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THE FIELDS INSTITUTE
FOR RESEARCH IN MATHEMATICAL SCIENCES

NEWSletter

SEPTEMBER 2002

DIRECTOR’S MESSAGE

This has been a busy summer at Fields, sometimes with three conferences running simultaneously. Kudos to our staff for surviving the onslaught with panache.

The highlight of the summer was our tenth anniversary celebration, with two days of wonderful talks and the opportunity to see many old friends. Details of the conference are contained in this newsletter. You should also look for the commemorative brochure we put out with lots of historical retrospectives (see http://www.fields.utoronto.ca/programs/scientific/01-02/fields10anniversary/Fields10Ann-24pg.pdf). It is quite fun to read.

We also took that opportunity to announce the creation of the Fields Institute Fellows to honour some of the people who have contributed to the Institute over the years. The first group of fellows are listed in the newsletter. We will be calling for nominations annually to add a few more each year, and I encourage you to endorse good candidates.

We heard in July that NSERC has renewed our funding at the level of $966K per year, and has raised the other institutes to this same level. This is a major success for the mathematics community compared to the various GSC results. However it does not seem that there are funds available from NSERC to significantly raise the level of institute funding to anywhere near funding of comparable institutes in other countries. We are of course disappointed that there was no

TENTH ANNIVERSARY
OF THE INSTITUTE

The Fields Institute celebrated its 10th anniversary this year on June 18 and 19. It was an occasion to reflect on the accomplishments of Fields since its birth in Waterloo in January of 1992, as well as the “prehistory” beginning some 5 years earlier.

The idea of a mathematics institute in Ontario originated with Bill Shadwick in early 1987, in response to the “Centres of Excellence” funding program of the Ontario Liberal government of the time. Bill started by consulting with some of his colleagues at Waterloo, then contacted others at McMaster, Ottawa and Toronto. Thus

Tenth anniversary reception

Anniversary continued on page 6

Director continued on page 3
The twentieth century witnessed spectacular advances in the applications of mathematics to problems of science, industry and society. Of all technological advances, perhaps none has had greater influence than the development of computers which perform millions of arithmetic operations a second. This computing power is used daily to forecast the weather, fight diseases, predict financial risks, build aircraft and create virtual worlds. Yet, it is essential to remember that it is not the computer which solves these problems, but the software which harnesses the raw power of the computer to specific tasks. Much of this software in turn is based on Numerical Analysis.

Numerical Analysis is the branch of mathematics which provides the bridge between analysis as it is performed by mathematicians, and the finite arithmetic performed by computer hardware. Numerical algorithms enable computers to solve equations, to work with integrals and differential equations, to find optimal solutions to complex problems and to model the real world. Numerical Analysis is almost completely a twentieth century product—there was little motivation for its development before computers existed. In the past half century, it has been one of the most rapidly developing areas of mathematics, and it continues to grow in power and sophistication. Current research efforts targeted in the Fields thematic year will enable computers to exploit the power of a new generation of high-performance massively-parallel computers and produce more reliable results, for example, in problems involving singularities, differential equations requiring adaptive mesh refinement and ill-conditioned inverse problems.

The thematic year in Numerical and Computational Challenges in Science and Engineering recognized the central importance of Numerical Analysis. At the heart of the program was the development, analysis and testing of new numerical methods for a broad class of mathematical problems arising in linear algebra, optimization, differential equations and dynamical systems. The program featured the following workshops and conferences:

- 1st Annual McMaster Optimization Conference: Theory and Applications (MOPTA 01), August 2 - 4, 2001. (Held at McMaster University, Hamilton, Ontario.)

The Fields Institute for Research in Mathematical Sciences publishes the Newsletter three times a year (September, December and June).

Director: Kenneth R. Davidson
Deputy Director: Bradd Hart
Managing Editor: Carl Riehm
Publications Coordinator: Maryam Ali
Distribution Coordinator: Laura Gass
new money from NSERC for several important projects which we wish to push forward. We will be seeking other avenues to help us raise the necessary funds.

In June, the directors of the three math institutes joined with Hermann Brunner to tour the three major Atlantic universities. The result was their commitment to annual funding for AARMS, matching contributions from the math institutes. This is a major step forward to establishing an effective autonomous network in the east.

For four weeks during July and August, we hosted a large conference on representations of algebras, ICRA X, which began with a week of instructional lecture series, followed by a major conference, and then followed by more specialized workshop. Those participating in the full program needed a lot of stamina, but apparently were enjoying themselves.

In August also, we had a conference in honour of Jerry Marsden’s 60th year. Jerry of course was the Institute’s first director, and spent considerable time helping to get it funded in the first place. As the author of over 250 papers and a dozen books, and the supervisor of 27 students so far, he has clearly established himself as a major influence in applied analysis. It was a pleasure to have his daughter Alison, a fourth year graduate student in mechanical engineering at Stanford, as the first speaker. She combined a photo array of her early “work” with Jerry with serious mathematical analysis of turbulence of the end of an airplane wing. Many of Jerry’s coauthors, students and friends participated in this event. Amazingly, a conference volume published by Springer was available at the meeting.

August was also the time of the ICM. Canada was represented by C. Stewart, C. Rousseau, N. Ghoussoub, J. Hurtubise and myself. The CMS and the math institute hosted a reception at the Canadian Embassy in Beijing. The Chinese strongly support mathematics, as demonstrated by the President of PRC, Jiang Zemin, attending the opening ceremonies and helping to present the two Fields medals.

At the time of writing, the fall program in Set Theory and Analysis has gotten started with a two week summer course to bring students up to speed to participate in the fall programs. It will be a full house during the fall semester.

Kenneth R. Davidson, Director

May 23-25, 2002, marked a special occasion at the Fields Institute in honour of David F. Andrews, Professor Emeritus of the Department of Statistics at the University of Toronto. The event sponsored by MITACS and the Fields Institute, attracted guests from Canada, the United States and Europe. Following a welcome by the University’s President, a relaxed and social atmosphere was fostered by having limited the number of speakers to four each day, with plenty of time for active and stimulating discussions. Of course the stellar cast helped—Sir David Cox (Oxford), Jamie Robins (Harvard), Rob Tibshirani (Stanford), Elizabeth Thompson (Washington), David Brillinger (Berkeley), Michael Newton (Wisconsin), Daryl Pregibon (AT&T Labs), and Augustine Kong (deCode Genetics). The third day was devoted to a workshop on the analysis of microarrays led by Terry Speed (Berkeley).

The success of the event was evidenced by the fact that registration was full one week in advance. The organizing committee consisted of Rob Tibshirani, Shelley Bull, Nancy Reid and Jamie Stafford of the University of Toronto. Many positive comments were received from the participants and, most importantly, Professor Andrews was greatly pleased by the event because of its deep personal relevance and substantial scientific content. Special thanks to MITACS, the Fields Institute, and in particular, Maryam Ali for support.

