HIGHLIGHTS

+ The Fields Institute partners with CNRS and FMJH
+ Thematic Program on Teichmüller Theory and its Connections to Geometry, Topology and Dynamics
+ 10 Years After the Crisis: Modelling Meets Policy Making
Contents

01 MESSAGE FROM THE DIRECTOR

02 NEWS: The Fields Institute partners with CNRS and FMJH

03 CALENDAR

04 SPECIAL LECTURES

06 FEATURED: Thematic Program on Teichmüller Theory and its Connections to Geometry, Topology and Dynamics

10 10 Years After the Crisis - modelling meets policy making

12 SPOTLIGHT: Peter Liljedahl, George Hart and Kang Lee

13 LIFE AT FIELDS

13 Research Showcase: Statistical Sciences at the University of Toronto

14 Math Minds: Transforming Mathematics Education

15 Combinatorial Algebra Meets Algebraic Combinatorics

16 Accelerator Weekend

18 Café Mathématique: the Flu, Math and You

19 CIHR STAGE International Speaker Seminar Series

20 PROFILES: Chris Bergevin and Nantel Bergeron

22 2018 Fields-AIMS-Perimeter - Africa Postdoctoral Fellowship: Taboka Chalebgwa

23 FUNDING, FELLOWSHIPS AND OTHER OPPORTUNITIES
We entered 2019 with the prospect of new exciting programs and events, but overshadowed by the sad news of the passing, on January 18, of our friend, colleague, and recent Fields Institute Director, Walter L. Craig. We will remember Walter for his unflagging support of the Fields Institute, his good humour, and his kindness.

The Fields Institute looks back on a busy fall 2018, highlighted by the major thematic program on Teichmüller Theory and its Connections to Geometry, Topology and Dynamics (July-December 2018), and the 2018 Fields Medal Symposium in honour of Maryam Mirzakhani. Later this year we will host the 2019 Fields Medal Symposium to celebrate the profound contributions of Artur Avila to chaos theory and dynamical systems.

As we move through 2019, an ambitious and ground-breaking Thematic Program is underway here at the Institute: The Fields CQAM Interdisciplinary Thematic Program is bringing together people from industry and academic fields to work on problems across a wide range of disciplines, including history, art conservation, economics, health research, pharmaceutical manufacturing, machine learning, energy and mining, and financial analytics. The Program is well aligned with the Fields CQAM vision of making "Ontario the international leader in the development and deployment of advanced mathematical methodologies for the emerging knowledge economy".

Another notable recent event was the Symposium on 50 Years of Complexity Theory: A Celebration of the Work of Stephen Cook (May 6-9, 2019). This four-day symposium featured an outstanding program of leading computer scientists, including many Turing Award and Nevanlinna Prize winners, centered around foundational research pioneered by Professor Stephen Cook (University of Toronto) on NP-Completeness and complexity theory.

We extend our congratulations to Taboka Prince Chalebgwa, 2019 recipient of the Fields-AIMS-Perimeter Africa Postdoctoral Fellowship. We look forward to welcoming him to the Institute in July 2019 to begin his fellowship.

My term as Director at Fields will end on June 30. I would like to express my warm thanks and personal appreciation to Arvind Gupta (Board Chair) and Deputy Directors Matheus Grasselli and Huaxiong Huang, who devoted so much of their talents and energy to Fields for the benefit of the whole community. In addition, I would like to thank all the staff at Fields over these past four years. Their hard work, dedication and flexibility have been essential in supporting the growing range and intensity of scientific activities at the Institute.

The Fields Institute recently announced the appointment of Professor Kumar Murty (University of Toronto) as Fields Institute Director, starting July 1, 2019. Professor Murty’s scientific accomplishments, track record of international collaborations and extensive administrative experience will all be great assets for the Fields Institute in the coming years. We are also very grateful to Professor Tom Salisbury (York University), who has agreed to help our transition as Interim Deputy Director from July 1, 2019 to June 30, 2020.

Ian Hambleton
Director
The Fields Institute, the Centre national de la recherche scientifique (CNRS), and the Fondation mathématique Jacques Hadamard (FMJH) forged new collaborations to further research in the mathematical sciences between France and Canada. The two-way partnerships aims to promote student exchanges and to provide a favorable framework for mobility for academics and postdocs to and from the CNRS, the FMJH, and Fields Principal Sponsoring Universities.

The three-year agreements, the first of their kind between Fields and French institutions, represent a high level of collaboration and aim to establish long-term relations between French and Canadian mathematical communities. The partnerships were formalized at a signing ceremony on April 9, 2019, in Paris, France.

“Through these agreements, Fields is able to offer exchange programs, share resources and work together with other institutes to enhance and promote excellence in mathematics research at home and abroad. The contributions of France-based researchers have been integral and vitally important to the intellectual life and success of the Institute and we hope to encourage and promote new connections through these agreements,” said Fields Institute Director Ian Hambleton.

Founded in 1939, the CNRS is a French interdisciplinary public research organization internationally recognized for the excellence of its scientific research. Its scientists explore the living world, matter, the Universe, and the functioning of human societies in order to meet the major challenges of today and tomorrow.

Founded in 2010, by decree of the French Prime Minister, the FMJH is an initiative that aims to support projects of scientific excellence in mathematical and related sciences. It contributes to the development and structure of mathematical training at the graduate, doctoral, and postdoctoral levels. It also helps make connections between mathematics and other scientific disciplines and reinforces and coordinates international collaborative programs in support of its mission.
Upcoming Programs & Events

**MAY**

**Fields CQAM Interdisciplinary Thematic Program**
January 1 - May 10, 2019

**Fields CQAM Industrial Problem Solving Workshop** • May 6-10, 2019 • Fields Institute
**Symposium on 50 Years of Complexity Theory: A Celebration of the Work of Stephen Cook** • May 6-9, 2019 • Fields Institute
**Workshop on Forms, Flags, Graphs, and Beyond** • May 9-12, 2019 • Fields Institute
**50 Years of Set Theory in Toronto** • May 13-17, 2019 • Fields Institute
**A Celebration of Women in Mathematics** • May 13, 2019 • Fields Institute
**2019 Workshop on Nonlinear Dispersive Partial Differential Equations and Inverse Scattering** • May 21-24, 2019 • Fields Institute
**Workshop on Vaccine Dynamics Modelling and Immunization Program Optimization** • May 21-23, 2019 • Fields Institute
**Arrangements at Western** • May 21-31, 2019 • Western University
**Carleton Finite Fields Workshop** • May 21-24, 2019 • Carleton University
**2019 Fields-China Joint Industrial Problem Solving Workshop** • May 27-31, 2019 • Fields Institute
**Analytic Low-Dimensional Dynamics: A Celebration of Misha Lyubich’s 60th Birthday** • May 27-Jun 7, 2019 • Fields Institute
**7th Canadian Discrete and Algorithmic Mathematics Conference (CanaDAM2019)** • May 28-31, 2019 • Simon Fraser University

**JUNE**

**Canadian Workshop on Information Theory** • Jun 2-5, 2019 • Fields Institute
**Society for Industrial and Applied Mathematics (SIAM) Conference on Financial Mathematics and Engineering** • Jun 4-7, 2019 • Fields Institute
**Workshop on Developments and Technical Aspects of Free Noncommutative Functions** • Jun 10-14, 2019 • Fields Institute

