases for six-digit postal codes in Canada. Their collection of information is expressed though thousands of individually tracked factors. This large collection of information about consumer behaviour is typically referred to as a data mine. The question posed to the group was to 1) find an algorithm that predicts the likelihood of consumers to respond favourably to a given product, based on very few factors. In addition, once this prediction is made for a given consumer the group was also asked to 2) develop a second algorithm that infers other statistical information regarding the consumer. The first algorithm identifies a few factors in the data mine which differentiate customers in terms of a particular product preference. Then the second algorithm builds on this information by looking for patterns and correlations in the data mine which identify related areas of consumer spending.

For more information please see **www.pims.math.ca/industrial/2003/ipsw/**.

PIMS at the Vancouver Island Tech Fair
November 17, 2003

The Vancouver Island Tech Fair brings together representatives from Vancouver Island hightech companies, consulting firms and academic institutions. A broad range of producsts and services were on display. PIMS had a booth at the fair, and was represented by UVic Site Director David Leeming, UVic PIMS Administrator Dil Baines, PIMS webmaster Kelly Choo and PIMS Deputy Director Manfred Trummer.

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 (IPSW).

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.

The PIMS Mathematical Biology Summer Workshop introduces undergraduate students to mathematical modelling and analysis applied to real biological systems.

The Frontiers of Mathematical Physics Summer School: This annual summer school is jointly sponsored by PIMS, Asia Pacific Center for Theoretical Physics, the Perimeter Institute for Theoretical Physics, with additional support by TRIUMF. It is intended to educate graduate students and young researchers about current developments in string theory.

Mathematics of Biological Systems: 2nd Annual PIMS Mathematical Biology Summer Workshop

University of Alberta, April 30–May 9, 2003

Organizer: **Centre for Mathematical Biology**

6th PIMS-IMA Graduate Industrial Math Modelling Camp

BIRS, May 17–22, 2003

Coordinator: **Rachel Kuske** (UBC)

PIMS-MITACS Summer School on Quantum Information Science

University of Calgary, June 23–27, 2003

Organizers: **Richard Cleve**, **Peter Høyer** and **John Watrous** (U. Calgary)

Seismic Wave Simulation and Seismic Imaging, A PIMS Summer School

University of Calgary, July 14–18, 2003

Organizer: **Gary Margrave** (U. Calgary)

Frontiers of Mathematical Physics—Summer School on Strings, Gravity and Cosmology

PIMS-UBC, July 14–25, 2003

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

Mathematics of Biological Systems: 2nd Annual PIMS Mathematical Biology Summer Workshop

University of Alberta, April 30–May 9, 2003

The Centre for Mathematical Biology (CMB), University of Alberta, hosted its 2nd Annual PIMS Mathematical Biology Summer Workshop entitled *Mathematics of Biological Systems*. The aim of this 10-day workshop was to introduce undergraduate mathematics students to mathematical modeling and analysis applied to real biological systems.

The instructors were **Gerda de Vries**, **Thomas Hillen**, **Mark Lewis**, **Frithjof Lutscher** (all from the University of Alberta), and guest instructor **Pauline van den Driessche** (University of Victoria). There was further assistance provided by volunteer graduate students, postdoctoral fellows, and staff.

Twenty-two 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 10 days in length and consisted of a combination of classroom instruction, computer lab sessions, pen and paper exercises, guided group project work, and project presentations. Communication between and among workshop participants and instructors was promoted through scheduled breaks and social events.

For the second consecutive year, the PIMS Mathematical Biology Summer Workshop received extremely positive feedback. Instructors are planning the 3rd Annual PIMS Workshop to be held May 4–14, 2004. The present structure of the workshop is very effective and requires little alteration. Instructors are also revising a book for publication that was used as the text for the present workshop and will be used for future workshops. This text is to be published by the Society for Industrial and Applied Mathematics.

Participants of the 2nd Annual PIMS Mathematical Biology Workshop.

For more information see **www.pims.math.ca/science/2003/mathbiosys/**.

Some of the camp mentors take a hike: Richard Braun, Rachel Kuske, David Misemer, Emily Stone, Robert Piché, Fadil Santosa.

6th PIMS Graduate Industrial Math Modelling Camp

BIRS, May 17–22, 2003

Organizers: Rachel Kuske (UBC), Fadil Santosa (IMA), Jack Maki (U. Alberta), Chris Bose (U. Victoria), Huaxiong Huang (York U.), and Ian Frigaard (UBC)

The 6th Annual PIMS-IMA Graduate Mathematics Modelling Camp (GIMMC) took place at BIRS this year. Thirty-four graduate students from North America participated in the programme. It was cosponsored by the Institute for Mathematics and its Applications (IMA).

GIMMC is designed to give graduate students in the Mathematical Sciences an opportunity to learn techniques of mathematical modelling under the supervision and guidance of experts in the field.

GIMMC is the first leg of the PIMS-IMA Industrial Mathematics Forum which also includes the PIMS-IMA Industrial Problem Solving Workshop (IPSW).

In a first session, the mentors presented the problems, and for the remainder of the week, they guided a group of graduate students through to a resolution, this culminated in a group presentation and a written document at the end of the week.

The Mentors & Problems were:

Emily Stone (Utah State U.): *Modelling PCR Devices for Fun and Profit*

The group developed models based on differential equations

for Polymerase Chain Reaction, used to amplify sequences of DNA. The goal was to identify the initial concentration of DNA, using only observations of the process over time.

Richard Braun (U. Delaware): *Thin Fluid Film Drainage Mathematical Models of a Boundary of a Thin Fluid*
A mathematical model for the evolution of a thin film boundary was developed and studied analytically and numerically to get a description of the thin film boundary decay rate. This quantity is important in quality control for the production of surfactants.

Sonja Glavaski (Honeywell): *Stability of Hybrid Systems using Sum of Squares (SoS) Programming Approach: VCCR System Example*
Hybrid systems are human controlled dynamic processes, such as air-conditioning systems and car transmissions, which have different states. Stability and control of these systems was studied with Lyapunov functions and Sum of Squares methods.

David Misemer (3M): *Modelling Polymer Purification by Counter-current Extraction*
The purification process in the production of adhesives is necessary for avoiding side-effects, as in medical patches, or malfunctions, as in electrical devices. The group built two models of purification via counter-current exchange, analysed both models and compared their results with experimental data.

Fadil Santosa (IMA & U. Minnesota): *Solar Car Racing Strategy*
The team developed models for power consumption in a car powered by solar energy. Using optimal control methods, they developed optimal racing strategies for a variety of weather, road, and racing conditions.

Robert Piché (Tampere U. Technology, Finland): *Converting Machine Tool Measurements into a CAD Model*

Graduate students Thalya Burden, Ying Han, Samet Kadioglu, Xinghua Deng, Lin Zhou, and Tzvetalin Vassilev worked on the problem that Robert Piché brought, namely, how to generate 3D geometric models using data from a measurement "arm".

Manufacturers of machine tools often rebuild and modify existing machine tools, incorporating new technology to meet customer requirements at significantly lower cost. A geometrical algorithm based on level set methods was developed to give a mathematical description of the measurements, which can then be input into a CAD package.

For more information please see **www.pims.math.ca/industrial/2003/gimmc/**.

PIMS-MITACS Summer School on Quantum Information Science

University of Calgary,
June 23–27, 2003

For more information see pag 59 of this annual report.

Seismic Wave Simulation and Seismic Imaging, A PIMS Summer School

University of Calgary,
July 14–18, 2003

For more information see page 38 of this annual report.

Frontiers in Mathematical Physics—Summer School on Strings, Gravity and Cosmology

PIMS-UBC, July 14–25, 2003

For more information see page 42 of this annual report.

MITACS: A Network of Centers of Excellence for the Mathematical Sciences

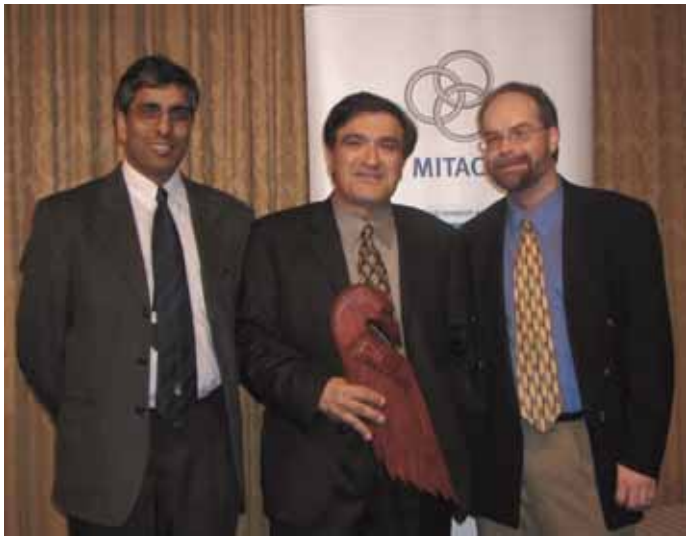
Mathematics of Information Technology and Complex Systems (MITACS) is one of the three Networks of Centers of Excellence (NCE) created in 1998. The MITACS NCE is a joint venture of the three Canadian mathematical sciences institutes: the Centre de Recherches Mathématiques, the Fields Institute for research 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 Chief Executive Officer/Scientific Director.

