CENTRE DE RECHERCHES MATHÉMATIQUES

Annual Report

2010
2011

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Also available on the CRM website

http://crm.math.ca/docs/docRap_an.shtml.

ISBN 978-2-921120-49-4

Presenting the Annual Report 2010 – 2011

In 2010 – 2011 two thematic semesters were organized by the CRM. The first one was devoted to Geometric, Combinatorial and Computational Group Theory and organized by Olga Kharlampovich (McGill University), Alexei Miasnikov (Stevens Institute of Technology), and their colleagues (Benson Farb, University of Chicago; Luis Ribes, Carleton University; Mark Sapir, Vanderbilt University; and Efim Zelmanov, University of California, San Diego). This semester featured five workshops, lectures at the leading edge, and series of Aisenstadt lectures; those events took place between August and October 2010. Of course group theory is a field of pure mathematics, but one of the goals of the semester was to demonstrate and stimulate the new links between this field and other areas of pure and applied mathematics, including applications to complexity theory and cryptography (and thus computer science). The Aisenstadt Chairs for the group theory semester were Yuri Gurevich (Microsoft Research), Angus MacIntyre (Queen Mary, University of London), and Alexander Razborov (University of Chicago).

The second thematic semester of the year 2010-2011 was devoted to statistics and organized by a committee including 15 researchers (11 researchers working in Canadian universities and 4 in other public institutions, including the Canadian Forest Service, the Institut de recherches cliniques de Montréal, and the Hydro-Québec Research Institute). The semester on statistics featured 7 workshops, covering theoretical topics (causal inference, analysis of survival and event history data, copula models and dependence) as well as methods applied to varied fields (meteorology, health, genomics, and forest management). Two of the workshops (those on meteorology and forest management, respectively) were included in the Climate Change and Sustainability Program, which also featured a course on viability theory by Professor Jean-Pierre Aubin (Université Paris-Dauphine) and a workshop on decision analysis and sustainable development (a joint CRM – GERAD – MITACS workshop). The Aisenstadt Chair for the statistics semester was Professor James Robins, from the Harvard School of Public Health.

In 2010 – 2011 the CRM general program contributed even more than usual to the financing of its laboratories activities, which covered topics such as number theory, cosmology, quantum cryptography, program construction, signal processing, bifurcation analysis, generation of combinatorial objects, statistical methodology, surfaces and representation theory, evolutionary games, and discrete and algorithmic mathematics. The CRM awards four prizes, either on its own or in collaboration with other institutes or professional associations. In 2011 the CRM – Fields – PIMS Prize (the most prestigious Canadian mathematical prize) was awarded to Mark Lewis (University of Alberta). Joel Kamnitzer (University of Toronto) was the recipient of the André-Aisenstadt Prize, awarded by the CRM International Scientific Advisory Committee to a young Canadian mathematician. Edward Susko (Dalhousie University) was the recipient of the CRM – SSC Prize, awarded by a joint committee of the CRM and the Statistical Society of Canada. Finally Robert Brandenberger (McGill University) was the recipient of the CAP – CRM Prize on Theoretical and Mathematical Physics, awarded by a joint committee of the CRM and the Canadian Association of Physicists.

In 2010 – 2011 the Grandes Conférences program continued to enjoy a large success. The three lectures were given respectively by Cédric Villani (Fields medallist and director of the Institut Henri-Poincaré), Doug Arnold (University of Minnesota), and Andrew Granville (Université de Montréal). The CRM is proud to have extended financial support to 45 postdoctoral fellows (all from outside Québec) in 2010 – 2011. This support demonstrates the scientific reach of the CRM and its attractiveness for young researchers from all over the world. Note that the CRM does not award postdoctoral fellowships to Ph.D. students completing their studies in Québec universities; indeed all those universities are affiliated with the CRM and the goal of the postdoctoral fellowship program is to offer diverse training experiences. Our Ph.D. students are offered fellowships in foreign countries and Ph.D. students from abroad apply for fellowships at the CRM. Each year 200 to 300 top-level students from all parts of the world apply for postdoctoral fellowships at the CRM. All professors at the large Québec universities may look at the applications and take part in the financing of a fellowship.