**Focus Program on Applications of Noncommutative Functions**
June 10-July 5, 2019

Workshop on the Theory and Applications of Stochastic Partial Differential Equations • Jun 10-14, 2019 • Fields Institute
Workshop on New Trends in Variational Models: From Superconductors to Liquid Crystals • Jun 17-21, 2019 • Fields Institute
**2019 Math Camp** • Jun 23-28, 2019 • University of Ottawa
**Smart Villages Conference 2019** • Jun 24-26, 2019 • Fields Institute
**Summer School on Algebraic Geometry in High-Energy Physics** • Jun 24-28, 2019 • University of Saskatchewan
**Workshop on Mathematical Ecology: Modeling Structured Populations** • Jun 27-28, 2019 • Queen’s University

**AUGUST**

**Graph Searching in Canada (GRASCan) Workshop** • Aug 6-7, 2019 • Fields Institute
**New Structures in Algebraic Geometry and Their Symplectic Interpretations** • Aug 6-9, 2019 • Fields Institute
**Workshop on New Geometry of Quantum Systems** • Aug 6-9, 2019 • Fields Institute
**Workshop on New Geometry of Quantum Systems: Modeling Structured Populations** • Aug 6-7, 2019 • Fields Institute
**Workshop on Mathematics of Model Development and Their Symplectic Interpretations** • Aug 6-9, 2019 • Fields Institute
**Workshop on Mathematical Ecology: Modeling Structured Populations** • Aug 23-28, 2019 • Fields Institute

**JULY**

**Thematic Program on Homological Algebra of Mirror Symmetry**
July 1-December 31, 2019

**Fields Undergraduate Research Program**
July 1-August 30, 2019

**SMS 2019: Current Trends in Symplectic Topology** • Jul 1-13, 2019 • Centre de Recherches Mathématiques
**Four Manifolds: Confluence of High or Low Dimensions** • Jul 8-12, 2019 • Fields Institute

**RRAGE: Ragnar’s Ramifications in Algebra and Geometry Emerging Workshop** • Jul 8-12, 2019 • Fields Institute
**Banach Algebras and Applications 2019** • Jul 11-18, 2019 • University of Manitoba
**Workshop on Lie Algebras, Their Generalizations, and Quantum Analogs** • Jul 15-19, 2019 • Fields Institute
**Summer School on Nonlinear Dynamics in Life Sciences** • Jul 15-19, 2019 • Fields Institute
**Society for Mathematical Biology Annual Meeting 2019** • Jul 22-26, 2019 • Centre de Recherches Mathématiques
**2019 Canadian Undergraduate Mathematics Conference** • Jul 24-28, 2019 • Queen’s University
**Graduate Summer School on Homological Algebra of Mirror Symmetry** • Jul 29-Aug 2, 2019 • Fields Institute
**Workshop on Operads and Higher Structures in Algebraic Topology and Category Theory** • Jul 29-Aug 2, 2019 • University of Ottawa
**Undergraduate Summer School on Homological Algebra of Mirror Symmetry** • Jul 29-Aug 2, 2019 • Fields Institute

**NEW**

New programs and events are continually being added. For updates and the latest, check fields.utoronto.ca/activities
Café Mathématique

Catherine Beauchemin, Ryerson University; David Fisman, University of Toronto; Seyed Moghadas, York University and Edward Thommes, Guelph University

Series on Infectious Disease: The Flu, Math, and You

November 21, 2018 • Fields Institute

CQAM Thematic Program Public Lecture

Kang Lee, University of Toronto

Affective Artificial Intelligence and its Applications

January 31, 2019 • Fields Institute

Fields CQAM Thematic Program Public Lecture

Piet Iedema, University of Amsterdam

Multiscale Modeling of Polymer Networks for Conservation of Old Oil Paintings

March 12, 2019 • Fields Institute

CQAM Thematic Program Public Lecture

Salvador García Muñoz, Eli Lilly

Digital Design of Pharmaceutical Manufacturing Processes

February 12, 2019 • Fields Institute

Keyfitz Lecture in Mathematics and the Social Sciences

Ivar Ekeland, University of British Columbia and Université Paris-Dauphine

Mathematics for Survival

April 3, 2019 • Fields Institute

Margaret Sinclair Memorial Award Lecture

Peter Liljedahl, Simon Fraser University

Thinking about Thinking Classrooms

February 23, 2019 • Fields Institute

CRM-Fields-PIMS Prize Lectures

Nassif Ghoussoub, University of British Columbia

From Monge Optimal Transports to Optimal Skorokhod Embeddings

April 11, 2019 • Fields Institute

Fields@Queen’s Lecture

Maria Chudnovsky, Princeton University

Parties, Doughnuts and Coloring: Some Problems in Graph Theory

Mathematics & Statistics Colloquium: Detecting Odd Holes

March 7-8, 2019 • Queen’s University

Public Lecture

Javier Jiménez, Universidad Politécnica de Madrid

Should we Trust Robot Scientists?

April 16, 2019 • Fields Institute
Public Lecture
Christos H. Papadimitriou, Columbia University
The Story of Complexity
May 6, 2019 • University of Toronto

Distinguished Lecture Series in Statistical Sciences
Michael I. Jordan, University of California, Berkeley
TBA
October 15-16, 2019 • Fields Institute

RCI Public Lecture
Keith Devlin, Stanford University
What Do Mathematicians Do Now That Machines Can "Do (All) the Math"?
May 15, 2019 • Fields Institute

Public Opening of the 2019 Fields Medal Symposium
Artur Avila, Institut für Mathematik Universität Zürich
TBA
November 4, 2019 • Fields Institute

Fields CQAM Thematic Program Public Lecture
Ayman Chit, Sanofi Pasteur
Assessing the effectiveness and cost-effectiveness of influenza vaccines: Review of Select work from industry-Academic collaborations
May 21, 2019 • Fields Institute

Student Night of the 2019 Fields Medal Symposium
Artur Avila, Institut für Mathematik Universität Zürich
TBA
November 5, 2019 • Fields Institute

Distinguished Visiting Professor Lecture Series
Roland Speicher, Saarland University
Dan-Virgil Voiculescu: Visionary Operator Algebraist and Creator of Free Probability Theory
June 14, 2019 • Fields Institute

Coxeter Lecture Series
Kenji Fukaya, Stony Brook University
TBA
December 2, 4 and 6, 2019 • Fields Institute

Distinguished Lecture Series
Victor Buchstaber, Steklov Mathematical Institute of Russian Academy of Sciences
TBA
March 17-19, 2020 • Fields Institute
Thematic Program on Teichmüller Theory and its Connections to Geometry, Topology and Dynamics

July 1-December 31, 2018 • Fields Institute

Organizers: Jon Chaika (University of Utah), Alex Eskin (University of Chicago), Yair Minsky (Yale University), Kasra Rafi (University of Toronto), Jing Tao (University of Oklahoma) and Alex Wright (Stanford University)
The Thematic Program on Teichmüller Theory and its Connections to Geometry, Topology and Dynamics was a tremendous success. There were a number of exciting activities throughout this six-month program that attracted hundreds of visitors from all over the world to the Fields Institute for collaborative research, discussion and lectures. The visitors represented an impressive breadth of mathematical areas, such as Teichmüller theory, homogeneous dynamics, algebraic geometry, and geometric group theory. It was particularly exciting to see so many women and young people represented among the speakers and participants. Some highlights include an introductory summer school, three workshops including a Sage Days workshop, the 2018 Fields Medal Symposium celebrating the work of Maryam Mirzakhani, the Coxeter Lecture Series by Fields Medallist Curtis McMullen, and three graduate courses, one of which was taught by the Dean’s Distinguished Visiting Professor, Mladen Bestvina.

