Pacific Institute for the Mathematical Sciences
Magazine
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Vol. 6 Issue 2 Fall 2002

Chinese President Jiang Zemin Confers the (Canadian) Fields Medals in Beijing

President Jiang Zemin kept his promise and his personal commitment to mathematical research by showing up at the Fields award ceremony to confer the medals to France's Roland Lafforgue (IHES) and Russia's Vladimir Voevodsky (IAS). The impressive ICM2002 opening ceremony was held at the Great Hall of the People in Beijing in front of more than 6000 Chinese and foreign mathematicians. This event undoubtedly signals the beginning of the final phase in China's steady march towards being a world's mathematical superpower.

We had unfortunately failed in our efforts to get senior Canadian officials to present the Fields medals at the ICM2002 opening ceremony in Beijing. Many thanks to the dozens of colleagues who wrote in support of this initiative.

see letter to Prime Minister on page 20

Fields Medal winner Vladimir Voevodsky, Chinese President Jiang Zemin, IMU chairman Jacob Palis and Fields Medal winner Roland Lafforgue at the ceremony in Beijing.

Inside this Issue

Is Economic Theory True?

Article by Ivar Ekeland on page 18

NSERC Reallocation Results, PIMS: A model for the research institute of the 21st century

NSERC's reallocations results are out and PIMS and the Canadian mathematical community have every reason to be proud of the accomplishments of the last 5 years.

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

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NSERC Funding for PIMS up 60%

"PIMS is emerging as the most exciting/dynamic research institute of the three math institutes in Canada. The vision driving this institute has, in 5 years, resulted in national (MITACS) and international (BIRS, Pacific Northwest Partnership, The Pacific Rim Initiative) initiatives which have done the most to raise the profile of Canadian mathematical research nationally and internationally. The specific proposals, individually and collectively, build upon a bold vision for the institute. The innovative programs (Math and Multimedia, summer schools in emerging areas, webcasting) and the outreach programs (BIRS, Pacific Rim, Prairie and Atlantic Canada) stand out particularly. The leveraged funding is extremely good for a mathematics institute. I wholeheartedly endorse the full reallocation request for this dynamic center."

That was one of the many compelling testimonials by a number of international referees. The reallocations committee awarded PIMS a 60% increase in its NSERC grant.

NSERC Re-allocation Results: PIMS: A model for the research institute of the 21st century

PIMS: Un institut sans frontières disciplinaires ni geographiques.
N. Ghoussoub

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Nassif Ghoussoub, PIMS Director

NSERC equalizes its funding for CRM, FIELDS and PIMS

The site visit committee also stated that *"PIMS has been successful at multiplying the opportunities provided by NSERC funds. However, it is also particularly underfunded compared to the other two institutes."* NSERC's reallocations committee agreed by awarding PIMS a 60% increase in its budget. Each one of the 3 Institutes (PIMS, Fields and CRM) will receive a grant of approximately $1 million/year for the period 2003–07. In addition, a joint proposal of the 3 institutes with the Statistics Grant Selection Committee (GSC 14) for a 4-year "National Programme on Complex Data Structures" has also been funded at the rate of $172K/year.

NSERC increases its funding for the Math. Grant Selection Committees

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

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

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

PIMS activities have broken through discipline and geographical boundaries
Site visit committee

Referees' unanimity on the Banff International Research Station

BIRS has been referred to—in almost all referees' reports—a major coup for the Canadian community. The annual budget of BIRS is about $2M ($500K from each of NSF, ASRA, and NSERC's MFA program; $100K from MITACS and $400K from PIMS). In addition $1.1M have finally been secured to renovate and upgrade the facilities ($300K from the PIMS universities and $800K from the Alberta government). We have an outstanding programme scheduled for 2003 and we have a call for proposals for the 2004 programme. Many thanks to Robert V. Moody for the incredible amount of work and energy he is investing to help set up this great continental resource.

The MITACS network up for renewal

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

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

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

The National Programme Committee to be restructured

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

Celebrating PIMS success at NSERC's re-allocation exercise.

An interview with Dick Peter, exiting Dean of Science, UA

by Heather Jenkins, PIMS Communications Officer

Dr. Richard E. Peter recently finished a 10-year term as Dean of Science at the University of Alberta. He is also a distinguished Professor in the Department of Biological Sciences. He has been a member and deputy Chair of the PIMS Board of Directors since PIMS was founded in 1996.

Dean Peter, you have been a part of PIMS since the beginning. Can you tell us something about the early days?

The vision of PIMS - to have mathematical and statistical scientists working together on research themes, working together on industry problems, and working together on math education - was something needed. I saw the community as being quite fractured and ineffective, and missing the boat on many opportunities. PIMS looked like a great opporunity to get things going. It turned out to be true!

As Dean of Science at U of A you have made the Mathematical Sciences a priority. Why did you chose to do this?

The mathematical sciences are the foundation for all areas of the sciences. We needed strong mathematical sciences research and teaching to be a strong Faculty of Science. Building a strong Mathematical and Statistical Sciences Department was one of my many priorities. I am pleased with the success of our recruitment of new faculty. Now the challenge for the Department is to have a view of itself as being a leader, and taking actions to do so.

You have been a very active member of the PIMS Board of Directors. How would you characterise your contribution to PIMS?

Being a member of the Board was a priviledge and an honor.

PIMS was new. I was caught up in the vision for PIMS. Nassif Ghoussoub kept expanding the vision, which made the Board interesting and challenging. Just when you thought one thing was sorted out and under way, Nassif would come up with another great initiative. The vision was great! Being a member of the Board gave me the opportunity to work towards the vision of PIMS and to help the vision become a reality.

I must also add that the people on the Board and Nassif intrigued me. Nassif and the other mathematical scientists on the Board had little to no administrative experience. I had lots of administrative experience so they thought I was brilliant, which goes to show you can fool some of the people some of the time! Many of the private sector members of the Board were leaders in their own right, and they had a vision of helping to build something great. It was a pleasure to work with them as well.

In your opinion, what sort of impact has PIMS had on U of A?

Tremendous! PIMS has given our mathematical and statistical scientists the opportunity to work more with others in research, to work more with industry, and to do more in math education - all of which would have otherwise not been available. It has given the Department the opportunity to be a leader.

While you served as Dean you have remained active with your research. Give us an outline of your main interests.

My research is on the brain regulation of food intake, growth and reproduction in fish. We work on the brain hormones that regulate these functions. In the last few years I have switched most of the research in my lab to food intake regulation, a new area in research for fish. We work from the molecular biology to behavior levels—a challenge! It's fun to be in a new field. The best is that I have had the privilege of having outstanding PDFs, graduate students and undergraduates to work with in my lab.

How do you think BIRS will benefit the province of Alberta?

Tremendous! The world spot light will be on PIMS as being the leader in BIRS. Through BIRS the opportunity presents itself for Alberta universities to become better known and to develop leadership in research.

Now that you are retiring from your position as Dean, what are your plans for the near future? Please tell us about some of your other interests.

I started as Vice President, Integrated Resource Management at the Alberta Research Council on August 1, 2002. This is an opportunity to lead the development of a program and research team that provides government, industry and communities practical information and advice about natural resource management, and new technologies and approaches for sustainable development. This is applied interdisciplinary science. Funding has to be brought in from government and industry or the research team will not exist. So, while the goals are noble, and society, governments and industry will benefit if we are successful, there are lots of challenges to make this a success.

Other interests? While my job at ARC is full time, I still have my research lab at the University of Alberta going full pace with an outstanding PhD student and two PDFs. Three other PDFs went off to jobs during the summer. On the personal side, my wife and I are taking a sommelier course and enjoying it very much. The challenge now is to build (i.e., fill) a wine cellar in our new home, which we moved into in July. Our new home comes with no shovelling or mowing - just shut the door and travel when the opportunity presents.

Thank you Dean Peter.

Dick Peter, University of Alberta

The Banff International Research Station

by Robert Moody, BIRS Scientific Director

Although it is still 6 months to the opening of BIRS, lots of things are happening on the long, sometimes arduous, ramp-up process.

The most significant developments since our last Newsletter are that all the funding is now in place, including the critical funding from the Alberta Science and Research Authority (ASRA) for the necessary renovations at the Banff Centre and that these renovations are now underway. BIRS will be physically 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. Both involve extensive renovations (total cost exceeding $1M). After well over a year and half of dealing with BIRS as a virtual entity, it is finally beginning to take a physical form.

It is a bit startling to realize that even before BIRS opens its doors for business in March 2003, the entire workshop programme for both 2003 and 2004 will be in place. But given the time for adjudication and the need to give organizers and participants a clear year of advance notice, the 2004 competition has to be in the fall of 2002. That means now.

The Call for Proposals for 2004 is already out!

Please check out the PIMS website. There is a considerable amount of information on the various BIRS programmes and the review process, as well as guidelines and online forms. The whole idea of BIRS is to take the administrative burden off organizers to let them concentrate on the science. If you have any inclination to organize something at BIRS, take a look and see how easy it is. The deadline for workshop submissions is October 15, 2002.

We also strongly suggest that you think of October 15 as the deadline for the other BIRS programmes too (research in teams, focused research groups, summer schools, etc.). The Scientific Steering Committee of BIRS will make its first round of decisions on these programmes soon after this date, and competition for space for the prime summer months will most surely be taken in this first round.

This brings us to another substantial development. In February **Jessica Douglas** joined the PIMS (UBC) staff as the Scientific Coordinator of BIRS. Jessica is the contact person for all BIRS scientific programmes. Jessica has also been working hard to make the BIRS website as useful as possible for organizers, participants, applicants of proposals, referees, and members of the scientific selection committees. You will notice substantial differences (and I hope improvements) to the appearance of the BIRS website. Underneath this there are many more developments, which allow everyone to interact with BIRS painlessly online. Jessica and **Heather Jenkins** (PIMS Communications Officer) also created the beautiful poster for the 2003 Workshop programme of BIRS. The credit for setting up the webpage and for many of the details of programming the data-base goes to the very able **Kelly Choo** (PIMS Website Manager) at the University of Victoria. **Sandy Rutherford** (PIMS Scientific Executive Officer) and **Shervin Teymouri** (PIMS Computer Systems Manager) are setting up the computer system at BIRS.

Heather, Jessica, Shervin and Sandy, working behind the scenes for BIRS. Missing from photo Kelly Choo.

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Focused Research Groups (FRG), Research in Teams (RIT) and Summer Schools (SS) 2003 Programme

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

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

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

May 17–22 **Graduate Modelling Camp** (SS) Organizers: R. Kuske (PIMS), F. Santosa (IMA)

May 24–Jun 07 **Topology and Analysis: Complementary Approaches to the Baum-Connes and Novikov Conjectures** (SS) Organizers: N. Higson (Penn State), J. Kaminker (Indiana-Purdue), S. Weinberger (Chicago)

Jun 07–21 **Quantum Algorithms and Complexity Theory** (FRG) Organizer: R. Cleve (Calgary)

Jun 21–27 **Summer School in Differential Geometry** (SS) Organizer: R. Bryant (UC Berkeley)

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

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

Jul 26–Aug 16 **Representation Theory of Linearly Compact Lie Superalgebras and the Standard Model** (RIT) V. Kac (MIT), A. Rudakov (NTNU)

Aug 02–16 **Variance of Quasi-coherent Torsion Cousin Complexes** (RIT) J. Lipman (Purdue), S. Nayak (Harish-Chandra Research Inst.), P. Sastry (Toronto)

Aug 16–30 **Invariant Manifolds for Stochastic Partial Differential Equations** (RIT) T. Caraballo (Universidad de Sevilla), J. Duan (Illinois Tech), K. Lu (Brigham Young), B. Schmalfuss (Merseburg)

Aug 16–Sep 06 **Local Uniformization and Resolution of Singularities** (RIT) S.D. Cutkosky (Missouri-Columbia), F.-V. Kuhlmann (Saskatchewan)

Sep 06–20 **Arithmetic of Fundamental Groups** (RIT) D. Harbater (Pennsylvania), F. Pop (Bonn)

Sep 20–Oct 02 **Mathematical Models for Plant Dispersal** (FRG) Organizers: M. Lewis (Alberta), J. Bullock (NERC Centre for Ecology and Hydrology)

Oct 02–04 **West Coast Operator Algebra** (2-day workshop) Organizer: B. Brenkan (Calgary)

BIRS — 2003 Programme for 5-day Workshops

Mar 15–20 **Recent Developments in Superstring Theory** Organizers: Jim Bryan, Moshe Rozali, Gordon W. Semenoff, Mark Van Raamsdonk (UBC), Steve Giddings (UC, Santa Barbara), Mikhail Kapranov, Amanda W. Peet (Toronto), Andreas Karch (Washington), K. Viswanathan (SFU)

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

Mar 29–Apr 03 **Commutative Algebra and Geometry** Organizers: Mark Green (IPAM), Jürgen Herzog (Gesamthochschule-Essen), Bernd Sturmfels (UC, Berkeley)

Apr 05–10 **BIRS Workshop on Noncommutative Geometry** Organizers: Alain Connes (IHES), Joachim Cuntz (Muenster), George Elliott (Toronto), Masoud Khalkhali (Western Ontario), Boris Tsygan (Penn State)

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

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

Apr 26–May 01 **The Many Aspects of Mahler's Measure** Organizers: David Boyd (UBC), Doug Lind (Washington), Fernando Rodriguez Villegas (Texas, Austin), Christopher Deninger (Muenster)

May 03–08 **Recent Advances in Algebraic and Enumerative Combinatorics** Organizers: Sara Billey (MIT), Ian Goulden, David Jackson (Waterloo), Curtis Greene (Haverford College), Richard Stanley (MIT)

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

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

May 31–Jun 05 **Symmetry and Bifurcation in Biology** Organizers: Martin Golubitsky (Houston), William F. Langford (Guelph), Ian Stewart (Warwick)

Jun 07–12 **Applicable Harmonic Analysis** Organizers: Rong-Qing Jia (Alberta), Sherman D. Riemenschneider (West Virginia), M. Victor Wickerhauser (Washington)

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

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

Jun 28–Jul 03 **Joint Dynamics** Organizers: Douglas Lind, Boris Solomyak (Washington), Daniel Rudolph (Maryland), Klaus Schmidt (Vienna)

Jul 05–10 **Mathematical Biology: From Molecules to Ecosystems; The Legacy of Lee Segel** Organizers: Leah Keshet (UBC), Simon A. Levin (Princeton), Mark Lewis (Alberta)

Jul 12–17 **Perspectives in Differential Geometry** Organizers: Richard Schoen (Stanford), Gang Tian (MIT), Jingyi Chen (UBC)

Jul 19–24 **Differential Invariants and Invariant Differential Equations** Organizers: Niky Kamran (McGill), Peter J. Olver (Minnesota)

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

Aug 02–07 **Monge-Ampere Type Equations and Applications** Organizers: Alice Chang, Paul Yang (Princeton), Pengfei Guan (McMaster)

Aug 09–16 **Localization Behavior in Reaction-Diffusion Systems and Applications to the Natural Sciences** Organizers: A. Bernoff (Harvey Mudd College), P. Fife (Utah), T. Hillen (Alberta), M. J. Ward (UBC), J. Wei (Chinese U.)