To conclude I would like to mention that in 2010 – 2011, the CRM welcomed 2,133 researchers from all parts of the world, including 55% of Canadian researchers. The CRM activities are numerous and varied and they demonstrate that the CRM plays a central role in the advancement of science, be it in Québec, Canada, or the world. I also wish to thank the institutions that support the CRM, especially NSERC (Government of

Canada), FQRNT (Government of Québec), the NSF (Unites States), the MITACS network, and the partner universities: first the Université de Montréal, then UQAM, Concordia University, McGill University, Université Laval, the Université de Sherbrooke, and the University of Ottawa.

François Lalonde, Director
Centre de recherches mathématiques (CRM)

Thematic Program

The core of each year's scientific program at the CRM is its thematic program. In 2010 – 2011 the thematic program consisted of two semesters: a semester on geometric, combinatorial and computational group theory (from July to December 2010) and a semester on statistics (from January to June 2011).

The CRM is very grateful to the National Science Foundation (NSF) for providing generous financial support to the young American mathematicians who attended the activities of the thematic program in 2010 – 2011. The CRM is also grateful for the support extended to its thematic program by the following institutions: NSERC, FQRNT, the Mprime network, the Fields Institute for Research in Mathematical Sciences, Hydro-Québec, the Ministère des Ressources naturelles et de la Faune of Québec, the Statistical and Applied Mathematical Sciences Institute (SAMSI), the Ouranos consortium, and the Canadian Forest Service. *The reports are presented in the language in which they were submitted.*

Thematic Programs of the Year 2010 – 2011 "Geometric, Combinatorial and Computational Group Theory" and "Statistics"

Geometric, Combinatorial and Computational Group Theory

The 2010 Fall Semester was devoted to developments in geometric, algorithmic, asymptotic group theory and applications. People from various branches of mathematics and computer science were brought together to work on some open questions in the field from a fresh viewpoint. The major goals of the semester were to strengthen the connections between group theory and other branches of mathematics and to highlight new and promising perspectives. A cornerstone of the activities of the thematic semester was a collection of workshops covering related themes. These workshops were intertwined to benefit students, postdocs, and local participants. The organizing committee of the semester consisted of Olga Kharlampovich (McGill University), Alexei G. Miasnikov (Stevens Institute of Technology), Benson Farb (University of Chicago), Luis Ribes (Carleton University), Mark Sapir (Vanderbilt University), and Efim Zelmanov (University of California, San Diego).

Statistics

The 2011 Winter Semester was devoted to branches of statistics that have undergone a vigorous development in recent years, such as causal inference, copula modelling, survival and event history analysis, genomic data analysis, and environmental statistics. The researchers participating in the semester included statisticians and experts in epidemiology, medicine, finance, climate sciences, and forestry who use statistical models in their own research. The semester on statistics had two main goals. The first one was to review the latest mathematical developments in thriving areas of the statistical sciences. The second goal was the promotion of exchanges between statisticians and scientists in other disciplines and the highlighting of promising avenues for theoretical and applied research in statistics. These goals were achieved through several workshops focusing on specific areas of statistics.

The scientific committee of the semester included the following researchers: Pierre Bernier (Canadian Forest Service), Richard Cook (University of Waterloo), Anne-Catherine Favre (Université Laval), Christian Genest (Université Laval), Raphael Gottardo (Institut de recherches cliniques de Montréal), Aurélie Labbe (McGill University), Fabrice Larribe (Université du Québec à Montréal), Jerry Lawless (University of Waterloo), Christian Léger (Université de Montréal), Erica E. M. Moodie (McGill University), Luc Perreault (Institut de recherche d'Hydro-Québec), Robert Platt (McGill University), Louis-Paul Rivest (Université Laval), David A. Stephens (McGill University), Chhun-Huor Ung (Canadian Forest Service).

Aisenstadt Chairholders in 2010 – 2011
Yuri Gurevich, Angus Macintyre, Alexander Razborov, and James Robins

Yuri Gurevich, Angus Macintyre, and Alexander Razborov were the Aisenstadt chairholders for the semester on group theory and James Robins the Aisenstadt chairholder for the semester on statistics.