MITACS 4th Annual Conference, National Arts Centre, Ottawa, May 8–10, 2003

For more information see www.mitacs.math.ca/AC2003/.



Arvind Gupta, Nassif Ghoussoub and Ed Perkins at the MITACS Forth Annual Conference in Ottawa, which took place in May 2003. A tribute to Nassif was part of the conference.

MITACS Projects at PIMS

The MITACS Administrator for PIMS-UBC is Clarina Chan.

PIMS Administers the following MITACS projects through its UBC/Central Office.

Biomedical Models of Cellular and Physiological Systems in Health and Disease

Project Leader: **Leah Keshet** (University of British Columbia)

Mathematical Modeling and Scientific Computation

Project Leader: **Brian Wetton** (University of British Columbia)

PIMS Administers the UBC researchers involved in the following project:

Modelling Trading and Risk in the Market

Antony Ware (University of Calgary)

For the full list of MITACS projects see **http://www.mitacs.ca/main.php?mid=10000005&pid=115**.

PIMS affiliated MITACS Postdoctoral Fellows 2003

Peter Berg, Simon Fraser University
Ronald Ferguson, Simon Fraser University
Atife Caglar, University of British Columbia
Paul Chang, University of British Columbia
Rong Ding, University of British Columbia
Marek Labecki, University of British Columbia
Stan Maree, University of British Columbia
Nathaniel Newlands, University of British Columbia
Joern Sass, University of British Columbia
Jianying Zhang, University of British Columbia
Rong Zhu, University of British Columbia
Hugh Geiger, University of Calgary
Peter Gibson, University of Calgary

VI. MATHEMATICS EDUCATION PROGRAMME

Student participating in Math Mania.

David Leeming (U. Victoria), Math Mania organizer.

Student building a kite at a MathClick workshop.

Participants of the June 2003 ESSO-CMS-PIMS Math Camp.

Initiatives for K–12 Students

PIMS is 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 activities took place for elementary school students in 2003/04.

Math Mania

Math Mania is part of PIMS "Alternative Math Education" programme where Faculty and Staff from the PIMS Universities present "fun" methods for teaching math and computer science to children (and adults!) using games and art. It takes place at elementary schools in Victoria BC. Typically included in the presentations are soap bubble demonstrations, constellations as 2D networks, geometry and paper, the Set Game, a binomial probability experiment using pennies, and exciting geometrical models from straws and paper. Other demonstrations involve chess games, parallel algorithms of network sorts, and recursive methods in mathematical puzzles. These events attract around 300 students and parents each evening.

The enthusiastic volunteers who participated in these events included James Andersen, Peter Anderson, Dil Bains, Kathy Beveridge, Charlie Burton, Jeff Campbell, Kelly Choo, Mike Crowle , Florin Diacu, Malgorzata Dubiel, Rod Edwards, Irina Gavrilova, Mike Fellows, Denton and Merilyn Hewgill, Elies Hoepner, Reinhard Illner, David Leeming, Shaun Pack, Jan and Paul Nienaber, Elena Prieto, Geoff Schmidt, Pauline van den Driessche and Julie Zhou.

The Math Mania events in 2003/04 were:

- January 28, 2003: **George Jay Elementary School, Victoria BC**
- May 28, 2003: **St. Michaels University Junior School, Victoria BC**
- October 28, 2003: **Frank Hobbs Elementary, Victoria BC**
- March 9, 2004: **Deep Cove Elementary School, Sidney BC**
- October 26, 2004: **St. Margaret's School, Victoria BC**

MathClick Workshops

MathClick workshops are full-day mathematics immersion experiential events for students in grades 5–7. They 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.

The 2003 MathClick workshop took place on August 29. The students all went home with certificates of participation.

Student playing a game at MathClick.

Judy Dalling, the parent of 2001 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!"*

Math Circles

Students in the MathCircles Coaching Programme.

The MathCircles Coaching Programme is a follow-up to the MathClick workshops. MathCircles took place for 1.5 hours on Saturdays over 17 weeks in fall 2003 and winter 2004, and is based on the Singapore Grade 6 programme with modifications. It is intended for all grade 5–8 students. It's goal is to ensure that the students develop mathematical competence by "learning new math" and "practising the math they've learned". One student commented, *"Math is fun. It's like there's a party in my brain. Math pumps up your brain to make you smart."*

Summer Institute for Mathematics for High School Students

U. Washington, June 22–August 2, 2003

Getting a glimpse of the depth and beauty of mathematics can be a transforming experience for a student, whatever interests the student may intend to pursue in the future. The Summer Institute for Mathematics at the University of Washington (SIMUW) is intended to provide talented, enthusiastic students with just such a glimpse. Admission into the SIMUW programm is competitive, based on an assessment both of ability in mathematics and enthusiasm for an intensive mathematical experience.

The first class of enthusiastic, talented students arrived at the campus of the University of Washington on June 22, 2003 for a six-week program of classroom activities, special lectures, field trips, social activities, and intense interaction with faculty, TA's and fellow students. Some topics such as elliptic curves and computer graphics were studied in two-week segments and other topics such as Markov chains and the mathematics of movement were discussed in special half-day sessions. Students in the program deepened their understanding and appreciation of many active areas of mathematics. Perhaps the most important aspect of the program was social — friendships and contacts were made that will last long after the final session.

The 2003 SIMUW program was organized by three University of Washington faculty members: Ron Irving, Sándor Kovács and James Morrow. Six mathematicians from UW, Microsoft, and the University of Chicago served as the instructors. In addition, other mathematicians and scientists from UW and elsewhere participated as special lecturers.

The 2003 SIMUW lectures were:

Tim Chartier (U. Washington): *Vectors and the Mathematics of Computer Graphics*

Dave Collingwood (U. Washington): *Mathematical Modeling and Problem Solving*

Ginger Warfield (U. Washington): *Probability—Thinking with Your Bare Hands*

Robert Pollack (U. Chicago): *Elliptic Curves—a Mix of Algebra and Geometry*

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.

Building 3-dimensional structures.

Deep in thought.

Throwing boomerangs: Pi in the Sky.

Sándor Kovács (U. Washington): *The Mathematics of Internet Security*
Henry Cohn (Microsoft Research): *Combinatorics*
Tom Daniel (U. Washington): *Movement in Biology: Math Meets Massive Muscles*
Judith Arms (U. Washington): *The Mathematical Theory of Knots*
Pat Averbeck (U. Washington): *The Mathematics that Orc-like Bankers and Car Dealers Don't Want You to Know*
Sara Billey (MIT): *Zometool Competition*
Kristin Lauter (Microsoft Research): *Cool Ways to Factor Large Numbers*
Eric Babson (U. Washington): *Juggling Mathematics*
Tatiana Toro (U. Washington): *Image Segmentation*
Brian Marcus (UBC): *Encoding Data on Disk Drives: (2,) and Beyond*
Nathan Kutz (U. Washington): *Lightwave Communications and the Physics Behind the Internet*
Richard Ladner (U. Washington): *The Mathematics of Data Compression*

This programme has been totally funded by a gift from a generous anonymous couple. Students from Washington, British Columbia, Oregon, Alaska, and Idaho are encouraged to apply for SIMUW 2004.

For more information please see **www.math.washington.edu/~simuw/.**

2003 ESSO-CMS-PIMS Math Camp
SFU, June 23–27, 2003

The 2003 ESSO-CMS-PIMS Math Camp for High School students took place at the SFU Burnaby campus. This was the third time SFU hosted the camp, which was organized by Malgorzata Dubiel and Justin Gray.

Thirty grade 9 and 10 students from 18 Lower Mainland schools were selected from over seventy applications send by their teachers. For five days, these exceptional students participated in exciting and challenging activities and problem sessions. The activities were organized by the SFU faculty and graduate students, and three invited speakers: **Lily Yen** (Capilano College), **Branko Curgus** (Western Washington University) and **Rob Scharein** (CECM, WestGrid & NewMIC).

The presentations included:
Keith Promislaw (Math, SFU, & Ballard Powersystems): *Fuel Cells: Where Does all the Water Go?*
Eirikus Palsson (Biosciences, SFU): *Modelling Cell Movements and Communications Using a 3D Model*
Rob Scharein (CECM SFU, WestGrid & NewMIC): *Knots and Pretzels*
Rina Zazkis & Peter Liljedahl (Faculty of Education, SFU): *Mathematics in the Movies*

Several problem sessions and challenge problems given every day culminated in a contest written Friday morning. And, since the quality and the enthusiasm of the participants was extremely high, everybody left with a prize — and some with more than one!

For more information and pictures from the camp, see the camp website at **www.cecm.sfu.ca/~lisonek/MathCamp.htm.**

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 are 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.

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.

The results of the first part of the 2003/04 Alberta High School Mathematics Competition are no longer available. Part I serves as a gateway to part II.