Jamie Stafford (University of Toronto)
Short Course in Statistics for Microarray Data Analysis

On May 25 a one-day Short course in Statistics for Microarray Data Analysis organized by Shelley Bull (University of Toronto and Samuel Lunenfeld Research Institute) was held in concert with the Workshop in Honour of David F. Andrews. The purpose of the short course was to introduce statisticians and other researchers to the design and analysis of high-dimensional gene expression studies.

Course leaders included Terry Speed (Berkeley, Department of Statistics and Program in Biostatistics, and The Walter & Eliza Hall Institute of Medical Research, Division of Genetics and Bioinformatics, Australia), Jean (Yee Hwa) Yang and Ben Bolstad (Berkeley, Department of Statistics).

Microarray technology, which provides a way to measure differential gene expression globally, promises to be extremely useful for the diagnosis, treatment, and prevention of complex disease as well as for the elucidation of biological mechanisms. These studies yield tens of thousands of simultaneous gene measurements from each biological sample. Issues in measurement and calibration of the microarrays need to be addressed appropriately in order to obtain valid datasets. To gain insight into genes and their function, patterns of expression and expression changes must then be discerned from high-dimensional data in which the number of observations is small relative to the number of variables.

Session 1 - Biological and technical background. Brief summary of issues relating to DNA, NA, transcription, cDNA, hybridization, cDNA microarray construction and use, including imaging and image analysis.

Session 2 - Design and preprocessing. Pros and cons of different designs including direct, reference, loop, factorial, and time series alternatives. Ways of looking at the data, and normalization to adjust for intensity-dependent and spatial biases, and other systematic effects.

Session 3 - Basic analyses. Estimating and testing for differential expression. Multiple testing adjustments. Empirical Bayes. Linear models for designed experiments.

Session 4 - Advanced analyses. Classification, clustering and other multivariate methods. Ideas for addressing issues relating to pathways and networks.

The course included hands-on computing sessions with a tutorial and the opportunity for participants to apply statistical methods to several datasets provided. The course slides were posted online at www.stat.berkeley.edu/users/terry/zarray/Course/.

The short course was fully registered with 90 participants from universities across Canada, Canadian Research Institutes/Hospitals, Federal and Provincial government research agencies, and the pharmaceutical industry. It was sponsored by MITACS and the Fields Institute with assistance from Iobian Informatics, www.iobion.com/, with The University Health Network Microarray Centre, University of Toronto, www.microarrays.ca/.

Shelley Bull (University of Toronto and Samuel Lunenfeld Research Institute)

In addition, the Coxeter Lecture Series featured two world-renowned numerical analysts:

• Gene Golub (Stanford University)  
  Matrices, moments and quadrature  
  October 29, 30 and November 1, 2001

• Randy LeVeque (Washington)  
  Solving Wave Propagation Problems in Heterogeneous Media  
  March 11, 12 and 14, 2002

The program also sponsored the following four research-level short-courses that were well attended by faculty and graduate students:

• Matrix Valued Function Theory  
  Five two-hour lectures: October 11, 18, 19, 25, 26, 2001.  
  Instructor: Olavi Nevanlinna (Helsinki University of Technology)

• Numerical Bifurcation and Center Manifold Analysis in Partial Differential Equations  
  Five two-hour lectures: November 19 - 28, 2001  
  Instructor: Klaus Böhm (Marburg)

• Numerical and Computational Challenges in Environmental Modelling  
  Five two-hour lectures: February 5, 7, 12, 14, 19, 2002

Instructor: Zahari Zlatev (National Environmental Research Institute, Denmark)

• Numerical Solution of Advection-Diffusion-Reaction Equations  
  Five two-hour Lectures: July 29 - August 2, 2002  
  Instructors: Jan Verwer (CWI, Amsterdam, and Korteweg-de Vries Institute, Univ. of Amsterdam) and Martin Berzins (Leeds)

The program also offered the following four graduate courses for students in Southern Ontario:

• Numerical Linear Algebra, Christina Christara (Toronto)

• Numerical Solution of ODEs, Wayne Enright and Ken Jackson (Toronto)

• Numerical Solution of PDEs, Robert Almgren (Toronto)

• Numerical Solution of Optimization Problems, Henry Wolkowicz (Waterloo)

This program was of great benefit to graduate students, faculty and researchers in scientific computing in Southern Ontario as well as to the many visitors attracted to the program from around the world.

Ken Jackson (University of Toronto)
Nonselfadjoint Operator Algebra Workshop

From July 8-12, I ran a cozy workshop in my own specialty area, (nonselfadjoint) operator algebras. The reason for the adjective “nonselfadjoint” is that in some circles, the term operator algebras has been cornered by the C*-algebraists. However the group claiming “operator algebras” for arbitrary algebras of bounded operators on Hilbert space is growing. This area has close links to operator theory (which studies operators one or three at a time) and the developing area of operator spaces (which develops functional analytic ideas in a context where there are norms on all matrix spaces over the algebra).

About two dozen preregistered, but the numbers came to about 30 including drop-ins from the local area. Speakers came

Ken Davidson (Fields Institute)

McMaster Optimization Conference

The McMaster Optimization Conference: Theory and Applications (MOPTA 02) August 1-3, 2002 was held in the still new Information Technology Building of McMaster University. (Conference website: www.cas.mcmaster.ca/~mopta). Continuing the MOPTA tradition, the organizers goal was to bring together researchers from diverse areas of theoretical and applied optimization in a medium-size conference, to facilitate interaction and the exchange of ideas. The conference was hosted by the Advanced Optimization Laboratory, www.cas.mcmaster.ca/~oplab/index.html, of the Department of Computing and Software at McMaster. MOPTA 02 was generously sponsored by the McMaster Faculty of Engineering, The Fields Institute as part of the Special Year on Numerical and Computational Challenges in Science and Engineering, MITACS, Materials and Manufacturing Ontario and IBM Canada.

The conference was attended by 106 registrants, 7 invited featured speakers and a Canadian Operations Research Society sponsored speaker. About half of the participants were from Canadian institutions, numerous others from the USA and countries as diverse as Singapore, Japan, Hong Kong, China, Venezuela, Germany, Italy, United Kingdom, Hungary, Romania.

The seven featured invited speakers gave one-hour talks on topics of wide interest: John Betts (Boeing), Steve Boyd (Stanford), Christodoulos Floudas (Princeton), Robert Freund (MIT), Aravind Srinivasan (Maryland), Richard Tapia (Rice) and Yinyu Ye (Stanford). Further, János Pinter (Pinter Consulting and Dalhousie) represented the Canadian Operations Research Society. A pleasant banquet at Lasalle Park in Burlington topped the technical program with an illuminating after-dinner presentation, Circuit Designers, Interior Point Methods and Venture Capitalists, by Steven Boyd.