Yuri Gurevich

Yuri Gurevich became famous for his pioneering works in logic, finite model theory, theory of computation, and computer science. He is currently Principal Researcher at Microsoft Research, where he created the Foundations of Software Engineering group, and professor emeritus at the University of Michigan. He is an ACM Fellow, a Guggenheim Fellow, a member of Academia Europaea, and received honorary doctorates from Universiteit Hasselt in Belgium and Ural State University in Russia.

The first lecture, entitled *The Church – Turing Thesis: Story and Recent Progress*, concerned the most fundamental problems of computation: what are computable functions and what are algorithms. The thesis states that every numerical function computable by means of a purely mechanical procedure is computable by a Turing machine. This thesis heralded the dawn of the computer revolution by enabling the construction of the universal Turing machine, which led, at least conceptually, to the von Neumann computer architecture and to the first electronic computers. Gurevich explained his recent paper with Nachum Dershowitz of Tel Aviv University, in which he makes an attempt to formulate axioms embodying the generally accepted properties of computability and then derive the thesis from those axioms. Although the Church – Turing thesis clarifies the notion of computability, it does not provide the definition of an algorithm. Indeed, it would be hard to argue that Turing machine simulation gives an adequate description of a modern operational system. In his talk, Yuri Gurevich described a solution to this problem based on abstract state machines.

In his second lecture, he discussed Security Policy as one of those fields where "engineers do logic." The Microsoft engineers created a policy language called Evidential DKAL (where DKAL stands for Distributed Knowledge Authorization Language). Yuri Gurevich presented this piece of applied logic and the issues of real-world computability. In an interesting digression, he also touched on the subject of what kind of mathematics and logic should be taught to modern software developers, and his conclusions were surprising for many of us. In his third lecture, he described some algorithmic problems that, unexpectedly, can be solved in linear time.

Angus Macintyre

Angus Macintyre is a famous model theorist, and has been a Fellow of the Royal Society since 1993. In 2003, he was awarded the Pólya Prize by the London Mathematical Society. Since 2009, he has served as the president of the London Mathematical Society.

The subject of Professor Macintyre's Aisenstadt lectures was the model-theoretic study of exponential fields. A unital ring R is exponential if it is equipped with a function $E\colon R \to R$ such that $E(x+y) = E(x)E(y)$ and $E(0) = 1$ hold. The most important examples of exponential rings are the fields of real numbers and complex numbers with the analytically defined exponential. The first lecture of the series was addressed to a general audience, and described the motivations and history of the subject, which goes back to the 1930s when Tarski posed the problem of extending the model-theoretical work on the fields of real numbers and complex numbers to the setting of these fields equipped with the exponential functions. Ironically, Tarski himself proved that the complex exponential field is undecidable. This relatively superficial result inhibited for nearly 70 years any model-theoretic analysis of definitions in that structure. It took 60 years to make a breakthrough on the case of the real exponential, first through Wilkie's theorem in 1991 stating that every formula of the real exponential field is equivalent to a boolean combination of existential formulas. Though Wilkie's proof was not effective, the work of Macintyre and Wilkie in 1992 revealed that if Schanuel's Conjecture is true, then the process can be made effective.

The second lecture started with a description of Schanuel's Conjecture or Schanuel's Condition, which plays a role in every aspect of the study of exponential fields. The most important open problem in this field

is to determine whether the complex exponential field satisfies this condition. Most of the lecture was spent on the theorems of Wilkie and those of Wilkie and Macintyre mentioned above. The third lecture was focused on Zilber's construction of "existentially closed" exponential fields, and his identification of very natural axioms for such fields. In a manner typical of model theory, progress on specific classical structures is often made through the study of more general structures ("nonstandard models"). The work of Zilber reveals the amazing possibility that these axioms hold for the complex exponential field (as conjectured by Zilber). Professor Macintyre sketched the state of the art results in this area, including Zilber's theorem stating that his field has a unique model of the cardinality of continuum. He also described some of the natural questions about which the current knowledge is very limited, particularly about the connection between Zilber's field and models of the theory of the real exponential.