Part II of the Alberta High School Mathematics Competition was written on February 4, 2004 by 69 students representing 19 schools.

For a list of top finishers, please see the website **www.math.ualberta.ca/~ahsmc**.

PIMS Elementary Grades Mathematics Contest
UBC, May 24, 2003

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.

The 5th ELMACON took place on May 24, 2003. It was organized by PIMS under the guidance of Dr. Cary Chien formerly 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.

A total of 283 students participated in the 5th annual contest, with 108, 93 and 82 in grades 5, 6 and 7 respectively. The format was the same as in previous years. There were 3 rounds, and the written part came first with the Sprint and Target rounds. The top 10 students from these rounds went on to the Countdown round where students dueled against each others. It started with the 9th and 10th ranking students, and the winner of that contest then went on to "duel" with the 8th place holder. As a result 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 dueling consisted of answering math questions against the clock and sounding a buzzer.

The top 10 in each grade received a T-shirt and medal. The top 3 also received a trophy. Certificates of participation were available for all students on the day. The top 10 winners in each grade were:

The top 3 ELMACON winners in each grade.

Grade 5: 1. Clara Hwang (Bayview Community) 2. Jeffrey Yeh (Vancouver Montessori) 3. Deshin Finlay (Braemar) 4. Duncan Dauvergne (Queen Mary) 5. Roger Zhang (Sir Wilfred Laurier Annex) 6. Kevin Fang (Dr Annie B Jamieson) 7. Anson Wong (Lord Byng) 8. Sandra Long (Sir William Osler) 9. Gloria Chu (White Rock) 10. Anne Zhu (Harold Bishop)

Grade 6: 1. Jeffrey Choi (John T Errington) 2. Denny Choi (St John's) 3. Juno Jung (Marlborough) 4. Jonathan Leung (James Whiteside) 5. Timothy Wai (Our Lady of Perpetual Help) 6. Yiyi Wang (Dr Annie B Jamieson) 7. Bill Xia (Tomekichi Homma) 8. Eric Shen (Maple Grove) 9. Keith Lui (St Francis Xavier) 10. Sophie Jisoo Kwalk (Canyon Heights)

Grade 7: 1. Aram Ebtekar (Maple Creek Middle) 2. Joel Li (David Lloyd George) 3. Qi Liu (Queen Mary) 4. Alarica Tang (Kitchener) 5. Yuan Liang (Pitt River Middle) 6. Tae Ken Kim (Holly) 7. Daniel Park (Kwayhquitlum Middle) 8. Aaron Lo (Lord Byng) 9. Bryan Huang (Sir William Osler) 10. Elliot Hoyt (Fort Langley)

A Contest for Epsilons
UVic, June 2, 2003

The students in the Math and Stat Course Union at the University of Victoria organized a half-day event entitled *Contest for Epsilons* for students in grades 5–7 in the Greater Victoria area. The event consisted of two contests and seminars on some mathematical topics. One hundred and thirty students from ten schools took part in the event. The students in the Course Union prepared the competition questions, did the registration and marketing of the event, and gave the presentations.

Students David Hosick and Michael Kim organized and ran the event with the assistance of students and faculty from the Department of Mathematics and Statistics. Some financial support was provided by the PIMS and the BC Association of Mathematics Teachers and refreshments were provided by Thrifty Foods.

The first contest was such a success that it is now to become an annual event.

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 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.

The 2003/04 PIMS BC Math Fair Project Developer is **Ilija Katic**. The Greater Vancouver Regional Science Fair is taking place at UBC on April 1–3, 2004.

Janet Martin, the 2001/2002 PIMS BC Math Fair Project Developer**,** received a UBC Faculty of Science Graduate Teaching Award in 2003.

Projects are judged as gold, silver or bronze based on a point system.

The first prize winner received $200, the second prize winners $100 each, and the third prize winners $50 each.

PIMS contributed $2500 travel money to send the two winners to the Canada-Wide Science Fair.

Calgary Youth Science Fair

The 2003 Calgary Youth Science Fair took place in the Big Four Building on the Calgary Stampede Grounds, April 2–5. The Pacific Institute for the Mathematical Sciences Award was given to Malcolm Stagg (Queen Elizabethe Jr. and Sr. High) for his project Evaluation of 3D Object Recognition Methods.

For more information about the Calgary Youth Science Fair see **www.cysf.org**.

Gary Margrave (PIMS Site Director, U. Calgary) & Malcolm Stagg in front of Malcolm's project.

Forever Annual Mathematics Exhibition (FAME)

Students in School District #61 (Greater Victoria) took part in FAME, the *Forever Annual Math Exhibition* at S.J. Willis Educational Centre on May 15, 2003. A total of 85 students participated in the event, with 7 senior entries, 16 junior and 13 elementary. Students from the following schools entered the exhibition: Lansdowne (21); Esquimalt (1); Lambrick (1); Hillcrest (3); Monterey (1); Frank Hobbs (6); and Royal Oak (3). In total, six Distinction awards (90+%), 12 First Class (80+%), 15 Runner-ups (70+%) and three

The elementary exhibit at FAME.

Participants certificates were given out. The winning schools (scores for top 3) were Frank Hobbs (elementary) and Lansdowne (junior and senior).

The junior high winners of FAME.

The event was organized by mathematics teachers Betty Doherty of Lansdowne and Wendy Swonnell of Lambrick Park. Fame is sponsored by PIMS, BCAMT, the Greater Victoria Teacher Association and School District #61.

Elementary Math Fairs in Alberta

The 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, Parkallen Elementary, and Terrace Heights Schools. 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.

Ted Lewis and Andy Liu (Math, U. Alberta) trained math fair organizers in 2003 and in 2004 at BIRS. Their own direct organization of math fairs is restricted to the practicum portion of Math 160 which consists of a large math fair in Dinwoodie at SUB each term. Many of our graduate students generously volunteer their time in support of these fairs.

That's a Good Problem! Math Fairs in Calgary

That's a Good Problem! is a collaborative project of the Galileo Educational Network (GENA), Mount Royal College in Calgary and PIMS. 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.

Having fun learning math with a frog game.

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 on the following dates:

- April 8, 2003: **Erin Woods Elementary**
- April 16, 2003: **Foothills Composite High School**
- April 16, 2003: **Sundre High School**
- April 24, 2003**: Captain John Palliser**
- May 2, 2003: **Pineridge Elementary**
- June, 2003: **Battalion Park**
- June 11, 2003: **Westmount Charter**
- June 2003: **Simons Valley**

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/**

*Students working on their math fair project at **Sundre High School.***

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 Event
UVic, UBC, SFU, January 9–12, 2004

This year the PIMS Graduate Information Event was hosted in British Columbia. About 30 senior undergraduate students from all over Canada spent Friday at Simon Fraser University and Saturday at the University of British Columbia. At SFU students were welcomed by Jonathan Driver (Dean of Graduate Studies) and Rolf Mathewes (Associate Dean of Science). Students heard presentations from representatives from various graduate programmes, notably Pure Mathematics, Applied Mathematics, Computer Science and Statistics. The Universities of Alberta and Calgary also had faculty representatives at the SFU event. Students had the opportunity to see the campus and various research labs; there was also ample opportunity to meet informally with faculty members and graduate students.

PIMS at the University of Victoria hosted the second part of the Graduate Information event. After arriving on Sunday, the students were free to explore the city. In the evening, a reception was held at the Executive House Hotel, host hotel for the participants. There, the students were able to meet informally with faculty and graduate students from the Departments of Mathematics and Statistics, Physics and Computer Science.

On Monday, the students came to the University of Victoria campus where Aaron Devor (Dean of Graduate Studies) welcomed them. Then they heard presentations from faculty and graduate students on graduate degree programs in pure, applied and discrete mathematics, statistics, physics and astronomy, and computer science. The participants ended their day at UVic with a brief tour of the campus.

We are grateful for the generous support provided to this event by the participating universities and departments, as well as for the efforts of faculty members, graduate students and local PIMS staff.

Statistics and Probability in Action
UVic, April 1–2, 2003

Statistics and Probability in Action was a poster session held at the University of Victoria. At the start of the winter academic term, the instructors for Statistics 260 (an introductory course in probability and statistics) asked their students to interview one or more individuals who use statistics and/or probability on a daily basis. The students constructed profiles of the individuals and displayed their work in posters. They explained how the people used statistics/probability in their jobs, what training and education they received, what the joys and challenges of their work were, and much more.

Over the course of two days in the last week of classes, the posters were displayed in the Student Union Building (SUB) where the students answered questions about their posters.

Popular subjects for the posters were actuaries and insurance companies, weather forecasters, scientists, and participants in the gambling industry. Some posters also investigated the usage of statistics by baseball scouts, the customer purchasing patterns and statistics in 7-Eleven stores, and how Sony determines the production levels for new lines of electronics. One student profiled a promotions manager who uses statistics and probability to estimate the costs, alcohol sales and viability of future events at night clubs; the imaginative student displayed the information on a bright orange T-shirt; and, the promotions manager agreed to wear the shirt at the poster session.

