FIELDSNOTES

FIELDS

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2005 Distinguished Lecturer: Edward Witten

Edward Witten

THE SPRING 2005 DISTINGUISHED Lecture Series was delivered by Edward Witten, the Charles Simonyi Professor of Mathematical Physics at the Institute for Advanced Study in Princeton.

Widely regarded as the most influential thinker in mathematical and high energy physics over the last quarter-century, Witten is certainly exceptional in the massive extent to which his ideas have influenced and energized fields of pure mathematics, including parts of algebraic topology, algebraic geometry, knot theory, geometry of 3- and 4-manifolds, and symplectic geometry, among others. Witten has received numerous awards and honours, including a MacArthur fellowship, the Dirac Medal, and a 1990 Fields Medal.

Witten is one of the world's foremost experts on superstring theory, currently the most promising candidate for a unified theory of fundamental physical interactions. As a result of this and his many public appearances explaining string theory to a general audience, he is well known to anyone with an interest in current trends in theoretical physics. His lectures, held in several large auditoriums at the University of Toronto, were well attended. Academics and aspiring researchers from many disciplines were on hand to hear Witten's three lectures. Instead of speaking about his groundbreaking work in string theory, Witten chose to describe several much more well-established physical ideas which do not receive as much mathematical attention as they deserve.

The first lecture focused on the relativistic scattering of fundamental particles. Witten explained that the scattering was described by an *S*-matrix, a geometric quantization of a symplectomorphism on the infinite dimensional manifold of free fields. The *S*-matrix depends on the incoming and outgoing particles in the scattering, described by points on a real quadric in Minkowski space, which has two components. Amazingly, the *S*-matrix extends to a holomorphic function on the complexified quadric, which has only one component. Physicists call

continued on page 2

Robbert Dijkgraaf

2005 Coxeter Lectures: Robbert Dijkgraaf

THE WINTER 2005 COXETER LECTURES were delivered by Robbert Dijkgraaf, Professor at the University of Amsterdam, on January 17 and January 20 at the Fields Institute, and on January 18 at Perimeter Institute.

Dijkgraaf was awarded a Ph.D. *cum laude* under the supervision of the Nobel laureate Gerard 't Hooft in 1989. He has been at the forefront of research in string theory, and his research has greatly contributed to the remarkable interplay experienced by theoretical physics and mathematics in the last 15 years. His ideas have proved fundamental in a vast array of research directions including (topological) string theory,

continued on page 2

2005 Distinguished Lecturer: Edward Witten

continued from page 1

this property of the *S*-matrix crossing symmetry and Witten explained how it can be used to deduce the existence of antimatter.

In the second lecture, the audience was treated to an eminently understandable account of gauge symmetry breaking in the context of superconductors. Witten described the Landau-Ginzburg model of superconductivity, where the material is

> "the model describing the quantum Hall effect involves no degrees of freedom associated to the surface"

endowed with a section of the square of the electromagnetic line bundle. Witten then explained that although a superconducting ring maintains a current for an extremely long time, the current does decay due to the nucleation of flux lines, which correspond to zeros of the section. The flux lines may attract or repel

Duco van Straten, Barbara Keyfitz, Paul Horja and Ed Witten

depending on the properties of the superconductor, and in the limiting case the equations describing the superconductor's 4-dimensional world volume approach Taubes' perturbation of the Seiberg-Witten equations for 4-manifolds. In this way, Witten showed that smooth invariants of 4-manifold theory pertain to the properties of superconductors! Witten then turned to the description of the weak force in directly analogous terms, but for a *U(2)* connection instead of the *U(1)* of electromagnetism. The breaking of *U(2)* to *U(1)* is described by a section of the *U(2)* bundle, and the same mechanism which keeps magnetic fields out of superconductors is responsible for the fact that the W and Z particles of the weak force are only visible at high energies and short distances.

In the third lecture, Witten introduced the quantum Hall effect, whereby a thin conducting surface, when exposed to perpendicular electric and magnetic fields, generates a measurable current whose strength is quantized. Witten then described a topological mechanism which explains the quantization of this current. It is remarkable that the model describing the quantum Hall effect involves no degrees of freedom associated to the surface whatsoever. In other words it is a pure gauge theory. Witten then produced the Lagrangian describing this model, which is a *U(1)* Chern-Simons theory on the 3-volume of the conducting surface. Generalizing this situation to an arbitrary gauge group, Witten described other invariants of 3-manifolds as well as the Jones polynomial invariant of knots in a 3-manifold. In the spirit of the previous lectures, we learned that esoteric 3-manifold invariants are directly linked to measurable physical phenomena.

Edward Witten's lecture slides are available on the Fields Institute website, along with audio recordings of the lectures themselves.

Marco Gualtieri (Fields)

2005 Coxeter Lectures: Robbert Dijkgraaf

continued from page 1

quantum gravity, Gromov–Witten theory, mirror symmetry and matrix models, to name just a few. A true Renaissance man, Dijkgraaf also studied painting at the *Gerrit Rietveld Academie*. He is an accomplished artist as well as a columnist for the newspaper *NRC Handelsblad* and the magazine *Folia*. In 2003, he was awarded the Spinoza Prize, the highest scientific award in the Netherlands.

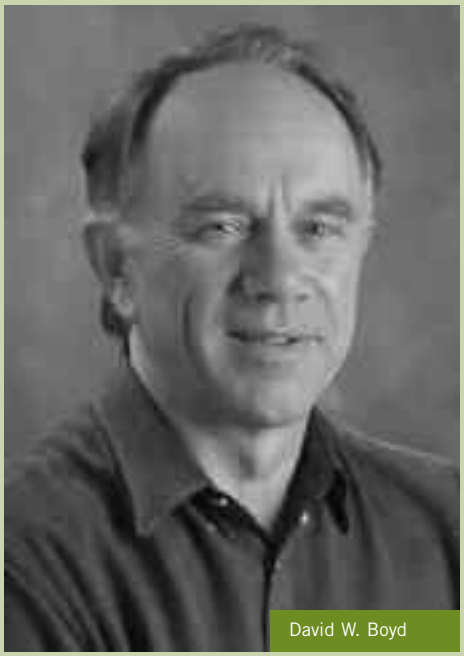
The first lecture, entitled *The Mathematics of String Theory*, was a delightfully informal presentation of the main research directions that have brought together (reluctantly, one might say, at least in the beginning) physicists and mathematicians. Punctuated by historical quotes and pictures, as well as by his own vivid drawings, Dijkgraaf took the audience on a tour that started with classical mechanics, touched upon the fundamental ideas in quantum mechanics and quantum field theory, and moved to string theory and quantum gravity. Paraphrasing the famous quote of Wigner, Dijkgraaf talked about the "Unreasonable Effectiveness of Quantum Physics in Mathematics". He then supported this assertion with a presentation of the main ideas that are involved in a plethora of subjects such as Gromov–Witten and knot invariants, mirror symmetry and Calabi–Yau varieties, matrix models and non-commutative geometry.