The Organizing Committee of the conference consisted of Stavros Kolliopoulos (McMaster), Tom Luo (McMaster), Jiming Peng (McMaster), Tamás Terlaky (Conference Chair-McMaster), and Henry Wolkowicz (Waterloo). The committee received excellent feedback from many of the attendees, and plans to repeat the event next year again. Preliminary commitments indicate that featured speakers of MOPTA 03 will include Masakazu Kojima (Tokyo Institute of Technology), Tyrrell Rockafellar (Washington) and Margaret Wright (Courant Institute). Up-to-date information about the MOPTA conferences and the Optimization Seminar series at the Advanced Optimization Laboratory can be found at the website http://www.cas.mcmaster.ca/~oplab/index.html

Ken Davidson (Fields Institute)

Tamás Terlaky (McMaster University)
known at the time as the Fields Institute Committee. Shortly thereafter Bill contacted Jerry Marsden, then at Berkeley, and asked him to be the "director designate". Jerry accepted and the whole enterprise was off and running.

The next stage was the appointment of a Scientific Committee (now known as the Scientific Advisory Panel) and the formulation of a constitution for the fledgling (but still fanciful) institution, both accomplished mainly by telephone with Bill on one end.

Fortunately the founding universities—McMaster, Toronto and Waterloo—were sufficiently far-sighted to give the organizing committee some modest financial support to underwrite the costs of the campaign.

As it happened the second round of the Centres of Excellence program failed to materialize, and the organizing committee was forced to look elsewhere for funding. Jerry, Bill and I made a pitch to Fraser Mustard’s board at the Canadian Institute for Advanced Research; Bill and Vic Snaith (then at McMaster) appeared before a parliamentary committee in Ottawa—the beginning of the eventually successful proposal to NSERC. Around the same time, some fruitless attempts were made to potential private benefactors.

At this point, Doug Wright, President of the University of Waterloo, made the critical suggestion that Bill should pay a visit to John Roth at Nortel, who in turn recommended that Bill get in touch with one of Roth’s fellow members of the Prime Minister’s Science Council, Peter J. Nicholson, a PhD in mathematics from Stanford and a Senior Vice-President at the Bank of Nova Scotia. Bill and John Chadam followed up on Roth’s suggestion, and managed to persuade Peter to become the Chairman of the Board of Directors of the nascent Fields Institute.

In 1990, NSERC announced a new funding program, which seemed to fit the Institute perfectly. Bill and John Chadam put great effort into readying the Institute proposal—I recall John rushing off to Toronto at the very last moment to get Steve Halperin’s signature on the document. And of course it was successful—NSERC and the Ontario Ministry of Colleges and Universities agreed to share the cost of funding the Institute.

Bill Shadwick’s energy and political savvy, along with the mathematical and organizational credibility lent by Jerry and Peter, were the critical ingredients in the success of the campaign which made the Institute a reality.

The Institute opened its doors in Waterloo in January of 1992 with the first thematic program “Control Theory”, but only after the preparation of the physical site and the management structure had taken place at a furious pace for several months. From the very beginning, the Institute looked as if it had been in place all along. The official opening took place later that year on June 11, with many luminaries present, among them Phillip Griffiths, Director of the Institute for Advanced Study, Avner Friedman, Director of the Institute for Mathematics and Its Applications in Minnesota, Francis Clarke, Director of the Centre de recherches mathématiques in Montreal, Cathleen Morawetz of the Courant Institute, Stephen Smale and David Brillinger of Berkeley, and Irving Kaplansky, Director of MSRI.

The next major development in the young life of Fields was the choosing of a permanent site. This was accomplished by a Site Selection Committee which toured the locations proposed by seven universities. It presented its recommendations at a meeting of the Board of Directors in June of 1993, and so the Fields Institute found its permanent home on the edge of the University of Toronto campus. Very critical in this decision was not only the superb and enthusiastic support offered by University of Toronto President Robert Pritchard and his administration, but the access that the location provided to the centers of research, technology and business in Toronto and its environs.

So in November of 1995, the Fields Institute once again opened its doors, this time at its permanent site, under the new Director John Chadam, Jerry Marsden’s successor. The building was designed by the architectural firm Kuwabara Payne McKenna Blumberg, with full involvement by Bill Shadwick and representatives of the University of Toronto who chose the overall design of the building after investigating other mathematical institutes—in particular the Newton Institute at Oxford. Of course there was again a period of furious activity in readying the new building and moving from Waterloo. But John Chadam recalls that everything fell into place, and on opening day he arrived at 9am to find George Elliott lecturing to a well-attended seminar in the main lecture room.

The Fields Institute has been blessed with fine leadership at all levels during its short life. Don Dawson succeeded John Chadam and served as Director during 1996-2000, followed by Ken Davidson since July, 2001. Bill Langford served as Deputy Director during 1996-98, and Bradd Hart since that time, including a year as Acting Director in 2000-01. Peter Nicholson was succeeded as chair of the Board by John Gardner, the former CEO of Sun Life of Canada.

After its birth in 1992, the Institute was quick to assume a major role in Canadian mathematical life. The monthly Mathematical Finance Seminar initiated by John Chadam was a grand success from its very beginning, bringing together mathematicians from the academic community and seasoned professional practitioners from Toronto’s vigorous financial community—by the end of the first year, it had attracted so much interest that the closing lectures, held in the old Toronto Stock Exchange,
James Stewart Library Renovation

Last fall, it became apparent that keeping up with the Institute’s expanding horizons would require more efficient use of our facilities. By January, a solution had been reached and plans to develop the James Stewart Library into a multi-purpose seminar and meeting room were in full swing.

After a few months of creative discussions and estimates, the work began. It was decided that the deadline would be early June, in order to coincide with the Fields Institute’s 10th Anniversary Event. The major jobs were to arrange for the removal of shelving on the west wall, installation of a chalkboard and projector screen, relocation of the computer workstations to the south atrium and the removal of the fixed centre table to make way for several new chairs and tables. Computer and electrical input was retained for presentation purposes.

The renovations went smoothly and, as many who attended our recent celebration can attest, the James Stewart Library was transformed into a highly versatile and usable space. We now have tables and chairs that seat up to 24 comfortably. The furniture can be rearranged to achieve seating that faces the new blackboard and projection screen on the west wall, or into a large table with surrounding seating for discussions and meetings.

In between scheduled events, the space is still available as a library with the remaining bookshelves on the east wall, along with the comfortable window bank seating.

The benefits of this project are quick in coming, not least the increased visibility of many Fields activities. Members have already taken advantage of this bright and comfortable room for monthly seminars, thematic short courses and informal working groups. Participants in Commercial and Industrial Mathematics events have also found it to be a useful meeting place. We believe that this new facility will prove invaluable for future programs, and the management would like to thank all those who played a part in its development.

Laura Gass (Fields Institute)

flowed the overflow room. Another early highlight was a public lecture by Andrew Wiles on his proof of Fermat’s Last Theorem, which drew an audience of over a thousand people!

There have been many other stellar mathematical events at the Institute of course, among them Vladimir Voevodsky’s announcement of his revolutionary proof of Milnor’s K-theory conjecture for which he was awarded the Fields Medal in August — and the symposium “The Legacy of John Charles Fields” in June 2000, featuring lectures by the nine Fields medalists John Milnor, Michael Atiyah, Stephen Smale, Alan Baker, Alain Connes, Vaughan Jones, Richard Borcherds, Timothy Gowers and Maxim Kontsevich.