Overall, the students thought the poster session was a positive and enjoyable experience. In addition to exposing the students to the uses of statistics and probability in the real world, it gave them the opportunity to gain insight into potential co-op jobs and future careers.

2nd PIMS Mathematics of Biological Systems Summer Workshop

U. Alberta, April 30–May 9, 2003

(See chapter on *Industrial & Scientific Training Activities*).

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.

6th PIMS-IMA Graduate Industrial Math Modelling Camp
BIRS, May 17–22, 2003

(See chapter on *Industrial & Scientific Training Activities*).

PIMS-MITACS Summer School on Quantum Information Science
U. Calgary, June 23–27, 2003

(See chapter on *Industrial & Scientific Training Activities*).

Frontiers in Mathematical Physics—Summer School on Strings, Gravity and Cosmology
PIMS-UBC, July 14–25, 2003

(See chapter on *Industrial & Scientific Training Activities*).

Connecting Women in Mathematics Across Canada (CWiMAC)
U. Alberta, June 12–13, 2003

The first workshop *Connecting Women in Mathematics Across Canada* (CWiMAC) was organized jointly by the Committee for Women in Mathematics of the Canadian Mathematical Society and PIMS.

Participation in the conference was by invitation: the applicants had to submit a statement of interest, a title and abstract of a talk about their work and/or research interests, and a letter of support from their supervisor. Twenty nine women graduate students from fifteen Canadian universities were selected to attend. They spent two intensive and exciting days, attending talks and presentations, and sharing experiences with eleven women faculty members—speakers and mentors at the conference.

The Participants of the Connecting Women in Mathematics Across Canada Workshop at the wrap-up session.

Two plenary talks were given:

Christiane Rousseau (U. Montreal): *An Academic Career: A Fantastic Opportunity to Mix Harmoniously Teaching and Research*

Priscilla Greenwood (Arizona State U. & UBC): *Mathematical Versatility*

Christiane Rousseau's talk focused on her work on applications of divergent series, while Priscilla Greenwood described her most recent work on applications of stochastic processes in Biology.

The conference included two panel discussions, which were followed by small group discussions, led by the members of the panels:

Panel I: *Balancing a Career and a Personal and Family Life*, with **Rachel Kuske** (UBC), **Judith McDonald** (Washington State U.), **Ortrud Oellerman** (U. Winnipeg) and Gerda de Vries (U. Alberta).

Panel II: *Career Strategies: How to Survive a Graduate School and Get a Job You Want*, with **Susan Cooper** (Queens U.), **Leah Edelstein Keshet** (UBC), **Kathy Heinrich** (U. Regina) and **Dorette Pronk** (Dalhousie U.).

Participants' presentations of their research formed an important part of the conference. They were divided by research interests into three groups: Combinatorics and Algebra, Mathematical Biology and Applied Mathematics.

The organizing committee was: Malgorzata Dubiel (Chair, SFU), Judith McDonald (WWU), Rachel Kuske (UBC), Mateja Sajna (U. Ottawa), Dorette Pronk (Dalhousie U.), Ortrud Oellermann (U. Winnipeg), Gerda de Vries (U. Alberta), Leah Edelstein Keshet (UBC) and Susan Cooper (Queens U.).

Additional support was provided by the Department of Math and Statistics, University of Alberta. Nelson. A Thomson Company co-hosted a dinner reception for conference participants.

For more information and the detailed schedule of the conference, see **www.cms.math.ca/bulletins/2003/cwimac03.e**.

All participants declared the conference a great success, and worth continuing. The next such workshop is being planned to take place in 2005 at BIRS.

Young Researchers' Forum in Mathematical & Statistical Sciences

U. Alberta, March 27–28, 2004

This was the first research forum organized for the graduate students of at the Universities of Alberta and Calgary. Twenty-five graduate students from Calgary and thirty-eight graduate students from Edmonton registered for this event. Ten of these students presented their research work covering topics from pure and applied mathematics and statistics. These presentations were well received by their fellow graduate students at the forum.

The participants had the opportunity to learn about and discuss the research done at both universities. A general discussion was arranged for feedback at the end of the forum. A second research forum is being considered for next year at BIRS.

Initiatives with Mathematics Educators

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 2003
SFU Harbour Centre, May 2, 2003

The Fifth Annual The sixth annual *Changing the Culture* conference sponsored by PIMS, and **Malgorzata Dubiel** was the main organizer. The conference brought together over 90 school teachers, college and university faculty and graduate students, to discuss issues related to teaching mathematics at all levels. In response to concerns raised earlier in the 2002/2003 school year, both by people teaching "Principles of Mathematics" 11 and 12 in BC high schools and people teaching first year calculus courses in BC colleges and universities, about algebraic skills of students, the theme of this year's conference was *Do We Need To Teach Algebra?*

The conference started with a plenary talk by **Bernice Kastner** (Towson University, Maryland) entitled *Algebra: The Language of Mathematics*. Kastner talked about the impact of technology on high school mathematics curricula. She identified positive gains, like new tools for developing intuition through visualization, and negative aspects, like a loss of ability amongst many students to "speak the language of Mathematics—algebra". She introduced the term "learned disability" to describe students' inability to think mathematically and go beyond routine algorithmic approaches to problem solving.

The problems connected with students' transitions from secondary to post-secondary mathematics courses were revisited during the panel discussion, with **Lorraine Baron** (Mount Boucherie Secondary) and **Kanwal Neel** (Steveston Secondary) representing high school mathematics teachers, and **Wayne Matthews** (Camosun College) and **Brian Wetton** (UBC) representing the post-secondary sector. The panelists did agree that the algebraic skills of high school graduates have declined in recent years. The possible reasons for this situation were discussed: overloaded high school curriculum, (mis)use of technology, statistics replacing big parts of algebra in the Principles of Mathematics 12 course, and others.

In between the talks and discussions, the participants could choose to attend two out of a possible three workshops:
1. *Helping Students Learn Calculus using Problem Solving Workshop*, by **Joanne Nakonechny** and **Roger Donaldson** (UBC) about how the UBC Mathematics Department is attempting to help students to succeed in first year calculus courses.
2. *Can Algebra be made Lively?,* by **Malgorzata Dubiel** (SFU) and **Klaus Hoechsmann** (PIMS) - on using pictures and visualization as an aid in algebraic proofs.
3. *Roots and Routes to Algebra*, by **Peter Liljedahl** (SFU) on how to aid pre- algebra students towards algebraic thinking.

The conference was concluded on a lighter note by a very entertaining and thought provoking talk by **Rina Zazkis** and **Peter Liljedahl** (SFU) titled *Hollywood Perceptions of Mathematics: Cultural truth or Mathematical Fiction?* By analyzing selected fragments of popular movies, the speakers and the audience examined the movie industry's (and the general public's) view of mathematics and people who are good at it.

Changing the Culture 2004 is entitled *Mathematics Curriculum: Could Less Be More?* and will take place on Friday April 23, 2004.

Teacher Association Meeting

Annual meetings of teacher associations provide an important venue for connections between PIMS researchers and school teachers. PIMS participated in the big 2003 October meetings of the British Columbia Association of Mathematics Teachers (BCAMT). PIMS had a display table there.

Third North-South Dialogue

The first North South Dialogue was held in Calgary in 2001 and the second in Edmonton in 2002. The interest and scope of the meeting has increased enormously over this short period of time, from a meeting involving primarily the University of Alberta (North) and the University of Calgary (South), to a meeting involving the mathematics departments of many of Alberta's institutions of higher learning. Those in attendance were: Augustana College, Concordia College, Grand Prairie Regional College, Mount Royal College, Red Deer College, and the Universities of Lethbridge, Alberta and Calgary. The programme for the meeting was also somewhat expanded, with a special session for graduate students added on Sunday. In addition to the Albertans, visitors from B.C., New York, India, and others participated actively in the meeting, adding diverse viewpoints and comparisons.

Third North-South Dialogue
University of Calgary, June 28–29, 2003

The meeting was humorously referred to as the North South 3.5, since the original one planned on April 26–27 had been snowed out by a major blizzard, and only a few of the Saturday talks were held (with a greatly reduced but very appreciative audience). In spite of all the difficulties this caused, e.g. the food for a 90 person banquet had to be thrown out, and travellers having had some rather dangerous highway conditions to cope with, it failed to dampen the Alberta Spirit and the rescheduled meeting in June was a great success.

The objectives of the meeting have expanded to include all issues involving higher education in mathematics in the province, as well as allowing a chance to meet those involved. The Saturday talks featured mathematical and statistical research, with new faculty members giving the majority of the talks, and were an impressive introduction to some of the fine research being done in the province. The fourth N-S, to be held at Red Deer College May 8–9, 2004, will also (for the first time) incorporate talks concerned with mathematical education.

There was an elegant banquet Saturday evening, giving ample time to socialize. Perhaps the most important part took place Sunday morning in the three discussion sessions. Here many ideas for the future of mathematics in the province, and for further opportunities for cooperation among the various institutions involved, were discussed. Thanks to all of this, the coming fourth North-South Dialogue in Red Deer promises to be even more extensive and exciting than its predecessors.