In the last two lectures, entitled *Topological String Theory*, Dijkgraaf explained how the *B*-model for topological strings on Calabi–Yau three-folds can be viewed as a way of "quantizing'" the Calabi–Yau complex geometry. Constructing a Kodaira– Spencer type theory for the generalized variations of complex structures involves the consideration of *D*-branes (subvarieties, or sheaves) on the Calabi–Yau variety. In certain situations, these variations of complex structures can be understood by studying the periods of one-forms on a Riemann surface naturally associated to the three-fold geometry under construction. Dijkgraaf characterized this result as a tree level computation. Remarkably, its quantum extension leads to matrix models and associated integrable systems, for example the KdV hierarchy.

Paul Horja (Fields)

David W. Boyd Awarded CRM - Fields Prize for 2005

DAVID BOYD OF THE UNIVERSITY OF BRITISH COLUMBIA is this year's recipient of the CRM–Fields Prize, for his seminal contributions to analysis, number theory, geometry and mathematical computation. David has also played a prominent role in Canadian mathematical life through his involvement in the CMS, PIMS, and NSERC – serving in 1977–78 and 2001–02 as chair of the Grant Selection Committee and on the Steacie Prize Selection Committee during 1990–92 — and on the boards of both the Centre de recherches mathématiques and the Fields Institute.


David W. Boyd

Established in 1994, the CRM–Fields Prize has become the premier prize in Mathematics in Canada. It is awarded in recognition of exceptional achievement in the Mathematical Sciences, for research conducted primarily in Canada or in affiliation with a Canadian university. The previous recipients are H.S.M. Coxeter, George A. Elliott, James G. Arthur, Robert V. Moody, Stephen A. Cook, Israel Michael Sigal, William T. Tutte, John B. Friedlander, John McKay, Edwin A. Perkins, and Donald A. Dawson. Boyd is the final recipient of the CRM-Fields prize; in 2006 it will be renamed the CRM-Fields-PIMS prize.

One of the principal themes of Boyd's research has been Mahler measure. The *logarithmic Mahler measure* of a polynomial $P(z)$ with complex coefficients is defined to be the average of $\log |P|$ over the circle,

$$\mathrm{m}(P) = \int_0^1 \log |P(e(t))|\, dt$$

where $e(t) = \exp(2\pi i t)$. If $P(z) = a_0(z-\alpha_1)\ldots(z-\alpha_d)$ (with $a_0 > 0$), it follows from Jensen's formula that the *Mahler measure*

$$M(P) := \exp \mathrm{m}(P) = a_0 \prod \max\{|\alpha_i|, 1\}.$$

The so-called Pisot and Salem numbers are of considerable interest in the subject because the Mahler measure of their monic irreducible polynomials is often very small. Boyd, in a series of papers in the 1970s, single-handedly revitalized this field. For example, in a remarkable paper in the *Duke Mathematics Journal* in 1977, he showed that the construction used by Salem to prove that every Pisot number is a limit point of Salem numbers, can be used to produce every Salem number. He then exploited this construction to determine the smallest Salem numbers known, lending credence to Lehmer's conjecture – the most prominent outstanding question in this field – that $\mathrm{m}(P)$ is bounded below by $c > 0$ for noncyclotomic polynomials P with integral coefficients.

A little later, he showed that the logarithmic Mahler measure of a polynomial in n variables (its average over the n-torus) is the limit of the logarithmic Mahler measures of suitable polynomials in one variable, at least for certain P – for example $\mathrm{m}(1 + x + y)$ is the limit of $\mathrm{m}(1 + x + x^n)$ as $n \to \infty$. This was proved later for general P, and made it apparent that it is natural to look at the larger set of (logarithmic) Mahler measures $\mathrm{m}(P)$ for polynomials of one *or more* variables. This led C. Smyth to show that the logarithmic Mahler measures of certain polynomials of 2 or 3 variables were given by the values of L-functions – for example that $\mathrm{m}(1 + x + y) = L'(\chi, -1)$ where χ is the quadratic character of conductor 3. This in turn led C. Deninger (in 1997) to show that, if $P(z_1, \ldots, z_n)$ does not vanish on the n-torus, then $\mathrm{m}(P)$ is a Deligne period of the motive associated to the variety defined by $P = 0$. At the same time, he conjectured further connections between Mahler measures and the values of L-functions, this time of elliptic curves. Boyd followed this by finding families of (conjectural) formulas of this general type relating $\mathrm{m}(P)$ to $L(E,2)$ for certain $P(z_1, z_2)$, where E is a factor of the Jacobian variety of the curve $P = 0$.

More recently in a sequence of papers (two of which are joint with F. Rodriguez-Villegas) David has established a fascinating and deep connection between the Mahler measure of certain polynomials of degree 2 and the values of the Bloch-Wigner dilogarithm $D(z)$ and of the zeta functions of number fields, in particular for "A-polynomials" which arise from one-cusped hyperbolic 3-manifolds. In this case, as in so many others, David's pursuit of the problem through extensive numerical calculations has led to startling new insights.

This article is based in part on an article by A. Granville to appear in the Summer, 2005, edition of the *PIMS Magazine*. The full article can be found at:
www.pims.math.ca/Scientific_Programme/CRM-Fields-PIMS_Prize /David_Boyd:_Recipient_of_the_2005_CRM-Fields_Prize/

Carl Riehm (Fields)

String Phenomenology

THIS WORKSHOP WAS HELD AS PART OF THE THEMATIC program on the Geometry of String Theory mounted jointly by the Fields Institute and Perimeter Institute (in Waterloo). The workshop ran from March 28 to April 1, 2005 at Perimeter, coming immediately after the closely related Fields workshop on N=1 Compactifications. The String Phenomenology workshop was organized by Jan Louis (Hamburg), Robert Myers (Perimeter) and Gary Shiu (Wisconsin).

String phenomenology has emerged as a research area at the rich interdisciplinary boundaries of string theory, particle physics, and cosmology. Although research in string phenomenology is motivated by physical questions, progress often comes from connections to more formal and mathematical aspects of string theory. This meeting brought together an international array of over 80 researchers from the United States, France, Spain, Italy, Germany, England, Japan and, of course, Canada, representing interests in all aspects of this field.

Traditionally, string phenomenology has focused on the issue of how the physics of elementary particles and forces, as observed in laboratory experiments, can arise from string theory. Hence the workshop included a number of technical talks assessing various proposals for how various features of the so-called Standard Model might arise in stringy constructions. In this domain, an extremely important question is how to recognize various signatures in the new collider experiments which will be run over the next few years. In particular, the largest such experiment, called the "Large Hadron Collider" (LHC), will turn on at the CERN laboratory in Geneva in 2007. Hence at the workshop, we called upon Gordy Kane (Michigan) to organize an "LHC Stretching Exercise", in which he presented mock experimental data and challenged us to determine the underlying stringy model. We expect such warm-up exercises will become a common feature for string phenomenology meetings as 2007 approaches.