The fourth lecture concentrated on the speaker's very recent work on Shapiro's conjecture. He explained how it has recently become clear that there is a deep connection between Ritt's Factorization Theorem for classical exponential polynomials (going back to the 1920s) and definability questions arising in the model theory, and described more connections between Zilber's fields and the complex exponential fields. These include results typically proven by analytic methods for the complex field, and by algebraic methods for Zilber's field, a striking example involving exponential functions with no zeros (Schanuel Nullstellensatz). Professor Macintyre concluded by discussing Shapiro's 50-year-old conjecture on pairs of exponential polynomials with infinitely many common zeros.

Alexander Razborov

Alexander Razborov won the Nevanlinna Prize in 1990 for introducing the "approximation method" in proving Boolean circuit lower bounds of some essential algorithmic problems, and the Gödel Prize in 2007 (with Steven Rudich) for their paper *Natural Proofs*. He was elected Corresponding Member of the Russian Academy of Sciences in 2000. Since 2008, he has been the Andrew MacLeish Distinguished Service Professor in the Department of Computer Science at the University of Chicago.

His first lecture dealt with some topics in extremal combinatorics, one of the branches of discrete mathematics, which studies how large (or small) a collection of finite objects can be if it has to satisfy certain restrictions. The area has undergone a period of spectacular growth in the recent decades, and Alexander Razborov reviewed some classical results and techniques from this field. A substantial part of extremal combinatorics studies relations existing between densities with which certain given combinatorial structures (fixed-size "templates") may appear in unknown (and presumably very large) structures of the same type. This was also the subject of the third lecture, dealing with Flag algebras.

The second lecture was concerned with the complexity of propositional proofs, an area where the speaker is one of the world experts. The question underlying propositional proof complexity is to determine when interesting propositional tautologies possess efficient proofs in a given propositional proof system. The motivations for studying complexity of propositional proofs come from algebra, automated theorem proving and, of course, computational (especially circuit) complexity. Razborov described some of the methods in this area and gave the audience a feeling of the current state of the art. Special attention was paid to algebraic and geometric proof systems, such as Polynomial Calculus and various proof systems inspired by the Lovász – Schrijver relaxation procedures.

The last lecture, a colloquium lecture, was entitled *Grand Challenges in Complexity Theory*. About 200 people attended this very entertaining presentation. The talk focused on classical computational complexity and proof complexity, and Razborov revealed some of the beautiful and unexpected connections existing between the different branches of complexity theory. He discussed the "grand challenges" in the field, including the "P vs. NP" question and questions about the power of classical proof systems.

James Robins

The Aisenstadt chairholder for the 2011 Thematic Semester in Statistics was James Robins, the Mitchell L. and Robin LaFoley Dong Professor of Epidemiology at the Harvard School of Public Health. The principal focus of Dr. Robins' research has been the development of analytic methods for drawing causal inferences from complex observational and randomized studies with

time-varying exposures or treatments. These methods include G-estimation of structural nested models, inverse probability-of-treatment weighted estimators of marginal structural models, and the parametric G-formula estimator. The usual approach to the estimation of the effect of a time-varying treatment or exposure on time to disease is to model the hazard incidence of failure at time t as a function of past treatment history using a time-dependent Cox proportional hazards model. Dr. Robins has shown that the usual approach may be biased, whether or not one further adjusts for past confounder history in the analysis, when

(A) there exists a time-dependent risk factor for, or predictor of, the event of interest that also predicts subsequent treatment, and
(B) past treatment history predicts subsequent risk factor level.

Conditions (A) and (B) will be true whenever there are time-dependent covariates that are simultaneously confounders and intermediate variables.

In contrast to previously proposed techniques, Dr. Robins' methods can:

(i) be used to estimate the effect of a treatment (e.g., prophylaxis for pneumocystis pneumonia or "PCP") or exposure on a disease outcome in the presence of time-varying covariates (e.g., number of episodes of PCP) that are simultaneously confounders and intermediate variables on the causal pathway from exposure to the disease;

(ii) allow an analyst to adjust appropriately for the effects of concurrent nonrandomized treatments or nonrandom noncompliance in a randomized clinical trial (for example, in the AIDS Clinical Trial Group (ACTG) Trial 002 of the effects of high-dose versus low-dose AZT on the survival of AIDS patients, subjects in the low-dose arm had improved survival, but they also took more aerosolized pentamidine, a nonrandomized concurrent treatment);

(iii) allow an analyst to adequately incorporate information on the surrogate markers (e.g., CD4 count) in order to stop, at the earliest possible moment, randomized trials up to the effect of the treatment (e.g., AZT) on survival.