The organizers would like to thank Michael Li (U of A) most of all for his constant help and support in planning the meeting, and also great thanks are due to PIMS for their overall support, as well as the local PIMS support from Gary Margrave and Marion Miles, to the Chairs of the two large departments (Tony Lau from U of A and Ted Bisztriczky from U of C), to all the speakers and session moderators, to ASRA (represented by Steve Vossos) for their support and interest in the meeting, and to many others.

For more information see **www.pims.math.ca/science/2003/north-south/.**

Numeracy and Beyond: A Two-Part Workshop

The main question this workshop will address is what minimum numeracy is required of the average citizen in this computer age, and how does it relate to the more advanced needs of the engineer or scientist?
The goal of this general analysis is to derive concrete suggestions which should be applicable to any educational system. Thus the first priority will be to identify key principles, which are simple, widely acceptable, practical, yet fundamental, which should guide the teaching of school mathematics independent of the particular school context.

Some topics that will be looked at are:
- *Numeracy: computation as an intelligent activity*
- *Arithmetical and geometric aspects*
- *The first hurdle: proportion, ratio, fractions*
- *The second hurdle: symbolic calculation*
- *Problem solving as vehicle and goal*

Numeracy and Beyond Workshop: Part I
PIMS-UBC, July 8–11, 2003

This workshop will include two public lectures:
Bernard Madison (U. Arkansas): *Numeracy and Democracy*
Yoram Sagher (U. Illinois, Chicago): *Lessons from the Singapore Curriculum*

There will be keynote lectures by
Tony Gardiner (U. Birmingham, UK)
Günter Törner (Duisburg, Germany)


Bernard Madison.

Workshops will be held on the topics:
- *Propaedeutics of counting and measuring*
- *Taking care of the gifted young*
- *The challenge of multiplicative thinking*
- *Problem solving as a vehicle and goal*

There will be panel discussions on
- *The political dimensions of numeracy*
- *Algebra, geometry, statistics: how much and what?*


Yoram Sagher.

Numeracy and Beyond: Part II
BIRS in Banff, December 5–9, 2004

The first part of the workshop is necessary for the preparation of the second. The reason is that the latter will be a kind of retreat in the style of Oberwolfach—though not for the communication and creation of new theorems in a well-defined mathematical specialty, but for the articulation of a sequence of reflections on the state and direction of mathematics education—intended as a tiny link in its long history, from Euclid to Hypatia, through the Indo-Iranian and Arabic teachers, to the European Renaissance and the present, with scant attention to other parts of the world. Without a firm and yet supple framework, such a workshop could, in five short days, produce no more than well-intentioned brainstorming. The meeting of July 2003 is intended to create this framework.

This two-part workshop is being organized by **Tony Gardiner** (Birmingham), **Klaus Hoechsmann** (PIMS), **Bernard Madison** (Arkansas), **Yoram Sagher** (Chicago) and **Günter Törner** (Duisburg).

For more information please see **www.pims.math.ca/birs/workshops/2004/04w5044/.**

BIRS Math Fair Workshop
April 10–12, 2003

The BIRS Math Fair workshop was unusual for BIRS in that its focus was Education rather than research. The participants were teachers from elementary schools, junior high schools, colleges and universities, and also people from other institutions and organizations that have a deep interest in Mathematics Education.

The purpose of the workshop was to help teachers learn how to run a successful math fair, to exchange information about math fairs, and to put the members of this diverse group in contact with each other. The deeper purpose was to change the mathematical culture in the classroom, and after five years of experience we believe that this is beginning to happen.

It must be stressed that the sort of math fair that we are talking about is radically different from a typical science fair. Without going into too much detail, the four main tenets are that the math fair be non-competitive (no prizes), that it be all-inclusive (not just for the elite students), that it be interactive (not a poster session) and that it be based on problem-solving.

The problem that we have now is to disseminate the news about the success of math fairs. Workshops are one way of helping teachers learn about math fairs, helping them sustain their efforts, and letting them share experiences with co-workers. As well, workshops build trust between teachers and other educators.

Teachers were invited to the workshop on the condition that they subsequently hold a math fair in their own schools. All participants received a booklet that contains the underlying principles for the math fair.

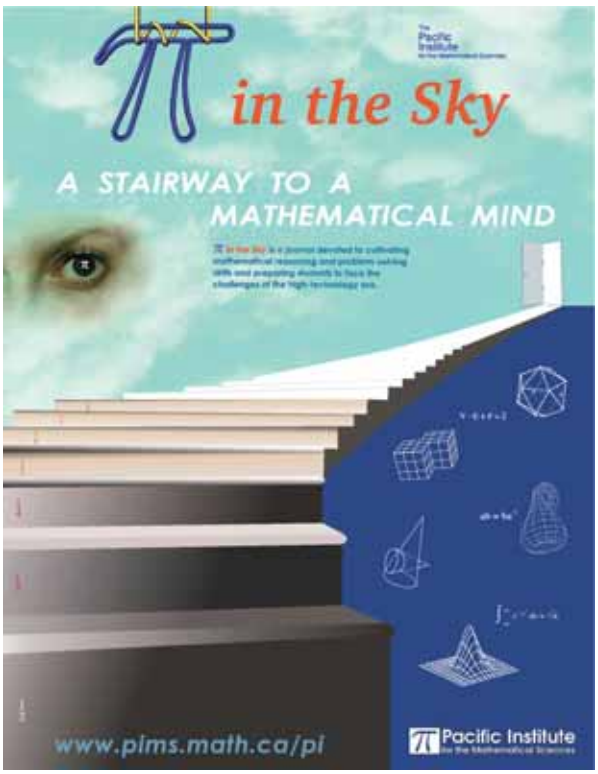
The workshop dealt with what constitutes a good problem for a math fair, included several examples, and described several different types of math fairs that are based on the guidelines. Many of the participants had already organized math fairs at their schools, and although there was great variation in the details, all followed the guidelines set out in our booklet.

How does a teacher find problems that are suitable for the math fair? Do you begin with a curriculum topic and design an appropriate puzzle, or do you start with a challenging puzzle and try to fit it to the curriculum? The workshop advocated the latter approach, and spent some time having the participants find ways to adapt a good puzzle to the curriculum. A few days ago we visited a math fair organized by one of the workshop participants, and saw that this adaptation was taking place.

One of the most valuable and spontaneous aspects of the workshop occurred when the teachers who had already conducted math fairs began sharing information about their experiences. The ones who had not yet had a math fair asked many questions and picked up the enthusiasm from those that did. There were some common fears experienced by teachers who had done the math fair for the first time: They want their students to succeed and have a tendency to intervene when students are presented with an unfamiliar task. The math fair works best when, as one teacher put it, you let the students take ownership of their problems. This is a difficult thing for teachers to do, especially when they know that the result is going to be on public display.

Because of the uncertainty of a new venture, many teachers will limit either exposure or participation on their "first-time" math fair. Discussions about this indicated that subsequent math fairs would be greatly expanded, and that the math fair would become a regular part of the students' math activities.

VII. COMMUNICATION OF THE MATHEMATICAL SCIENCES



In Fall 2003 PIMS produced a poster advertising Pi in the Sky Magazine. *This poster was designed by Sarah Bentz who is in her final year of a Bachelor of Design degree in Visual Communication Design at the University of Alberta. The poster was financed by Gary Kachanoski, the Vice President Research at the University of Alberta.*

Pi in the Sky

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

The Editor in Chief is **Ivar Ekeland** (PIMS Director). The rest of the editorial Board consists of **Len Berggren** (SFU), **John Bowman** (U. Alberta), **John Campbell** (Archbishop MacDonald Academic High School, Edmonton), **Florin Diacu** (U. Victoria), **Sharon Friesen** (Galileo Educational Network, Calgary), **Dragos Hrimiuc** (U. Alberta), **Klaus Hoechsmann** (UBC), **Michael Lamoureux** (U. Calgary), **David Leeming** (U. Victoria), **Mark MacLean** (UBC), **Alexander Melnikov** (U. Alberta), **Volker Runde** (U. Alberta) and **Wendy Swonnell** (Lambrick Park Secondary School, Victoria).

Pi in the Sky accepts materials on any subject related to mathematics or its applications, including articles, problems, cartoons, statements, jokes, etc. Copyright of material submitted to the publisher and accepted for publication remains with the author, with the understanding that the publisher may reproduce it without royalty in print, electronic, and other forms. Submissions are subject to editorial review and revision.

Pi in the Sky is mailed to schools in Alberta, B.C., and Washington State. Individuals may request a copy of Pi in the Sky magazine by sending their mailing address to pi@pims.math.ca.