A particularly exciting and active area of string phenomenology in recent years has been addressing questions at the interface between cosmology and string theory. Cosmology has entered an extraordinary era where experimental data has fixed the basic parameters describing the evolution of our universe and points towards the existence of an inflationary phase of accelerated expansion in its very earliest stages. At the same time, string theory has seen remarkable progress in the past few years to move from a stage where people questioned the compatibility of string theory with cosmological observations to one where people regularly propose detailed models and compare their predictions with the experimental data. Hence a good proportion of the workshop was devoted to string cosmology with a variety of talks on topics such as cosmic superstrings, string signatures in the cosmic microwave background and even the wave-function of the universe.

Raul Rabadan, Fernando Quevedo, Per Berglund and Soo-Jong Rey round out lunch with a discussion on string cosmology

One of the most interesting aspects of superstring cosmology has been the recent realization that rather than "providing a unique answer", string theory may consistently describe a huge number of different kinds of universes. This broad array of different possible solutions is known as "the string theory landscape". At the workshop, Thursday was devoted to a range of talks on different aspects of the landscape. The day ended with a lively panel discussion on "The Landscape: What is it good for?",

This broad array of different possible solutions is known as "the string theory landscape."

in which Herman Verlinde (Princeton) moderated a discussion between Shamit Kachru (Stanford), Nima Arkani-Hamed (Harvard), Lee Smolin (Perimeter), Bobby Acharya (Trieste) and a fascinated audience. While the discussion drew no specific conclusions, it certainly proved that the landscape will remain a source of many new ideas and active debate in the future.

It is perhaps a reflection of the vigor and excitement about string phenomenology that one-third of the plenary talks were presented by postdoctoral researchers and graduate students. We are grateful to the NSF for providing funding to bring junior participants from American universities. To further enhance the participation of junior researchers, Tuesday ended with a session in which participants were given the opportunity to describe their recent work in a short (5 minute) presentation—a challenge that all thirteen of the speakers handled masterfully. This session was unofficially known as the "Gong Show". In fact the session came complete with a gong which Gary Shiu picked up in Toronto's Chinatown while at the Fields workshop the previous week. The gong was also called into service throughout the week to announce the beginning of each new session.

While participants were mentally stimulated by a busy schedule of talks and ample informal discussions, our palates were also stimulated by meals in Perimeter's Black Hole Bistro where our Perimeter chef, Russell, served up various delights. Hence as the conference closed and people headed home on Friday, we received many compliments about both the science and cuisine. So the organizers are happy to declare the meeting a success. We would like to thank the staff at both Perimeter and Fields for all their help in bringing the meeting together and ensuring that everything ran smoothly.

Robert Myers (Perimeter)

Young Mathematicians' Conference on Partial Differential Equations and Dynamical Systems

THE SECOND ANNUAL EDITION OF THIS CONFERENCE was held in the Department of Mathematics and Statistics at McMaster University on Saturday January 29, 2005, attracting about 40 participants from all over Canada.

The objective of this meeting was to encourage scientific exchange, and to create an opportunity for young mathematicians in an early stage of their career to get to know each other and each other's work. The program consisted of two senior plenary speakers, Pengfei Guan of McGill and Catherine Sulem of the University of Toronto, and 8 speakers chosen from the group of young invited participants. In addition to the speakers, numerous young mathematicians from around the country whose mathematical interests are in PDE and dynamical systems were invited to attend, with support for their participation from the conference (often shared with support from their doctoral or postdoctoral advisor). The informal rule has been that, except for the two plenary speakers, all other talks are to be given by people within a few years (either way) of their PhD. Young people were invited from all over Canada for the event, as well as a few who did their PhD in Canada and are presently post-doctoral fellows in the US. We feel that this is a good way to help to develop and maintain a feeling of community in the discipline.

The topics presented during the lectures included geometric PDE, studies of nonlinear wave equations, inverse problems,

talks… given by people within a few years (either way) of their PhD

mathematical aspects of kinetic theory, elliptic variational problems, mathematical modelling and statistical mechanics.

Funding was provided by the organizers' NSERC Leadership Support Initiative Grant, the Fields Institute, the Department of Mathematics and Statistics at McMaster University, and the CRC Program.

Walter Craig (McMaster)
Catherine Sulem (Toronto)

Operator Algebras, Ten Years Later

EXACTLY TEN YEARS AGO, IN 1994–1995, the Fields Institute held a thematic program year in Operator Algebras and Applications, led by George Elliott. This program was a catalyst for pushing forward the field, and helped the area become well established in Canada—indeed, a notable strength of Canadian mathematics.

Uniquely among Fields programs, this one has continued beyond its focused year, with a steady stream of graduate students and PDFs passing through Fields. Ten years after the start of this program, George Elliott has written a history of the evolution of this field, which will soon appear on the program website, www.fields.utoronto.ca/programs/scientific/04-05/operator_algebras/ . Below is a brief excerpt, concerning the topic of **Free Probability**.

"One more major area of research in operator algebras—in addition to subfactor theory, as espoused by Jones (and also Witten!)—to K-theory and index theory (a.k.a. noncommutative geometry!)—[to quantized Banach spaces (as founded by Edward Effros)]—and to K-theory and C*-algebra structure (related also as shown by many people, including notably Putnam and N.C. Phillips, to the structure of dynamical systems!)—is the theory of free random variables (or free probability) developed by Dan-Virgil Voiculescu (together with many co-workers) over the last twenty years. This is based on a profound observation by Voiculescu concerning the relation between the distribution of the eigenvalues of a large, random, self-adjoint matrix, on the one hand, and the spectral distribution of the self-adjoint part of the sum of the generators of a free group with a large (finite) number of generators, on the other hand (these generators considered as unitary operators in the regular representation of the group, and the spectral distribution measured with respect to the canonical trace vector, the vector corresponding to the identity element of the group).

The distribution involving random matrices had been shown to converge by Wigner, to what is now called the Wigner semicircle law (namely, a semicircle!). Needless to say, this discovery of Wigner was important in itself. The second distribution, involving the generators of a finitely generated free group, had been calculated by Kesten for each finite number of generators—but not shown to converge. Voiculescu noticed that Kesten's expression for the distribution, although rather complicated, converged as the number of generators became large—to the Wigner semicircle law! (Again—as in the case of Jones's discovery of gaps in the values of his subfactor index—or, perhaps, as in the discovery by Rutherford, an earlier illustrious New Zealander, of alpha particles bouncing backward off supposedly transparent gold foil—the rest is history!)