The Sage Days workshop (Sage Days 96) was held on August 13-16. It brought together students, researchers, and advanced programmers for a fruitful exchange. It was an occasion for newcomers to learn about Sage and for more advanced users to exchange their views. There was also time set aside for individuals to work on their personal coding projects with the help of the experts that were present. These included projects in Teichmüller theory, interval exchanges transformations, translation surfaces and train-tracks. There was also new code developed that was added to the source code of SageMath and so made available to the community.

The Thematic Program represents a large and interconnected area of mathematics where major results use techniques and tools from disparate areas. To acquaint young researchers with these tools, an introductory summer school was held on August 20-24. This five-day school featured four exciting mini-courses: Arithmeticity of discrete subgroups by Yves Benoist (Université Paris-Sud), Homogeneous Dynamics and Hyperbolic Manifolds of Infinite Volume by Hee Oh (Yale University), Random walks on weakly hyperbolic groups by Giulio Tiozzo (University of Toronto), and Mirzakhani’s Work on Earthquakes by Alex Wright (University of Michigan). Each speaker gave four lectures. To facilitate learning by graduate students and people outside of the field, problem/discussion sessions were held in the afternoon.
About 100 participants, primarily early career mathematicians, attended the summer school. The Workshop on Geometry of Teichmüller Space occurred the week after the summer school, on August 27-31. This workshop featured 19 speakers who gave talks across a broad range, spanning much of Teichmüller theory and connected areas. There were over 90 participants in total and many spectacular talks on cutting edge research in higher Teichmüller theory. Some of the talks gave new insights into the intricate geometry of Teichmüller and moduli spaces and the coarse geometry of mapping class groups. The workshop also included a lunch-hour round-table discussion on women in mathematics, which was attended by almost all workshop participants.

The Workshop on Dynamics and Moduli Spaces of Translation Surfaces, held on October 22-26, had roughly 70 registrants. This workshop brought together participants in the broad area of translation surfaces, which has been influenced from areas across dynamics, geometry, and even algebra and number theory. There were 20 speakers who talked about work across dynamical, geometric, and algebro-geometric perspectives. The workshop also benefitted from some speakers talking about related topics like random Riemann surfaces, dynamics on infinite volume homogeneous spaces and stability conditions in more general settings.

The main body of the program featured three graduate courses and two regular seminars. The three courses reflected the diversity and breadth of the Thematic Program. The first course, Topology and Geometry of Automorphism Groups of Free Groups, was taught by the Dean’s Distinguished Visiting Professor, Mladen Bestvina (University of Utah). The second, Dynamics and its Connections to Teichmüller Theory, was taught by Jon Chaika (University of Utah). Finally, the course on Geometry and Dynamics in Teichmüller Space Equipped with the Thurston Metric was taught by Kasra Rafi (University of Toronto). Courses were well attended by local students, postdocs, and long- and short-term visitors. The seminars ran weekly and one was organized by the Program’s postdoctoral fellows.

The Coxeter lectures had 35 participants and featured three inspiring lectures by Curtis McMullen (Harvard University). These lectures were titled Planes in Number Theory, A Panorama of Teichmüller Curves; and Billiards and the Arithmetic of Non-arithmetic Groups.

The program was fortunate to overlap with the Fields Medal Symposium in honor of the late Maryam Mirzakhani (Fields Medal 2014). The symposium had roughly 140 participants and featured 16 talks. The Public Opening featured remarks by Ian Hambleton (Fields Institute Director), Vivek Goel (Vice President, Research and Innovation, University of Toronto), Donna Strickland (2018 Physics Nobel Prize winner and Professor, University of Waterloo), and Carlos Kenig (President-Elect, International Mathematical Union). Jenya Sapir (Binghamton University), Maryam’s first student, delivered a moving introduction. The evening ended with a riveting public lecture.
by Amie Wilkinson (University of Chicago) on the *Illumination Problem and the Work of Mirzakhani*. The Student Night saw 140 participants enraptured by Diana Davis’ (Swarthmore College) beautiful lecture on *Flat surfaces and Pentagon Billiards*. Alex Eskin (University of Chicago) gave a keynote address that showcased the explosive impact of Maryam’s work. The symposium also held a panel discussion on gender and diversity. The panellists included: Francis Bonahon (University of Southern California), Almut Burchard (University of Toronto), Diana Davis (Swarthmore College), Ursula Hamenstädt (Universität Bonn), Kathryn Mann (Brown University), Juan Souto (Université de Rennes). The panel had the privilege of being moderated by Molly Shoichet, Ontario’s first Chief Scientist and Professor of Chemical and Biomedical Engineering at the University of Toronto.

In addition to hundreds of workshop participants, the Fields Institute also hosted over 50 long- and short-term visitors from July to December 2018. The program was lucky to have six excellent Fields postdoctoral fellows: Benjamin Dozier, Eduard Duryev, Ian Alexander Frankel, Ilya Gekhtman, Kate Vokes, Derrick Wigglesworth, in addition to three wonderful postdoctoral scholars from the University of Toronto, Mary He, Yulan Qing, and Anja Randecker. The program also hosted three Clay Research Fellows for short-term visits: Brian Bowditch (University of Warwick), Camille Horbez (Université Paris-Sud), and Juan Souto (Université de Rennes).

This exciting semester brought together researchers and perspectives from across the world and benefitted from the welcoming atmosphere of the Fields Institute.
Ten years ago, the world faced an international financial crisis unparalleled since the Great Depression. Largely sparked by a widespread mortgage and housing bust in the US and unexpected failure by global finance services firm Lehman Brothers, global markets immediately sank. This eventually led to massive bank bailouts, bankruptcies, and foreclosures.

But what have we learned over the last decade? Are we any better prepared to predict similar catastrophic events?

On January 14-16, 2019, a conference with the Fields Institute Centre for Financial Industries and the New Approaches to Economic Challenges (NAEC) of the Organisation for Economic Co-operation and Development was held to pose this very question. Dozens of leading academic experts and policy makers gathered to reflect on the lessons learned over the past 10 years.

The discussions included how to model financial markets and their interactions with the real economy and featured speakers such as Andy Lo (MIT), John Geanakopulos (Yale University) and Blake LeBaron (Brandeis University). Themes included the Complexity of the Financial System (ABM and networks), Cyber-security, and the Financial System, Financialization and Inequality, Climate Finance, Behavioural Finance, and a final round table discussion asking "Are We Ready for the Next Crisis?"

A number of senior Canadian officials and policymakers from Finance Canada, the Bank of Canada, the Federal Reserve and the Canadian financial regulatory authority also participated, as did several representatives from the banking and high-tech industries.

The discussions began with a number of mini-courses with leading academics on issues such as Complexity Economics, Analysis and Agent-based (ABM), Asset Price Bubbles, Networks and Systemic Risk, and Blockchain.

The conference offered different perspectives on the financial system, how it works, develops endogenous shocks, and how it could be regulated. The outcomes will inform the NAEC book on the Financial System, edited by Patrick Love, which is nearing completion.