Dr. Robins has applied his methods to analyze the effect of a nonrandomized treatment (aerosolized pentamidine) on the survival of AIDS patients in ACTG Trial 002; the effect of arsenic exposure on the mortality experience of a cohort of Montana copper smelter workers; the effect of formaldehyde on the respiratory disease mortality of a cohort of U.S. chemical workers; and the effect of smoking cessation on subsequent myocardial infarction and death within the MRFIT randomized trial.

Dr. Robins gave a series of three lectures during his stay in Montréal in May 2011. His first talk, entitled *Ontological Primacy of Causation versus Manipulation*: *The Case of the Pure Direct Effect*, dwelt on the topic of direct effects and was given as part of the Workshop on Causal Inference in Health Research. Starting with the seemingly straightforward question: *Does a binary variable X have a direct causal effect on an outcome Y that is not mediated through Z?*, Dr. Robins explained that this problem has been formalized in three different ways in the recent literature: via the controlled direct effect (CDE), the principal stratum direct effect, or the pure direct effect. He showed that of these three definitions, only the CDE is manipulable, and thus leads to an implementable, real-world intervention strategy. Dr. Robins went on to show that two common models for the CDE, his own *Finest Fully Randomized Causally Interpretable Structured Tree Graph* (FFRCISTG, Robins 1986) and the *Non-parametric Structural Equation Model* (NPSEM) of Pearl (2001), encoded different assumptions. He also stated that the NPSEM could be demonstrated to be a sub-model of the FFRCISTG. He concluded his lecture with a call to abandon the use of models for contrasts whose predictions cannot be refuted by any experimental predictions, and to adopt manipulable causal contrasts whose parameters are subject to experimental testing.

Dr. Robins' second lecture, entitled *Modern Mathematical Methods for Drawing Causal Inferences from Observational Data*, was geared towards a wide audience. It was delivered mid-way through the Workshop on Causal Inference in Health Research. Dr. Robins explained the difficulty in modelling time-varying exposures in a repeated measures study where exposure may be mediated through variables that simultaneously act as confounding variables for future exposures and the outcome. He went on to explain how marginal structural models using estimation via inverse weighting can overcome these modelling challenges, drawing on examples in HIV from his seminal papers on causal inference for longitudinal data (e.g., Robins et al., 2000). Dr. Robins' third lecture, delivered during the Workshop on Analysis of Survival and Event History Data, was a technical description of *Higher Order*

Inference in Complex Models. This lecture was a stimulating seminar on the use of higher-order influence functions that can be used to increase the degree of robustness of estimators based on coarsened data.

Aisenstadt Chair

The Aisenstadt chair was endowed by Montréal philanthropist Dr. André Aisenstadt. Under its auspices, one or more distinguished mathematicians are invited each year for a period of at least one week, ideally one or two months. During their stay the lecturers present a series of lectures on a specialized topic. They are also invited to prepare a monograph (see the chapter on publications in the present report for a list of these monographs). At the request of Dr. Aisenstadt, the first lecture given by an Aisenstadt chairholder should be accessible to a wide audience. Previous holders of the Aisenstadt chair are: Marc Kac, Eduardo Zarantonello, Robert Hermann, Marcos Moshinsky, Sybren de Groot, Donald Knuth, Jacques-Louis Lions, R. Tyrrell Rockafellar, Yuval Ne'eman, Gian-Carlo Rota, Laurent Schwartz, Gérard Debreu, Philip Holmes, Ronald Graham, Robert Langlands, Yuri Manin, Jerrold Marsden, Dan Voiculescu, James Arthur, Eugene B. Dynkin, David P. Ruelle, Robert Bryant, Blaine Lawson, Yves Meyer, Ioannis Karatzas, László Babai, Efim I. Zelmanov, Peter Hall, Sir David Cox, Frans Oort, Joel S. Feldman, Roman Jackiw, Duong H. Phong, Michael S. Waterman, Arthur T. Winfree, Edward Frenkel, Laurent Lafforgue, George Lusztig, László Lovász, Endre Szemerédi, Peter Sarnak, Shing-Tung Yau, Thomas Yizhao Hou, Andrew J. Majda, Manjul Bhargava, K. Soundararajan, Terence Tao, Noga Alon, Paul Seymour, Richard Stanley, John J. Tyson, John Rinzel, Gerhard Huisken, Jean-Christophe Yoccoz, Wendelin Werner, Andrei Okounkov, Svante Janson, Craig Tracy, Stéphane Mallat, Claude Le Bris, and Akshay Venkatesh.