Aug 09–16 **Defects and their Dynamics** Organizers: Peter W. Bates (Brigham Young), Lia Bronsard (McMaster), Changfeng Gui (Connecticut)

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

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

Aug 30–Sep 04 **A Scientific Creative Writing Workshop at BIRS** Organizers: Marjorie Senechal (Smith College), Chandler Davis (Toronto)

Aug 30–Sep 04 **Locally Finite Lie Algebras** Organizers: Yuri Bahturin (Memorial Newfoundland), Georgia Benkart (Wisconsin-Madison), Ivan Penkov (UC-Riverside), Helmut Strade (Hamburg), Alexander Zalesskii (Northern Anglia)

Sep 06–11 **Regularization in Statistics** Organizers: Ivan Mizera (Alberta), Roger Koenker (Illinois)

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

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

Sep 27–Oct 02 **Stochastic Partial Differential Equations** Organizers: Martin Barlow, Edwin Perkins (UBC), Krzysztof Burdzy (Washington), Robert Dalang (Ecole Polytechnique Fédérale)

Oct 04–09 **Quadratic forms, Algebraic Groups, and Galois Cohomology** Organizers: R. Elman, A.S. Merkurjev (UCLA), J. Minac (Western Ontario), C. Riehm (McMaster)

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

Oct 18–23 **MITACS Special Industrial Forum**

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

Nov 01–06 **PIMS HOT TOPICS**

Nov 08–13 **MSRI HOT TOPICS**

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

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

Nov 29–Dec 04 **Nonlinear Dynamics of Thin Films and Fluid Interfaces** Organizers: A. L. Bertozzi, R. P. Behringer, T. P. Witelski (Duke), R. Almgren, M. C. Pugh (Toronto), M. Shearer (NC State)

Dec 06–11 **Calabi-Yau Varieties and Mirror Symmetry** Organizers: Victor Batyrev (Tübingen), Shinobu Hosono (Tokyo), James D. Lewis (Alberta), Bong H. Lian (Brandeis), S.-T. Yau (Harvard), Noriko Yui (Queen's), Don Zagier (Max-Planck)

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

Dec 13–18 **Coordinate Methods in Nonselfadjoint Operator Algebras** Organizers: Allan Donsig (Nebraska), Michael Lamoureux (Calgary)

PIMS Thematic Programme on Asymptotic Geometric Analysis

Contributed by Sandy Rutherford, PIMS

This past summer, PIMS-UBC hosted a 7-week Thematic Programme on Asymptotic Geometric Analysis. The scientific committee was co-chaired by **Vitali Milman** (Tel Aviv) and **Nicole Tomczak-Jaegermann** (University of Alberta). The other members of the committee were **Nassif Ghousoub** (PIMS and UBC), **Robert McCann** (University of Toronto) and **Gideon Schechtman** (Weizmann Institute).

Asymptotic geometric analysis is concerned with the geometric and linear properties of finite-dimensional convex bodies, especially with the asymptotics of various quantitative parameters as the dimension of the underlying space tends to infinity. This field is multi-disciplinary in nature, typically combining geometric, analytic, probabilistic and combinatorial methods.

This Thematic Programme brought together over 220 senior experts, young researchers, postdocs and advanced Ph.D. students from mathematics and computer science. Represented among the programme of speakers were laureates of many different honours and prizes, such as the Fields Medal, Nevanlinna Prize, Wolf Prize, Salem Prize, Ostrowski Prize, and many others. The flavor of the workshop may be felt from the following examples of speakers and directions (in broad categories and listed in every group alphabetically). Many more talks in every direction were, in fact, given.

Fields medalist Jean Bourgain, IAS.

• In the field of **Asymptotic Combinatorics** (which included also lectures relating to graph and information theory), lectures were given by Noga Alon (Tel Aviv University), Imre Barany (University College London), Jennifer Chayes (Microsoft), Gil Kalai (Hebrew University), Michael Krivelevich (Tel Aviv University), Laszlo Lovasz (Microsoft) and Miklos Simonovits (Hungarian Academy of Sciences).

• Keith Ball (University College London), Apostolos Giannopoulos (University of Crete), Yehoram Gordon (Technion), Hermann Koenig (Universität Kiel), Vitali Milman (Tel Aviv University), Gideon Schechtman (Weizmann Institute), and Nicole Tomczak-Jaegermann (University of Alberta) lectured on **Asymptotic Geometric Analysis**.

• **Classical Convexity** was represented, for example, by lectures given by Erwin Lutwak (Polytechnic University), Rolf Schneider (University of Freiburg), and Peter Gruber (University of Technology, Vienna).

• In the direction of **Analysis**, Jean Bourgain (IAS), Alexander Koldobsky (University of Missouri-Columbia), Izabella Laba (UBC), Mikhail Sodin (Tel Aviv University) spoke.

• **Complexity Theory** was represented by the talks of Ravi Kannan (Yale), Shmuel Safra (Tel Aviv University), and Avi Wigderson (Institute for Advanced Study).

• Talks on **Statistical Physics and Random Matrices** were given by Christian Borgs (Microsoft), Ravindran Kannan (Yale University), Leonid Pastur (Université Paris VII), Alexander Soshnikov (University of California, Davis), and Stanislaw Szarek (Université Paris VI and Case Western Reserve).

• Franck Barthe (Université de Marne-la-Vallée, CNRS), Yann Brenier (CNRS), Jose A. Carrillo (Universidad de Granada), and Robert McCann (University of Toronto) gave lectures on the **Transportation of Measure**.

• Lectures in **Probability Theory** were given by Rafal Latala (Warsaw University), Michel Ledoux (Université de Toulouse), and Krzysztof Oleszkiewicz (Warsaw University).

• Edward Effros (UCLA), Marius Junge (University of Illinois), Alexandru Nica (University of Waterloo), Zhong-Jin Ruan (University of Illinois), and Roland Speicher (Queen's University) represented **Non-commutative Phenomena**.

• Lectures on **Infinite Dimensional Banach Spaces** were given by Tadeusz Figiel (Polish Academy of Sciences), Joram Lindenstrauss (Hebrew University), Aleksander Pelczynski (Polish Academy of Sciences), Haskell Rosenthal (University of Texas), and Thomas Schlumprecht (Texas A&M University).

This list is only an excerpt from the very rich programme of talks. For the complete list of participants and lectures see the Asymptotic Geometric Analysis Thematic Programme webpage **www.pims.math.ca/aga**.

Close to 100 of the lectures in the programme were taped and are available in both streaming realvideo and MP3 formats. This provided an online resource to conference participants, allowing them to review previous lectures throughout the programme. To provide a resource to the mathematics community at large, we have now made entire collection of taped lectures available from the main Thematic Programme webpage given above and from the PIMS online lecture archive, **http://www.pims.math.ca/video**.

The main directions of study were convex geometric analysis (asymptotic theory of convex bodies and normed spaces), some problems of discrete mathematics (one may call it asymptotic combinatorics) including problems of complexity theory, and some problems of statistical physics. A number of lectures were also given on closely-connected subjects in probability and nonlinear PDEs arising in convex analysis and geometric inequalities.

AGA participants enjoying a reception at PIMS.

The Programme was divided into six sections: a Conference on Convexity and Asymptotic Theory of Normed Spaces, a Concentration Period on Measure Transportation and Geometric Inequalities, a Conference on Phenomena of Large Dimensions, a Focused Research Groups Session on Random Methods and High Dimensional Systems, a Conference on Non-commutative Phenomena and Random Matrices, and a Conference on Banach Spaces. The programme was strongly connected thematically with many of the lectures illustrating the cross-over between these fields. Most of the participants took advantage of this by attending a number of the sessions in the programme.

Conference on Convexity and Asymptotic Theory of Normed Spaces

The programme opened with the Conference on Convexity and Asymptotic Theory of Normed Spaces, organized by Erwin Lutwak (Polytechnic University) and Alain Pajor (Marne-La-Vallée). Lasting one week (July 1–5) this conference featured lectures on classical convexity theory, Radon transforms and Fourier methods in convexity, asymptotic theory of high dimensional convex bodies, geometric functional inequalities, probabilistic methods in convexity, and isoperimetric-type inequalities

Concentration Period on Measure Transportation and Geometric Inequalities

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

Conference on Phenomena of Large Dimensions

The Conference on Phenomena of Large Dimensions ran from July 15–23. It was organized by Vitali Milman (Tel Aviv), Michael Krivelevich (Tel Aviv), Laszlo Lovasz (Microsoft Research) and Leonid Pastur (U. Paris VII). The main topics covered in the lectures were different phenomena observed in complexity theory, asymptotic combinatorics, asymptotic convexity, statistical physics and other theories of very high parametric families (or large dimensional spaces).

Focused Research Groups on Random Methods

The period from July 24 to August 5 was devoted to the Focused Research Groups on Random Methods and High Dimensional Systems. Participants took advantage of this period to discuss previous lectures in the programme and to work in new directions. Furthermore, Gideon Schechtmann (Weizmann Institute) and Alexander Litvak (University of Alberta) each organized an informal series of lectures during this period.

Conference on Non-commutative Phenomena and Random Matrices,

The Conference on Non-commutative Phenomena and Random Matrices, August 6–9, was organized by Gilles Pisier (U. Paris VI and Texas A & M) and Stanislaw Szarek (U. Paris VI and Case Western Reserve). Topics addressed in this conference related to the distribution of eigenvalues of random matrices, norms of such matrices, some aspects of free and quantum information theories, quantized functional analysis and operator spaces, and non-commutative L_p spaces.

Conference on Banach Spaces

The programme closed with the Conference on Banach Spaces, which was organized by Bill Johnson (Texas A & M) and Ted Odell (U. Texas, Austin). Unfortunately, personal circumstances required Bill Johnson to cancel his participation at the last minute and his presence was greatly missed. This conference focused on the asymptotic theory of Banach spaces and other applications of local theory to the geometry of infinite dimensional Banach spaces.

PIMS is grateful for the additional support provided to this Programme by the CRC grant of Nicole Tomczak-Jaegermann, by the NSF conference grants of Erwin Lutwak and Ted Odell, and by Microsoft. Furthermore, we thank all of the organizers, speakers and participants for making this Programme such a success with their enthusiasm and dedication.

The Asyptotic Geometric Analysis Thematic Programme organising committee: Vitali Milman (Tel Aviv), Nicole Tomczak-Jaegermann (University of Alberta) and Gideon Schechtman (Weizmann Institute). Missing from photo Nassif Ghousoub (PIMS and UBC) and Robert McCann (University of Toronto).

Around Group Rings Seminar, Jasper, Alberta, February 18–21, 2002

Contributed by G. Cliff, University of Alberta

The conference was attended by 48 participants from North America (Canada, United States), South America (Brazil), and Europe (Ireland, Italy, Poland, The Netherlands, Belgium, Germany) and Asia (Japan).

The speakers were Passman (Wisconsin-Madison), Goncalves (Sao Paulo), Bakhturin (Memorial and Moscow State) on the first day, Lichtman (Wisconsin-Parkside), Giambruno (Palermo), Marciniak (Warsaw), Hertweck (Stuttgart) on the second day, Nebe (Ulm), Riley (Western), Szechtman (Waterloo), Jespers (Brussels), and Gupta (Manitoba) on the third day, and Roquette (Heidelberg) and Hurley (Galway) on the last day. There was a problem session on Monday afternoon, where many open problems in the subject were mentioned and discussed by the participants.

A volume of proceedings will appear in the series Resenhas do IME published by the University of Sao Paulo.

Kneeling (L-R): Y. Yoshi, G. Cliff, T. Hurley, F. Szechtman, J. Goncalves, Y. Bahturin. Standing (L-R): A. Herman, E. Osmanagic, P. Campbell, F. Levin, A. Doom, unknown, N. Strungaru, T. Yokonuma, Y. Li, A. Weiss, C. Polcino, K. Hoechsmann, M. Hertwick, P. Roquette, A. Valenti, E. Jespers, A. Lichtman, S. Sehgal, A. Giambruno, M. Parmenter, M. Shirvani, N. Gupta, D. Passman, Z. Marciniak, M. Dokuchaev, L. Creedon, W. Kimmerle

Representations of Reductive p-adic Groups

Banff, Alberta, February 21–23, 2002

Contributed by Clifton Cunningham, University of Calgary and Fiona Murnaghan, University of Toronto

In February 2002 the Banff Centre hosted a small, focused, and very successful research workshop on Representations of Reductive p-adic Groups, bringing mathematicians from Canada, France, Germany and the US to the future site of the Banff International Research Station.

The workshop was organized around three mathematical themes reflecting recent progress in the field: The construction of types for admissible representations of reductive p-adic groups and applications to character theory; applications of rigid analytic geometry to p-adic group representation theory; results on L-packets. Organized by Clifton Cunningham (University of Calgary) and Fiona Murnaghan (University of Toronto), the workshop included thirteen talks over the 21–23 February and a number of participants arrived early or stayed late in order to have more time with colleagues and the mountains. Speakers and titles are listed below.

Jeffrey Adler (University of Akron), *Supercuspidal character germs for classical groups*
Anne-Marie Aubert (CNRS ENS), *Sheaves on adic spaces for p-adic group representation theory*
Stephen Debacker (Harvard), *Quixotic quests*
Laurent Fargues (Institut de mathématiques de Jussieu), *An introduction to Rapoport Zink spaces and their l-adic cohomology*
David Goldberg (Purdue), *The norm map and consequences*
Jeffrey Hakim (American University), *Supercuspidal Representations Attached to Symmetric Spaces*
Thomas Hales (Pittsburgh), *Motives and Representations of Reductive p-adic Groups*
Chris Jantzen (East Carolina), *Degenerate principal series for even-orthogonal groups*
Henry Kim (Toronto), *Application of Langlands' functorial lift of SO(2n+1) to GL(2n)*
Julee Kim (IAS, Princeton), *Dual blobs and Plancherel formula*
Peter Schneider (Universität Münster), *The algebraic theory of tempered representations*
Matthias Strauch (Universität Münster), *Representations on vanishing cycles, trace formulas and boundaries*
Jiu-Kang Yu (Maryland), *Integral schemes for Moy-Prasad filtrations*

Other participants appearing in the photograph are **Peter Campbell** (Alberta), **Jason Levy** (Ottawa) and **Loren Spice** (Chicago).