Collectively mathematicians, physicists, computer programmers, economists and policymakers came to some important conclusions about modelling and policy-making:

- The building blocks of traditional economic models have their shortcomings, including the assumptions on agents (lack of heterogeneity) and their behaviour (rational expectations). There has been too little consideration of cycles and interactions of financial products and practices (the leverage cycle and interplay between leverage, collateral, and asset prices).
- Alternatives and new modelling tools and techniques are needed to improve our understanding of systems, such as Network ABM and Bayesian Graphical Models.
• There is a high degree of acceptance now of the need to think about the economy and the financial system as a complex adaptive system and the tools of complexity are increasingly being used in policy-making institutions, regulatory agencies, and central banks.

• Network analysis is essential to understand systemic risks. Stresses in one or more institutions could trigger default or stresses on other institutions leading to scale cascades of system failure.

• The Institute for New Economic Thinking (INET) provided details of state-of-the-art ABM modelling which offers a more realistic way of thinking about markets. They will continue to be a key partner of NAEC, as the Organisation for European Cooperation and Development gets up to speed in this area. Joint work will be supported financially by a three-year funding package by Baillie Gifford.

• Cyber-security has emerged as one of the most important systemic risks to financial stability and should be considered like other risks – credit risks, operational risks, etc. It is now a major and impending concern of financial institutions. Beyond technical solutions which should be enhanced, it should be remembered that there is always a weak human link and that employees and customers should be made aware of these threats.

• Proportionally, the wealthy spend less of their income and the poor and middle class increasingly have to borrow to maintain living standards, leading to financialization. Neo-classical models are poorly equipped to model these relationships. Unbalanced growth will increase financial fragility, generate periodic crises, and lead to real economy instability.

• Inequality has probably increased financialization rather than vice-versa as is commonly assumed according to Lars Osberg (Dalhousie University) and Steve Pressman (Monmouth University).

• Using stock-flow consistent models, Gaël Giraud and his co-authors suggested that climate change, unchecked, could lead to financial and economic collapse. A price signal (carbon tax) provides the right incentive to avoid most of the climate damage but would not preclude financial risks.

• New paradigms and narratives are needed to understand financial markets. This would include better understanding of how individuals make mistakes, learn, and adapt, and how such evolution determines market dynamics. Negative feedback is essential and Andrew Lo suggested a financial NTSB be established for analyzing market crashes.

The Central Bank of Canada and Finance Ministry were reasonably confident about the ability of the authorities to handle another crisis and that buffers, safeguards, and resilience were adequate. However, economist Bill White suggested another crisis is inevitable and its magnitude could be even greater than that of the crash ten years ago.

The conference highlighted the benefits and the necessity of collaboration, experimentation and inter-disciplinarily planning in promoting new economic thinking and action. It highlighted the important role NAEC is playing in focusing the energies of different clusters of researchers to develop a systemic perspective on some of our most pressing challenges and the tools, techniques and narratives needed to understand them. Findings of the discussion are intended to be shared with the Committee for Financial Markets in April 2019.

The Fields Institute is an ideal collaborator for NAEC and there were several opportunities discussed for strengthening co-operation, involving parts of the Canadian government (this was discussed at a meeting with a Senior Director from the Bank of Canada) and INET. There may also be interest in funding such a joint effort with the Natural Science and Engineering Research Council pledging resources.

Alan Kirman (Aix-Marseille University) made an excellent contribution to the conference, continually questioning the approaches presented and pushing for policymakers to go further in implementing some of the key insights of NAEC. Overall, the event was extremely well received.

I cannot think that, if I had to spend my birthday away from home, I could have found a better environment. To spend it with such a interesting and friendly group with such different backgrounds was a real pleasure. This sort of thing should be easy to do but is, in fact, extremely rare. Thanks everybody it was a memorable occasion for me.

- Alan Kirman (Aix-Marseille University)
PETER LILJEDAHLL  
2018 MARGARET SINCLAIR MEMORIAL AWARD LECTURE SPEAKER  

Peter Liljedahl is the recipient of the 2018 Margaret Sinclair Memorial Award, which recognizes innovation and excellence in mathematics education at any level. He is Associate Dean of Graduate Studies at Simon Fraser University and he began his career in mathematics education as a grades 8-12 mathematics and physics teacher at a school in Vancouver. His research interests are as wide-ranging as his influence: creativity and discovery in mathematics teaching and learning, affect; beliefs; classroom practice, professional growth of teachers, numeracy, instructional design and assessment in mathematics, student learning behavior (studenting), interactions between students in collaboration, teacher tensions, and building thinking classrooms.  

On February 23, 2019, Liljedahl came to Fields to present the Margaret Sinclair Memorial Award Lecture. His talk, titled *Thinking About Thinking Classrooms*, explored a popular framework for teaching mathematics both in Canada and abroad; unpacking the framework’s effectiveness in transforming mathematics classrooms into spaces where students’ mathematical thinking is considered ubiquitous and the norm.

GEORGE HART  
2018-2019 RCI LECTURE SPEAKER  

To the public, the Royal Canadian Institute for Science or RCI, as it is commonly know, is the place to go to hear and learn about science. Founded in 1849, the RCI is among the oldest societies of its kind in Canada. After more than a century, and with few interruptions during times of global crisis, RCI lectures continue to take place today. In 2013 Fields and the RCI partnered to bring outstanding mathematicians to Toronto to explore the math behind everyday life and they have continued to do so ever since. On December 2 and 3, 2018, George Hart, an interdisciplinary sculptor, mathematician, computer scientist and educator, recently retired from Stony Brook University, New York, came to deliver RCI and Fields lectures. His talks, titled *Making Math Visible* and *From Mathematics to Sculpture*, featured hands-on activities for audiences of all ages. Hart’s mathematical research centers on novel polyhedral structures and algorithms for producing them. He has produced algorithms for generating various new classes of polyhedra, which he then presents to the world in sculptural forms. His mathematically informed sculptures, crafted with metal, wood, plastic, or 3D-printed, were on view during his presentations.

KANG LEE  
FIELDS CQAM PUBLIC LECTURE SPEAKER  

The Fields CQAM Interdisciplinary Thematic Program aims to bring together industry and academia to work on problems found in a wide range of disciplines. With a common focus on modelling, computation, and data science, the Program features conferences, workshops, seminars, and public lectures to offer hands-on experience.

As part of a Fields CQAM public lecture, Kang Lee (University of Toronto) came to Fields to give a talk on *Affective Artificial Intelligence and its Applications* on January 21, 2019. Drawing on more than two decades of research and insights from a century of psychological research on human emotion, Kang Lee discussed methods that artificial intelligence (AI) developers can use to develop intelligent systems with affective AI. This included the ability to detect, decode, interpret, and simulate human affects. In discussing AI’s shortcomings, Lee was hopeful about the future of this technology to transform our lives, asserting that AI IQ must work in tandem with EQ or emotional intelligence. The lecture was very popular and extremely well-attended.
The University of Toronto Department of Statistical Sciences is the leading research unit in statistical sciences in Canada and is recognized as among the best internationally. The Department’s research has a long tradition anchored in theory and methods, statistical computing, actuarial science and mathematical finance. In recent years the Department has expanded its research activity in theory and applications of data science and has strengthened its connections with other academic departments and with industrial partners. After opening remarks by Nancy Reid (University of Toronto), nine faculty members, several recently appointed, presented their work and showcased the Department’s growing research breadth and latest contributions to statistics and data sciences. Presenters included new and seasoned faculty members, including Jeffrey Rosenthal, Fanny Chevalier, David Duvenaud, Mike Evans, Murat Erdogdu, Linbo Wang, Zhou Zhou, Daniel Roy and Patrick Brown. In addition to the platform talks, there were lively discussions and a number of poster presentations during the coffee and lunch breaks to provide an opportunity for students, postdoctoral fellows and early career researchers to disseminate research results and to discuss with peers. Professor Craiu, Chair of the Department provided closing remarks. The success of this event is perhaps best summarized by an unsolicited message from an attendee from industry.