Activities of the Thematic Semesters

Workshop
Geometric, Asymptotic, Combinatorial Group Theory with Applications (GAGTA)

August 15 – 19, 2010, CRM

Organizers:
Olga Kharlampovich (McGill), Mark Sapir (Vanderbilt), Nicholas Touikan (UQAM), Enric Ventura (UP Catalunya)

Speakers:
Elena Aladova (Bar-Ilan), Jason Behrstock (Lehman Coll., CUNY), Lewis Bowen (Texas A&M), Alexander Dranishnikov (Florida), Mikhail Ershov (Virginia), David Fisher (IU Bloomington), Daniel Groves (UIC), Vincent Guirardel (Paul Sabatier), Anton Klyachko (Moscow State), Gilbert Levitt (Caen), Alex Lubotzky (HUJI), Alexei G. Miasnikov (Stevens Inst.), Alexander Yu. Olshanskii (Vanderbilt), Eugene Plotkin (Bar-Ilan), Marina Popova (Marina Popova & Assoc. Inc.), Timothy Riley (Cornell), Mark Sapir, Diane Vavrichek (Montréal), Alina Vdovina (Newcastle, UK), Enric Ventura, Pascal Weil (Bordeaux 1), Efim Zelmanov (UC San Diego)

Number of participants: 64

The first workshop of the thematic semester on group theory also happened to be the fourth in the GAGTA sequence of conferences (the previous ones were held in Manresa, Spain; in Dortmund, Germany; and at the Stevens Institue of Technology, United States). Because some of the participants of this workshop were also planning to attend an ICM satellite conference in Goa, this workshop exceptionally started on a Sunday. This gathering was a big success: there were 64 participants and many beautiful new results were presented.

David Fisher and Mark Sapir gave mini-courses for this workshop. David Fisher, in his mini-course *Quasi-isometric Rigidity*, presented some of his joint work with Alex Eskin and Kevin Whyte and that of Irene Peng, which gives a quasi-isometric classification of certain classes of virtually polycyclic groups. This result is one of the major recent breakthroughs in geometric group theory and has generated a lot of excitement. He sketched the proof and also indicated some of the obstacles to be overcome in order to achieve further generalizations.

Mark Sapir gave the second mini-course, which was entitled *Asymptotic Cones of Groups*. Although the first application of asymptotic cones to geometric group theory was Mikhail Gromov's celebrated theorem on groups of polynomial growth, Mark's treatment was geared towards the study of "nonpositively curved" groups. He discussed their applications to Dehn Func-

tions, divergence of geodesics, and equations over groups. He also described the asymptotic cones of relatively hyperbolic groups and mapping class groups.

Some very nice algorithmic results were presented during the workshop. Vincent Guirardel announced a proof of the isomorphism problem for rigid residually hyperbolic groups. Alexander Olshanskii presented a result that connected the space complexity of a group's word problem with some very natural and well-known group invariants. Enric Ventura gave some conditions enabling one to construct recursive presentations of Mihailova's subgroups (these are subgroups of the direct product of two free groups for which we know that the membership problem is undecidable). These conditions allowed for the construction of new examples of groups with pathological properties.

There were also many new results in asymptotic group theory. Jason Behrstock discussed the quasi-isometric classification of 3-manifold groups; in particular we were shown a very simple description of the quasi-isometry classes of graph manifolds. Alexander Dranishnikov gave a presentation on the dimension growth of groups, a notion related to asymptotic dimension and growth, and showed how it could be computed in some instances. He ended with an intriguing open question relating sub-exponential dimension growth and amenability. Daniel Groves presented some of his recent work on understanding the sets of homomorphisms to mapping class groups, which ultimately should lead to an understanding of surface bundles.