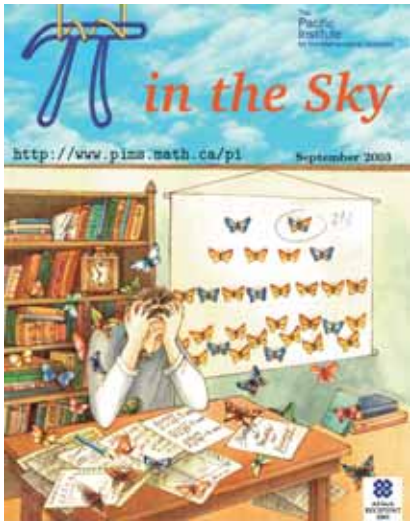
All issues of *Pi in the Sky* can be downloaded for free from the Pi in the Sky web page.

Significant funding for *Pi in the Sky* is provided by

Alberta INNOVATION AND SCIENCE

The September 2003 Issue

The seventh issue of the PIMS educational magazine *Pi in the Sky* came out in the fall of 2003. The cover was created by Czech artist Gabriela Novakova. The scene depicted was inspired by the article on mathematical biology written by Jeremy Tatum, *Maths and Moths*, which is published in the issue. Prof. Zmodtwo is again featured on the cover page, this time doing research on moths and butterflies.



The cover of the September 2003 issue of the Pi in the Sky.

The Math Opinions section features *Reckoning and Reasoning or The Joy of Rote* by Klaus Hoechsmann. This article talks about the D'Amore Test.

A. N. Kolmogorov and His Creative Life by Alexander Melnikov is included in the Math Biography section. Andrei Nikolaevich Kolmogorov was the foremost mathematician of the 20th century, and the article was written to mark the 100th anniversary of his birth.

Other articles include *Its All For the Best: How looking for the best explanations revealed the properties of light* by Judith V. Grabiner, *Why I Don't Like Pure Mathematics* by Volker Runde, *Shouting Factorials!* by Byron Schmuland, *A Generalization of Synthetic Division* by Rohitha Goonatilake, *Why Not Use Ratios?* by Klaus Hoechsmann and *"Quickie" Inequalities* by Murray S. Klamkin.

The PIMS Math Fair Booklet

PIMS published the math fair booklet by **Ted Lewis** (PIMS Education Coordinator, U. Alberta) in the Spring of 2002. 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.

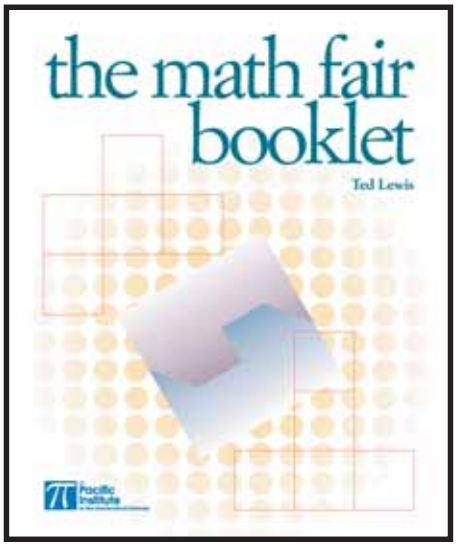
The booklet may be purchased from PIMS University of Alberta for a nominal fee (US$10.00 for shipping and handling in North America, US$15.00 elsewhere).

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 paricipants 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 reason 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 Magazine

Scientific Articles that appeared in the PIMS Magazine in 2003-04:

• Volume 7.1: *Algebraic Z^d Actions*
by **Klaus Schmidt** (University of Vienna and Erwin Schrödinger Institute)

• Volume 7.1: *Numerical Construction of Spacetimes*
by **Luis Lehner** (Louisianna State University)

• Volume 7.2: *Recent Progress on De Giorgi's Conjecture*
by **Changfeng Gui** (University of Connecticut)

• Volume 7.2: *Mahler's Measure*
by **Jeffrey D. Vaaler** (University of Texas, Austin)

• Volume 7.2: *A Simple Multiresolution Technique for Diffraction Image Recovery*
by **D. Russell Luke** (PIMS Postdoctoral Fellow, SFU)

• Volume 7.2: *Numeracy & Beyond: Developing a Mathematical Habit of Mind in K–12*
by **Sharon Friesen** (Galileo Educational Network, Calgary)

The cover of the Spring 2003 issue of the PIMS Magazine.

The cover of the Fall 2003 issue of the PIMS Magazine.

PIMS Offers Lectures via Streaming Video over the Internet

PIMS now has well over 2000 lectures available over the internet using on-demand streaming video and audio. The lectures are available at **www.pims.math.ca/Publications_and_Videos/Streaming_Videos/**.

There are 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 six main sections:
- BIRS Workshops
- Ceremonies and Meetings
- Seminar Series and Distinguished Lectures
- Thematic Programmes, Conferences and Workshops
- Minicourses
- Educational Activities

The videos that were added in 2003-04 include the following:

BIRS Workshops

Recent Developments in Superstring Theory
March 15–20, 2003

- **Steve Giddings** (UC Santa Barbara) , *The Fate of Four Dimension*
- **Shamit Kachru** (Stanford U.), *de Sitter Vacua in String Theory*
- **Shiraz Minwalla** (Harvard U.), *Hagedorn Transition in Free Yang-Mills* (Part 1)
- **Shiraz Minwalla** (Harvard U.), *Hagedorn Transition in Free Yang-Mills* (Part 2)
- **Hirosi Ooguri** (Caltech), *Nonplanar Diagrams*

Quantum Mechanics on the Large Scale
April 12–17, 2003

- **Dmitri Averin** (SUNY Stony Brook), *Mesoscopic Quantum Measurements*
- **Aashish Clerk** (Yale Dept. Applied Physics), *Mesoscopic Detectors and the Quantum Limit*

Computational Fuel Cell Dynamics-II
April 19–24, 2003

- **Stephen Paddison** (LANL), *Understanding proton conduction in the polymer electrolyte membrane through molecular and statistical mechanical modeling* (Part 1)
- **Stephen Paddison** (LANL), *Understanding proton conduction in the polymer electrolyte membranethrough molecular and statisical mechanical modeling* (Part 2)

The Many Aspects of Mahler's Measure
April 26–May 01, 2003

• **Matilde Lalin** (U. of Texas at Austin), *Examples of Mahler measures as multiple polylogarithms*
• **F. Rodriguez Villegas** (U. Texas at Austin), *A new proof that .16666666... = 1/6*

Recent Advances in Algebraic and Enumerative Combinatorics
May 03–08, 2003

• **Mireille Bousquet-Melou** (CNRS - Universite Bordeaux 1), *Minimal transitive factorizations of permutations*
• **William Fulton** (U. Michigan) and **Sergey Fomin** (U. Michigan), *Eigenvalues, singular values, and Schubert calculus* (Part 1)
• **William Fulton** (U. Michigan) and Sergey Fomin (U. Michigan), *Eigenvalues, singular values, and Schubert calculus* (Part 2)

Statistical Mechanics of Polymer Models
May 10–15, 2003

• **Tony Guttmann** (U. Melbourne), *Polymer Models*
• **Frank den Hollander** (Scientific Director, EURANDOM), *Random Co-polymers Near Interfaces*

Symmetry and Bifurcation in Biology
May 31–June 05, 2003

• **Michael Forger** (Universidade de Sao Paulo), *Symmetry Breaking and the Degeneration of the Genetic Code*
• **Peter Thomas** (Salk Institute for Biological Studies), *Symmetry-induced coupling of cortical feature maps*

Current Trends in Representation Theory of Finite Groups
October 25–30, 2003

• **Alexander Kleshchev** (U. Oregon), Title is not available

Galaxy Formation: A Herculean Challenge
November 01–06, 2003

• **Sara Ellison** (P. Universidad Catolica de Chile), *The Structure of High Redshift Absorption Galaxies from Gravitational Lensing*
• **Jerry Ostriker** (U. Cambridge), *Galaxy Formation: More Questions than Answers*
• **Alice Shapley** (Caltech), *Rest Frame Optical Spectra of z~2 Star-Forming Galaxies: Evidence for Disks and Solar Metallicity*

The Interaction of Finite Type and Gromov-Witten Invariants
November 15–20, 2003

• **Marcos Marino** (Harvard U.), Title not available
• **Marcos Marino** (Harvard U.), Title not available

Theory and Numerics of Matrix Eigenvalue Problems
November 22–27, 2003

• **Gene Golub** (Stanford U.), Title not available
• **Volker Mehrmann** (Technische Universitat Berlin), *Numerical solution of parametric eigenvalue problems in robust control*

Nonlinear dynamics of thin films and fluid interfaces
November 29–December 04, 2003

• **John Bush** (MIT), *New Structures in free surface flows*
• **Linda Smolka** (Duke U.), *Exact solution for the extensional flow of a viscoelastic fluid*

Calabi—Yau Varieties and Mirror Symmetry
December 06–11, 2003

• **Chuck Doran** (Columbia U.), *Integral Structures, Toric Geometry, and Homological Mirror Symmetry*
• **Klaus Hulek** (U. Hannover) and Helena Verrill (Louisiana State U.), *Examples of Non-Rigid Modular Calabai-Yau Manifolds* (Part 1)
• **Klaus Hulek** (U. Hannover) and Helena Verrill (Louisiana State U.), *Examples of Non-Rigid Modular Calabi-Yau Manifolds* (Part 2)

Interactions Between Model Theory and Geometry
March 13–18, 2004

• **Deirdre Haskell** (McMaster U.), *EI in valued fields tutorial 4*
• **Thomas Scanlon** (UC Berkeley), *Jets*

Ceremonies and Meetings

• *Banff International Research Station – Inaugral Meetings*, The Banff Centre, Banff Alberta, February 28–March 1, 2003

Seminar Series and Distinguished Lectures

PIMS PDE/Geometry Seminar 2003
UBC, May 8, 2003

• **Robert Finn** (Stanford U.), *Unusual Comparison Properties of Capillary Surfaces,* UBC, May 8, 2003

IAM-PIMS 2002–03 Joint Distinguished Colloquia, UBC

• **Gordon E. Swaters** (Institute of Applied Mathematics, U. Alberta), *Dynamics of Abyssal Ocean Currents*, Octobe 7, 2002

IAM-PIMS 2002–03 Joint Distinguished Colloquia (l–r):Gordon E. Swaters (Institute of Applied Mathematics, U. Alberta), David Chandler (Department of Chemistry, UC), Parviz Moin (Center for Turbulence Research, Stanford U.) and Lloyd N. Trefethen (Oxford U. Computing Laboratory).