I will not attempt to discuss Voiculescu's resulting theory ... except to point out that it has resulted in important progress concerning the von Neumann algebras arising from free groups (which are not amenable), and in particular in a fascinating interpolation between the different possible numbers of generators of a free group to extend this sequence of algebras to a continuous family—which, as has been shown, are either all different or all the same! (A very interesting comment on a well-known problem of Kadison). It has also had an application to the K-theory classification program for amenable C*-algebras (surprising, given that the free groups are not amenable!)—namely, the theorem, due to Haagerup, that every positive functional on the ordered K_0-group arises from a trace on the algebra. ...

Voiculescu's free probability theory has evoked considerable interest beyond the field of operator algebras—for instance in physics, in combinatorics, and in current mathematical probability theory! (The latter not only because of random matrices.) One may hope to see further interaction with all three of these areas—which are well represented in Canada. In Canada—in fact in Ontario—there is a very strong free probability group."

Deputy Director of the Fields Institute

CALL FOR NOMINATIONS

This is a call for nominations for the position of Deputy Director of the Fields Institute for a term beginning July 1, 2006 for a period of three or four years. The deputy director works closely with the director on all aspects of the Institute's oversight and program development.

Qualified candidates should be mathematical scientists with good management skills, an excellent research record, and a strong interest in developing the programs of the institute. Women and members of under represented minorities are strongly encouraged to apply.

While, in the past, this position has been filled by a mathematical scientist seconded from a local university, we are also open to other strategies, such as using this as an opportunity to recruit new faculty to Ontario. Inquiries can be addressed to any member of the search committee: Derek Corneil, Bradd Hart or Barbara Keyfitz.

A brief letter of nomination and a curriculum vita should be sent to the Director by August 1, 2005.

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Physmatics:
Gauge Symmetry and Fiber Bundles


Eric Zaslow

ERIC ZASLOW (NORTHWESTERN) WAS named a Clay Mathematics Institute Senior Scholar for 2004–2005, and is in residence at the Fields Institute as part of the Geometry of String Theory program. On June 2, 2005 he will present a public lecture on *Physmatics*. The following are brief excerpts from his planned lecture.

"In the 350 years since Newton, mathematics and physics have coevolved, now being commonly recognized as distinct disciplines with some shared ground. Quantum theory, gauge theory and geometry prove to be useful terrain to explore in this context. The term 'mathematical physics' has described the way in which mathematics is useful in the articulation of physical ideas. 'Physical mathematics' might be used to describe the reverse process. 'Physmatics' does the same, plus implies the links are profound and inseparable."

"A major theme in physmatics is the interplay of geometry and classical field theories. Maxwell (Scotland, 1831-1879) formulated electricity and magnetism in a unified field theory. In this theory, the electric field and the magnetic field are not fundamental. For example, a static electric field can be derived as the gradient of the electric potential (or the voltage, in a circuit). So the three components of the electric field are efficiently expressed in terms of the value of one function. Note that we are 'free' to add a constant to the potential as it does not affect the gradient, just as the overall altitude of a ski slope does not affect its steepness. In fact, there is a much larger freedom at play here, called 'gauge symmetry'. We mention that the three components of the electric field vector may be determined from a single potential function. Likewise, the magnetic field is derivable from a more fundamental magnetic potential. Together, one finds a gauge symmetry allowing a change by an arbitrary function, with no effect on the physical fields. This symmetry is much greater than the shift by a constant.

Let us review how this works. Have you heard about the Suite Vollard building? Each apartment can rotate independently by an arbitrary angle, or 'phase'. So the angle as a function of height is arbitrary, but we are still left with the same remarkable building. Similarly, the combined electric and magnetic potentials A can be altered by a 'gauge transformation' defined by a function which changes by an arbitrary phase at all points in spacetime. To give a toy mathematical model of independence of a function f, imagine that A=(a,b) from which we derive some electric quantity E=b/a and a magnetic quantity B=a/(a+b). If we change A from (a,b) to (af,bf) then E and B remain the same. The mathematical picture behind this (the real model, not our toy version) is something like a giant combination lock, i.e. one circle with no natural 'starting point' at every point of spacetime. Such a structure is called a 'fiber bundle', the phrase being an agricultural metaphor to a sheaf of wheat: any cross-section gives a slice which looks like our 'base space' (the set of stalks) and is intersected once by a stalk or 'fiber' (the piece of wheat). Yang and Mills generalized this symmetry notion to include the field theories that describe atomic physics, and the mathematical constructs - in which the fibers are more general than circles - have become central pillars of twentieth century mathematics."

In string theory these ideas give rise to fiber bundles on objects called "branes", which in turn can represent physical objects such as black holes, charged particles, and monopoles. But for an introduction to branes and their role in mirror symmetry duality, you'll have to come to Zaslow's public lecture…


Suite Vollard building

Mathematical Medicine Seminar

THERE IS A LONG AND PRODUCTIVE history of the interplay between mathematics, physics, and the medical sciences. One of the unifying themes of mathematical modelling and experimental research in the medical sciences is the elucidation of the underlying biological processes that result in a particular observed phenomenon.

It is now apparent that, even in the rare cases where the mechanisms are well understood, mathematics is still essential to explore the consequences of changing various parameters—for example, in the case of cancer and angiogensis (with its possible implications for cancer therapy), the number of options fast becoming available to practicing oncologists will be overwhelming unless we find mathematical approaches for simulating particular treatment protocols before applying them in practice.

A new monthly seminar series, launched by the recently formed Centre for Mathematical Medicine (CMM) at the Fields Institute, is aimed at bringing together research expertise in mathematics and in medicine to address the plethora of research questions arising at the mathematics/medicine interface. As such, the talks are intended to be accessible to both mathematical and medical research communities.

Siv Sivaloganathan, Kristen Swanson, Barbara Keyfitz and Amit Oza

The inaugural talk was given by Kristen Swanson, Shaw Research Assistant Professor in Pathology at the University of Washington, Seattle, who spoke on *Clinical applications of quantitative modelling for invasive brain tumours*. Her presentation demonstrated how quantitative modeling can not only shed light on the spatio-temporal growth of gliomas but also can have specific clinical application in real patients. The conclusion was that, although current imaging techniques remain woefully inadequate in accurately resolving the true extent of gliomas, quantitative modeling provides a new approach for the dynamic assessment of real patients and helps direct the way to novel therapeutic approaches.

Swanson's talk was followed by an excellent reception, and we are grateful to Alison Conway and the Fields Institute staff for the excellent organization and equally excellent choice of hors d'oeuvres!

The monthly seminar series is slated to take place on the last Friday of each month at 4 pm (although this may vary initially). The list of speakers will be displayed under "Mathematical Medicine Seminar Series" at the Fields Institute website.

Amit Oza (Princess Margaret Hospital)
Siv Sivaloganathan (Waterloo)
The authors are the directors of the Centre.