1st PIMS Mathematics of Biological Systems Summer Workshop

University of Alberta, May 11–19, 2002

Contributed by Mark Lewis, University of Alberta

The participants.

From May 11–19, 2002, the Centre for Mathematical Biology (CMB) offered the 1st annual **PIMS Mathematical Biology Summer Workshop** entitled "Mathematics of Biological Systems". Our aim was to introduce undergraduate mathematics students to mathematical modeling and analysis applied to real biological systems. Instructors were Gerda de Vries, Thomas Hillen, Mark Lewis, and Michael Li, all from the University of Alberta. There was further assistance provided by volunteer graduate students, postdoc fellows, and staff (Robert Bechtel, Andrew Beltaos, Gustavo Carrero, Christina Cobbold, Tomas de Camino-Beck, Lisa Haraba, Annemarie Pielaat, Shirley Mitchell).

We received applications from almost 40 students from all over North America. In the end, 26 students came to the workshop from 14 different Universities across Canada and the United States, many on their own funding. More than half of the attendees were women.

The workshop was 8 days in length and was a combination of classroom instruction, computer lab instruction and exercises, guided group project work, and project presentations.

The extremely positive feedback that was received, in combination with the large number of applicants and participants, has led us to pursue the workshop as an annual event. We strongly believe the exchange of ideas and knowledge that occurred between students will be carried back to their home universities and that the program will grow in popularity over the years to come.

Photographs and presentations from the workshop can be found at: **www.math.ualberta.ca/~mathbio/events.html**.

International Conference on Robust Statistics

PIMS-UBC, May 12-18, 2002

Contributed by Ruben Zamar, Statistics, UBC

Nearly 100 researchers from 10 different countries came to UBC last May to participate in the International Conference on Robust Statistics (ICORS 2002) hosted by PIMS and jointly sponsored by PIMS, MINERVA Research Foundation (USA) and SBF 475 at University of Dortmund (Germany). Participants gathered at PIMS to present and discuss recent research on robustness and computational statistics. ICORS 2002 was then followed up by a weekend **Workshop on Computational Robustness** hosted by PIMS and co-sponsored by NSF. Videos and slides of the following lectures are availabe from the website **www.pims.math.ca/icors2002/**:

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

Tadeusz Bednarski (Zielona Gora), *Robust Inference for the Cox Model*

Graciela Boente (Buenos Aires), *Robust Estimators in Partly Linear Models*

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

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

Laurie Davies (Essen), *Breakdown and Groups*

Peter Filzmoser (Vienna U. of Technology), *Robust Factor Analysis*

Xuming He (Illinois at Urbana-Champaign), *Straight Talks about Robust Methods*

Karen Kafadar (Colorado), *Statistical Analysis of Microarray Data from Affymetrix Gene Chips*

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

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

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

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

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

Elvezio Ronchetti (Geneva), *Resistant Parametric and Nonparametric Modelling in Finance*

Peter Rousseeuw (Antwerp), *Robustness Against Separation and Outliers in Binary Regression*

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

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

David Tyler (Rutgers), *High Breakdown Point Multivariate M-Estimation*

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

Doug Wiens (U of A), *Robust, Sequential Design Strategies*

Victor Yohai (Buenos Aires), *High Breakdown Point Robust Regression with Censored Data*

Julie Zhou (UVic), *Robustness Issues for Confidence Intervals*

ICORS participants during their excursion to Capilano.

Americas V Conference
Edmonton, July 7–12, 2002

Contributed by Jim Muldowney, University of Alberta

Shui-Nee Chow with some of his former PhD students at Americas V.

The **Americas Conference in Differential Equations and Nonlinear Dynamics** is a biennial series that was established in 1994 as a joint initiative of four major research centres in South and North America: The Center for Dynamical Systems and Nonlinear Studies (CDSNS) at Georgia Institute of Technology, USA, the Instituto de Investgaciones en Matemticas Aplicadas y en Sistemas (IIMAS) at Universidad Nacional Autonoma de Mexico (UNAM), Mexico, the Instituto de Matemática Pura e Aplicada (IMPA), Brazil, and Fundayacucho, Venezuela, with an initial objective of fostering close collaborations and exchanges among researchers in this scientific field among the four countries.

The series was developed as a forum for the dissemination of scientific accomplishments in the Americas and for the creation of new opportunities for collaboration in dynamical systems. It has grown into one of the major international opportunities in this area. The first four conferences were held in Taxco, Mexico (1994), Aguas de Lindoa, Brazil (1996), Atlanta, USA (1998) and Mérida, Venezuela (2000).

Americas V had 120 participants from 9 Americas countries (Canada, USA, Mexico, Brazil, Venezuela, Colombia, Chile, Argentina and Peru) as well as from Asia and Europe. The conference was dedicated to Professor Shui-Nee Chow (Georgia Tech and University of Singapore) on his sixtieth birthday. Shui-Nee along with a handful of others such as Jack Hale (USA), Gilberto Flores (Mexico) and Hildebrando Rodriguez (Brazil) have been active for many years in the development of scientific exchanges in the Americas especially at the graduate level.

The plenary lectures were delivered by Jorge Sotomayor (Brazil), Jack Hale (USA), Hildebrando Rodrigues (Brazil), Mark Lewis (Canada), Jianhong Wu (Canada), Raúl Manasevich (Chile), George Sell (USA), Alfonso Castro (Colombia, USA), Antonmaria Minzoni (Mexico), Jorge Cossio (Colombia), Tomas Gedeon (USA), Robert Gardner (USA), Kening Lu (USA), John Mallet-Paret (USA), Peter Polacik (USA), Yingfei Yi (USA) & Hugo Leiva (Venezuela).

An innovation at this conference was the PIMS Posters at Americas V which was a web-based poster session. A prize of $1000 for the best graduate student poster was shared by Germán Jesus Lozada Cruz (from Peru, studying for his PhD at Universidade de São Paulo, Brazil) and Horacio Gómez-Acevedo (from Mexico, studying for his PhD at U of A, Canada). The Selection Jury for the graduate student posters was Raúl Manasevich (Chile), Gilberto Flores (Mexico) and Jianhong Wu (Canada).

PIMS Postdoctoral Fellows for 2002/03

The following PIMS postdoctoral fellows were selected for the year 2002/03. The review panel was Michael Lamoureux, (Chair, Math, UC), David Brydges (Math, UBC), Leah Keshet (Math, UBC), Richard Lockhart (Stats, SFU), Bryant Moodie (Math, UA) & Frank Ruskey (Comp Sci, UVic).

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

From PIMS' Mailbag:

Subject: Thank you for the two years support!

Dear Prof. Nassif Ghoussoub,

Thank you and PIMS for giving me the chance to work at PIMS. It is a great experience to be a PIMS postdoc. You and all the people at PIMS are very kind and helpful, providing a very nice working environment for academic research. During the past two years, I have enjoyed my life in Vancouver and I worked happily and enthusiastically with my professors. More importantly, as a new immigrant, my whole life and academic experience in Canda started from PIMS. Wherever I stay in the future, I will miss PIMS and Vancouver for the rest of my life.

I hope PIMS will be stronger and stronger in the future.

Best regards,

Yuqing Wang

PIMS-APCTP-PI Frontiers in Mathematical Physics: Workshop on "Brane Worlds and Supersymmetry"

University of British Columbia, July 22– August 2, 2002

Contributed by Sandy Rutherford, PIMS

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

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

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

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

Lectures were given by:

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

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

Cliff Burgess (McGill), *Fixing runaway moduli*

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

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

Bogdan Dobrescu (Yale), *Universal extra dimension*

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

Emanuel Katz (Washington), *Little Higgses*

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

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

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

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

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

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

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

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

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

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

Neal Weiner (Washington), *Supersoft supersymmetry breaking*

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

This workshop was the sixth of the annual workshops in the Frontiers in Mathematical Physics series. It was co-sponsored by PIMS, the Perimeter Institute for Theoretical Physics and the Asia Pacific Center for Theoretical Physics. The organizing committee was chaired by **John Ng** (TRIUMF). Other members of the organizing committee were **Andreas Karch** (University of Washington), **Taejin Lee** (APCTP), **Moshe Rozali** (UBC), **Alexander Rutherford** (PIMS) and **Gordon Semenoff** (UBC).

Recent Pacific Northwest (PNW) Seminars

PNW String Seminar, PIMS at UBC, March 08–10, 2002

Contributed by Sandy Rutherford, PIMS

The second annual PNW String Theory Seminar featured a series of talks on recent developments in string theory. It was organized by Kazayuki Furuuchi (PIMS & UBC), Moshe Rozali (UBC) and Gordon Semenoff (UBC). This weekend meeting provides an opportunity for graduate students to interact with leading researchers in the field. The talks were given by: **Kazuyuki Furuuchi** (PIMS & UBC), **Andreas Karch** (UW), **David Kutasov** (Chicago), **Shin Nakamura** (KEK), **Kazumi Okuyama** (Chicago), **Jan Plefka** (AEI, Potsdam), **Lisa Randall** (Harvard), **Eva Silverstein** (Stanford), **Matthias Staudacher** (AEI, Potsdam) and **Leonard Susskind** (Stanford).

2002 Spring Meeting of the PNW Statistical Group, UBC, April 12, 2002

Contributed by Jenny Bryan, UBC

This biannual meeting is organized by the statisticians at several institutions and universities in the Pacific northwestern U.S. and western provinces of Canada. The Spring 2002 meeting was held at St. John's College at UBC and included 44 participants, with good representation from various institutions and excellent participation by graduate students. The main speaker was**: Ying MacNab** (Health Care and Epidemiology, UBC and Centre for Community Health and Health Evaluation Research, BC Research Institute for Children's and Women's Health), *Statistical modeling issues in hospital performance comparison studies: the Neonatal Health Services in Canada Project.*

Sixth Annual Pacific North West Number Theory Conference, PIMS-SFU, April 20–21, 2002

Contributed by Peter Borwein, SFU

The sixth annual PNW Number Theory Meeting had about 40 participants primarily from Washington, Oregon, Alberta and British Columbia. The invited speakers were: **Kristin Lauter** (Microsoft), **Greg Martin** (UBC), **Carl Pomerance** (Bell Labs), **Mark Sheingorn**, **Fernando Rodriguez Villegas** (Texas, Austin) and **Hugh Williams** (U of C).

Spring Session of the West Coast Optimization Meeting, SFU, May 3–4, 2002

Contributed by Philip Loewen, UBC

The West Coast Optimization Meeting (WCOM) occurs twice each year, with one meeting in Greater Vancouver and one in Seattle. The spring session was well-attended, with over thirty participants. There were seven 45-minute technical presentations and a short theoretical talk, covering the full spectrum of theory, implementations, and applications of continuous optimization. The following people spoke at the meeting: **James V. Burke** (UW), **Asen Dontchev** (Mathematical Reviews), **Oliver Dorn** (UBC), **Marian Fabian** (Czech Academy of Sciences), **Gabor Pataki** (North Carolina), **Tamas Terlaky** (McMaster), **Paul Tseng** (UW) and **Jonathan Borwein** (SFU). The session concluded with a small group discussion, led by Tamas Terlaky, of the prospects for stimulating and structuring a nationwide collaboration in optimization.

Western Canada Linear Algebra Meeting, University of Regina, May 10–11, 2002

Contributed by Steve Kirkland, U. of Regina

This meeting was the sixth in the ongoing series of WCLAMs, which have been held roughly every two years since 1993. The meeting received financial support from the National Programme Committee, the University of Regina Conference Fund, and the University of Regina Faculty of Science. WCLAM 2002 featured 18 talks by speakers from Canada, the United States and Germany. The lectures covered a range of research areas associated with linear algebra, include matrix theory, operator theory, graph theory, applied mathematics, numerical analysis and combinatorics. The list of speakers included two winners of the Hans Schneider prize, which is given out every three years by the International Linear Algegra Society for outstanding contributions to research in linear algebra. In addition to the contributed talks, the meeting featured lectures from three invited speakers: **Jane Day** (San Jose State), **Ludwig Elsner** (Universität Bielefeld) and **Chris Godsil** (Waterloo).

Joint Meeting of the PNW Geometry Seminar and the Cascade Topology Seminar, UWashington, May 11–12, 2002

Contributed by John Palmieri, UW

Roughly 60 people attended this meeting, mostly from Washington, Oregon, and British Columbia. Individually, the PNW Geometry Seminar and the Cascade Topology Seminar are regular, regional meetings for geometers and topologists, respectively. This joint meeting provided a good setting for the usual interactions within each group, but also interactions between the groups. The meeting also received funding from the National Science Foundation. The talks were designed so as to be accessible to the entire audience, and they were well-received. This was reflected in the broad participation in the problem sessions following the talks. Topics for talks included information theory, gauge theory, conformal field theory, and rational homotopy theory. Speakers: **John Baez** (UC Riverside), **Dan Christensen** (Western Ontario), **Ralph Cohen** (Stanford), **Megan Kerr** (Wellesley), **Laura Scull** (UBC) and **Deane Yang** (Polytechnic University).

3rd PNW PDE Meeting, Washington State University, Pullman, May 23–25, 2002

Contributed by Gunther Uhlmann, UW

This meeting was held in honor of **John R. Cannon**'s 65th birthday. The conference was organized by **Robert Dillon**, **Alex Khapalov**, **V.S. Manoranjan** and **Hong-Ming Yin**, from Washington State University. The invited speakers covered a wide range of topics in partial differential equations including inverse and ill-posed problems, free boundary problems, PDE's arising in the life sciences, PDE's arising in financial mathematics and numerical analysis of PDE's.

For more information about PNW Seminars please see ***www.pims.math.ca/science/pnw.***

PIMS 2003 Thematic Programme on Inverse Problems & Applications

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

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

Pan-American Advanced Studies Institute (PASI) on PDEs, Inverse Problems and Non-Linear Analysis

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

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

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

The PASI is sponsored by the US NSF, US Dept. of Energy, PIMS, Conicyt and the CMM.

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

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

BIRS Workshop on Scattering and Inverse Scattering

Banff, March 22–27, 2003

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

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

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

PIMS-MITACS Workshop on Inverse Problems in Geophysics

PIMS, U. Calgary, July 21–26, 2003

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

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

PIMS-MITACS-IMA Workshop on Industrial Applications of Inverse Problems

PIMS-UBC, July 27–August 1, 2003

Organisers: Fadil Santosa (Chair, U. Minnesota), David Dobson (Texas A & M), Gary Margrave (U. Calgary) and Gunther Uhlmann (U. Washington).