• **David Chandler** (Department of Chemistry, UC), *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, Austria), *Spatial Complexity in Ecology and Evolution*, December 2, 2002
• **Parviz Moin** (Center for Turbulence Research, Stanford U.))and NASA Ames Research Center), *Turbulence and its Computation*, January 13, 2003
• **Lloyd N. Trefethen** (Oxford U. Computing Laboratory), *Fast Accurate Solution of Stiff PDE*, March 17, 2003

IAM-PIMS 2003–04 Joint Distinguished Colloquia, UBC

• **Jorge Nocedal** (Northwestern U.), *The New Faces of Nonlinear Optimization*, September 22, 2003
• **Harry Swinney** (U. Texas at Austin), *Spatial Patterns and Shock Waves in Sand*, October 6, 2003
• **Chris Bretherton** (U. Washington), *Understanding the Circulation of the Tropical Atmosphere Using Simple Mathematical Models*, November 3, 2003
• **Mary Pugh** (U. Toronto), *The Richness of Thin Films*, January 19, 2004
• **Marco Avellaneda** (Courant Institute, NYU), *Reconstructing Volatility*, February 23, 2004
• **Stephen Boyd** (Stanford U.), *Recent Advances in Convex Optimization*, March 15, 2004

Stephen Boyd (Stanford U.).

Distinguished Lectures

• **Klaus Schmidt** (U. Vienna and Director of the Erwin Schrödinger Institute for Mathematical Physics), *Mahler Measure, Factors of Markov Shifts and Symbolic Representations of Group Automorphisms,* UBC, May 8, 2003
• **Vaughan Jones** (UC Berkely), *Skein Theory in Knot Theory and Beyond,* UBC, November 4, 2002

Thematic Programmes, Conferences and Workshops

Workshop on Inverse Problems & Medical Imaging

PIMS-UBC, August 4–8, 2003
44 lecture are available.

Cascade Topology Seminar

PIMS-UBC, November 2–3, 2002
6 lectures are available.

Minicourses

Minicourses by PIMS Distinguished Chairs

Yuri Gurevich (Microsoft Research), PIMS Distinguished Chair, SFU, April 17, 2003
• *Executable Specifications: The Abstract State Machine Approach*

Guther Uhlmann (University of Washington), PIMS Distinguished Chair, UBC, Nov., 2002
• *The Dirichlet to Neumann Map and Inverse Problems* (lecture 1)
• *The Dirichlet to Neumann Map and Inverse Problems* (lecture 2)
• *The Dirichlet to Neumann Map and Inverse Problems* (lecture 3)

Donald G. Saari (UC Irvine), PIMS Distinguished Chair, U. Victoria, Sept., 2002
• *Mathematical Social Sciences, an Oxymoron?* (lecture 1)
• *Singularity Theory and Departmental Discussions* (lecture 2)
• *Evolutionary Game Theory; Examples and Dynamics* (lecture 3)
• *Chaotic Dynamics of Economics* (lecture 4)
• *Economic and Dynamics* (lecture 5)




Numeracy and Beyond lecturers (l–r):Tony Gardiner (U. Birmingham, UK), Bernard Madison (U. Arkansas), Günter Törner (Duisburg, Germany) and Yoram Sagher (U. Illinois, Chicago).

Educational Activities

Numeracy and Beyond: Part I

• **Klaus Hoechsmann** (PIMS, UBC), *Interview on the Stirling Faux show, CKNW Newstalk 980, Corus radio network, Canada*, June 28, 2003
• **Tony Gardiner** (U. Birmingham, UK), *Passing the Torch: What have Mathematiciancs to Contribute to the Next Generation?* (Keynote Lecture), Numeracy Workshop I, UBC, July 9, 2003
• **Bernard Madison**, (U. Arkansas), *Numeracy and Democracy* (Public Lecture), Numeracy Workshop I, UBC, July 9, 2003
• **Günter Törner** (Duisburg, Germany), *Number Sense in the Calculator Age* (Keynote Lecture), Numeracy Workshop I, UBC, July 10, 2003
• **Yoram Sagher** (U. Illinois, Chicago), *Lessons from the Singapore Curriculum* (Public Lecture), Numeracy Workshop I, UBC, July 10, 2003

PIMS Changing the Culture
SFU Harbour Centre, May 2, 2003

• **Bernice Kastner** (Towson U., Maryland and the Rochester Institute of Technology), *The Language of Mathematics*
• **Rina Zazkis** and **Peter Liljedahl** (Faculty of Education, SFU), *Hollywood Perceptions of Mathematics: Cultural Truth or Mathematical Fiction?*

Appendix: Financial Report

The information in this appendix outlines the income and expenses of PIMS for the fiscal year April 1, 2003 to March 31, 2004. PIMS activities are supported by ongoing base funding from the following partners:

• The member institutions (Simon Fraser University, University of Alberta, University of British Columbia, University of Calgary, University of Victoria and University of Washington) and affiliated institutions (University of Lethbridge).

• The government of Canada through the Natural Sciences and Engineering Research Council.

• The government of Alberta through the Alberta Ministry of Innovation and Science (Alberta Science and Research Authority).

• The government of British Columbia through the Ministry of Competition, Science and Enterprise (Science and Information Technology Agency).

PIMS also received substantial contributions from 60 industrial partners (to March 31, 2004) for its industrial programmes and for the PIMS-affiliated MITACS industrial collaborative research projects.

Income for 2003-04

The total income received by PIMS in the 2003-04 fiscal year is listed in Table 1. Each founding university makes an annual cash contribution equivalent to one full-time faculty position at their university at the time of the founding of PIMS. The universities also make considerable inkind contributions of office space, computer labs, and infrastructure, in addition to releasing personnel from teaching duties in order to provide scientific leadership to the Institute.

SFU: Simon Fraser University made a cash contribution of $75,000 to the PIMS operating budget. In-kind support in the form of a 4000-square foot research facility is estimated to be $150,000 per annum.

UA: The University of Alberta made a cash contribution of $70,000 to the PIMS operating budget.

UBC: The University of British Columbia made a cash contribution of $200,000 to the PIMS operating budget. In-kind support in the form of a 4800-square foot research facility is estimated to be $150,000 per annum. In addition, the university provides services to PIMS (financial accounts, e.g.) at an estimated value of $30,000 per annum.

UC: The University of Calgary made a cash contribution of $61,000 to the PIMS operating budget.

UVic: The University of Victoria made a cash contribution of $60,000 to the PIMS operating budget. In-kind support in the form of office space is estimated to be $60,000 per annum.

UW: The University of Washington provided in-kind support for administration and scientific leadership estimated at $10,000 USD ($15,000 CAD). Direct expenses incurred at the site office are estimated to be $7,000 USD ($10,000 CAD).

ULeth: The University of Lethbridge, an affiliated institution of PIMS, made a cash contribution of $5,000.

MITACS: The MITACS NCE makes an annual contribution to PIMS to cover the direct expenses of PIMS in providing administration and infrastructure support to the PIMS-affiliated MITACS projects, and for networking activities, theme meetings and workshops.