Under Don Dawson’s leadership, the Institute established its influence in 1998 in two other important directions. The first was the revision of the entire secondary mathematics curriculum in Ontario, carried out by a Fields team with Bill Langford and mathematics educators, at all levels, from across the province, and as well as several people from the business community. The Fields Institute Mathematics Education Forum has since remained very active, providing guidance to the implementation of the new curriculum, and dealing with many other issues in mathematics education.

The other important development in 1998 was the formation of MITACS under the federal National Centres of Excellence program, with the cooperation of Luc Vinet and Nassif Ghoussoub, the Directors of the CRM and the Pacific Institute for the Mathematical Sciences respectively. MITACS is a network of mathematical scientists from across Canada, structured into project teams from universities and industry. It opened its doors at the University of Toronto in March 1999 with Steve Halperin as its Program Leader, followed by Don Dawson who served as interim leader until Arvind Gupta took over the helm later that year. MITACS is now headquartered at Simon Fraser University.

Scientific activity at the Fields Institute centers around each year’s thematic programs. The current program is Set Theory and Analysis, and future programs are Automorphic Forms (January to May 2003), Partial Differential Equations (August 2003 to June 2004), and The Geometry of String Theory (August 2004 to June 2005).

The Fields Institute looks back on its first few years with considerable pride, and with a determination to continue to play a key role in Canadian and world mathematics.

This article is adapted from the booklet published for the tenth anniversary celebration in June, available at www.fields.utoronto.ca/programs/scientific/01-02/fields10anniversary/Fields10Ann-24pg.pdf

Carl Riehm (Fields Institute)
Call for proposals, nominations and applications

Please see the website for detailed information on the proposal and nomination process: www.fields.utoronto.ca/proposals

GENERAL SCIENTIFIC ACTIVITIES
Proposals for short scientific events in the mathematical sciences are welcome at any time, with a lead time of at least one year recommended. Activities supported include workshops, conferences, seminars and summer schools. If you are considering putting in a proposal, we recommend that you contact the Director (davidson@fields.utoronto.ca) or Deputy Director (bhart@fields.utoronto.ca).

THEMATIC PROGRAMS
Proposals for semester- and year-long programs at the Fields Institute will be considered in November and May of each year. Potential organizers are advised that several years lead time is required, and that they should contact the director early on to discuss possibilities.

POSTDOCTORAL OPPORTUNITIES AT THE INSTITUTE
Applications are invited for postdoctoral fellowship positions for the 2003-2004 academic year. The thematic program on Partial Differential Equations will take place at the Institute from August 2003-June 2004. Qualified candidates who have recently completed a PhD in the mathematical sciences are encouraged to apply. These fellowships provide for a period of at least one year engaged in research and participating in the activities of the Institute. One or more positions may involve teaching or carrying out collaborative research with business or industrial partners. Applicants seeking postdoctoral fellowships funded by other agencies (such as NSERC and international fellowships) are encouraged to request the Fields Institute as their proposed location of tenure, and should apply to the address below for a letter of invitation.

In addition to regular postdoctoral support, the Jerrold E. Marsden Postdoctoral Fellowship will be awarded. It pays a stipend of $40,000 (Cdn) and provides for a twelve-month period at the Institute for research and participation in the activities of the core program. No teaching is required. In addition to the stipend, a $2000 (Cdn) research grant will be available during the tenure of the award. Standard NSERC guidelines will apply to this grant.

Postdoctoral applications should reach the Institute by January 6, 2003

CRM-FIELDS PRIZE
The Centre de recherches mathématiques (CRM) and the Fields Institute for Research in Mathematical Sciences solicit nominations for this joint prize in recognition of exceptional achievement in the mathematical sciences. The deadline is October 1. Previous recipients are H.S.M. Coxeter, George A. Elliott, James Arthur, Robert Moody, Stephen A. Cook, Israel Michael Sigal, and William T. Tutte and John Friedlander. Please see www.fields.utoronto.ca/proposals/crm-fields_prize.html for details.

Nominations for the CRM-Fields Prize should reach the Institute by October 1, 2002.

NATIONAL PROGRAM COMMITTEE GRANTS
The three Canadian Institutes in the Mathematical Sciences—CRM, Fields and PIMS—support joint activities in the mathematical sciences through the National Program Committee. Program proposals of national interest lying outside the direct mandate of any of the individual institutes are welcome. Proposals should reach the Institute by October 15, 2002. Please see www.fields.utoronto.ca/proposals/natprogcomm.html for details.

Please send applications, nominations and proposals to:
The Director
The Fields Institute for Research in Mathematical Sciences
222 College Street, 2nd Floor
Toronto, Ontario
M5T 3J1 Canada
Activities at The Fields Institute
July 2002—June 2003

Please see www.fields.utoronto.ca/programs/ for detailed information on these activities

THEMATIC PROGRAMS

Set Theory and Analysis August – December 2002
For more information, see www.fields.utoronto.ca/programs/scientific/02-03/settheory/ or write to us at settheory@fields.utoronto.ca

October 6–12, 2002  Workshop on Descriptive Set Theory, Analysis and Dynamical Systems
Organizers: I. Farah, G. Hjorth, A. S. Kechris

November 10–16, 2002  Workshop on Geometry of Banach spaces and Infinite Dimensional Ramsey theory
Organizers: N. Tomczak-Jaegermann, E. Odell, S. Todorcevic, T. Schlumprecht

Wednesday at 2pm  Set Theory Seminar Series (weekly)

Graduate Courses
Fall 2002
Descriptive Set Theory, Borel Relations and Dynamical Systems
Instructor: H. Becker
Partition Theory and Banach Spaces
Instructors: I. Farah, S. Todorcevic

Automorphic Forms January-June 2003
For additional information, see www.fields.utoronto.ca/programs/scientific/02-03/automorphic_forms/ or write to us at automorphic@fields.utoronto.ca

March 4–8, 2003  Workshop on Shimura Varieties and Related Topics
Organizers: T. Haines, G. Pappas

May 5–9, 2003  Workshop on Automorphic L-functions
Organizers: H. Kim, R. Murty

June 2–27, 2003  Summer School supported by the Clay Math Institute
Organizers: J. Arthur, J. Milne, F. Murnaghan, R. Kottwitz

Graduate Courses
Winter 2002
Course on Automorphic L-functions
Instructors: H. Kim, R. Murty

GENERAL SCIENTIFIC ACTIVITIES

September 20–21, 2002  AD HOC NetwOrks and Wireless (ADHOC NOW)
Program Co-chairs: M. Barbeau, E. Kranakis
www.scs.carleton.ca/~adhocnow

September 23–28, 2002  Workshop on Categorical Structures for Descent and Galois Theory, Hopf Algebras and Semiabelian Categories
Organizers: G. Janelidze, B. Pareigis, W. Tholen
www.fields.utoronto.ca/programs/scientific/02-03/galois_and_hopf

October 19, 2002  New FRSCs Day

October 22, 2002  CRM-Fields Prize Lecture: Prof. John Friedlander
www.fields.utoronto.ca/programs/scientific/02-03/crm-fields/