Workshop on the Geometry of Very Large Data Sets

A WORKSHOP WAS HELD AT THE University of Ottawa, February 23–25, 2005. Its goal was to bring together researchers and students from areas of statistics, topology, and computer science to explore and identify areas of potential research on the geometric structure of very large dimensional data sets. The essential elements of topology and stochastics were covered the first day by Paul-Eugène Parent, Barry Jessup and André Dabrowski, all of Ottawa. Peter Bubenik (Lausanne) presented slides of Gunnar Carlsson (Stanford), who was unable to attend, on *Persistent homology*. Two talks by Alexander Gorban (Leicester) on *How to discover a geometry and topology in a finite dataset by means of elastic nets* engendered numerous side discussions on the computational and conceptual tools involved. Peter Kim (Guelph) spoke on *Nonparametrics in High Dimensions* with a particular emphasis on applications to cometary orbits and the statistical inverse problem on a Riemannian manifold. Additional presentations by Peter Bubenik (Lausanne), Maia Lesosky (Guelph) and Ulrich Fahrenberg (Aalborg) completed the scientific program.

Despite a short time frame, twenty-five participants in all enjoyed the workshop. This included senior faculty from Canada, postdoctoral fellows from Canada, Switzerland and Sweden, PhD and MSc students from Quebec, Nova Scotia, and Ontario, and some undergraduate students from Ottawa and Nova Scotia. Participants were drawn from mathematics, statistics, management, and government. The workshop provided ample time for interaction, and each session was accompanied by numerous – sometimes heated – discussions on approaches and methods for particular problems. In particular, the entire group participated in contributing ideas towards a potential research program in this area. The organizers will be pursuing this line of research and will collect the comments of workshop participants and present progress via a webpage. Researchers interested in joining this group are asked to contact the organizers.

André Dabrowski (Ottawa)

Carleton Functional Analysis Day 2005

HELD AT CARLETON UNIVERSITY ON SATURDAY, APRIL 2, this successful meeting brought together world-class specialists in various areas of modern analysis where quantum methods play a crucial role. Organized by C.K. Fong, Wojciech Jaworski and Matthias Neufang, all of Carleton University, and sponsored by the Fields Institute, it consisted of four hour-long lectures that surveyed and described recent developments in non-commutative geometry, operator spaces and quantum field theory.

Masoud Khalkhali (UWO) gave a talk on *Locally compact quantum groups, non-commutative geometry, and cyclic cohomology;* Zhong-Jin Ruan (Urbana-Champaign) spoke about *Operator spaces and their applications to harmonic analysis;* David Blecher (Houston) discussed his findings *On the necessity of operator space methods*, and Israel Michael Sigal (Toronto and Notre Dame) gave his talk on *Spectral and dynamical problems arising in quantum field theory.*

The event attracted many young Canadian researchers representing diverse areas of mathematics, including graduate students and postdoctoral fellows. The talks produced lively discussions and research collaboration among the participants.

C.K. Fong, Wojciech Jaworski and Matthias Neufang (Carleton)

Ontario Combinatorics Workshop

THIS WORKSHOP, HELD AT THE Fields Institute on Friday April 15 and Saturday April 16, brought together graduate students studying Combinatorics from southern Ontario so that they could get an idea of the scope and depth of their subject. In addition, it provided students with an opportunity to meet faculty from other institutions at which they might wish to pursue their studies or careers. It was also a useful opportunity for the faculty to maintain contact with each other.

The conference included twelve 25-minute student presentations and three invited talks from Robin Thomas (Georgia Institute of Technology), Claude Tardif (Royal Military College) and Jim Geelen (Waterloo).

Since 2003, the Peter Rodney Memorial Book Prize has been awarded to the best student presentation. This year's winner was Lap Chi (Toronto) for his talk "Packing Steiner Trees and Forests".

There were approximately 40 participants at the workshop. This was the first at Fields and we thank the Institute for its support.

Chris Godsil and Bruce Richter (Waterloo)

Ontario Combinatorics participants

Resolutions, Inverse Systems, and Co-invariants

HELD JANUARY 13–15 AT THE UNIVERSITY OF OTTAWA, this was the second workshop on these topics. It was organized by Riccardo Biagioli (UQAM), Sara Faridi (Ottawa), and Mercedes Rosas (York).

The purpose of this meeting was to bring together researchers from two different mathematical communities, namely commutative algebraists and algebraic combinatorialists. It was a continuation of the successful meeting that took place a year before at Queen's University. That meeting highlighted several connections between similar techniques used by algebraic combinatorialists and commutative algebraists to study different problems. The Queen's meeting led to collaborations among several of the participants on new research topics, applying techniques from algebraic combinatorics to examine conjectures in commutative algebra and vice-versa.

These new results were reported at this year's workshop in Ottawa, and new topics were introduced. The main speakers generally spent the morning or a large part of the afternoon introducing a topic and talking about the main results of the field and the direction of current research. On the side of algebraic combinatorics, these included talks by François Bergeron (UQAM) on particular representations of symmetric groups, by James Haglund (Penn) about Macdonald polynomials, and by Nantel Bergeron (York) about open problems in algebraic combinatorics that grew out of topics discussed during the workshop.

From the commutative algebra side, Tony Geramita (Queen's) explained where inverse systems appear in algebraic geometry and what kinds of problems they solve, and Tony Iarrobino (Northeastern) talked about more general questions regarding inverse systems and level algebras.

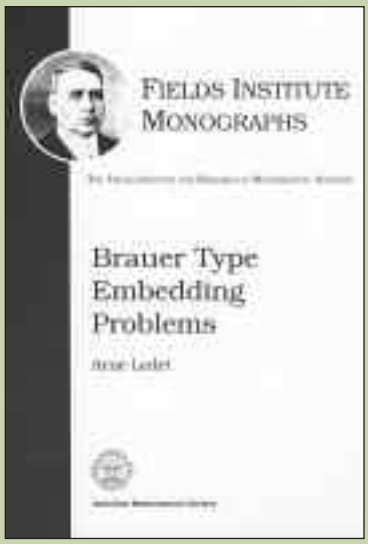
Workshop participants

Each day ended with shorter talks by young researchers who presented specific research related to topics of the workshop.

The workshop was attended by 25 participants including 10 graduate students and postdocs. The younger participants commented afterwards how much they had enjoyed the workshop, and how they had benefited from the talks. The friendly and familiar atmosphere of the meeting contributed greatly to this feeling. We look forward to reconvening in a year.

Sara Faridi (Ottawa)

Fields Publications



The newest addition to the Fields Monograph series is *Brauer Type Embedding Problems* by Arne Ledet. In addition to its main theme of Galois embedding problems of Brauer type, it contains an excellent introduction to Brauer groups, infinite Galois theory, group cohomology and quadratic forms, as well as inverse Galois theory.