"Just a line to say that I really enjoyed the event on Friday. Academics in your department are truly rock stars, and yet all so modest. It’s really impressive to see that. As a non-statistician, I was not expecting to get as much from the day as I did. All talks were excellent (as was expected) but (more of a surprise) I could follow and learn"

— Industry Participant
On Friday, February 22, JUMP Math and the Fields Institute Centre for Mathematics Education (CME) co-hosted a full day conference at Fields. Brent Davis (University of Calgary), the Principal Investigator of the Math Minds research partnership, presented his work on Transforming Mathematics Education. John Mighton spoke on Closing the Achievement Gap and Tracy Solomon presented her research on how the cognitive and neurosciences can inform classroom practice. Former Director of Education at Toronto District School Board, Geraldine Connelly, welcomed guests and introduced the event.

There were 80 participants, including school principals, superintendents, classroom teachers, and staff from the Ministry of Education and the Deputy Minister. Brent Davis’ keynote presentation on the results of the Math Minds research partnership generated extensive interest in bringing the Math Minds model to Ontario.

The event concluded with a panel of speakers and a lively discussion facilitated by Dragana Martinovic, CME co-director.

Math Minds is a unique partnership that began in Calgary in 2012, with the goal of putting Math Minds research findings directly into the hands of educators. The partners include: University of Calgary’s Werklund School of Education, boards of education in the Calgary region, JUMP Math, and funder Suncor Energy Foundation.

Math Minds is building an approach to teaching mathematics that is evidence-based, theory-driven, and outreach-oriented. JUMP Math resources were used in classrooms involved in the project. Using JUMP Math resources in combination with the Math Minds PD model enables users to leverage and multiply the strengths of each. At the centre of the Math Minds approach is the notion that teachers require the support of a strong, well-designed resource, and that together the teacher and the resource create an essential and effective alliance.

The ultimate purpose of the Math Minds approach to teaching is to strengthen and sustain mathematics ability and performance, improve student and teacher confidence, boost student enjoyment of mathematics, and develop a replicable model of excellence in mathematics pedagogy.

Over the course of seven years, students in three pilot schools steadily improved their percentile rankings on tests of computation, and problem solving, and doubled their average ranking on a composite measure based on the three tests (from 27 to 55 percentile).

The Math Minds research team is currently developing in-class and online versions of the Math Minds teacher education course and plans to make them widely available.
This was the 16th iteration of Combinatorial Algebra Meets Algebraic Combinatorics. The goal of these meetings is to advance an ongoing dialogue between researchers in algebraic combinatorics working in combinatorial aspects of representation theory and polyhedral combinatorics, and commutative algebraists with combinatorial interests such as toric geometry and tropical geometry. The interaction between these two groups has proven to be immensely fruitful, leading to a cross-fertilization of ideas.

The 2019 event was held at the University of Ottawa. It attracted over 60 participants from across Canada and the United States. As with previous events, the workshop included four invited lectures and a number of shorter contributed talks. Uniquely, this year’s event also featured a CRM - University of Ottawa Distinguished Lecture. The event resumed on Saturday morning with an invited talk by Daniel Erman (University of Wisconsin-Madison) and talks by Adam Van Tuyl (McMaster University), Maryam Ehya (Dalhousie University), Oliver Pechenik (University of Michigan), and Daniele Turchetti (Dalhousie University). The mathematics presented in the morning spurred conversations over lunch in the university dining hall. The afternoon session began with an invited talk by Rosa Orellana (Dartmouth College) and talks by Sara Faridi (Dalhousie University), Michael Reeks (University of Ottawa), Erika Ordog (Duke University), Kaveh Mousavand (Université de Québec à Montréal), and Glenn Appleby (Santa Clara University). Saturday evening featured a conference dinner at Byward Market. Sunday began with an invited talk by Kirill Zainoulline (University of Ottawa), followed by talks by Véronique Bazier-Matte (Université de Québec à Montréal), Yuly Billig (Carleton University), and Nancy Wallace and Hugh Thomas (Université de Québec à Montréal). The workshop was a resounding success, further strengthening the research connections between these two groups of researchers.
The only one rule at the Hatchery Accelerator weekend is that there are no rules.

Fuelled by coffee, snacks and sage advice, teams of up to four students worked furiously to transform their wildest entrepreneurial ideas into viable business models in just 28 hours. The 2019 competition, hosted by The Entrepreneurship Hatchery, was kicked off by a special panel presentation from Silicon Valley seed accelerator Y Combinator, the incubator that launched companies such as Airbnb, Dropbox, Reddit, and Thalmic.

Accelerator Weekend 2019 was a huge success with 81 student participants, 18 teams, six finalists, and two prizes. The 28-hour process sees young entrepreneurs go from idea to startup, as they move through the stages of their ventures—all conceived within the span of a few hours.

As in the real world, students' models and ideas were judged by a panel of industry experts and entrepreneurs, which included Isi Caulder (EngSci 8T9), Richard Helbig (GeoE 7T3), Michael Augustanavicous (ElecE 7T6), Dag Enhorning (Siltech Corporation) and Richard Louttet (Canadian Professional Sales Association). The top team took home a grand cash prize of $2,000, and the runner up won $1,000. Students across U of T disciplines were invited to join this challenge that brought together multidisciplinary teams, who with the guidance from successful entrepreneurs, developed a business model around an idea. The final journey concluded with a pitch that was presented to participants and mentors at the 28th hour.

About The Entrepreneurship Hatchery: We create startups. Founded in 2012, The Entrepreneurship Hatchery provides a comprehensive suite of programs and services designed to help students with entrepreneurial ambitions form teams, develop new competencies, and launch their companies. Over the last seven years, The Hatchery has helped to launch over 80 new startups, which collectively have raised about $40 million in seed funding.

Students start by attending events in the Evangelism stage — the Hatchery offers Idea Markets, Virtual Idea Market, Speaker Series, Coffee Days, Cofounder Day, Hatchery Circle, Accelerator Weekend – events that nurture a strong culture of entrepreneurship on campus. From there, teams apply to one of the Hatchery's four processes:

- Hatchery NEST, fostering the creation of startups and the entrepreneurial mindset amongst all U of T students.
- LaunchLab, enabling graduate and faculty level research driven startups.
- Start@UTIAS + Hatchery, University of Toronto Institute of Aerospace Studies student-led start-up companies.
- Hatchery Social, Enabling Social Impact Startups (non-profit, solving social critical challenges).