October 25, 2002  Workshop on Industrial Applications of Computer Algebra
Organizers: D. Jeffrey, S. Watt

November 21, 2002  Second Annual Conference on Personal Risk Management
The Individual Finance and Insurance Decisions (IFID) Centre
Supported by MITACS
www.fields.utoronto.ca/programs/cim/financial_math/ifid.html
Stephen Cook
Propositional Proofs of Combinatorial Principles

Related to the famous question of whether $P$ equals $NP$, is whether $NP$ equals co-$NP$. A problem is said to be $NP$ if there is a polynomial time algorithm for checking if a purported solution is correct. Co-$NP$ is the class of complements of problems from $NP$. A representative example of a problem in $NP$ is the task of checking if a given formula in propositional logic is satisfiable. This problem’s complement, checking if a formula is not satisfiable, lies in co-$NP$. It is fairly easy to see that $NP = co-NP$ if there is a propositional proof system for which proofs of tautologies are of polynomial length in the length of the tautology. Such a proof system is called a super proof system. Most complexity theorists believe that super proof systems don’t exist which is good news for implementers of various encryption systems since if $NP = co-NP$ then there is a polynomial time algorithm for factoring.

In his talk, Steve Cook surveyed the current state of affairs towards proving the non-existence of a super proof system. In general, in a proof system, a lower bound on proof lengths for tautologies is proved by finding a combinatorial principle which translates into a family of tautologies whose proofs require concepts not easily expressed by the lines in a formal $S$ proof. For example the Pigeonhole Principle translates into tautologies requiring exponential size proofs when the lines in the proof are restricted to have a bounded AND/OR alternation depth. For less restricted proof systems no good lower bounds are known, although linear algebra and graph theory supply interesting combinatorial principles that are conjectured to require super-polynomial proofs.

Persi Diaconis
Patterns in Eigenvalues

The idea that empirical data from a wide range of phenomena fall into universality classes associated with basic probability distributions is one of the major themes of modern science. However the idea that purely deterministic basic mathematical objects can have this same behaviour is a relatively new and important development. Persi Diaconis’s brilliant lecture gave an exciting glimpse of this. He outlined an amazing research program combining analytical results, large scale computer explorations and statistical data analysis that has identified a probabilistic structure in the zeros of the Riemann zeta function.

The story begins with conversations around 1970 between the mathematician H. Montgomery and the physicist F. Dyson. Montgomery’s work indicated that the pair correlation function of the zeros of the zeta function is given by

$$1 - \left(\frac{\sin \pi x}{\pi x}\right)^2$$

and Dyson recognized this as the pair correlation function for the eigenvalues of random Hermitian matrices in the Gaussian Unitary Ensemble. This led to the “GUE-Hypothesis” asserting that the spacings of $N$ successive zeros of the zeta function and the eigenvalues of $N \times N$ Hermitian matrices have the same statistical properties in the $N \to \infty$ limit.

To make this more precise consider a “randomly chosen” Hermitian $N \times N$ matrix. There are two ways to describe what this means. One is to consider the unitary group and to choose a matrix by sampling from the Haar measure on this group. This turns out to be equivalent to choosing its real diagonal elements and complex upper triangular elements as independent Gaussian random variables. Now consider the empirical distributions of the sequence of normalized spacings of the $N$ eigenvalues, and of the first $N$ zeros of the zeta function. Diaconis addresses the hypothesis that the statistical properties of these two sequences become the same in the $N \to \infty$ limit. From an empirical point of view this can be formulated as a “statistical test of hypothesis” provided that sufficient data is available. Fortunately, Andrew Odlyzko has computed the $10^{20}$th zero of the Riemann zeta function and 175 million of it neighbours, and Diaconis bases his analysis on this “data”. In a recent paper he and Marc Coram consider the spacings of 50,000 zeros starting near the $10^{20}$th, divided into groups of size 42, and then map each group onto the unit circle. They compare these to the eigenvalues of random elements in $U_{42}$. Diaconis outlined results of a number of statistical tests of the “null hypothesis” that these two random objects are the same. There are many ways to formulate this—some is to consider the resulting eigenvalues as a random measure in $[0, 2\pi]$. It was discovered by K. Wieand that this produces a “strange” limiting correlation structure and Coram and Diaconis tested whether the zeta spacings share this property. They conclude that the strange correlations are also present in the zeta data, providing new evidence for the GUE hypothesis. To check on the “power of the test” they considered two alternative models—uniform points and a “picket fence model”. In both cases the test showed that these are clearly different from the GUE behaviour, thus demonstrating the ability of the test to distinguish on this basis.

Further evidence that eigenvalues of random matrices are fundamental objects and that this is not simply a strange coincidence is provided by analytical results, beginning with a seminal paper of Rudnick and Sarnak, that have demonstrated universality of the behaviour of correlations between successive zeros for a class of $L$-functions. And to demonstrate that universality phenomena involving random matrices have implications far beyond the zeros of the zeta function, Diaconis concluded his lecture with a list of diverse fields including group theory, representation theory, probability, statistics, data mining, number theory, physics, combinatorics, dynamical systems, complex analysis, operator algebras, Toeplitz operators and telephone encryption, in which random matrices play a significant role.
Martin Golubitsky
Animal gaits and coupled cell systems

How many different modes of locomotion are possible for a quadruped? And how can these different modes be accomplished within a fairly simple common system? Take a horse, for example. A horse has several different modes: the walk, trot, pace, gallop and canter.

The scientific study of animal gaits is over a century old. In the 1890’s, Edward Boyerbridge was commissioned to decide if a trotting horse ever has all four feet off the ground simultaneously. By an ingenious set of trip wires and cameras, he was able to determine that the answer is yes.

A mathematical analysis, due to Golubitsky and Ian Stewart, is much more recent. They consider a proper gait to be a periodic motion of the four legs. They postulate the existence of a central pattern generator built from a number of identical neuronal nets, the same number associated to each leg, and looked for sufficient complexity that parameter changes will yield different symmetries including the walk, trot and pace. For example, the trot has left front-right rear legs together, and right front-left rear legs out of synch by half a cycle; whereas a walk is LF-RR-RF-LR in sequence, equally spaced.

Golubitsky and Stewart were able to use elementary group theory to show that, while a network of four cells is insufficient, a unique network of 8 cells (2 per leg) has enough complexity to account for the walk, trot, pace and gallop corresponding to different parameters. Several other natural modes also occur, including the bound (front legs together, then rear legs) and the pronk (all legs together). The canter turns out to be quite complicated, and so far is incompletely understood.

More generally, one studies ODEs with periodic solutions \[ x(t) = x(t+1) \] which exhibit symmetry under a phase shift: \[ \sigma x(t) = x(t+\varphi) \] where \( \sigma \in \Gamma \), a finite group acting on \( \mathbb{R}^n \), and \( \varphi(\sigma) \in \mathbb{R}/\mathbb{Z} \) is a character of \( \Gamma \). One identifies subgroups \( K < H < \Gamma \) consisting of these symmetries which are spatial (spatial-temporal) respectively. There is a nice structure theorem describing properties of this triple.