Information on our publication program can be found at www.fields.utoronto.ca/publications/index.html

We are very pleased to welcome Noriko Yui of Queen's University to our Editorial Board. Noriko has already contributed a great deal to our publication program, and we are certain that she will continue to do so.

Editorial Board: John Bland, Kenneth R. Davidson, Joel Feldman, R. Mark Goresky, Barbara Keyfitz, Carl Riehm (managing editor), Tom Salisbury, Cameron Stewart, Noriko Yui

Carl Riehm (Fields)

Diversity at the Institutes

INCREASING THE PARTICIPATION of women and (underrepresented) minorities is a priority at the American Institute of Mathematics (AIM), as it is at many math institutes. However, one approach at AIM to achieving this has been from a somewhat uncommon angle.

In addition to asking organizers to find appropriate women and minority participants for their programs, we also look for such participants ourselves. We devote significant resources to building strong ties and networks in these communities, which accomplishes more than is possible with most one-time efforts by organizers.

The major research activities at AIM are the one-week workshops we run, now up to 24 a year. These are small (usually 32 people) and the selection process for workshops is very competitive: only 1/3 to 1/2 of all proposals are selected to run. We make it clear up front to potential organizers that they will be able to invite 24 participants, and that the remaining 8 participants will come from an applicant pool which the organizers will help us evaluate. Our workshops are designed to be this size to encourage the invaluable research experiences and connections that are more common to small meetings. The size also means that we can fully fund all participants (travel, hotel, and per diem), which adds to the inclusive atmosphere. Our hope is to not only increase the participation of underrepresented groups in our own programs, but to also tie members of these groups to other mathematicians, and thereby increase the participation of women and minorities in more programs in other locations.

The competitive nature of our proposal selection process has meant that each year's proposals have been more inclusive in their lists of suggested participants, as the Scientific Board considers this aspect in their selection process. Counting all of the workshops we have run (October 2001 through March 2005), 21% of our participants have been women, and 6% have been underrepresented racial or ethnic minorities. The latest graduation rates (in the March 2005 AMS Notices) show 33% of the math PhD's in the US went to women, and 8% to underrepresented minorities in 2003-04. Although we aspire to do even better than we have, the community of active research mathematicians has not yet achieved high levels of diversity, and we believe our participation rates represent a significant accomplishment.

Helen Moore

> "the internet has been an invaluable tool in helping in these efforts"

Much of my effort goes toward getting appropriate people into our applicant pool. Practically, what this means is that I travel quite a lot. I attend many conferences and sessions specifically for women and minorities (where I often see directors from other math institutes). I distribute information about opportunities at AIM, attend talks and introduce myself to people. I find out who is active and what areas they are working in, and try to see if their interests fit one of our upcoming workshops. It helps that we provide full funding for all successful applicants, so that my solicitations are received as genuine research opportunities. In addition to finding researchers to apply to attend scheduled workshops, I also look for active researchers who might want to propose a workshop at AIM.

In addition to my travels, the internet has been an invaluable tool in helping in these efforts to find good matches for our programs. Google, MathSciNet, and the Mathematics Genealogy web pages have been the most useful. We perform keyword and math classification searches, but we also look for students and coauthors of invited participants. Organizers are not always familiar with the students or coauthors of people they have invited to a research program, but these groups often contain appropriate participants. We work to identify potential participants from these groups and include them in lists of names for organizers to consider inviting (if the organizers request this) or encourage them to apply to attend.

Increasing participation by underrepresented groups is a priority for me personally, and I love that it is part of my job. It is also a personal priority of mine that the work we do and resources we use at AIM toward this purpose be shared with other mathematics institutes, and with organizers of research activities elsewhere who share the same priorities. The major investment we have made is in identifying people in these underrepresented groups with various research interests. The marginal cost of sharing this information with others who have a similar goal is small in comparison. We welcome collaborations and ideas toward this end.

Dr. Helen Moore (Associate Director, American Institute of Mathematics)

Thanks to Our Donors

The Fields Institute launched an Annual Giving Campaign in fall 2004. For further information about donations, please follow the 'Fundraising' link at www.fields.utoronto.ca

The management and Board of Directors of the Institute wish to express their profound thanks to the following individuals, whose generous donations will support the work of the Institute.

Ian Ainsworth
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Mollie O'Neill
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Chris Robinson
David Rudd
Tom Salisbury
Arthur Sherk
Susan Coxeter Thomas
Noriko Yui
Anonymous (9)

The Institute would also like to thank the 31 additional individuals who gave donations to the May 2004 Workshop on Large Scale Nonlinear and Semidefinite Programming, in honour of Jos Sturm.

OTHER EVENTS

SINCE THE BEGINNING OF January, a number of Institute activities have taken place which are not mentioned elsewhere in this issue. From the thematic program these include the workshop on *Topological Strings* (organized by E. Getzler, K. Hori, and S. Katz, and held January 10–14), the workshop on *N=1 Compactifications* (organized by M. Douglas, K. Hori, and S. Sethi, from March 21 to 25), and a variety of string theory seminars and courses. Other workshops at Fields were *Text Mining Tools for Bioinformaticians and Biologists* (held February 4), a weekend workshop on *Arithmetic and Geometry of Higher Dimensional Varieties with Special Emphasis on Calabi-Yau Varieties and Mirror Symmetry* (held March 5-6 with principal organizer N. Yui), and a MITACS workshop on *Aeronautics* (held April 28-29). The *Great Lakes Geometry Conference* was held at Perimeter Institute, April 30 – May 1. An NRC/tri-institute meeting on Computational Biology in the post genomics era was held at CRM, March 19-20. The Quantitative Finance seminar audience heard from Tom Hurd (February 23) on credit risk, and from Robert Almgren (March 30) on portfolio optimization. Credit risk was also the topic of the PRMIA risk management seminar on February 7 (at the Rotman School), given by John Hull and a panel of discussants. PRMIA returned to Fields on March 16 with a presentation by Suzanne Labarge. The new Industrial Optimization seminar continued its successful first year with pairs of academic and industrial talks on each of February 1, March 1, and April 5. The Mathematics Education Forum met three times, with discussions of research projects in mathematics education, the high school-university transition, and on possible revisions to the high school mathematics curriculum. Ongoing seminar series in algebraic combinatorics, set theory, probability, geometry and model theory, and quantum information continued to meet regularly.

Tom Salisbury (Fields)

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The Fields Institute is grateful to all its sponsors for their support.