The goal of the workshop is to stimulate the creation of interdisciplinary teams, consisting of mathematicians, engineers and scientists, that would continue working on inverse problems posed by industry scientists at the workshop. The teams will comprise of a mix of senior and junior mathematicians that are broadly trained in mathematics and are interested in collaborating with industry on real-world inverse problems.

This workshop will concentrate on industrial applications of inverse problems. The goal is to determine defects, corrosion, cracks, very small inhomogeneities, cavities or inclusions by noninvasive measurements. The object under study is probed using X-rays or electromagnetic and elastic waves and the mathematical methods are based on the study of inverse boundary and scattering problems.

Workshop on Inverse Problems and Medical Imaging

U. Washington, Seattle, August 4–8, 2003

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

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

PIMS Collaborative Research Groups

by Nassif Ghoussoub, PIMS Director

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 programs of these groups will be supported through a new PIMS program 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.

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 programs. Groups may already be organizing joint seminars and workshops, making joint PDF appointments, or developing joint graduate training programs. 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 programs 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 program, and they enhance the attractiveness of the universities.

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

Periods of Concentrated activities for the CRGs

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

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

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

In due course, all 32 of the PIMS CRGs recognized so far would be given the benefit of a period of concentration. This approach should dramatically increase the effectiveness of the PIMS research program 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 program's extended time scale, its multi-event nature and its cross-university character together distinguish it from any other institute program. Its implementation will allow PIMS to achieve several of its goals. It will:

- Provide new ways of having its scientific programs driven by its member scientists: The program will help elicit proposals for thematic summers, miniprograms, BIRS events, and distinguished scholars as part of the application process. These programs will have strong local interest and will encourage grass-roots generation and longterm planning of activities with a much more inclusive and flexible for-

mat than standard thematic programs.

- Foster multi-site interactions and collaborations: The program 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, the Banff station 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 program.
- 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 program 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 program 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 programs can also be developed in collaboration with other organizations and institutes, hence multiplying the opportunities.

Upcoming Areas of Concentration: 2003–06

String Theory: 2003–05

The concentration of researchers in string theory and closely related fields in the PIMS and Perimeter Institute communities has reached a critical size and has the potential to be a major player in the international research community.

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

Scientific Computing: 2003–05

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

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

Number Theory: 2003–05

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

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

Mathematical Ecology: 2003–05

This concentration period will incubate significant new original research, foster local interactions, provide leadership to the new researchers, and strengthen the international profile of mathematical ecology & evolution in our universities.

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

Dynamics & Related Topics: 2003–05

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

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

Probability Theory & Statistical Mechanics: 2004–06

Two challenging and related topics looked at by this group will be:

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

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

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

For more information please see **www.pims.math.ca/CRG/**.

Important Deadlines for PIMS Opportunities

PIMS Postdoctoral Fellowship Nominations

The Pacific Institute for the Mathematical Sciences invites applications for Postdoctoral Fellowships from outstanding young researchers in the mathematical sciences for the year 2003–2004. Applicants must be nominated by a scientist(s) affiliated with PIMS or by a Department (or Departments) affiliated with PIMS. The fellowships are intended to supplement support made available through such a sponsor. The Institute expects to support up to 20 fellowships tenable at any of its Canadian member universities: Simon Fraser University, the University of Alberta, the University of British Columbia, the University of Calgary, and the University of Victoria, as well as the affiliated universities: the University of Northern British Columbia and the University of Lethbridge.

The deadline is **February 7, 2003**. Please see **www.pims.math.ca/opportunities/pdf.html** for details.

National Programme Committee Call for Proposals

Submission of proposals involving joint initiatives with the Fields Institute and CRM should be made by **October 15, 2002**.
Applications should be sent to:

Chair, National Programme Committe
Pacific Institute for the Mathematical Sciences
Room 205, 1933 West Mall
University of British Columbia
Vancouver BC V6T 1Z2
Canada

or by email to **npc@pims.math.ca**

Please see the webpage **www.pims.math.ca/opportunities/natprogcomm.html** for details.

Call for Proposals for PIMS Conference, Workshops, Seminars and Related Activities

PIMS is now welcoming applications for support for conferences, workshops, seminars and related activities in the Mathematical Sciences, to occur after April 1, 2003.
The deadline for applications is **October 15, 2002**. After being reviewed by the PIMS Scientific Review Panel, the decisions will be announced by January 31, 2002.
For further information please see **www.pims.math.ca/opportunities/proposals.html.**

Call for Proposals for BIRS 2004 Season

The Banff International Research Station is now accepting proposals for the 2004 season which runs March 12 – December 18, 2004. The deadline for workshop proposals is **October 15, 2002**. This is the optimal, but not necessary, date for other types of programs too. If possible, proposal submissions should be made online using the Online Submission Forms. Please see the website **www.pims.math.ca/birs/proposals_menu/** for further details including descriptions of the various BIRS programmes and guidelines for submitting proposals.

Call for Nominations for PIMS Prizes

PIMS is now accepting nominations for the following prizes:

1. PIMS Research Prize
Awarded for a particular outstanding contribution to the mathematical sciences that was disseminated during the five-year period prior to the award being given. Open to Canadian citizens, permanent residents of Canada and residents of Pacific Rim countries who maintain academic ties to the Canadian mathematical sciences community.

2. PIMS Education Prize
Awarded to a member of the PIMS community who has made a significant contribution to education in the mathematical sciences. This prize is intended to recognize individuals from the PIMS member universities or other educational institutions in Alberta and British Columbia, who have played a major role in encouraging activities which have enhanced public awareness and appreciation of mathematics, as well as fostering communication among various groups and organizations concerned with mathematical training at all levels.

3. PIMS Industrial Outreach Prize
Awarded to an individual who has employed mathematical analysis in the resolution of problems with direct industrial, economic or social impact. This prize is intended for individuals from the academic, private or government sectors. This prize will be given to individuals who at the time of nomination are Canadian citizens or permanent residents of Canada.

Nominees for each prize should be nominated by three sponsors. They are to provide a cover letter explaining the nominee's contribution, impact and relevance for the prize. The nomination should also include a CV of the nominee, a publication list, a list of creative works or list of industrial products, and relevant samples of the nominee's work, such as reprints, patents or educational materials.

Nominations should be sent to:

Attention: PIMS Prizes
PIMS Director's Office
Room 200, 1933 West Mall
University of British Columbia
Vancouver BC V6T 1Z2
Canada

Nominations must be received by **Oct 15, 2002**. For more information, please see the webpage **www.pims.math.ca/prizes**.

New Lectures Available via Streaming Video over the Internet

Many more videos are now available at **http://www.pims.math.ca/video/** The videos are in Realvideo format. We have high resolution jpeg images of the speaker's slides when possible. MP3 files are also available for listening to for many of the lectures. The library is divided into five main sections. The following list gives some of the more recent videos that PIMS is offering.

Ceremonies and Meetings

• *PIMS Awards Ceremony 2001*, Vancouver, December 1, 2001

• *Announcement Ceremony for the Banff International Research Station*, The Banff Centre, Banff Alberta and The National Science Foundation, Washington, DC, September 24, 2001

• *Opening Ceremonies and Banquet of the 2001 Canada-China Mathematics Congress*, UBC, August 20, 2001

Seminar Series and Distinguished Lectures

MITACS Annual General Meeting, UBC, May 23–25, 2002

• **Gilbert Strang** (MIT), *Filtering and Signal Processing*
• **Ron Graham** (UC, San Diego), *Guessing Secrets*
• **Anil K. Jain** (University of Michigan), *Fingerprint Matching*

IAM-PIMS 2001–02 Joint Distinguished Colloquia, UBC

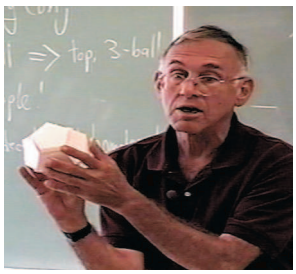
• **Eva Tardos** (Cornell University), *Approximation Algorithms and Games on Networks*
• **Adam Arkin** (UC, Berkeley), *Signal Processing in Cellular Regulatory Networks: Physical Models, Formal Abstractions and Applications*
• **Russel Caflisch** (UCLA), *Modeling and Simulation for Epitaxial Growth*
• **Joel H. Ferziger** (Stanford University), *Numerical Simulation of Turbulence*
• **David Gottlieb** (Brown University), *Spectral Methods for Discontinuous Problems*
• **Philippe R. Spalart** (Boeing, Seattle), *Detached-Eddy Simulation*

Eva Tardos, Cornell University

Distinguished Lectures

• **Ivar Ekeland** (Université Paris-Dauphine), *Systems of Nonlinear PDEs arising in economic theory*, UBC, March 22, 2002

• **David Gillman** (UCLA), *Odd embeddings on lens spaces*, UBC, May 31, 2001



David Gillman, UCLA

• **Douglas Arnold** (Director, IMA, Minnesota), *Colliding Black Holes and Gravity Waves: A new Computational Challenge*, UBC, May 16, 2001

• **David Eisenbud** (Director, MSRI), *Chow Forms and Resultants—old and new*, UBC, April 12, 2001

Thematic Programmes, Conferences and Workshops

Thematic Programme on Asymptotic Geometric Analysis, PIMS at the UBC, July 1–August 15, 2002

100 lectures are available!

International Conference on Robust Statistics, UBC, May 13–17, 2002

23 lectures are available!

PNW String Theory Seminar, PIMS at the UBC, March 8–10, 2002

10 lectures are available!

Minicourses

Minicourses by PIMS Distinguished Chairs

Michael Shelley (Courant Institute), PIMS Distinguished Chair, Simon Fraser University, November–December, 2001
• *Computing Free Boundary Problems in Moving Fluids* (lecture 1)
• *Computing with Surface Tension, and Discovering Singularities* (lecture 2)
• *Pattern Formation in Fluid Dynamics: Fluid Dynamics meets Materials Science* (lecture 3)
• *Why do Flags Flap?* (lecture 4)
• *Bending in the Wind: Elasticity and Drag Reduction* (lecture 5)

Vladimir Turaev (National Center of Scientific Research, France), PIMS Distinguished Chair, U. of Calgary, July–August, 2001
• *Torsion of chain complexes* (lecture 1)
• *Mehler's Formula and the Renormalization Group* (lecture 2)
• *Euler structures and refined torsions* (lecture 3)
• *The torsion function of 3-manifolds* (lecture 4)
• *Properties of the torsion function* (lecture 5)

Educational Activities

PIMS Changing the Culture 2002, SFU Harbour Centre, April 26, 2002

• **Ed Barbeau** (Mathematics, University of Toronto), *Symbiosis: Intuition and Rigour*
• **Brent Davis** (Education, University of Alberta), *Rigour : Mathematics : : Intuition : Teaching ... And Vice Versa*

Ed Barbeau, U. Toronto

Is Economic Theory True?

By Dr. Ivar Ekeland, Université Paris-Dauphine


Ivar Ekeland

I. The problem of testing

Economic theory, like physics, works from the bottom up. For the physicist, objects, as we see them, are built from atoms aggregated in various ways. For the economist, society is a collection of decision-making individuals who interact. So we need to know how people make decisions. Let us look at the simplest case of a lone individual, having an amount $w \in \mathbb{R}_+$ to spend on the purchase of K goods. If he buys the quantity x^k of good k, he pays $p_k x^k$, where p_k is the unit price of good k. In classical economic theory, his tastes are subsumed by a *utility function* $U : \mathbb{R}^K_+ \to \mathbb{R}$, which we will assume to be concave and smooth. The individual then chooses the goods bundle $x(p)$ which maximizes his utility under the budget constrain (throughout the paper, transposition is denoted by prime):

$$\max_x U(x) \text{ for } p'x \leq w$$

So the individual decision process is reduced to a concave optimization problem. It is a very simple model, and very tractable mathematically, but is it true? Certainly, there is little *prima facie* evidence for utility functions; we cannot just peer into ourselves and find it. So the problem of testing the model is a difficult one, and we have to handle it in a roundabout way. The basic idea is to look at the demand function $p \to x(p)$, which gives the choices of the consumer as prices change. Certainly, ways can be devised to observe that. We get a map from $\mathbb{R}^K$ into itself, and the question is whether the theory predicts some properties which can be tested against the observations.

II. Testing with individual data

Introduce the indirect utility function :

$$V(p) = \max_x \left\{U(x) \mid p'x = w\right\}$$

By the classical theory of Lagrange multipliers, there is some $\lambda(p) > 0$ such that:

$$V(p) = \max_x \left\{U(x) + \lambda(p)\left(w - p'x\right)\right\}$$

where the maximum on the right-hand side is attained at $x(p)$. Applying the envelope theorem, we get:

$$D_p V(p) = -\lambda(p)\, x(p) \tag{1}$$

This is a remarkable relation, because it tells us that the vector field $x(p)$ (which we know) is collinear to the gradient of an unknown function $V(p)$. In addition, λ must be positive and V convex. This is a very strong condition on $x(p)$, and the economists have long worked out some necessary and sufficient conditions (see for instance the treatise [4]). Introduce the so-called *Slutsky matrix* $S(p) = \left(s^{ij}(p)\right)_{i,j}$ associated with $x(p)$:

$$s^{ij}(p) = \frac{\partial x^j}{\partial p_i} - \sum_k p^k \frac{\partial x^j}{\partial p_k} x^i$$

Then $x(p)$ can be decomposed in the form (1) if and only if its Slutsky matrix of $x(p)$ is symmetric negative definite. In other words, the k partial derivatives of $x(p)$ have to satisfy $K(K-1)/2$ distinct conditions. This is a lot, and there are many conditions to be tested. They have been, and the results make a nice story.

Up to 1996, all econometric tests applied on collected data rejected the symmetry of the Slutsky matrix. That year, a paper by Browning and Chiappori appeared, which did two things. First, they tested the symmetry hypothesis on data for singles. The point is that all collected data concerns household, not individual, consumption: when food is bought, it is for the whole family. In previous tests, no provision was made to weed out data concerning households with two or more individuals. Browning and Chiappori [1] argued that the theory should not apply to that case: two individuals have two utility functions, not one. For households, the individual choice problem is compounded by a sharing problem. It turned out that they were right: on consumption data concerning singles, the symmetry of the Slutsky matrix was not rejected.