Each team accepted into any of the Hatchery processes is matched with an advisory board including dedicated mentors, and gain access to resources such as work space, 3D printing, prototyping...
resources and fellowships. Teams refine their pitch by receiving detailed feedback on how to hone their message and build confidence to attract their first investors.

Finally, teams that enter the third stage, Go-To-Market, receive access to lawyers, to help secure intellectual property protection, marketing experts to help refine branding, and to other resources such as access to the investment community, accounting and finance advice, HR and grant application support and many other benefits.

Y Combinator, The Hatchery’s special guest, created a new model for funding early-stage startups. Twice a year Y Combinator invests a small amount ($120K) in a large number of startups. Since 2005, Y Combinator has funded over 1,900 startups. Y Combinator is a community of over 4,000 funders and their companies have a combined value of over $100B.

—Joseph Orozco, Executive Director, The Entrepreneurship Hatchery

We are here to celebrate the build-up of the entrepreneurial mindset and the passion and the energy and the commitment of a whole community to make sure that the next generation of entrepreneurs is prepared to think big and to transform Canada.
The first of six Café Mathématiques was held at the Fields Institute on November 21, 2018. These general public events are designed to raise awareness of the application and relevance of mathematics in biomedical fields and to provide insight into topics of popular interest. The Cafés provide a fantastic opportunity for the general public to meet local researchers and discuss some of the most interesting research underway.

Café Mathématiques typically take place at cafés, pubs, restaurants, or in community centres and are not intended to be lectures or seminars, but a way of getting research knowledge about mathematics issues of popular interest to the general public. The November 21 Café, titled The Flu, Math, and You, centred on infectious disease modelling, specifically, the mathematical modelling of influenza. Infectious disease modelling is a field of applied mathematics that involves the development and analysis of mathematical models, and dynamical systems, and computer simulations, so that characteristics of infectious diseases can be discerned.

Given the recent advances in public health contact tracing methods, laboratory detection, sequencing methods, computer hardware and the diverse nature of data sources, mathematical modelling provides the necessary tools to understand the complexities of infectious disease over many scales, from within a person, to a population. It also provides the means on which predictions and forecasts on the effectiveness of public health, pharmaceutical, and medical interventions can be made. The field is well known in research communities globally, but disease modeling (and even Mathematical Biology in general) is not well-known to the public.

Moderator Jane Heffernan (York University) and Panelists Catherine Beauchemin (Ryerson University), David Fisman (U of T), Seyed Moghadas (York University and Pan-InfORM), and Edward Thommes (Sanofi Pasteur and University of Guelph) began the evening with short introductions to their work modelling influenza at the in-host, community, and population levels.

This was followed by an engaging question period from the audience and discussions on the utility of mathematics to questions about public health and medicine. A lively debate and sharing of different ideas and anecdotes ensued. Future Cafés are being planned in Ottawa, Winnipeg, Montreal, Fredericton, and Vancouver.
The CIHR STAGE International Speaker Seminar Series (ISSS) comprises eight international seminars and group discussions annually. These one-hour long seminars are lead by some of the world’s most distinguished researchers in the fields of statistical genetics and genetic epidemiology. Each seminar attracts, on average, 60-70 people from the Toronto area, and an additional 15-20 remote participants. The seminars are two hours in length, open to all, and they aim to

- expose trainees to high-calibre international research,
- further interdisciplinary research innovation, discovery, and learning,
- foster a cohesive research community of genetic epidemiologists and statistical geneticists in Canada, and
- enable new networks of collaborative research.

The ISSS was created when Toronto-based researchers capitalized on a high concentration of statistical geneticists, genetic epidemiologists, and biomedical researchers at the University of Toronto and nearby institutions to pioneer a cross-disciplinary, multi-activity training program at the Dalla Lana School of Public Health. The training program, best known as CIHR STAGE, launched in 2010 and is excited to host its ISSS at the Fields Institute.
Many people might be surprised to know that healthy ears emit sounds too. These sounds, called otoacoustic emissions (OAEs), are believed to be generated by healthy ears from within the cochlea and can be measured using a sensitive microphone placed in the ear canal. In fact, OAE tests are used routinely in clinical settings, such as for testing the hearing of newborn babies.

“Scientists have assumed that OAEs are produced by cellular vibrations in the cochlea, which then propagate back out through the middle ear,” said Chris Bergevin (Physics & Astronomy). “But empirical evidence is weak and the biophysical principles underlying OAEs are not well understood, thereby limiting their potential use.”

Bergevin is taking a comparative approach to understanding how OAEs are generated and why animals, including people, also have a unique spectrum of emissions, like an acoustic fingerprint. He has studied the ears of humans, owls and tigers and is now focused on a type of lizard called the green anole.

“Lizards have remarkable OAEs and their ears are relatively simple, making them easier to study,” explained Bergevin. He is collaborating with a team at SickKids to relate the unique morphology of lizard ears to their OAE characteristics. He hopes to fill a major gap in understanding of how OAEs are created.
“What the Ancient Greeks devised in math is still taught in schools,” points out York Research Chair Nantel Bergeron (Mathematics & Statistics). “And over time, we have kept accumulating and accumulating knowledge.”

Algebra is the study of structure within mathematics and has also evolved over centuries. It deals with symbols and the rules for manipulating those symbols. In the early 20th century, however, algebra took on a new complexity by entering the abstract realm, creating a new world of mathematics to explore. This is the world that Bergeron finds himself in.

“I see myself as an artist in a way, developing a language that allows us to better understand the world,” he says.

He studies the structures in algebra, combining objects and breaking them in various ways to understand how different operations on the objects relate to each other.

“It’s about learning what properties I can expect and deduce when I manipulate these objects,” he explains. “And when we have a system of operations that are compatible, we call it algebra, and we can start developing algorithms.”

His work has applications for computer science, where there is a demand for better computational processes. But still, it takes many years to apply mathematical solutions. Bergeron points out that Google algorithms were in fact developed hundreds of years ago.

Mathematics is the language of modern science. It dates back thousands of years BCE. But unlike many scientific theories that were replaced by new ones over time, mathematical results and ideas are still valid since their infancy.
The 2019 recipient of the Fields - AIMS - Perimeter fellowship, early career scientist Dr. Taboka Prince Chalebgwa, has recently completed a PhD at Stellenbosch University in South Africa. Originally from Botswana, Chalebgwa holds two Master’s in mathematics with distinction. He received his first Master’s degree from AIMS in 2014, researching the critical points of complex polynomials, followed by a second Master’s degree from Stellenbosch University in 2016, exploring the geometry of complex polynomials and Sendov’s Conjecture. He then embarked on his PhD, with a focus on Nevanlinna Theory and algebraic values of meromorphic functions. While completing his PhD, Chalebgwa was a teaching assistant at AIMS South Africa, moderating courses on abstract algebra, model theory, algebraic number theory, computational algebra, and surfaces. Throughout his fellowship, he will be based at the Fields Institute, and is expected to arrive in July 2019 to begin his research.