Angus Macintyre
Various manifestations of the Frobenius map in model theory

Angus Macintyre spoke on the role that the Frobenius map has played in some recent investigations in model theory. By a Frobenius map, one means \( f(x) = x^p \) in a field of characteristic \( p \). Early work in logic by Tarski gave a precise meaning to the Lefschetz Principle that algebraic-geometric statements true in sufficiently high finite characteristic are true in characteristic zero. Macintyre spoke about recent work of his (and independently, Hrushovski) which has brought Frobenius maps into the picture in an attempt to make sense of them in characteristic zero. The principal result is that generic automorphisms of the complex numbers are, essentially, limits of Frobenius maps; that is, one can obtain a generic automorphism of the complex numbers by taking countable, algebraically closed fields of finite characteristic together with their Frobenius maps and forming an ultraproduct. The proof depends on the Weil Conjectures (proved by Deligne) and the result has applications to the algebraic theory of difference equations.

Another application of the Frobenius map arises in the model theoretic study of Witt vectors. They are of basic importance in many parts of algebra and number theory and the model theory of Witt vectors has been thoroughly analyzed. The Frobenius map acts naturally on the Witt vectors and one now knows enough, in principle, to allow one to decide which difference equations are solved in this setting. An analogue of the Ax-Kochen-Ershov Theorem has been proved, showing that as \( p \) goes to infinity the behaviour of the Witt Frobenius converges to that obtained by allowing the Frobenius map to act coefficient by coefficient on fields of formal series over the algebraic closure of finite fields.

Speakers continued on next page
Chris Rogers spoke on a novel approach to using Monte Carlo simulations to price a variety of American options. An American option is one which allows the buyer of the option to exercise it at any time up to the termination date of the option. The American put is a classic example of an option for which there is no closed form solution and which needs numerical methods for pricing. When the payoff depends on a single underlying quantity (e.g., a stock price); techniques from partial differential equations can be used. However, when more than a few underlying quantities need to be modelled, such techniques are no longer feasible, and a probabilistic approach is preferable. So far, such approaches have focused on finding the optimal stopping rule for the option or some approximation to it, and so have obtained lower bounds on the price of the option. The approach taken here is to find an upper bound on the price by approximating an optimal hedging strategy.

In order to obtain this approximation, one decides on a few carefully chosen martingales (and Rogers agrees that this part is more art than science), and considers the linear combination of these which works best as a hedging strategy for the option under consideration. At this stage, one is using relatively few sample paths and very coarse time steps. Once the best linear combination has been determined, then a more intense simulation of the option value is undertaken with many more sample paths and finer time step. Rogers gave several numerical examples including the test case of an American put, which can be approximated by various existing numerical methods, the American min-put on several assets, and the more exotic Bermudan max call on multiple assets. Although in all cases, prices obtained were quite good (less than 1% error), the mean absolute deviation obtained by the supposed “hedge” could be quite large and more work is planned in order to improve the practical application of this technique.

Hart Rubin
Ranks of Elliptic Curves

An elliptic curve (over the rational numbers) is of the form \( y^2 = x^3 + ax + b \), with \( a \) and \( b \) integers such that the roots of \( x^3 + ax + b \) are distinct. Its points with rational coordinates (plus the “point at infinity”) form an Abelian group \( E(\mathbb{Q}) \), determined by the fact that 3 collinear points sum to 0. It was shown to be finitely generated by Mordell in 1922. Its (finite) torsion part is well understood by theorems of Nagell, Lutz and Mazur—the latter showed that exactly 15 small order groups are possible. However comparatively little is known about the rank \( r \) of \( E(\mathbb{Q}) \), not even if it is unbounded or not. The largest known rank is currently 24.

In the 1950s, Birch and Swinnerton-Dyer had the idea of comparing \( r \) to the normalized product

\[
\prod_{p \leq X} \frac{\#E(\mathbb{F}_p)}{p}
\]

of the number of points of \( E \) over the finite fields \( \mathbb{F}_p \) (\( p \) a prime) as \( X \to \infty \). This led them to their famous conjecture that the rank of \( E(\mathbb{Q}) \) is equal to the order of the 0 at \( s = 1 \) of the complex L-function \( L(E,s) \) (which is defined by an Euler product for \( \Re(s) > 3/2 \) and continued analytically to all of \( \mathbb{C} \) — that this continuation is possible was only shown later by Wiles and others). Very little is known about the validity of this conjecture, aside from the fact that if the order is 0 or 1, the rank \( r \) is correspondingly 0 or 1. Rubin also discussed the related but weaker “Parity Conjecture”.

The notion of quadratic twist is a powerful method for deriving results on ranks—it consists of considering a family \( E_d: dy^2 = x^3 + ax + b \) (\( a \) and \( b \) fixed) of elliptic curves. Particularly strong results are known for \( dy^2 = x^3 - x \). The proofs generally involve finding points on an elliptic curve \( r(t)y^2 = x^3 - x \) over the rational function field \( Q(t) \) and then specializing to \( Q \). Rubin closed his lecture by discussing another method applied to the same family \( dy^2 = x^3 - x \). One begins by choosing \( x \), and then a suitable \( d \) (and \( y \)) to get points on members of the family. In this way one finds that some curves in the family have nontrivial ranks. For example, N. Rogers showed that the rank of \( E_{205015206} \) is 5.

Fellows of the Royal Society of Canada

This year’s new Fellows of the Royal Society of Canada were recently announced. Three of these were in Mathematical Sciences, V.P. Godambe, (Waterloo), N. Kamran (McGill) and N. Madras (York). Also one of our Board Members, C. Simson (WaveNET) was a specially elected fellow.

Fields is pleased to hold a one day event to feature talks by the new fellows in mathematical and physical sciences on Saturday October 19. The speakers will be V.P. Godambe, J.P. Guthrie, N. Kamran, N. Madras and D. Wayner.

Further information is available at http://www.fields.utoronto.ca/programs/
The New High School Course in Data Management

The new high school curriculum in Ontario is about to enter its fourth year and with this comes the last set of new courses to be introduced. As with the old five year curriculum, there are three courses in fourth year aimed at students bound for university. Two of these courses, calculus, and algebra and geometry, fill roughly the same niche that they did in the old curriculum although there are important changes. The third course, the mathematics of data management, is an entirely new course, quite a bit different from the old finite math course. Over the past couple of years, the Mathematics Education Forum at the Fields Institute has been working with teachers and professional societies both to get the word out about the new features of this course, as well as to provide valuable resources for teachers.

The stated goals of the data management course are: to teach students how to acquire and manage large data sets, introduce probabilistic and statistical methodologies for dealing with this data, and to integrate all aspects of the course in a culminating project. Two aspects of these goals have been the focus of attention for the Fields Forum. With the introduction of statistics into the high school curriculum, the students need, and hence the teachers need, to feel comfortable with the statistics software that will be used. The chosen software is called Fathom which has been licensed for use in all Ontario schools. To prepare teachers for the use of this software, the Fields Institute with the help of Gila Hanna, Tom Steinke, Stewart Craven and Gord Cooke created a series of Fathom workshops at five sites around Ontario.