III. Testing with household data

Then Browning and Chiappori built a theory for household data and tested it. We shall model two-persons households in a very simple way: two individuals sharing the same budget constraint. Let $U_1(x_1)$ and $U_2(x_2)$ be their utility functions. Individual consumptions x_1 and x_2 are not observable, but joint consumption $x = (x_1 + x_2)$ is. The total earnings of the household are w, and they share it in an unknown way, allotting $w_1(p)$ to the first and $w_2 = w - w_1(p)$ to the second. Then each one solves his/her own problem:

$$\begin{array}{ll} \max_x U_1(x) & \max_x U_2(x) \\ px \leq w_1(p) & px \leq w - w_1(p) \end{array}$$

Leading to the indirect utility functions:

$$V_1(p) = \max\left\{U_1(x) \mid p'x = w_1(p)\right\}$$
$$V_2(p) = \max\left\{U_2(x) \mid p'x = w - w_1(p)\right\}$$

and to the equations:

$$D_p V_1(p) = -\lambda_1(p)\left(x_1(p) - D_p w_1(p)\right)$$
$$D_p V_2(p) = -\lambda_2(p)\left(x_2(p) + D_p w_1(p)\right)$$

$$-\frac{1}{\lambda_1(p)} D_p V_1(p) - \frac{1}{\lambda_2(p)} D_p V_2(p) = x_1(p) + x_2(p) = x(p) \tag{2}$$

We now raise the question: given a vector field $x(p)$, when can we find convex functions V_1 and V_2, and positive functions λ_1 and λ_2 such that the decomposition (2) holds locally? A necessary condition was found by Browning and Chiappori, and proved to be sufficient by Ekeland and Nirenberg [3]: the Slutsky matrix $S(p)$ of $x(p)$ should split into the sum of a symmetric, negative definite matrix, and a matrix of rank 1 :

$$S(p) = \Sigma(p) + a(p)\, b(p)', \text{ with } \Sigma(p) = \Sigma(p)' > 0 \qquad (3)$$

So household demand, although it does not satisfy the Slutsky condition, satisfies a weaker condition, which is (3) in the case when the household consists of two persons. Lo and behold, this condition is not rejected by econometric tests conducted on collected data. I find it a most remarkable fact that people solve complicated systems of nonlinear PDEs simply by taking care of themselves.

IV. Testing with market data

Consumption data concerning households or individuals is difficult to come by. It would be much easier to test the theory on market data, that is, the aggregate consumption of many individuals, which is readily found in many available sales statistics. Let us again consider a simple model, consisting of N individuals, each one with his own utility function U_n, and his own wealth w_n, resulting in an individual demand function $x_n(p)$. We observe the w_n and the aggregate demand $X(p) = \sum x_n(p)$.

As above, we have:

$$x_n(p) = -\frac{1}{\lambda_n(p)} D_p V_n(p)$$
$$w_n = -\frac{1}{\lambda_n(p)} p' D_p V_n(p)$$

Substituting, we get a system of K nonlinear PDEs for the V_n:

$$\sum_{n=1}^{N} \frac{w_n}{p' D_p V_n(p)} D_p V_n(p) = X(p)$$

and, as above, we seek convex solutions. Chiappori and Ekeland [2] have shown that such a solution exists (locally) for any analytic right-hand side. From the economic point of view, this is a negative result: any analytic map X from $\mathbb{R}^K$ into itself can be a market demand function, so there are no conditions to test. From the mathematical point of view, this raises another question, to which I would very much like to know the answer: what about smooth, but not analytic, right-hand sides? To give a specific example, can one find functions $u(x,y,z)$ and $v(x,y,z)$ such that

$$\frac{u_x}{u_z} + \frac{v_x}{v_z} = f(x,y,z)$$
$$\frac{u_y}{u_z} + \frac{v_y}{v_z} = g(x,y,z)$$

where the right-hand sides f, g are C^∞? The question is open.

References

[1] M. Browning and P.-A. Chiappori "Efficient Intra-Household Allocations: a General Characterization and Empirical Tests", *Econometrica*, 66 (1998), 1241-1278.

[2] P.A. Chiappori and I. Ekeland "Aggregation and Market Demand : an Exterior Differential Calculus Viewpoint", Econometrica 67 (1999), 1435-58

[3] I. Ekeland and L. Nirenberg, "A convex Darboux theorem", to appear, Methods and Applications of Analysis

[4] A. Mas-Colell, M. Whinston, J. Green, "Microeconomic theory", Oxford University Press, 1995

This article is based on a talk Dr. Ekeland gave as a PIMS Distinguished Lecturer. The lecture is entitled *Systems of Nonlinear PDEs arising in economic theory* and can be viewed at **www.pims.math.ca/science/2002/dist_lect/ekeland/**.

Upcoming Cascade Topology Seminar

PIMS-UBC, 2–3 November 2002

Contributed by Dale Rolfsen, PIMS-UBC

The 29th meeting of the **Cascade Topology Seminar** (CTS) will be held at PIMS-UBC over the weekend of 2–3 November. The CTS is a regional seminar which takes place twice a year in western Canada or the northwest region of the US, on a rotating basis. It is supported by PIMS as well as by an NSF grant.

There will be five lectures on Saturday and Sunday (ending noon Sunday) and a social event on Saturday evening. Students and postdoctoral fellows are especially encouraged to attend, and may qualify for financial support.

Among the confirmed speakers are:

- **Ian Hambleton** (McMaster Universit)
- **Vaughan Jones** (UC Berkeley)
- **Sergey Yuzvinsky** (University of Oregon)

with two others not available at press time. Details will be posted on the PIMS website as they are confirmed.

Open Letter to The Prime Minister of Canada, The Honorable Jean Chretien

The Fields Medal is the highest recognition that the world mathematics community offers for research in mathematics, and in prestige it rivals the Nobel Prize (which is not given in mathematics). Unfortunately, few are aware that J. C. Fields was a Canadian, that the Fields Medal was a Canadian idea, and that the Fields Foundation is located in Canada. This is in sharp contrast with the Nobel Prize which is usually announced and presented by the King of Sweden.

Recently, the Norwegian Prime Minister, Mr. Jens Stoltenberg, has taken the lead by granting US$22 million to fund the Abel prize: a new international prize in mathematics that is supposed to serve as the counterpart of the Nobel Prize for our discipline. This is in sharp contrast with the token monetary value of the Fields medal.

In 2002, there may be an opportunity to change that:
(1) to clearly identify Canada with the Fields Medal,
(2) and to increase the monetary value of the Fields Medal.

The International Congress of Mathematicians will meet in Beijing in August 2002. The Chinese President is expected to be present at the opening ceremony where the medals will be presented. It is important that a very prominent Canadian—the Prime Minister, the Governor-General or the Minister of Industry—be present in Beijing to award the Fields Medals. It is also a good opportunity for the government of Canada to align the medal with the Nobel Prize by announcing an appropriate level of funding.

This is a unique opportunity to brand Canada as a leader at the highest level of international research, and to retain that branding through the continuing identification with the Fields Medal. It is entirely consistent with the government's goal of moving Canada up ten places in world R&D. It deserves to be seized and given much prominence at the highest level.

Nassif Ghoussoub, Director, PIMS
Arvind Gupta, Director, MITACS
Robert V. Moody, Scientific Director, BIRS

Philippe Tondeur's Remarkable Term at NSF Comes to an End

In June 2002 Philippe Tondeur retired from his position as Director of NSF's Division of Mathematical Sciences.

It is known to all what an articulate voice Philippe Tondeur has been for the Mathematical Sciences within the U.S. Science and Engineering enterprise. Philippe's tireless work for mathematics during his tenure as the Director of the Division of Mathematical Sciences, has also had a substantial impact beyond the United States borders.

From the Canadian perspective, Philippe's leadership at the NSF will always be connected to the Banff International Research Station (BIRS). When this station was proposed Philippe had the foresight to realize that it would provide an incomparable resource for the Mathematical Sciences community in North America, and indeed the world.

Through their support of BIRS, NSF Director Rita Colwell, NSERC President Tom Brzustowski, and Philippe set a new precedent for joint U.S-Canada scientific collaborations. BIRS will be one of the enduring legacies of Philippe's tenure at the NSF.

The recent renaissance and awareness of the Mathematical Sciences in North America owes a great deal to Philippe's work at the NSF.

On May 15, 2002 a celebration in Philippe's honor was held in the Great Hall of the National Academy of Sciences in Washington, D.C.

continued from page 4

If you are an organizer or participant of an upcoming BIRS programme, be sure to check out the website for the links to the Banff Centre and its extensive programme of artistic activities, its very considerable athletic facilities (swimming pool, climbing wall, etc.) and other links to the National Parks, shuttle services, accommodations for extending your stay, maps, and so on. You will also find that your workshop has its own webpage.

The location of BIRS in the lively artistic community of the Banff Centre raises the potential for workshops that combine the normal fare of the mathematical sciences with other parts of cultural world that makes up our society. One such example is a BIRS workshop on Creative Scientific Writing that will be held around Labour Day 2003. Each year we would like to run a couple of events of this type. If you are interested in creating a proposal that crosses boundaries between the traditional mathematical/scientific culture and the any of the arts (music, dance, theatre, visual arts, media, etc.), BIRS is certainly receptive.

BIRS opens its doors for business on March 15, 2003. It was in October 2000 that Nassif Ghossoub first began to travel around, sounding out how much enthusiasm there was for a North American answer to Oberwolfach, to be situated in the Canadian Rockies. The response was immediate and emphatic; Do it! But to do it, and to have actually done it (in just 2 years), that is another matter. And to have done it by creating an international partnership with one of the top mathematics institutes in America, and with the cooperation of scientific funding agencies in United States, Canada, and Alberta as well as MITACS – this is more than we could have dreamed at the time.

To celebrate the remarkable achievement of creating this new institution there will be a party on February 28 at the Banff Centre. This will be a gala affair the combining of the Boards of Trustees of PIMS, MSRI, MITACS, the Academic Sponsors of MSRI, the Scientific Advisory Board of BIRS, and of course suitable representatives of NSERC, ASRA, and the NSF — all told some 150 people.

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

MITACS Scientists Converge on UBC: Third AGM Brings Together Bright and Young in the Mathematical Sciences

Contributed by Louise Clark, MITACS

The MITACS (Mathematics of Information Technology and Complex Systems) Third Annual General Meeting, held at the University of British Columbia from May 23–25, 2002, brought together over 350 students, researchers and industrial representatives from across Canada and the United States. The participants enjoyed a range of activities that included lectures by illustrious scientists, a poster and demo exhibition and competition, administrative meetings and social gatherings.

Anil Jain (Michigan State University) speaking about "Fingerprint Matching" at the MITACS AGM.

The AGM Exhibition commenced on May 23, when students and postdocs began mounting over 70 posters and demos. The display area quickly became filled with lively interaction, culminating in the afternoon poster judging session for the Best Poster Competition. Presenters then had the chance to explain their results and field specific questions from the judges.

After the judging session, **Gilbert Strang** from MIT, gave a stimulating talk entitled *Filtering and Signal Processing*. The AGM welcoming reception took place on Thursday evening at UBC's Museum of Anthropology. Dr. Indira Samarasekera, VP Research at UBC, delivered the opening address.

On Friday morning, **Ron Graham** of the University of California, San Diego, treated participants to a lecture entitled *Guessing Secrets*. The rest of the day was filled with lectures and informal discussion in the exhibition area. A highlight of the AGM was the conference banquet, held Friday evening at UBC's Sage Bistro. In attendance were **Arthur Carty**, President of the National Research Council (NRC) and **Philippe Tondeur**, Director of the Division of Mathematical Sciences at the National Science Foundation (NSF). Both Carty and Tondeur gave inspiring talks that emphasized the importance of mathematical research to society at large.

Following the talks, Dr. Gupta, MITACS Inc. Scientific Director, announced the winners of the Best Poster Competition. In all, eight posters earned prizes, which consisted of plaques and cash awards. Three companies generously sponsored the First Place prizes: **Object Technology International, Inc.**; **StemCell Technologies Inc.**; and **Alcatel**.

MITACS AGM Demonstration Presenter.

On Saturday morning, **Anil Jain** of Michigan State University presented a fascinating lecture entitled F*ingerprint Matching*. Lectures and informal interaction continued until noon.

This year's AGM drew remarkable press coverage, with television and radio stations seeking out scientists and students for interviews. News about the AGM appeared on CBC Newsworld, the Discovery Channel and the Multilingual Fairchild TV, to name but a few. Thanks to a generous donation by the Globe and Mail, the winners of the poster competition appeared in the Saturday, June 1 issue of the national newspaper.

Ron Graham (University of California, San Diego) giving a lecture entitled "Guessing Secrets" at the AGM.

The lectures of Gilbert Strang, Ron Graham and Anil Jain are available online at **www.mitacs.math.ca/agm2002/**

Gilbert Strang (MIT) talking about "Filtering and Signal Processing".

5th PIMS Graduate Industrial Math Modelling Camp

Simon Fraser University, May 18–23, 2002

Contributed by Marc Paulhus, University of Calgary

PIMS held its 5th Annual **Graduate Industrial Math Modelling Camp** (**GIMMC**) at Simon Fraser University May 18–23. At the camp 60 graduate students from all over Canada, the US and even some from as far as Europe cut their teeth on some problems in Industrial Mathematics presented by prestigious academic mentors.

As usual the week begins when the mentors present a mathematical problem inspired from an industrial application. The students then break into teams and spend 5 intensive days trying to solve the problem. The mentor, who has a good idea of how to solve the problem, acts as a gentle guide helping the students reach their goal. The objective is to prepare the students for the types of challenges they may face when they move out into the workforce. Also, many students are exposed to truely applied mathematics for the first time. Finally, it is a way of preparing for the **PIMS Industrial Problem Solving Workshop** held the following week.

Brett Stevens of Carleton University presented a problem in software testing. The idea was to apply combinatorics and statistical design to devise the best possible set of tests for a piece of abstract software. The students worked very hard devising combinatorial coverings of the space of possible input parameters.

Tim Myers of the University of Cape Town presented a problem on heating an airplane wing in order to evaporate water before it freezes. His students made great progress in modelling and solving this challenging thin film problem.

Chris Budd of the University of Bath presented a problem where you use a prod to test for the freshness of fish. His students were challenged into building a mathematical model the fish prods response and attempting to infer what information on the freshness of the fish could be retrieved from the data. Fortunately Prof. Budd came with some pre-made fish data so that no fish had to be prodded during the investigation.

Yongji Tan came all the way from Fudan University in Shanghai China to present a problem applicable to the oil and gas industry. The students were asked to investigate the results of a well log tool that measures the resistivity in the surrounding structure. The students learned a great deal about finite element methods.