Message from the Director: Existence Proofs

continued from page 16

next PIMS newsletter. In this issue of *FieldsNotes*, we have invited Helen Moore, deputy director of AIM (the American Institute of Mathematics, a privately funded US institute), to give her perspective on improving the climate for women. Unlike some US institutes, Fields has not had formal rules or quotas on participation rates by underrepresented groups. But like those institutes, and consistent with the messages that circulated in response to Summers, we are determined to re-examine our hidden biases. There is no magic formula for making all our institutions inclusive overnight, just as we have not learned a simple way to predict who among our talented young people – women or men – will achieve the highest pinnacles of greatness. But Fields plans to showcase a greater variety of people who have succeeded, in the hope of finding ways to encourage and develop the best talents of all our students.

Research starts at home, but it doesn't have to stay there. In addition to all the activities at 222 College Street, distributed activity continues, in many forms: the Summer School in Operator Algebras in Ottawa in June is a major event, and includes a celebration in honour of George Elliott; and Fields is also a co-sponsor of events like the Networking 2005 computer science conference at Waterloo and MOPTA, at the University of Windsor this year.

It's not only show-and-tell. Together with CRM and PIMS, Fields works to improve the research environment in other areas of the country and in other areas of the mathematical sciences. One of these joint efforts is AARMS (the Atlantic Association for Research in the Mathematical Sciences) which receives half its funding from the three institutes and the other half from universities in the Atlantic provinces. Since its inception, AARMS has acted as an Atlantic arm of the institutes: AARMS runs a postdoctoral fellow program and provides support for workshops as well as operating an international summer school, its most ambitious program. Hermann Brunner, who has been a leading force behind the formation of AARMS and serves as its first director, has just taken the step of forming a Board of Directors for AARMS—a reminder that people who talk about how to help other people to do research are also contributing to the enterprise. Fields and CRM are also becoming partners with PIMS, at BIRS. In a similar spirit, the three institutes and the Statistical Society of Canada applied for and obtained funding from NSERC to operate the National Program on Complex Data Structures, as a way to include statistical scientists in the networking activities that have been so fruitful for core mathematics. NPCDS also provides another way for statisticians to use the institutes to communicate about their work, as the NPCDS projects all involve one or more workshops, typically held at one of the institutes.

Last fall, representatives of many mathematical constituencies in Canada met for a two-day retreat at BIRS to talk about the shared responsibilities of the learned societies, the institutes and the community in setting priorities—for funding, for education, for national and international action. We hope soon to present our thoughts to the mathematical community for comment, and we hope that by obtaining a consensus on the best directions for our efforts we will be able to continue to encourage more of the positive growth of mathematics in Canada that the past decade has witnessed.

So, what have we proved? The eager audiences and probing questions at events at Fields are proof that our programs have impact on people's approach to research. Our search for new communities, and our efforts to widen the community that participates in our programs are proof that we have the spark of innovation without which an institution becomes stale. The excitement about programs at all three institutes, and at AARMS, at BIRS and NPCDS is evidence of how warmly mathematicians across Canada welcome the research, communication and networking opportunities the institutes provide.

Barbara Lee Keyfitz (Director)

Activities

continued from page 15

JUNE 9–12, 2005
Designing Mathematical Thinking Tools, at the University of Western Ontario

JUNE 19–24, 2005
33rd Canadian Operator Symposium (COSy), at the University of Ottawa

JUNE 26–29, 2005
International Linear Algebra Society—12th Conference, at the University of Regina

JULY 4–5, 2005
Large Deviations and Rare Events in Networks, at the University of Ottawa

JULY 25–27, 2005
5th Annual MOPTA Conference, at the University of Windsor

JULY 25–29, 2005
Control of Infinite-Dimensional Systems, at the University of Waterloo

AUG. 8–11, 2005
Profinite Groups and Applications, at Carleton University

AUG. 10–12, 2005
17th Conference on Computational Geometry, at the University of Windsor

AUG. 18–20, 2005
Covering Arrays, at Carleton University

SEPT. 17, 2005
Carleton Applied Probability Day, at Carleton University

SEPT. 21–25, 2005
Jordan Algebras and Related Fields, at the University of Ottawa

OCT. 13–15, 2005
Longitudinal and Clustered Data Analysis Conference, at Fields

OCT. 21–23, 2005
Medical Imaging Workshop, at the University of Waterloo

The Fields Institute for Research in Mathematical Sciences publishes FIELDSNOTES three times a year (September, January, and May).

Director: Barbara Lee Keyfitz
Deputy Director: Thomas S. Salisbury
Managing Editor: Maryam Ali
Distribution Co-ordinator: Tanya Nebesna
Scientific Editor: Carl Riehm

Call for Proposals, Nominations, and Applications

For detailed information on making proposals or nominations, please see the website: www.fields.utoronto.ca/proposals

General Scientific Activities

Proposals for short scientific events in the mathematical sciences should be submitted by October 15 or March 15 of each year, with a lead time of at least one year recommended. Proposals will be considered at other times as funds permit. Activities supported include workshops, conferences, seminars, and summer schools. If you are considering a proposal, we recommend that you contact the Director (bkeyfitz@fields.utoronto.ca) or Deputy Director (salt@fields.utoronto.ca).

Thematic Programs

Deadlines for letters of intent and proposals for semester or year-long programs at the Fields Institute are March 15 and August 31 each year. Organizers are advised that a lead time of several years is required, and are encouraged to submit a letter of intent prior to preparing a complete proposal. They may consult the directorate about their projects in advance to help structure their proposal.

Postdoctoral Opportunities

Applications are invited for postdoctoral fellowship positions for the 2006-2007 academic year. The thematic program on Cryptography will take place at the Institute from August-December 2006, while the thematic program on Geometric Applications of Homotopy Theory will run from January-June 2007. Qualified candidates who have recently completed a PhD in a related area of the mathematical sciences are encouraged to apply. The fellowships provide for a period of engagement in research and participation in the activities of the Institute. They may be offered in conjunction with partner universities, through which a further period of support may be possible. One recipient will be awarded the Institute's prestigious Jerrold E. Marsden Postdoctoral Fellowship. Applicants seeking postdoctoral fellowships funded by other agencies (such as NSERC or 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.

The deadline for postdoctoral applications for the 2006-2007 programs is December 9, 2005, although late applications may be considered.

CRM–Fields–PIMS Prize

Nominations are invited for this joint prize in recognition of exceptional achievement in the mathematical sciences. The candidate's research should have been conducted primarily in Canada or in affiliation with a Canadian university. Previous recipients are H.S.M. Coxeter, George A. Elliott, James Arthur, Robert Moody, Stephen A. Cook, Israel Michael Sigal, William T. Tutte, John Friedlander, John McKay, Edwin Perkins, Donald A. Dawson and David Boyd.

Nominations for the CRM-Fields-PIMS Prize should reach the Institute by October 1, 2005.

Distinguished Lecture Series in Statistical Science (DLSS)

Nominations are being solicited for the sixth Fields Institute Distinguished Lecture Series in Statistical Science, to be given in Spring, 2006. The awardee will be an internationally prominent statistical scientist, who will give two lectures (one general, one specialized) at the Fields Institute. The previous lecturers are Peter G. Hall, Donald Fraser, Don Dawson, Sir David Cox and Brad Efron.