Each year, the Fields Institute, the African Institute for Mathematical Sciences (AIMS) and the Perimeter Institute award a joint, year-long postdoctoral fellowship. This is a unique opportunity for recent PhDs who are African nationals working in areas of mathematical sciences or fundamental theoretical physics. Launched in 2012, the fellowship program was initially a joint endeavour by Fields and Perimeter. In 2017, the two institutes partnered with AIMS Next Einstein Initiative, with the shared goal of supporting the careers of young researchers committed to advancing science and mathematics across Africa. The fellowship program was renewed for an additional five years, and more opportunities have since been created for African researchers to participate in the range of programs at Fields and Perimeter. Selected fellows are invited to pursue their research at the Fields Institute, Perimeter Institute, or both, depending on their research interests. Over the years, the program has welcomed many talented and dedicated up-and-coming researchers, all of whom have greatly contributed to and benefitted from the stimulating environment at Fields.

“So far, our partnership has succeeded beyond any initial hopes,” said Neil Turok, Director of the Perimeter Institute. “The Fields-Perimeter Fellowship has attracted excellent candidates, distinguished not only by the quality of their science but also by their commitment to create opportunities for others. There is an abundance of youthful talent in Africa. Everything we can do today to hasten its development will bear great fruits for Africa and for science in the future.”

Organizers: AIMS Next Einstein Initiative • Fields Institute • Perimeter Institute

Launched in 2012, the fellowship program was initially a joint endeavour by Fields and Perimeter. In 2017, the two institutes partnered with AIMS Next Einstein Initiative, with the shared goal of supporting the careers of young researchers committed to advancing science and mathematics across Africa. The fellowship program was renewed for an additional five years, and more opportunities have since been created for African researchers to participate in the range of programs at Fields and Perimeter. Selected fellows are invited to pursue their research at the Fields Institute, Perimeter Institute, or both, depending on their research interests. Over the years, the program has welcomed many talented and dedicated up-and-coming researchers, all of whom have greatly contributed to and benefitted from the stimulating environment at Fields.

“So far, our partnership has succeeded beyond any initial hopes,” said Neil Turok, Director of the Perimeter Institute. “The Fields-Perimeter Fellowship has attracted excellent candidates, distinguished not only by the quality of their science but also by their commitment to create opportunities for others. There is an abundance of youthful talent in Africa. Everything we can do today to hasten its development will bear great fruits for Africa and for science in the future.”

Organizers: AIMS Next Einstein Initiative • Fields Institute • Perimeter Institute

Launched in 2012, the fellowship program was initially a joint endeavour by Fields and Perimeter. In 2017, the two institutes partnered with AIMS Next Einstein Initiative, with the shared goal of supporting the careers of young researchers committed to advancing science and mathematics across Africa. The fellowship program was renewed for an additional five years, and more opportunities have since been created for African researchers to participate in the range of programs at Fields and Perimeter. Selected fellows are invited to pursue their research at the Fields Institute, Perimeter Institute, or both, depending on their research interests. Over the years, the program has welcomed many talented and dedicated up-and-coming researchers, all of whom have greatly contributed to and benefitted from the stimulating environment at Fields.

“So far, our partnership has succeeded beyond any initial hopes,” said Neil Turok, Director of the Perimeter Institute. “The Fields-Perimeter Fellowship has attracted excellent candidates, distinguished not only by the quality of their science but also by their commitment to create opportunities for others. There is an abundance of youthful talent in Africa. Everything we can do today to hasten its development will bear great fruits for Africa and for science in the future.”

Organizers: AIMS Next Einstein Initiative • Fields Institute • Perimeter Institute
## ACTIVITIES

- **Major Thematic Programs.** Four to six-month programs in areas of current research interest in the mathematical sciences. Two year lead time.
- **Focus Programs.** One to two-month programs in areas of current research interest in the mathematical sciences (to run concurrently with major thematic programs). Two year lead time.
- **General Scientific Activity.** Scientific events, such as workshops, conferences, seminars, and summer schools, in the mathematical sciences. Nine month lead time.
- **Outreach Activity.** Projects that aim to promote mathematical culture at all levels and bring mathematics to a wider audience. Nine month lead time.

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>Deadline(s)</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Thematic Programs</td>
<td>Mar and Sep 15</td>
<td>$350K</td>
</tr>
<tr>
<td>Focus Programs</td>
<td>Mar and Sep 15</td>
<td>$75K</td>
</tr>
<tr>
<td>General Scientific Activity</td>
<td>Feb, Oct, and Jun 15</td>
<td>$5K/day</td>
</tr>
<tr>
<td>Outreach Activity</td>
<td>Same as above</td>
<td>$25K</td>
</tr>
</tbody>
</table>

## FELLOWSHIPS

- **Fields Institute Fellowships.** Lifetime appointments to recognize individuals who have made outstanding contributions to Fields and its activities. By nomination.
- **Fields-Ontario Postdoctoral Fellowships.** Two-year term. Six-months at Fields and 18 months at one or more of Fields Principal Sponsoring Universities. Two to three fellowships awarded each year, typically in connection with a major thematic program.
- **Fields Research Fellowships.** Opportunity for a period of full-time “Research in Residence” at Fields. Faculty members at Principal Sponsoring Universities may apply or nominate a collaborator.
- **AIMS-Fields-Perimeter - Africa Postdoctoral Fellowship.** One-year term for African nationals with recent PhDs in areas of mathematical sciences or fundamental theoretical physics. Joint program between Fields, the African Institute for Mathematical Sciences (AIMS-NEI), and Perimeter Institute for Theoretical Physics.
- **Postdoctoral Fellowships.** Six month-terms. Qualified candidates with a recently completed PhD in a mathematical sciences area related to a major thematic program.

<table>
<thead>
<tr>
<th>FELLOWSHIP</th>
<th>Deadline(s)</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fields Institute Fellowships</td>
<td>Feb 15</td>
<td></td>
</tr>
<tr>
<td>Fields-Ontario Postdoctoral Fellowships</td>
<td>Open</td>
<td>$50K/year</td>
</tr>
<tr>
<td>Fields Research Fellowships</td>
<td>Jan, May and Sep 15</td>
<td>$3.5K/month</td>
</tr>
<tr>
<td>AIMS-Fields-Perimeter - Africa Postdoctoral Fellowship</td>
<td>Nov 15</td>
<td></td>
</tr>
<tr>
<td>Postdoctoral Fellowships</td>
<td>See MathJobs</td>
<td>$30K/term</td>
</tr>
</tbody>
</table>

## PRIZES, AWARDS, DDVP, START UP & FIELDS CQAM

- **CAIMS-Fields Industrial Mathematics Prize.** The CAIMS-Fields annual industrial mathematics prize is awarded to a researcher in recognition of exceptional research in any branch of industrial mathematics, interpreted broadly. This Prize acknowledges industrial mathematics as a fundamental and vibrant discipline within the research culture of Canada.
- **CRM-Fields-PIMS Prize.** The premier Canadian award for research achievements in the mathematical sciences. Awarded jointly by the three Canadian mathematics institutes.
- **Dean’s Distinguished Visiting Professorship.** Anually, a leading international researcher in mathematical sciences is selected and invited to Fields to give a full-term course during a thematic program.
- **Fields CQAM.** Lab, startup, research, internships, and student placements. See website for details.
- **Fields Startup Program.** Fosters startup companies that commercialize mathematical ideas and that can benefit from the expertise at Fields.
- **The Margaret Sinclair Memorial Award.** Awarded annually to an educator in Canada with proven innovation and excellence in mathematics education at elementary, secondary, or university levels.