Alexander Melnikov came from the University of Alberta with some problems in financial mathematics. His problem attracted the largest number of students who were interested in learning about hedging and option in both complete and incomplete market settings.

Petra Berenbrink was a local mentor from SFU. She brought her students right to the very edge of research in the complex area of routing in ad-hoc networks. The students came up with many new approaches and some counter-examples to this very difficult problem.

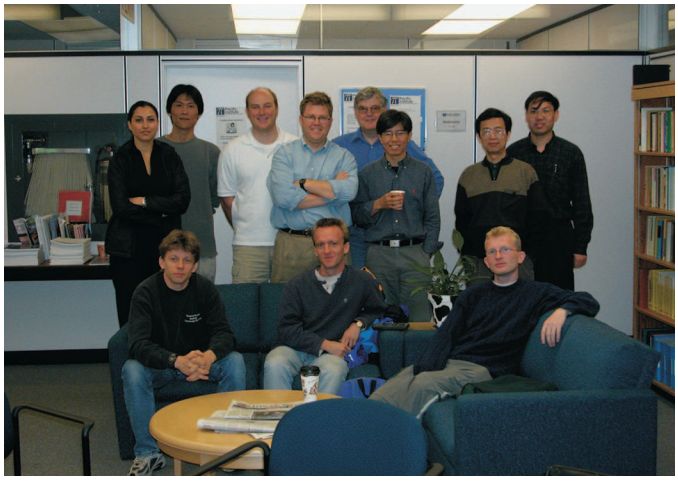
Brian Wetton from UBC challenged the students with a very complex problem in modelling a protein membrane of a fuel cell. His students did an excellent job of solving some very difficult mathematics.

This year the students had a unique opportunity to present the results of the week's work in the form of a poster at the MITACS-AGM.

PIMS-MITACS Crystal Growth Workshop

PIMS-UBC, May 26, 2002

Contributed by C. Sean Bohun, Penn State



One of the recent MITACS research collaborations involves modelling the industrial manufacturing of crystals. Led by Dr. Huaxiong Huang, the project is entitled *"Mathematical and Computational Modelling of Semi-Conductor Manufacturing Processes"*. The main goal of the project is to improve semiconductor manufacturing through scientific modelling. Many of the group participants, the author included, were first introduced to a portion of this problem by Bill Micklethwaite of **Firebird Semiconductor** at the 5th **PIMS Industrial Problem Solving Workshop** held in June 2001 in Seattle.

The group consists of a handpicked international collection of researchers with a variety of backgrounds and expertise. This last May the group met for the inaugural PIMS-MITACS crystal growth workshop that took place at UBC. Shown standing from left to right are San Arjoriandi (UBC), Wenxiang Zhu (Penn State), Colin Carrew (Firebird), Ian Frigaard (UBC), Bill Micklethwaite (Firebird), Huaxiong Huang (York University), Dong Liang (York University), Shuqing Liang (York University). Sitting from left to right are C. Sean Bohun (Penn State), Tim Myers (University of Cape Town) and Matt Bolton (UBC). Missing are Carl Ollivier-Gooch (UBC), Brian Seymour (UBC) and John Stockie (University of New Brunswick).

6th PIMS Industrial Problem Solving Workshop

University of British Columbia, May 27–31, 2002

Contributed by Marc Paulhus, University of Calgary and Ian Frigaard, University of British Columbia

PIMS held the 6th **Industrial Problem Solving Workshop** (**IPSW**) at the University of British Columbia in Vancouver on May 27—31. About 100 people registered for the event, including the 60 graduate students who had taken part in the graduate modeling camp the week before. Faculty from as far away as South Africa, Finland and China were also involved. Participants split up into six groups to attack the industrial problems brought to the workshop, spanning a broad range of applications and mathematical techniques. Most of the industrial participants were able to stay all week this year, and were actively involved in working with the groups. A brief description of the problems and some of the progress made is given below. More complete problem descriptions may be found on the website, **www.pims.math.ca/industrial/2002/ipsw/problems.html**, and proceedings papers are now being written by each group.

Edmond Lou represented **Capital Health** of Edmonton and brought a problem involving automating the process of analysis data from a 3D laser scanner that is used to diagnose patients with scoliosis. The current process, although good, relies on many manual user steps to complete the analysis. The team was able to show how some standard (and some not so standard) image processing techniques could be used to fully automate the data analysis process. Further, Capital Health was interested in knowing if it was necessary to use the physical marker points that they currently place on the patient's back before the scanning process. The team was convinced, after looking at a large amount of sample data, that the information given by the marker points could not be retrieved mathematically from the data, and hence are necessary.

Kai Meunzer from **Shell Canada** came to the workshop with an inverse problem: Given seismic and magnetotelluric data, can we determine geological properties of the Canadian foothill? After some discussion on the background materials of both seismic and magnetotelluric methodologies, the team realized that the best approach was to construct a simple one-dimensional 3-layer model to test a hybrid seismic-magnetotelluric approach by minimizing the weighted least square errors of both seismic and magnetotelluric data. Even though the team worked on this project was the smallest, each participant brought considerable expertise from various areas. With the help of Doug Oldenburg, (an expert in geophysical inverse problems), Yongji Tan, (an expert in inverse problems), and with the help of two graduate students, it was found that the hybrid method works better than either seismic or magnetotelluric approaches. This was only true if appropriate weight functions were chosen. Kai Meunzer was very satisfied with the progress made during the workshop and some follow-up work after the workshop has provided further insight into the problem.

Edward Keyes of **Semiconductor Insights** was interested in an algorithm to automatically stitch a large number of images of an integrated circuit together in order to reconstruct the image of the entire circuit itself. This problem attracted a large number of participants who quickly broke into teams to test the many different approaches that were suggested. The most straightforward approach, based on least-squares was implemented and tested during the week and was found to be a significant improvement over the current method. Other approaches, based on graph theory, simulated annealing and linear programming also showed a great deal of promise. It is clear that once the smoke clears the company will have an algorithm that is a significant improvement over the current techniques.

Appearing in his second IPSW, Bruce McGee of **MacMillan-McGee** presented the following scenario. One method of recovering soil contaminants is to electrically heat the soil with various electrodes inserted into wells in the ground. By injecting water into certain electrode locations and pumping fluids out of the remaining locations, the contaminants are slowly removed. If the contaminants are actually removed, as is intended, this process should change the resistivity of the soil as it progresses. For this reason, departures from the characteristic evolution of resistivity are of particular interest. The workshop participants were given the inverse problem of find the actual resistivity, given the response curve of the current, (or indeed any other measurable data). Failing this, was it possible to localize where in the domain any changes in resistivity occurred? Because of the size of the group (7 faculty and 9 graduate students), various aspects of the problem were investigated. To understand the forward problem a sequence of one and two-dimensional models were constructed to determine (i) the time evolution of the temperature field when cold water is injected and (ii) the sensitivity of the model to small localized changes in the resistivity. These preliminary investigations illustrated that an internal transition layer is generated during the propagation of the shock of injecting cold water, which persists in the steady state. Furthermore, the measured voltage between the electrodes is much more sensitive than the outflow fluid temperature to localized resistivity changes. Using these forward models as justification, the temperature field was neglected for the inverse problem and an attempt was made to implement the generalized sensitivity theorem in a square domain with a localized resistance anomaly at its centre. By combining the computed voltage field in the domain without the anomaly with a series of voltage measurements obtained with the anomaly in place, a picture of where the anomaly was located was built up. Work continues on the problem specifically in extending the analysis of the inverse problem to a simple layered medium. Investigations to increase the resolution of the inverse problem using an analytic Green's function and finite difference rather than finite element methods are ongoing. Bruce McGee was quite pleased with the progress made on the problem and anticipates a predictive model that can be used onsite. In Bruce's words, "It's all good!"

Ritchie He of the **RBC Financial Group**

The PIMS Industrial Problem Solving Workshop participants beside the PIMS facility at UBC.

presented a challenge to compute the closed form solutions to some very complex "pseudo" statistics. The team for this problem consisted almost entirely of graduate students, most of whom were new to financial mathematics. Nevertheless, the result was achieved and we look forward to seeing the full solution presented in the report.

In the areas of petroleum exploration and reservoir engineering, geoscientists use concepts from seismology to image the subsurface and determine essential rock-physics properties. Experimental conditions are typically in the form of a seismic survey whereby measurements are made of a seismic wave traveling between source and receiver. **Talisman Energy** presented an inverse seismic ray problem that sought to incorporate recent technological advances in the determination of elastic moduli. In particular, with the development of three-component geophones it is now possible to measure particle displacement associated with a seismic wavefront at depth. Such an experiment, whereby sources are located at the surface and geophones are place within the earth, is called a VSP, (vertical seismic profile). It was hoped that pairing particle displacement (i.e., polarization angle) with recorded traveltime would lead to an in situ inversion for elastic modulii requiring only a single source/receiver pair. Using concepts of asymptotic ray theory and continuum mechanics the team was able to formulate a system of eight non-linear equations that could be solved for the elastic modulii that were sought. Unfortunately, with the introduction of experimental errors, the system proved highly unstable and had to be abandoned. However, with the introduction of some further, yet not overly restrictive, assumptions, the team went on to formulate a new system of four non-linear equations. Initial follow up work suggests the new formulation is reasonably stable under experimental conditions.

Apart from the mathematics, an enjoyable social time was had by all. Mathematical modeling of industrial problems is an interactive social activity and many problems were discussed well into the evening at Koerners pub.

Proceeding from IPSW will soon be available at **www.pims.math.ca/publications/proceedings**

The annual prize for the best "PIMS-slip" went to **Fabien Youbissi** for the following gem:

> Receptionist at Gage: *"Your name please?"*
> Fabien: *"Youbissi"*
> Receptionist at Gage: *"No, your name, not your university"*

Witnesses report that a few more repetitions occurred, before the light came on ... It is not known if Fabien shared the traditional prize with the receptionist.

PIMS-MITACS-COE Undergraduate Industrial Case Study Workshop

University of British Columbia, May 25–27, 2002

The **Centre for Operations Excellence** (**COE**) hosted this successful workshop at UBC from May 25–27, 2002. Sixteen undergraduate students in commerce, engineering, business, physics, mathematics, statistics, and computer science were invited from across Canada to meet industry executives and renowned academics, and to explore graduate study opportunities, and to work in teams to solve challenging business problems.

The focus of the workshop was a real-world case study competition, culminating with teams presenting their findings to industry executives and academics on May 27. Cash prizes were awarded to the team that produced the best case study and presentation.

Universities represented in the workshop were UBC, SFU, U of A, U of C, McGill and Mount Allison. Workshop judges **Glen Darou** (COE Director, Industry), **Carol Leacy** (Vice President, Systems and Process Integration, Mark Anthony), **Bernard Lamond** (Professor and Director, Department of Operations and Systems, Université Laval) and **Maurice Queyranne**, (COE Director, Academic) were presented with outstanding presentations from the workshop teams. All participants were awarded with certificates and COE sweatshirts for their excellent work over the weekend. Team four, composed of **Derrick Chung** (McGill), **Amir Motamedi** (McGill), **Igor Naverniouk** (UBC), and **Philip Seo** (UBC), was honored with the prize for "Best Overall Case Analysis and Presentation".

Please see the web page **www.coe.ubc.ca/pimsworkshop** for more information.

The Fourth Annual PIMS Fluid Dynamics Summer School

University of Alberta, July 28–August 9, 2002

Contributed by Bruce Sutherland, University of Alberta

A knowledge of the dynamics of fluids is the starting point to understanding such diverse fields of study as aerodynamics, weather forecasting, ventilation, lubrication and turbulence. Fluid flows can be described by mathematical equations but these cannot be solved except in special circumstances. Instead scientists solve the equations numerically or use the results of laboratory experiments to guide their intuition in finding solutions.

In its dedication to the training of highly qualified personnel, each year the Pacific Institute for the Mathematical Sciences (PIMS) sponsors a fluid dynamics summer school at the University of Alberta. The two week long event is attended by graduate students and senior undergraduates from around the world. Each morning the participants attend lectures on a broad range of topics including waves and turbulence, convection, physical oceanography and climate modelling. The afternoons are spent gaining hands-on experience running numerical simulations and performing laboratory experiments which are designed to complement the lectures and which are adapted from the lecturers' current research. At the end of the school the students give presentations based on the results of their work.

There are two other annual fluid dynamics summer schools in the world, one at the University of Cambridge, England and the other at Woods Hole Oceanographic Institution, MA, USA. The PIMS Fluid Dynamics Summer School is unique in its emphasis on computational fluid dynamics and computer-aided laboratory measurements. Indeed, with its modern computational resources and its concentration of expertise in experimental and numerical fluid dynamics, the University of Alberta is one of the few institutions in the world capable of running a school which simultaneously exposes participants to theory, numerical and experimental methods.

This year the Fourth Annual PIMS Fluid Dynamics Summer School ran from July 28 to August 9. The summer school was fully attended by eighteen participants from Canada, England, Germany and the United States. Core lectures were given by **John Bowman** (Turbulence Modelling), **Andrew Bush** (Climate Modelling), **Peter Minev** (Computational Fluid Dynamics), **Bryant Moodie** (Wave Theory), **Bruce Sutherland** (Stratified Flows) and **Paul Myers** (Physical Oceanography).

We had four invited lecturers: **John Allen** (University of Oregon) spoke on *"Coastal Oceanography"*. **John Bush** (MIT) spoke on *"Geophysical Plumes"*. **Jean-Luc Guermond** (LIMSI, University of Paris, Orsay) spoke on *"Large Eddy Simulations"*; and **Peter Rhines** (University of Washington) spoke on *"Overturning Circulations in the Oceans and Atmospheres"* and *"Montainous Flows in Rotating Fluids: Vorticity Dynamics, Form Drag and Induced Circulation"*.

More information about this summer school can be found at **http://fdss.math.ualberta.ca**.

2002 Fluid Dynamics Summer School participants.

Lunchbox & Showcase Lecture Series, University of Calgary

Contributed by Gary Margrave, University of Calgary

The University of Calgary PIMS site has recently completed the first term of two very popular lecture series. These series were motivated by the desire to increase the profile of mathematical research at the University of Calgary. The **Spotlight Series** was conducted on campus and consisted of four lectures given by invited University of Calgary scientists for whom mathematics plays a strong role in their research. We deliberately selected speakers from a broad range of scientific disciplines and advertised the talks widely around the campus. We were very pleased with the quality of the presentation and with the size of the audiences, which ranged from 25 to 60 people.