These four-day workshops provided some 180 teachers with a hands-on learning experience that allowed them to translate their new knowledge easily and effectively into classroom practice. An online resource was also developed and housed at www.vlearning.ca. This site will not only serve as a forum for online discussion among teachers, but will also be staffed to provide them with knowledgeable assistance. During the first two days participants used Fathom to import, model and analyze real-life data from the Internet (including E-STAT), gathered from electronic probes and hands-on experiments. The use of Fathom as a powerful student learning tool for the Mathematics of Data Management course was the heart of the final two days.

In addition to The Fields Institute, these workshops were supported by The Imperial Oil Centre for Studies in Science, Mathematics and Technology Education, OISE/UT; MSTE Group, Queen’s University; Nelson Thomson Learning; McGraw-Hill Ryerson; Lambton Kent, Thames Valley and London Catholic District School Boards; Spectrum Educational and Apple Canada.

Another novel aspect of this course is the requirement of a culminating project. Mathematics courses have not traditionally had a term project, and many teachers, and students, worry about what such a project should entail. The task force on data management of the Math Ed Forum gave some thought to this issue and the outcome was a resource page with examples both of the process one needs to follow in setting up a project, and of some potential culminating projects. One can find this resource page at www.brocku.ca/~cmt/mdm4u/web/. It was created by Eric Muller from Brock University and his summer students Sherrie Dyck, Bruce Petrie, Rebecca Black, Janice Cho and Tony Liu. This fall, the Math Ed Forum will create an online discussion group for teachers as they cope with the introduction of this new course.

Bradd Hart (Fields Institute)

CMS Math Camps

The Math Camps Program has been a considerable success—in only a few years, it has grown to include at least one camp in every province. In 2002, in addition to two International Mathematical Olympiad (IMO) Training Camps and one National Camp, thirteen regional camps have taken place across Canada.

The Winter IMO Training Camp took place this year at York University in January, and the Summer IMO at Memorial University of Newfoundland in July. The Winter Camp is designed for students with the potential to be selected to the Canadian team for the next IMO—fifteen students were invited to it. The Summer Camp is mainly a concentrated training camp for the six students chosen to represent Canada at the 43rd IMO in Glasgow. In addition, six local students attended some of the sessions during the first of the two weeks. The Canadian team did remarkably well, tying for 12th place out of 84 participating countries and winning one gold medal, three silver, one bronze, and an honourable mention.

CMS continued on next page
The National Camp is designed for students with the potential to make the Canadian IMO team two or three years hence. In 2002, 25 students were invited to attend the National Camp at the University of Western Ontario.

The National Camp Program was started in 1998 and part of the success of the Canadian IMO team may be due to the fact that potential students are identified early and have the opportunity to receive the necessary on-going training.

The thirteen Regional Math Camps are designed to provide students with some mathematics enrichment in a fun and rewarding environment. There are usually about 25 students from grades 9 to 11 at each camp. The format of the camps depends on the preference of the local host university—some are day camps lasting from 2 to five days, some weekend residence camps, and some are week-long residence camps. In 2002, Regional Math Camps took place at Sir Wilfred Grenfell College, the University of New Brunswick at Fredericton, the University of Prince Edward Island, Dalhousie University, Collège Jean de Brebeuf, the University of Ottawa (two camps—one in English and one in French), Brock University, the University of Western Ontario, the University of Manitoba, the University of Regina, the University of Alberta, and Simon Fraser University.

All of the sessions are given by local university professors and teachers on a voluntary basis. Local undergraduate and post-graduate students help as counsellors. Hence costs are kept to a minimum and the funding received is used to pay for the direct costs—meals, accommodation, supplies and, to a limited extent, travel expenses. 

Further information regarding the 2002 Math Camps can be found at www.cms.math.ca/MathCamps/ and pictures from those which have just concluded at the University of Ottawa can be found at www.cms.math.ca/MathCamps/Ottawa02/

The Math Camps Program is possible because of the significant support received from the Fields Institute and the other research institutes, the Imperial Oil Charitable Foundation, NSERC PromoScience, the host universities, several provincial ministries of education, and the Canadian Mathematical Society.

Dr. Graham P. Wright (CMS Executive Director)

### Commercial/Industrial Mathematics Program Shorts

For the seventh consecutive year, the Institute will host the Quantitative Finance Seminar monthly throughout the academic year on the last Wednesday of the month. The program has almost been finalized for the year and will be appearing shortly on the seminars homepage, www.fields.utoronto.ca/programs/cim/financial_math/finance_seminar/02-03/ September’s seminar will feature John Hull and Alan White from the Rotman School of Management on the topic of the valuation of credit default swaps.

- Fields will host a conference on Adhoc, Mobile and Wireless Networks (Adhoc-NOW) on Sept. 20-21. Organized by Evangelos Kranakis (Carleton) and Michel Barbeau (Ottawa), this conference is sponsored by the CANCCOM project as well as MITACS. For more information, see www.scs.carleton.ca/~adhocnow/
- Jointly with the Ontario Research Centre for Computer Algebra, ORCCA, and Maple, the Institute will hold a workshop on Industry, Mathematics and Computer Algebra on Oct. 25. See www.fields.utoronto.ca/programs/cim/02-03/INDACA/
  - For the second year in a row, the Individual Finance and Insurance Decision Centre and Fields will hold a conference on personal risk management. A keynote talk will be given by James Poterba (MIT) entitled After-tax Benchmarks for Individual Investors. The conference takes place on Nov. 21 and more information can be found at www.fields.utoronto.ca/programs/cim/financial_math/fields/personal_risk/02-03/
  - The Fields Institute and CIRANO, the Montreal-based economics institute, have teamed up to create a series of short courses on quantitative finance aimed at professional financial managers. With a two-day format which involves both theoretical background and hands-on computer labs, 9 courses will be offered throughout the upcoming year. For more information, please see www.fields.utoronto.ca/programs/cim/02-03/quantitative_finance/
Publications

This past year saw the appointment of a prestigious Editorial Board for Fields Institute publications:

Kenneth R. Davidson, Director
Bradd T. Hart, Deputy Director
John Bland (Toronto)
Walter Craig (McMaster)
Donald A. Dawson (Carleton/McGill)
R. Mark Goresky (Institute for Advanced Study)
Andrew J. Granville (Georgia/Montreal)
Nicholas Pippenger (UBC/Princeton)

with Carl R. Riehm as Managing Editor. Our Publications Manager Alesia Zuccala resigned in June to take up an academic position at the University of New South Wales, and we are very pleased that Debbie Iscoe, who is our technical assistant in publications, has taken over Alesia’s duties as well.

Our online assistance for potential authors has been revised and updated, and describes completely the process from an author’s or editor’s initial contact with the Institute regarding publication of a volume, to the final stages of assembling and forwarding the manuscript to the American Mathematical Society for publication. Our website also now provides the editorial board with up-to-date information on the publication status of all manuscripts currently under consideration or production.