<table>
<thead>
<tr>
<th>EVENT</th>
<th>Deadline(s)</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAIMS-Fields Industrial Mathematics Prize</td>
<td>Jan 31, 2019</td>
<td>$1K</td>
</tr>
<tr>
<td>CRM-Fields-PIMS Prize</td>
<td>Nov 1</td>
<td></td>
</tr>
<tr>
<td>Dean’s Distinguished Visiting Professorship</td>
<td>Mar and Sep 15</td>
<td>$50K/term</td>
</tr>
<tr>
<td>Fields CQAM</td>
<td>Various</td>
<td></td>
</tr>
<tr>
<td>Fields Startup Program</td>
<td>Year-round</td>
<td></td>
</tr>
<tr>
<td>The Margaret Sinclair Memorial Award</td>
<td>Feb 28</td>
<td>$5K</td>
</tr>
</tbody>
</table>

For more information visit: fields.utoronto.ca/resources/proposals-and-applications

Questions? Contact Esther Berzunza, eberzunz@fields.utoronto.ca
MATHEMATICS MATTER!

From medicine to economics to ecology, mathematics underpins every aspect of science and technology.

At Fields, we endeavour to create a supportive, inclusive and stimulating environment that promotes mathematical research to make a tangible difference in people’s lives.

Our programming brings together the best and brightest of the wider mathematical world to create a place where innovative research thrives - and your support is what makes this possible.

By making a donation to Fields you could:

- Support a team of bright young girls from across Canada in the European Girls’ Mathematical Olympiad
- Sponsor a student in the Fields Undergraduate Summer Research Program
- Enable a public lecture by a world-renowned mathematician
- Support a student for a one-week program at Fields
- Cover the cost of a student registration for a workshop

Become a supporter of the Fields Institute

Mathematics provides a deep and powerful way of thinking about the world, yet it is not a static, finished subject. There are still many questions and great intellectual challenges to be solve, and with your support you become a part of the discovery.

Donate today and help us find the solutions!

Donations are tax-deductible. For more information, please visit fields.utoronto.ca/about/fundraising or contact development@fields.utoronto.ca.
2019 DONATION FORM
YES, I WANT TO BE A PART OF MATHEMATICS!

ABOUT YOU

TITLE □ PROFESSOR □ DR. □ MR. □ MRS. □ MS. □ OTHER __________
FIRST NAME ___________________________ LAST NAME ___________________________
MAILING ADDRESS
PROVINCE/STATE ______________________ POSTAL/ZIP CODE __________ COUNTRY ___________________________
PHONE ___________________________ EMAIL ___________________________
☐ I WOULD LIKE TO BE ADDED TO THE FIELDS INSTITUTE EMAIL LIST TO RECEIVE INFORMATION ABOUT UPCOMING EVENTS AND ANNOUNCEMENTS

ACKNOWLEDGEMENT OPTIONS
☐ I PREFER TO MAKE THIS DONATION ANONYMOUSLY
☐ I WOULD LIKE TO DEDICATE MY DONATION TO RECOGNIZE A MILESTONE, CELEBRATE A HOLIDAY, OR IN MEMORY OF SOMEONE SPECIAL. PLEASE WRITE THE DETAILS BELOW:

DONATION DETAILS

I WOULD LIKE TO GIVE: ☐ $2,000 ☐ $1,000 ☐ $500 ☐ $200 ☐ $100 ☐ OTHER __________

PAYMENT METHODS
• ONLINE: FIELDS.UTORONTO.CA/ABOUT/FUNDRAISING
• CHEQUE/MONEY ORDER: PAYABLE TO “THE FIELDS INSTITUTE”
• CREDIT CARD (COMPLETE DETAILS BELOW)

☐ VISA ☐ MASTERCARD ☐ AMEX
CARDHOLDER’S NAME (AS IT APPEARS ON THE CARD) ___________________________
CREDIT CARD NUMBER
EXPIRY DATE __________ CCV OR CVC NUMBER __________
SIGNATURE ___________________________ DATE ___________________________

SUPPORT OPTIONS (SELECT ONE)
☐ FIELDS MEDAL SYMPOSIUM ☐ UNDERGRADUATE SUMMER RESEARCH PROGRAM ☐ SCIENTIFIC PROGRAMMING
☐ PUBLIC LECTURES ☐ GRADUATE STUDENTS AND POST DOCS ☐ OUTREACH AND K-12 EDUCATION

THANK YOU FOR SUPPORTING THE FIELDS INSTITUTE

TAX-DEDUCTIBLE RECEIPTS WILL BE ISSUED TO ALL CANADIAN RESIDENTS. PLEASE ALLOW FOR A THREE WEEK TURNAROUND TIME.
NON-ANONYMOUS DONORS WILL BE ACKNOWLEDGED BY NAME IN THE INSTITUTE’S NEWSLETTER AND ANNUAL REPORT.
THE FIELDS INSTITUTE HAS A STRICT PRIVACY POLICY. ALL DONOR INFORMATION IS CONFIDENTIAL AND WILL NOT BE DISTRIBUTED TO EXTERNAL ORGANIZATIONS.
ABOUT
Mirror Symmetry is a phenomenon first observed to occur in High-energy Theoretical Physics. Since the early 90s, mirror symmetry has been used to solve difficult mathematical problems known as curve-counting or enumerative questions in Algebraic Geometry. In his 1994 ICM address, Kontsevich proposed that mediating the rich geometry of Mirror Symmetry was abstract foundational mathematics which amounts to a categorical equivalence. From this sprang the conjecture of Homological Mirror Symmetry (HMS).

HMS views two very different areas of mathematics, Symplectic Geometry and Algebraic Geometry, as opposite sides of the same categorical coin. Today, HMS is the cornerstone of an extremely active research field, reaching in influence far beyond its original formulation as a duality between Calabi-Yau manifolds, to such subjects as representation theory, singularity theory, and knot theory. At the core of the HMS research community are three different groups of researchers: algebraic geometers, symplectic geometers, and mathematical physicists.

This Thematic Program will focus on teaching young researchers all aspects of the field and will bring together algebraic geometers, symplectic geometers, and mathematical physicists from around the world who focus on the most modern aspects of HMS with an emphasis on engagement with students and young researchers.

COURSES
- Dean’s Distinguished Visiting Professorship: Xenia de la Ossa Osegueda - Sep 6-Dec 6, 2019

EVENTS
- Graduate Summer School on Homological Algebra of Mirror Symmetry - Jul 29 - Aug 2, 2019
- Undergraduate Summer School on Homological Algebra of Mirror Symmetry - Jul 29 - Aug 2, 2019
- New Structures in Algebraic Geometry and their Symplectic Interpretations - Aug 6-9, 2019
- The Geometry and Algebra of Landau-Ginzburg Models - Aug 6-9, 2019
- Workshop on Higher Structures in Geometry and Physics - Nov 18-22, 2019
- Coxeter Lecture Series: Kenji Fukaya - Dec 2, 4 and 6, 2019

REGISTRATION
fields.utoronto.ca/activities/19-20/mirrorsymmetry

ORGANIZERS
Mohammed Abouzaid, Columbia University
Matthew Ballard, University of South Carolina
Kevin Costello, Perimeter Institute
David Favero, University of Alberta
Ludmil Katzarkov, University of Miami and University of Vienna
Ailsa Keating, University of Cambridge
Tony Pantev, University of Pennsylvania
Johannes Walcher, Universität Heidelberg
Ursula Whitcher, American Mathematical Society and University of Michigan