The **Lunchbox Lecture Series** was held in the downtown core with the intention of attracting an audience from the large body of scientists and engineers who work there. Shell Canada generously agreed to sponsor the lectures and provided both an excellent meeting facility and a light lunch that was free to all attendees. The attendance at these lectures was even greater than at the Spotlight Series on campus, with the typical crowd being about 80 but that ranged to as high as 120. While there were many downtown professionals in attendance,

we also attracted people from the Calgary Board of Education, the University, and elsewhere. We conducted a survey of the audience to ask what topics would be of interest in future lectures and were surprised to find that they wanted to hear about quite theoretical subjects as well as applied ones.We plan to renew both lecture series in the fall and run them through spring of 2003. At that point we will take stock of the situation and plan anew.

Here is a list of the Spotlight Lectures:

Jim Nicholls (Geology), *Mathematical modeling of processes beneath the volcano*

David Hobill (Physics), *The non-linear dynamics of gravitatingsystems in general relativity*

Marcello Epstein (Mechanical Engineering), *The Uses of Differential Geometry in the Mechanics of Deformable Media*

Christian Jacob (Computer Science), *Design by Evolution—The Artand Science of Genetic Computer Programming*

And here is a list of the Lunchbox Lectures:

Michael Lamoureux (Mathematics), *Wavelets in Industry*

Rita Aggarwala (Statistics), *Designing better industrial experiments*

Antonin Settari (Chemical and Petroleum Engineering), *Mathematics of coupled reservoir and geomechanical modeling*

Ian Frigaard (Mathematics and Mechanical Engineering, UBC), *Advances in understanding well-construction fluid mechanics: cementing flows andturbulence*

Richard Churchill (Mathematics, Hunter College CUNY), *Fermat's Last Theorem*

Upcoming lectures in the Lunchbox Series: **Len Bos** (Mathematics and Statistics), **Christian Jacob** (Computer Science), **Tony Ware** (University of Calgary) and **Edward S. Krebes** (Geology and Geophysics).

Participants at Richard Churchill's talk.

Upcoming PIMS-IAM Joint Distinguished Colloquium Series

University of British Columbia

PIMS and the Institute for Applied Mathematics at UBC jointly sponsor six distinguished colloquia each year. The speakers for the year 2002–2003 are:

- **Gordon E. Swaters** (Institute of Applied Mathematics, University of Alberta), *Dynamics of Abyssal Ocean Currents*, October 7, 2002
- **David Chandler** (Chemistry, University of California), *Transition pathways in complex systems: throwing ropes over rough mountain passes, in the dark*, October 28, 2002
- **Ulf Dieckmann** (International Institute for Applied Systems Analysis, Laxenburg), *Title TBA*, December 2, 2002
- **Parviz Moin** (Center for Turbulence Research, Stanford University and NASA Ames Research Center), *Title TBA*, January 13, 2003
- **Leon Glass** (Department of Physiology, McGill University), *Dynamics of Genetic Networks*, January 27, 2003
- **Lloyd N. Trefethen** (Oxford University Computing Laboratory), *Fast accurate solution of stiff PDE*, March 17, 2003

Videos of last year's series may be watched by going to **www.pims.math.ca/industrial/2001/iampims_lect/**

Upcoming PIMS-ASRA Industrial Workshop: Mathematical Prediction of Sound Transmission through Composite Lightweight Walls

ATCO Noise Management, Calgary, November 7, 2002

This workshop shall include discussion of:

- the factors affecting sound transmission loss, mathematical formulations for the prediction of transmission coefficient
- predicting sound transmission loss of panels using the Mass Law or the unit per mass area
- the coincidence effect and resonance phenomenon
- estmiated transmission loss of untested composite lightweight walls
- data collection
- factors affecting sound transmission loss.

The organisers of this workshop are **Daryl Caswell** (University of Calgary), **Liming Dai** (University of Regina), **Dave Nichols** and **Salem Hertil** (ATCO Noise Management).

The New PIMS Math Fair Booklet by Ted Lewis

PIMS published **the math fair booklet** by Ted Lewis in the Spring. This is a major new resource for teachers and others interested in math fairs for schools. It is based on the experience of the author and his colleagues over the past few years. It is a rich source of guidelines to organizing math fairs, and to finding suitable problems puzzles and challenges.

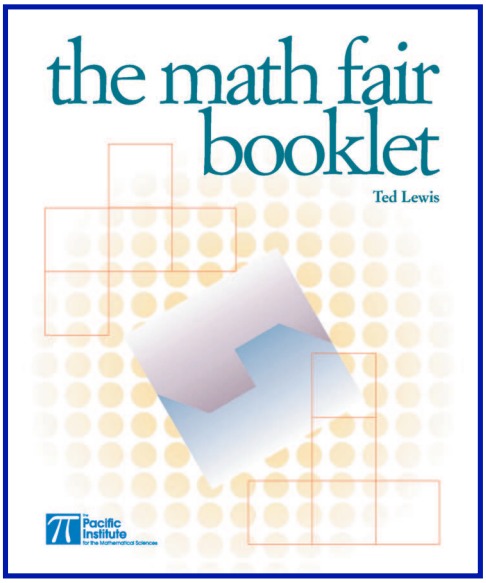
The booklet will shortly be available for free download in pdf format suitable for laser printing. Hard copies may be purchased from PIMS University of Alberta for a nominal fee (US$10.00 for shipping and handling in North America, US$15.00 elsewhere).

From the Introduction: the math fair booklet by Ted Lewis, PIMS 2002.

Everybody knows what a science fair is. Students find projects to work on, they prepare posters and demonstrations, the public is invited to come and see what they have done, and a panel of judges awards prizes for projects that are deemed to be the best.

A math fair is similar, but two important differences set our concept apart. Although mathematics is extremely diverse, our math fairs concentrate on just one aspect of the subject, namely problem solving, and our fairs are officially non-competitive, so there are no awards or prizes. We have chosen to focus on problem solving for several reasons. It is one activity that is common to most of mathematics, it is frequently an explicit part of the mathematics curriculum and it encourages skills in students that can be applied in all areas of their lives.

The problems in this booklet are ones that young students can solve and truly understand with a reasonable amount of work. They will not need a broad educational background, but the problems are not simple and most will have to think before solving them. The same is true about the people who visit the math fair even though they may be adults or students from higher grades. When the participants present their problems, they will discover that the visitors need help to work through the solutions,



and the presenters will gain the satisfaction and confidence that comes from helping more talented or older persons.

The interaction between the participants and the viewers at a problem-based math fair can have a profound effect on the poise, confidence, communication skills and patience of the participants. The 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 cooperative 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.

PIMS/University of Alberta Math Fair, March 21, 2002

Contributed by Ted Lewis, University of Alberta

How often do you find grade school students happy to spend two and a half hours doing mathematics? This is what happened for about 450 students from elementary and junior-high schools in the Edmonton area on Thursday, March 21, at the PIMS/U of A Math Fair. There were actually two parts to the activities—the fair itself which was presented by the students of the Math 160 class, and a problem solving session conducted by Andy Liu.

The math fair was non-competitive, and presented mathematical puzzles for the visitors to try. The puzzles were very diverse, from river-crossing problems to the towers of Hanoi. Here's one that was very popular (and it's solution is not immediate even for us): Put 8 hockey pucks in a straight line. The problem is to make four piles with two in each pile by jumping some of the pucks over the others. Each jumping puck must pass over exactly two pucks and land on a single puck. It doesn't matter whether the two pucks you are jumping over are an existing pile of two or are sitting by themselves. Spaces don't count.

After the students solved that puzzle they were asked to see if they can start with 10 pucks and end with 5 piles of two, or 12 pucks and end with 6 piles of two and so on. At least one child figured out the recursion and showed how to do it for up to 16 pucks.

On the way to the Math Fair.

Among other things, Andy's session involved "scientific origami". Unlike the math fair, where the students moved from booth to booth, Andy's was a sit-down session. The problems were very challenging, and the success rate among the students was very high.

The math fair is part of the curriculum for

Math 160 and has significantly revitalized the course. This is the first time that the math fair took place on campus instead of at individual schools. Moving the fair here was prompted by both the popularity of the fairs and associated logistical problems of taking a Math 160 class to a school away from the campus. Holding it here solved some problems but raised several others. Renee Polziehn from the university outreach center provided many useful suggestions.

Shirley Mitchell and Lisa Haraba from PIMS were invaluable in helping with the organization of the fair. For the past few years, PIMS has sponsored the math fairs, and the result is strong cooperative effort between our department, PIMS, and the schools in Alberta in promoting mathematics. Feedback from school teachers show that the math fairs widen the children's interest and perception about mathematics. The idea is spreading and math fairs modelled after the Math 160 fair are in the works for Going to the Math Fair, March 21 2002 Calgary, Vancouver and Ft. McMurray.

Math Fair at Greater Vancouver Regional Science Fair

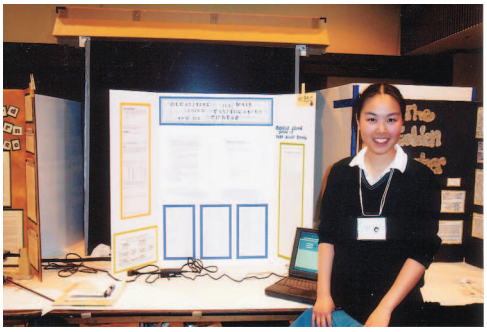
University of British Columbia, April 4–6, 2002

Contributed by Janet Martin, PIMS Education Officer

The Math Fair project took place this year amidst the teachers' job action. Yet despite this obstacle, ten projects were entered in the Computational and Mathematical Sciences category at the 2002 Greater Vancouver Regional Science Fair (GVRSF) and of these, two were selected to attend the Canada-Wide Science Fair held in Saskatoon, Saskatchewan in May 2002. These students were Gabrielle Arden of Burnaby South Secondary School and Rochelle Leung of York House School (pictured).

PIMS gave the following awards.

First: **Rochelle Leung** (York House): *Decrypting the math behind cryptography and its ciphers*



Rochelle Leung with her project, Decrypting the Math behind Cryptography and its Ciphers.

Second: **Gabrielle Arden** (Burnaby South Secondary): *Forecasting weather with neural networks*, **Frank Sun** and **Winnie Ho** (Windermere Secondary): *Matrices and cryptology*, **Harvey Zhang** (Burnaby North Secondary): *Inscribed triangles in circles and ellipses*

Third: **Pearly Trinh** and **Elaine Lee** (Windermere Secondary): *RSA algorithm cryptology*, **Galina Meleger** and **Kathryn Cheng** (York House): *The golden number*

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

Considering there were only ten projects entered in the Computational and Mathematical Sciences category, it is noteworthy that the GVRSF judges selected two of these projects as part of the top ten projects at the entire science fair.

PIMS contributed $2500 travel money to send two winners to Saskatoon.

Gabrielle Arden with her project, Forecasting Weather with Neural Networks.

At the Canada-Wide Science Fair, Gabrielle Arden won a Gold Medal and a $2000 scholarship to the University of Western Ontario in the Intermediate Computational and Mathematical Sciences category, and Rochelle Leung won a Bonze Medal and a $1000 scholarship to the University of Western Ontario in the same category. Congratulations to both students on their outstanding projects!

That's a Good Problem! Math Fairs in Calgary

Contributed by Indy Lagu, Univ. of Calgary

That's a Good Problem is a collaborative project of PIMS, the Galileo Educational Network (GENA), and Mount Royal College in Calgary. It is based on the highly successful math fairs organised by **Ted Lewis** (PIMS Education Coordinator, University of Alberta). Teams of teachers from several Calgary-area schools were invited to a half-day workshop. The focus of the workshop was on teaching mathematics through explorations and investigations by working through a number of mathematical explorations, suggestions for introducing explorations to other teachers, organising and promoting a school math fair.

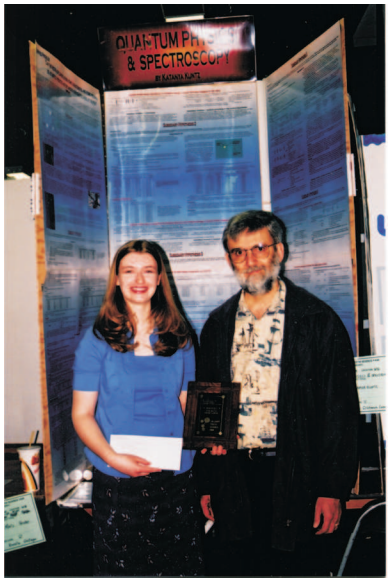
The teachers returned to their schools armed with Ted Lewis' excellent booklet on how to run a math fair. **Sharon Friesen** of GENA and **Indy Lagu** (PIMS Education Coordiantor, Calgary) made visits to the schools to work with the teachers and students before the math fairs.

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. More information about the math fairs (including lots of photographs) can be found at **www.galileo.org/math/sumtalk/index.html**.

Dr. Friesen and Dr. Lagu are planning to involve 10 or 12 new schools in the project next year.

Calgary Youth Science Fair April 10—13, 2002

At this year's Calgary Youth Science Fair the PIMS award went to **Katanya Kuntz,** a grade 11 homeschooler from Alberta Distance Learning. Her project was called *Quantum Physics and Spectroscopy*. The objective of the project was to learn more about Quantum Physics and to test mathematical models of the atom (the Bohr theory and the Quantum theory) for their accuracy in predicting and explaining the atomic universe. Her Unified Hypothesis was "Spectroscopic signatures, other atomic characteristics, and atomic phenomena can be accurately predicted and explained by a mathematical model of the atom." She concluded that the Quantum theory is the best known model (so far) that is *extremely* accurate in predicting and explaining the atomic universe.



Katanya Kunts and Gary Margrave in front of her project.

PIMS ELMACON 2002

Contributed by Heather Jenkins, PIMS

The fourth annual PIMS Elementary Grades Math Contest took place on May 25 at UBC.

This contest is organized by PIMS under the guidance of Dr. Cary Chien of David Thompson Secondary School in collaboration with the BCAMT and volunteers from Lower Mainland schools of all levels. It is open to students in Grades 5 to 7 giving them a chance to experience mathematics as an exciting sport.

A total of 229 students competed in the contest with 67, 80 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 from these rounds went on to the Countdown round where the students "duelled" starting with the 9th and 10th. The winner of that contest then went on to "duel" with the 8th place holder. So the person who ranked 10th had the potential of winning the contest by beating the 9 people ahead of him/her one by one. The duelling consisted of answering math questions against the clock and sounding a buzzer.

The top 10 in each grade received a t-shirt and medal. The top 3 also received a trophy and an electronic calculator donated by Sharp. Certificates of participation were available for all students on the day.