We would like to maintain the high quality of our two book series, and we urge authors or those contemplating writing a book, to contact us for information about publishing with Fields. We point out that among the advantages of publishing with the AMS through us, rather than a commercial publisher, are the low cost, high quality and guarantee that books are kept in print indefinitely.

During the last publication year (which ended August 31, 2002), we have published the following volumes:

Communications Series
A. Galves, J.K. Hale, C. Rocha Editors
*Differential Equations and Dynamical Systems* (Vol 31)

F-V Kuhlmann, S. Kuhlmann, M. Marshall Editors
*Valuation Theory and its Applications* Volume 2

Monograph Series
B. Hart, M. Valeriote Editors
*Lectures on Algebraic Model Theory* (Vol 15)

N. Madras
*Lectures on Monte Carlo Methods* (Vol 16)

V.I. Voloshin
*Coloring Mixed Hypergraphs: Theory, Algorithms and Applications* (Vol 17)

VOLUMES IN PREPARATION:

Communications Series
T.J. Lyons, T.S. Salisbury Editors
*Numerical Methods and Stochastics*

M. Marshall, F-V. Kuhlmann, S. Kuhlmann Editors
*Valuation Theory and its Applications* Volume 2

Y. Eliashberg, B. Khesin, F. Lalonde Editors
*Symplectic and Contact Topology*

S. Ruan, J. Wu, G.S.K. Wolkowicz Editors
*Dynamical Systems and Their Applications to Biology*

P. Pardalos, H. Wolkowicz Editors
*Novel Approaches to Hard Discrete Optimization*

A. J. van der Poorten, S. Stein Editors
*Primes and Misdemeanours: Lectures in Honour of the 60th Birthday of Hugh Cowrie Williams*

L. Horvath, B. Szyszczewicz Editors
*Asymptotic Methods in Stochastics: Volumes I and II*

S. Berman, Y. Billig, Y-Z. Huang, J. Lepowsky Editors
*Vertex Operator Algebras in Mathematics and Physics*

G. Janelidze, B. Pareigis, W. Tholen Editors
*Galois Theory, Hopf Algebras and Semiabelian Categories*

J. Wu, X. Zou Editors
*Difference and Differential Equations*

N. Yui, J. Lewis Editors
*Arithmetic, Geometry and Physics around Calabi-Yau Varieties and Mirror Symmetry*

R.-O. Buchweitz, V.Dlab Editors
*International Conference on Representations of Algebras and Related Topics (ICRA X)*

Monograph Series
L. Tunel
*Polyhedral and Semidefinite Programming Methods in Combinatorial Optimization*

C. Y. Dong
*Vertex Operator Algebras and Their Representations*

R. J. Elliot, R. Norvaisa, D.M. Salopek
*New Approaches to the Mathematics of Finance and Insurance*

O. Nevanlinna
*Variations around the Nevanlinna Theory*

S. Berman, Y. Gao
*Extended Affine Lie Algebras*

J.P. Spinrad
*Efficient Graph Representations*
International Conference on Representations of Algebras and Related Topics [ICRA X]

July 15 - August 10, 2002

This biannual series of conferences began in 1974 in Ottawa and returned now to Canada for its tenth installment. As is tradition, the conference was opened with a week long Instructional Workshop aimed at graduate students and young researchers who wish to learn in depth about the latest developments in the area of representations of algebras and their applications.

This time, there were eight lecture series, with topics ranging from applications of representations of algebras in Probability Theory (K.S. Brown, Cornell), a survey of results in the theory of tame algebras (T. Bruestle, Bielefeld), the application of representations of weighted projective lines to the Deligne-Simpson problem for local monodromy of differential equations (W. Crawley-Boevey, Leeds), the use of semi-invariants of quiver representations culminating in an elegant proof of the saturation of Littlewood-Richardson coefficients (H. Derksen, Michigan), the recent solution of long standing conjectures by M. Auslander on representation dimension and by Solomon on Euler factors of $S$-functions of lattices (O. Iyama, Kyoto), a complete description of representations of the symmetric groups and affine Hecke algebras and their branching rules in positive characteristic via crystal bases (A.S. Kleshchev, Oregon), the use of filtrations and stratifications in the representation theory of Lie algebras (S. Koenig, Leicester), to an exposition of results on representations and Hecke-Iwahori algebras of reductive monoids (M.S. Putcha, North Carolina State, and L. Renner, Western Ontario). The lecture series were well attended, with graduate students from many different countries in the audience.

The actual ICRA conference ran from July 22 to 31, with more than 80 talks covering the whole range of representations of algebra, from (co-)tilting theory and the structure of modules of infinite length, Koszul algebras and modules, applications of Hochschild cohomology to various questions in group representations or relating to varieties of modules, the role of crystal bases in various aspects of representation theory both of algebras and Kac-Moody Lie algebras, categorical aspects of representation theory, such as the structure of triangulated hereditary categories, the theory of particular classes of algebras including tame, supercanonical, standard stratified, or poset algebras, to results on the geometry of representation varieties of quivers and the role of quasi-hereditary and related algebras in various applications. Also combinatorial aspects, such as the theory of representations of the Temperley-Leeb, Schur, or Brauer algebras, were thoroughly covered.

Although the program was packed, with ten talks a day on average, attendance and feedback were excellent. It is as well that this conference takes place only every second year; there is always so much new material that is to be digested and exploited through further research. At the end of the conference, the team from Mexico announced that they will organize ICRA XI in 2004.

The third part of this year’s ICRA consisted of three interwoven Special Workshops on Commutative Algebra, Algebraic Geometry and Representation Theory (organized by R.-O. Buchweitz, Toronto; W. Crawley-Boevey, Leeds; Y. Drozd, Kiev), Finite Dimensional Algebras, Algebraic Groups and Lie Theory (E. Neher, Ottawa; L.L. Scott, Virginia), and Quantum Groups and Hall algebras (S. Berman, Saskatchewan; C.-M. Ringel, Bielefeld). The seven days of these workshops saw several survey lecture series, such as one by K. Rietsch (Oxford), and Y. Saito (Tokyo), who covered in an introduction to perverse sheaves and canonical bases Lusztig’s geometric construction of bases for affine Kac-Moody and Ringel-Hall algebras, and one by Y. Drozd (Kiev), who gave an overview of the classification of vector bundles and Cohen-Macaulay modules on surfaces and curves. Despite their rather different cores, it was remarkable how well the three workshops fit together, and accordingly all sessions were in general attended by participants from all three workshops. This innovative concept of interwoven workshops brought researchers together that otherwise are not likely to be found at the same conferences.

More than 30 participants, about half of them graduate students, stayed for the full four week marathon of mathematics. It was a remarkable experience that can likely only be organized by an institution such as the Fields Institute. It is intended to publish proceedings of the event in the Fields Communications Series, and the solicited survey articles should serve for a long time as reference volumes for active research.

Ragnar-Olaf Buchweitz (University of Toronto)