PIMS Total Income: April 1, 2003 - March 31, 2004

Source	Carry-forward	Income 03/04	Operating Funds	In-Kind Support
NSERC	$146,880	$1,023,100	$1,169,980	
BC (CSE/ISTA)	($109,227)	$148,125	$38,898	
BC (NCE)	$19,658	$64,351	$84,009	
Alberta (ASRA)	$147,266	$200,000	$347,266	
Universities	$86,022	$0	$86,022	
SFU		$75,000	$75,000	$150,000
UAlberta		$70,000	$70,000	$60,000
UBC		$200,000	$200,000	$180,000
UCalgary		$61,000	$61,000	$60,000
UVictoria		$60,000	$60,000	$60,000
ULethbridge		$5,000	$5,000	
UWashington		$0	$0	$25,000
MITACS	$1,706	$145,000	$146,706	
Other**	($43,185)	$115,809	$72,624	
Total	**$249,121**	**$2,167,385**	**$2,416,506**	**$535,000**

*** Does not include industrial contributions to PIMS activities or PIMS/MITACS projects.*

Total Operating Funds	**$2,416,506**
Reserve Fund	**$130,163**
Industrial Funds Received (PIMS/MITACS)	**$297,464**
Total Funds At-Hand	**$2,844,133**
Total In-Kind Support	**$535,000**

Table 1

Industrial Funding

PIMS receives substantial industrial funding in support of its programmes, in particular, various industrial workshops, seminar series and industrial collaboration postdoctoral and graduate student fellowships. PIMS also manages the industrial funds provided by various companies in support of the thirteen MITACS collaborative projects associated with PIMS. A summary of the industrial funding received to March 31, 2004 is given in Table 2.

PIMS and PIMS-MITACS Industrial Funds

Project	Company	Before March/03	April/03-March/04	Total to March/04
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	$25,000	$0	$25,000
Project 3	Waterloo Maple	$175,750	$33,000	$208,750
	Workfire Development Corp.	$20,000	$0	$20,000
Project 4	FinancialCAD	$99,000	$6,000	$105,000
	Powerex	$62,000	$0	$62,000
	TransAlta	$42,000	$0	$42,000
	Royal Bank	$0	$5,000	$5,000
	Nexen	$0	$3,333	$3,333
Project 5	CREWES	$10,000	$0	$10,000
	Imperial Oil	$30,000	$0	$30,000
	C&C Systems Limited	$10,000	$0	$10,000
Project 6	NORTEL	$120,000	$0	$120,000
Project 7	Kinetek	$15,000	$0	$15,000
	SmithKline Beecham	$160,000	$0	$160,000
	In Silico	$77,556	$0	$77,556
	StemCell	$5,000	$0	$5,000
	Bayer	$10,000	$0	$10,000
	Takeda	$0	$2,630	$2,630
Project 8	VisionSmart	$7,473	$0	$7,473
	Lockheed Martin	$98,789	$0	$98,789
	Acoustic Positioning Research	$24,000	$0	$24,000
Project 9	Canadian Airlines	$87,000	$0	$87,000
	BCTel	$43,500	$0	$43,500
	Telus	$43,500	$0	$43,500
	Workers' Compensation Board	$182,500	$25,000	$207,500
	Vancouver International Airport	$77,750	$0	$77,750
Project 10	Powertech	$20,000	$0	$20,000
	Ballard Power System Inc.	$493,500	$166,000	$659,500
Project 11	Organon Canada	$20,000	$0	$20,000
	Starlab	$8,141	$0	$8,141
	Kinetana	$35,400	$0	$35,400
	National Institute of Health	$5,941	$0	$5,941
	Cybercell	$20,000	$0	$20,000
Project 12	Insightful	$23,814	$0	$23,814
	iCapture (McDonald Research Lab)	$12,500	$21,500	$34,000
Project 13	Monsanto Company	$2,920	$0	$2,920
	Merak	$2,000	$0	$2,000
	Charles Howard & Associates	$1,000	$0	$1,000
Project 14	Imperial Oil	$4,000	$0	$4,000
	McMillan-McGee	$2,000	$0	$2,000
	Michelin	$2,889	$0	$2,889
	Stern Stewart & Co.	$2,889	$0	$2,889
Project 15	Firebird Semiconductors	$2,000	$0	$2,000
	Algorithmics	$2,000	$0	$2,000
	IBM	$1,974	$0	$1,974
	Microsoft	$3,011	$0	$3,011
	Dept. of National Defence (CSE)	$2,000	$0	$2,000
	AEC Oil & Gas	$2,000	$0	$2,000
Project 16	Firebird Semiconductors	$23,000	$25,000	$48,000
Project 17	Toronto Dominion	$20,000	$0	$20,000
Project 18	MathSoft	$21,708	$0	$21,708
Project 19	Vortek	$10,000	$0	$10,000
Project 20	Schlumberger (Etudes & Productions)	$96,000	$0	$96,000
Project 21	Schlumberger (Cambridge)	$30,000	$10,000	$40,000
Project 22	NORTEL/StatCar	$12,604	$0	$12,604
Project 23	Galdos Systems	$15,000	$0	$15,000
Project 24	Capital Health	$2,000	$0	$2,000
	McMillan-McGee	$2,000	$0	$2,000
	RBC Risk Management	$2,000	$0	$2,000
	Semiconductor Insights	$2,000	$0	$2,000
	Shell Canada	$2,000	$0	$2,000
	Talisman Energy	$2,000	$0	$2,000
Project 25	Microsoft Research	$7,531	$0	$7,531
Project 26	Sun MicroSystems	$105,458	$0	$105,458
Project 27	McMillan-McGee	$0	$2,000	$2,000
	Orisar (Semiconductor Insights)	$0	$2,000	$2,000
	Schlumberger	$0	$2,054	$2,054
	Total	**$2,459,610**	**$297,464**	**$2,882,116**

Table 2

Other Contributions

Table 3 outlines the cash operating budget of PIMS for funds flowing through PIMS accounts at the various sites. Additional contributions in support of PIMS researchers and events are estimated below.

University Infrastructure: PIMS has offices at all five Canadian member institutions. Computational facilities, infrastructure and administrative support are provided. The PIMS central office at UBC is housed in a 4,800 sq ft facility that accommodates up to 40 researchers, plus a seminar room and reading room. The PIMS-SFU site office is housed in a 4,000 sq ft facility that accommodates up to 20 researchers, plus a seminar room.

BC-NCE Infrastructure Support: Only the BC-NCE infrastructure award held at the PIMS central office at UBC is listed in Tables 1 and 3. These funds are made available through the Vice President, Research at UBC to support federal NCE activities.

MITACS Projects: The majority of the industrial funds listed in Table 2 go to support the PIMS-affiliated MITACS projects. The NCE matching funds provided by MITACS for these projects are not listed, however, these funds are managed by PIMS.

Additional Support for Industrial PDFs: The PIMS contributions to industrial postdoctoral fellowships ($10- $20K each) are matched (one-to-one) by the corresponding industrial partners. These funds are usually paid as salary directly to the postdoctoral fellow and are not reported here.

Additional Support for Scientific PDFs: The PIMS contributions to scientific postdoctoral fellowships ($20K each) have been at least matched (minimum $20K contribution) by individual research grants and by teaching stipends from the PDF's department. These funds are usually paid as salary directly to the postdoctoral fellow and are not reported here.

Conference Support: Most PIMS conferences receive additional financial support in the form of registration fees, contributions from the research grants of organizing committee members, and/or cosponsorship with other organizations.

Corporate Support: Industrial partners or corporations sometimes contribute to official receptions and banquets connected to scientific and industrial activities. Shell Canada provides lunch and meeting space for the Lunchbox Lectures in Calgary, for example.

Industrial Support: Many industrial outreach events, in particular, the *Graduate Industrial Math Modelling Camp and Industrial Problem Solving Workshop* (among many others) are partially supported by direct and indirect contributions from the industrial participants.

Education Support: Most education activities of PIMS are cosponsored by schools, university departments, provincial ministries of education, and professional societies.

PIMS Summary of Expenditures: April 1, 2003 - March 31, 2004

Expense Category	Budgeted	Actuals	Over/Under
Site Offices	$187,000	$191,256	-$4,256
Scientific Personnel	$104,795	$109,099	-$4,304
Central Office	$316,000	$320,609	-$4,609
Special Events	$121,000	$107,523	$13,477
Industrial Outreach*	$197,000	$106,821	$90,179
Education Programmes	$161,500	$110,708	$50,792
Scientific Activities	$873,500	$663,481	$210,019
PIMS Postdoctoral Fellows**	$320,000	$289,174	$30,826
Total Expenses	**$2,280,795**	**$1,898,671**	**$382,124**

** Figures include neither industrial funds nor MITACS projects*

*** Figures include neither industrial PDFs nor matching funds*

Source	Operating Funds	Budgeted	Actuals	Carry-forward
NSERC	$1,169,980	$990,000	$813,811	356,170
BC (CSE/ISTA)	$38,898	$142,000	$88,336	-49,438
BC (NCE)	$84,009	$0	$300	83,709
Alberta (ASRA)	$347,266	$341,500	$261,090	86,176
Universities	$557,022	$509,795	$463,378	93,644
MITACS	$146,706	$136,000	$133,661	13,045
Other	$72,624	$161,500	$138,094	-65,470
Total Expenses	**$2,416,506**	**$2,280,795**	**$1,898,671**	**517,836**

Table 3

Central Academic Building, PIMS-UA Site Office.

Mathematical Sciences Building, PIMS-UC Site Office.

East Academic Annex, PIMS-SFU Site Office.

Clearihue Building, UVic Site Office.

University of Washington Campus, PIMS-UW Site Office.

Corbett Hall, BIRS, Banff Centre.

PIMS Central & UBC Site Office.

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