Top 10 winners in each grade are as follows:
Grade 5: 1. Juno Jung (Nelson) 2. Aram Ebtekar (Glen) 3. Jeffrey Choi (John T Errington) 4. Karen Bennie Ho (Oppenheimer) 5. Nikita Zouev (Lynn Valley) 6. Jeffrey Yeh (Vancouver Montesorri) 7. Sophie Ji-Soo Kwalk (Canyon Heights) 8. Veronika Dikoun (Maywood Cummunity) 9. Phil Chang (Simon Fraser) 10. Yanga Zhu (Eric Langton)

Grade 6 winners (l-r) Daniel Park, Jimmy He, Alarica Tang.

Grade 6: 1. Alarica Tang (Kitchener) 2. Jimmy He (Pinewood) 3. Daniel Park (Kwayhquitlum Middle) 4. Bryan Huang (Osler) 5. Yuan Liang (Pitt River Middle) 6. Silviu Toderita 7. Sherwin Kwan (Seaforth) 8. Jonathan Zhang (Oppenheimer) 9. Hank Duan (Mapple Creek Middle) 10. Simon T H Tseng (Chantrell Creek)
Grade 7: 1. James Chen (John T Errington) 2. Arthur da Silva (St. Paul's) 3. Anthony Chuang (Maple Lane) 4. Sebastian Crema (Boundary Community) 5. Jerome Li (Kwayhqitlum Middle) 6. Steven Karp (Kitchener) 7. Jeffrey Hsiung (Emily Carr) 8. Kevin Xiao (Confederation Park) 9. Mulin Yang (University Hill) 10. Javin Chen (Thunderbird)

While the markers where ranking the kids in preparation for the countdown round Cary Chien gave a talk on strategies and common mistakes. A video tape of his talk and other parts of the contest will soon be available at **www.pims.math.ca/elmacon/**.

AB High School Math Competition, 2001–2002

Contributed by Ted Lewis, UA PIMS Eduation Coordinator

This was the 46th year of the Alberta High School Mathematics Competition. In this two part competition, part I, with 1093 participants, occurred on November 20, 2001, and part II, with the top 69 competitors from part I, took place on February 6, 2002. The major prize winners attended the PIMS awards dinner, which was held in Calgary. The awards dinner will be held in Edmonton next year. The dates for 2002–2003 are: Part I: Tuesday, November 19, 2002. Part II: Wednesday February 5, 2003. For more details and a complete list of last year's winners see our website at **www.math.ualberta.ca/~ahsmc**.

Left photo: Grade 5 winners (l-r) Jeffrey Choi, Aram Ebtekar, Juno Jung. Right photo: Grade 7 winners (l-r) Anthony Chuang, Arthur da Silva, James Chen.

More Fun for Kids at Math Mania Nights

Contributed by David Leeming, UVic PIMS Education Coordinator

The very successful Math Mania program continues to thrive in Victoria with the third event of the 2001–02 school year being held at Lampson St. Elementary School in Esquimalt on May 28, 2002. Math Mania presents a variety of interactive demonstrations, puzzles, games and art such as "goats and gold", the penny game, the "game of 24", kaliedoscopes and hexaflexagons, and a variety of mathematical puzzles and paradoxes. These activities are designed to demonstrate to children and their parents fun ways of learning both math and computer science concepts.

Math Mania is sponsored by PIMS and the presenters are enthusiastic volunteers from the faculty, staff and students (and some family members) of the Department of Mathematics and Statistics at the University of Victoria.

A video report about Math Mania will soon be available on the PIMS webpage.

Fifth Annual FAME is Bigger than Ever!

Contributed by David Leeming, UVic PIMS Education Coordinator

Students in Greater Victoria (School District #61) took part in FAME, the **Forever Annual Math Exhibition** at S.J. Willis Educational Center on April 10, 2002. A total of 120 students participated in the events, with 20 elementary entries, 13 junior entries and 20 senior entries. Twelve students won Distinction Awards (score 90+/100). The winning schools (in terms of scores for the top 3) were Fairburn (elementary) and Lansdowne (junior and senior).

A selection of some of the topics chosen this year were Optical illusions, Tower of Hanoi, The average sleeper, Numbers that make you go hmm, History of math in South America, Codes and ciphers, Catapults and What is the fourth dimension?

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

Changing the Culture 2002

Contributed by Malgorzata Dubiel, SFU PIMS Education Coordinator

The 5th Annual **Changing the Culture** conference took place April 26, 2002 at the SFU Harbour Centre campus. The conference was attended by 78 participants: Teachers from all levels, from elementary through university; student teachers and graduate students in mathematics and math education.

The theme of this year's conference was *Rigour and Intuition in Mathematics*. Two plenary speakers: **Ed Barbeau**, a mathematician from the University of Toronto, and **Brent Davis**, a Canada Research Chair in Education at the University of Alberta in Edmonton, presented their views on understanding mathematics and the respective roles of intuition and logic in the process of achieving it.

A lively panel discussion, chaired by **Klaus Hoechsman** (PIMS), addressed the topic in the afternoon. **Lin Hammill** (Kwantlen University College), **Christine Stewart** (SFU), **Günter Törner** (German Mathematical Society, DMV) and **Kirsten Urdahl-Serr** (School District 42, Maple Ridge), presented their views on the subject.

The participants were offered a choice of 3 workshops to enrich their experiences: **Sue Haberger** of Centennial Secondary School led a workshop *The Moment of Proof*, which described methods and tricks she has developed and successfully used over the years to make students appreciate the need for rigour.

Natasa Sirotic of Collingwood School gave a workshop on 'Proofs' of Fallacies, or how to spot problems in seemingly flawless reasoning.

David Lidstone of Langara College invited participants of his *Intuition in Problem Solving* workshop to test their mathematical intuition in a series of challenging problems.

2002 Esso-CMS-PIMS Summer Math Camp

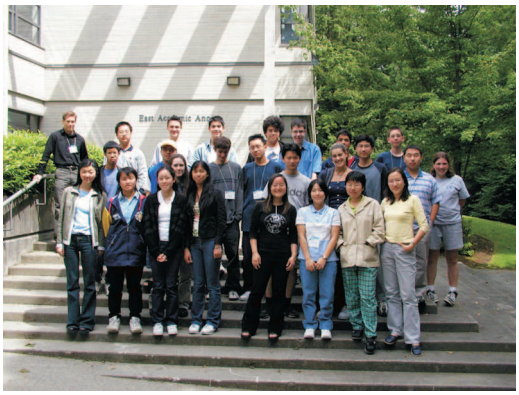
SFU, July 2–5, 2002

Contributed by Malgorzata Dubiel, SFU PIMS Education Coordinator

The second **Esso-CMS-PIMS Summer Math Camp** for High School students took place July 2–5, 2002, at the SFU PIMS Site in the East Academic Annex.

Twenty-five students from schools across the Lower Mainland were selected to participate in the camp, out of almost 50 nominations send by their teachers. For four days, they participated in exciting and challenging activities organized by the SFU faculty and graduate students. Two guest speakers were invited as well: **Lily Yen** from Capilano College and **Branko Curgus** from Western Washington University.

For more information about the camp, and the pictures, see **www.cecm.sfu.ca/~lisonek/mathcamp.html**.



The participants of the Esso-CMS-PIMS Summer Math Camp for High School students outside East Academic Annex SFU.

Upcoming Education Activites

- October 9, 2002: **Math Mania Night**, Happy Valley Elementary School, Victoria
- November 19, 2002: **The Alberta High School Mathematics Competition**, Part I of the 2002–2003 season, Alberta and Northwest Territories
- May 2, 2003: **Changing the Culture 2003**, SFU Harbour Centre
- June 23–27, 2003: **ESSO-CMS-PIMS Math Camp for High School Students**, East Academic Annex, SFU Burnaby Campus

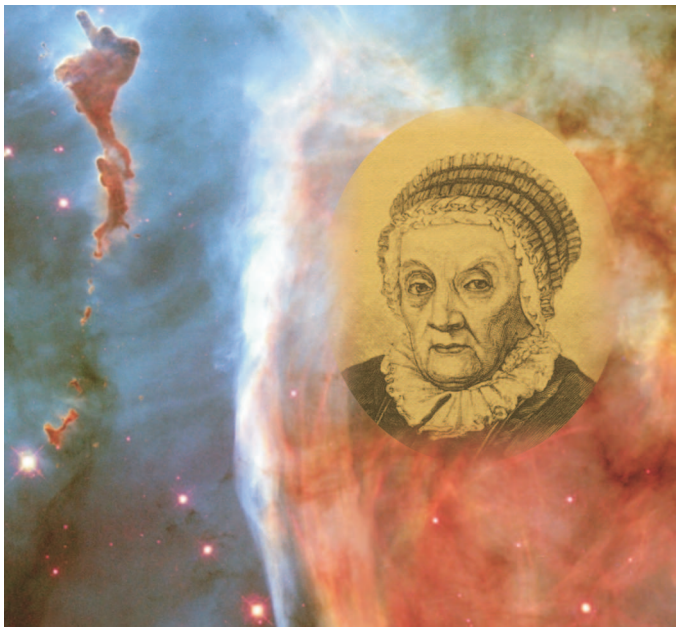
Women and Mathematics Contest Winners

Contributed by Heather Jenkins, PIMS Communications Officer

In January 2002 the **Women and Mathematics** contest came to an end. We now feature short profiles of the winners of the last 7 months of the contest.

Back in July when Florence Nightingale was featured, the winner was **Alain Goulet** of Victoria, BC. He is a 46 year old father of 4 who is studying towards a B.Sc. in Mathematics at the University of London through their External Programme. Most of his career so far has been in the financial/accounting field, which he hopes to change when he is ready to start his graduate studies in mathematics. Recently he has also become interested in astronomy.

In August, the month we featured Maria Goeppert Mayer, the winner was **Stefanie Smith** of Kingston ON. She is 24 year old student at Queen's University working on a Ph.D. in Computational Chemistry. Her interests include camping, curling and skiing. She found out about the contest from a friend, and she thinks that it's a great way to learn about famous women in science and math.



Astronomer Caroline Herschel

Jordan Bemmels of Richmond, BC won the September Emmy Noether contest. He was 14 years old and in Grade 9 at the time, and he found out about the contest from his math teacher. He said *"I think that the contest is a great way for everyone to learn more about "Women in Mathematics," and mathematics in general. Learning mathematics can be useful throughout life, so this contest is very practical for nearly everybody."* He is interested in geography and the humanities, plays the piano and trumpet, and roller-blades.

In October the winner was **Lichung Jen** also of Richmond, BC, who works at Minerva Database Marketing Consultants Ltd. The contest featured Sofia Kovalevskaya. Lichung is 40 years old and found the contest very interesting.

Caroline Herschel appeared in November and the winner was **Wayne Chevrier** of Langley, BC. He was also a winner of the **Mathematics is Everywhere** contest.

The December winner was **Michelle McGinty** of Waterloo, ON and that month we featured Maria Gaetana Agnesi. She is 39 years old and is a University Waterloo Mathematics Graduate and teaches secondary school mathematics at Waterloo Collegiate Institute. Michelle said *"I think what PIMS is doing is fantastic: your semi-annual Pi in the Sky publication, your visits to elementary and secondary schools and your contest. I have all of the posters of this year's contest posted in my classroom. I have some of last year's bus posters that were sent to me posted on my classroom windows. They are wonderful, the posters initiated a great deal of discussion and problem solving by my students."*

Emilie de Breteuil concluded the contest in January and **Wendy Bennett** of Victoria, BC, was our final winner. She is 51 year old mother of three children who has degree in Political Science. She lists her main interest as a fascination with people. Her middle son, Andrew, is a math student and she found out about the contest through him.

To find out more about these women see **www.pims.math.ca/education/2001/women**.

The New Issue of Pi in the Sky Magazine

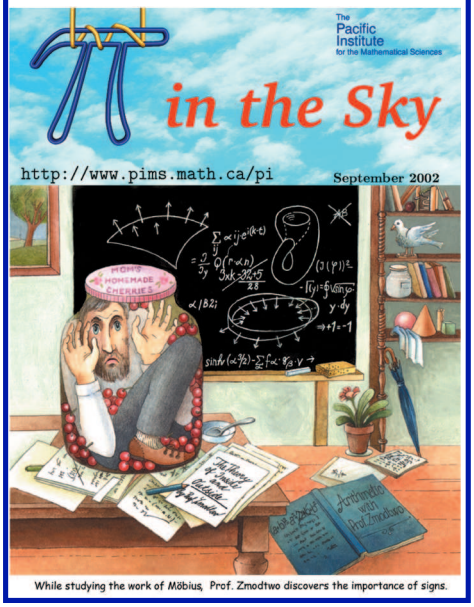
The fifth issue of the PIMS educational magazine **Pi in the Sky** came out in September 2002. The cover was specially created by Czech artist Gabriela Novakova according to an original idea by George Peschke, and the meaning of the scene is explained in the article *"Oops!!! Just what happened to Prof. Zmodtwo?"*

The Math & Astronomy section features *"Solar Eclipses: Geometry, Frequency, Cycles"* by Hermann Koenig. Read a biography of female mathematician "Emmy Noether" by Volker Runde.

"From Rabbits to Roses: A Geometric Mystery Story" by Klaus Hoechsmann is the continuation of the mystery series "The Rose and the Nautilus".

Other article include "S*tudent's Workshop: Polyhedra with Six Vertices"* by Richie Ng, *"Mathematics of the Past"* by Garry Kasparov, and *"Decoding Dates from Ancient Horoscopes"* by Wieslaw Krawcewicz. Another article is about *"Gibbon, Malthus, and the Ancients"*.

In addition to being distributed to high schools in British Columbia, Alberta and Washington State, "Pi in the Sky" is now being distributed to people across North America who have requested to be added to our mailing list. All the issues are also available for download on the website **www.pims.math.ca/pi.**



In April this year **Robert Moody** (Professor, University of Alberta and BIRS Scientific Director) became one of five Canadian scholars to win a 2002 Killam prize for outstanding career achievements. Administered by the Canada Council for the Arts, the prizes are worth $100,000 each. Photo: Canada's Governor General, Adrienne Clarkson, congratulates Robert Moody.

PIMS is supported by:

- **The Natural Sciences and Engineering Research Council of Canada**
- **The Alberta Ministry of Innovation and Science**
- **The British Columbia Ministry of Competition, Science and Enterprise**
- **Simon Fraser University**
- **University of Alberta**
- **University of British Columbia**
- **University of Calgary**
- **University of Victoria**
- **University of Washington**
- **University of Northern British Columbia**
- **University of Lethbridge**

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This newsletter is available on the web at www.pims.math.ca/publications.

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