The deadline for DLSS nominations is October 15, 2005.

Deputy Director Position – see page 6

Send applications, nominations, and proposals to: The Director, Fields Institute
222 College Street, Toronto, Ontario, M5T 3J1 Canada

Fields Activities

Chalk it up to Mathematics

MAY TO OCTOBER 2005 *at Fields unless otherwise indicated*

Detailed information: www.fields.utoronto.ca/programs

Thematic Programs

GEOMETRY OF STRING THEORY, 2004–2005

Organizers: K. Hori, L. Jeffrey, M. Kapranov, B. Khesin, R. Myers, A. Peet

MAY 2-6, 2005
Workshop on Gravitational Aspects of String Theory

MAY 9–11, 2005
Coxeter Lecture Series
Renata Kallosh (Stanford)

JUNE 2, 2005
Clay Math Institute Public Lecture
Eric Zaslow (Northwestern)

JUNE 8–12, 2005
Workshop on Schubert Varieties

JUNE 20–JULY 8, 2005
Summer School - Strings, Gravity and Cosmology, at Perimeter Institute

JULY 11–16, 2005
Strings Toronto 2005, at the University of Toronto

RENORMALIZATION AND UNIVERSALITY IN MATHEMATICS AND MATHEMATICAL PHYSICS, FALL 2005

Organizers: P. Bleher, M. Lyubich, M. Yampolsky

SEPTEMBER 2005
Start of graduate courses

SEPT. 13–15, 2005
Coxeter Lecture Series
Oded Schramm (Microsoft)

SEPT. 20–24, 2005
Workshop on Percolation, SLE, and Related Topics

OCT. 18–22, 2005
Workshop on Renormalization and Universality in Mathematical Physics

General Scientific Activities

MAY 2–6, 2005
Networking 2005, at the University of Waterloo

MAY 5–7, 2005
Numerical and Analytic Methods in Fluid Dynamics, at Carleton University

MAY 5–8, 2005
IMACS International Symposium on Iterative Methods in Scientific Computing, at the University of Toronto

MAY 6–8, 2005
2005 CMS Canadian Mathematics Education Forum, at the University of Toronto

MAY 9–11, 2005
Empirical Likelihood Methods, at the University of Ottawa

MAY 12–13, 2005
Southern Ontario Statistics Graduate Students Seminar Days, at York University

MAY 12–14, 2005
Nonassociative Algebras

MAY 13–14, 2005
Ottawa-Carleton Discrete Mathematics Day, at the University of Ottawa

MAY 14–17, 2005
Modelling the Rapid Evolution of Infectious Disease: Epidemiology and Treatment Strategies, at the University of Western Ontario

MAY 24–28, 2005
Forest Fires and Point Processes, at Fields

MAY 31, 2005
4th Annual IFID Conference, at Fields

JUNE 1–3, 2005
Number Theory and Random Matrix Theory, at the University of Waterloo

JUNE 1–4, 2005
Mathematical Programming in Data Mining and Machine Learning, at McMaster University

JUNE 6–9, 2005
DNA Computing Conference, at the University of Western Ontario

JUNE 7–17, 2005
Summer School in Operator Algebras, at the University of Ottawa

continued on page 13

From the Director: Existence Proofs


Barbara Keyfitz

EVERY WEEK BRINGS NEW EVIDENCE of what makes Fields such a vibrant place to visit, and such an exciting place to work. The "Ontario Combinatorics Workshop", taking place outside my office as I write this, is only the most recent step in the proof. This two-day meeting, organized this year by Bruce Richter and Chris Godsil of Waterloo, has filled the building with graduate students and their mentors, who have come from near and far to talk, listen to each other, and get to know the plenary speakers, Robin Thomas, James Geelen, and Claude Tardif. The young people filling our building this weekend are learning first-hand that learning mathematics means, among other things, creating new mathematics and communicating one's results.

Last week we heard from a master of creating and communicating mathematics, when Edward Witten, Fields medalist and Charles Simonyi Professor at the Institute for Advanced Study, gave the Distinguished Lecture Series for 2004-05. A report appears elsewhere in this issue, so I will say only how invigorating it is to see, from the size and enthusiasm of the audience, such proofs that Fields activities are warmly appreciated.

Although the activities of the year-long Geometry of String Theory program are well over halfway complete, there is still plenty of activity planned for May, June and July: the final thematic workshop on "Gravitational Strings", a Coxeter lecture series by Renata Kallosh of Stanford University titled *Towards String Cosmology* a summer school at Perimeter Institute, and, to top it off, the international conference 'Strings 2005' which Fields is hosting jointly with Perimeter at the University of Toronto. "Strings" is going public, too, with a general lecture by the program's Clay Senior Scholar, Eric Zaslow, on June 2. (Information about the talk appears in this issue.)

And that isn't all: in May, Fields is hosting the Canadian Mathematical Society's Canadian Mathematics Education Forum, a national event at which we expect participation by mathematicians, educators and politicians.

In addition, we are starting to look forward to next year's activities. The thematic program for 2005–2006 is really two programs: a fall program on 'Renormalization and Universality in Mathematics and Mathematical Physics' and a winter/spring program on 'Holomorphic Dynamics, Laminations, and Hyperbolic Geometry'. (The term 'holodynamics' is now used locally around the Institute to refer to this ambitious set of topics). The organizing committee is chaired by Mikhail Lyubich of Stony Brook and the University of Toronto and Michael Yampolsky from Toronto. The other committee member in the fall is Pavel Bleher of IUPUI. In the second semester, Michael Shub of Toronto, Yair Minsky of Yale, and Bruce Kleiner of Michigan are also on the organizing committee.

Besides activities related to the thematic program—workshops, lecture series and visitors—the fall promises a number of other events. This year, the Distinguished Lecture Series in Statistical Sciences will be given by Brad Efron of Stanford. Elsewhere in this issue, you will read about the winner of this year's CRM-Fields Prize, David Boyd, who will lecture here in the fall. We congratulate Dave on this achievement, and look forward to his visit. Yet another event this fall is the continuation of mathematics talks in the Royal Canadian Institute series, with a public lecture by Jean Taylor on Sunday afternoon, November 20. The RCI talks take place in the Medical Sciences Building on the University of Toronto campus.

You may notice more lectures by women in our upcoming series. We have something to prove here, too. After the dismissive remarks by Lawrence Summers, president of Harvard University, were reported in the press, the Canadian (as well as the international) mathematics community hastened to issue messages of support and encouragement for women's achievements and potential in mathematics. Fields issued a press release (picked up in the AWM Newsletter, among other places), as did PIMS. I feel honoured to have been invited to contribute an article on the subject, which will appear in the

continued on page 13

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