Gilbert Levitt presented a proof of finiteness properties of stabilizers of conjugacy classes of free groups and of point stabilizers of points on the boundary of Culler – Vogtmann outer space. Lewis Bowen presented his remarkable result that a (finitely generated) free subgroup of a Lie group is, up to some small perturbations and passing to a finite index subgroup, a subgroup of *any* co-compact lattice. Diane Vavrichek talked about some conditions for a subgroup to be essentially mapped to another subgroup via a quasi-isometry.

On the more combinatorial side of things we had a presentation by Tim Riley on his hydra groups, which are hugely distorted subgroups of surprisingly nice CAT(0), one-relator, free-by-cyclic groups. Anton Klyachko elaborated on some properties of groups obtained by adding one generator and a special type of relator to the presentation of a nontrivial group. Pascal Weil showed another very natural model of a "random subgroup" of a free group; this model is remarkable because the arising algebraic properties are quite different from the standard random model. Mikhail Ershov introduced positive weighted deficiency and showed how this could be used to construct examples of residually finite groups whose every finitely generated subgroup is either finite or of finite index.

Alexei Miasnikov gave a talk on large-scale first-order logic, a very general idea that applies to a multitude of structures, and discussed the large-scale first-order properties of Cayley graphs and of hyperbolic groups. Elena Aladova presented the notion of logical separability and an ambitious effort to give geometric interpretations to fundamental notions of model theory. Alex Lubotzky discussed presentations of finite simple groups and sieve methods (see the following report on Lectures at the Leading Edge). Eugene Plotkin surveyed new characterizations of finite solvable groups and Alina Vdovina presented a new family of expander graphs coming from finite groups with a very small number of generators and relations.

The cultural content of this workshop was also greatly enhanced by Marina Popova's presentation, entitled *Abstract Art and Mathematics*: *At the Crossroads*. Marina Popova discussed abstract art, her work, and how mathematical imagery has been inspiring to her as of late. Four of her beautiful paintings were on display at the CRM (on the fifth floor of the Aisenstadt pavilion) and all agreed that they added a very welcome touch of class to the workshop.

Lectures at the Leading Edge
Alex Lubotzky and Efim Zelmanov

August 16 – 17, 2010

The semester on group theory included prestigious lectures (*Lectures at the Leading Edge*) given by Professor Efim Zelmanov and Professor Alex Lubotzky, respectively. Those lectures took place within the GAGTA workshop (see the previous report). Efim Zelmanov is famous for his work in nonassociative algebra and group theory, including his solution of the restricted Burnside problem. He was awarded a Fields Medal at the International Congress of Mathematicians in Zürich in 1994. He obtained a doctoral degree at Novosibirsk State University in 1980, and a higher degree at Leningrad State University in 1985. He is a professor at the University of California, San

Diego. Professor Zelmanov gave lectures in Montréal on several occasions, and was the CRM Aisenstadt Chairholder in 1996. Efim Zelmanov's Leading Edge Lecture, which he gave on August 16, 2010, was entitled *On Geometric Theory of Algebras*. In this lecture he presented some new efforts to apply ideas of growth, expanders, and self-similarity to problems in the theory of algebras.

Alex Lubotzky is the Maurice and Clara Weil Chair in mathematics at the Einstein Institute of Mathematics, which is famous for research in group theory, Lie groups, combinatorics and field arithmetic. Professor Lubotzky is a recipient of the Bergman Memorial Prize of the United States-Israel Binational Science Foundation (in cooperation with Professor Hyman Bass of Columbia University). His other prizes include the 1991 Erdős Prize of the Israeli Mathematical Union (a prize awarded to the best Israeli mathematician/computer scientist under the age of 40), the 1993 Ferran Sunyer i Balaguer Prize (awarded by the Institut d'Estudis Catalans for the book *Discrete Groups, Expanding Graphs and Invariant Measures*), the 2002 Rothschild Prize, and the 2002 Ferran Sunyer i Balaguer Prize for the book *Subgroup Growth* with Professor Dan Segal. In 2005 he was elected Foreign Honorary Member of the American Academy of Arts and Sciences. In 2006 he received an honorary doctoral degree from the University of Chicago, and in 2007 the Rector's Prize of the Hebrew University (for excellence in research, teaching, and service to the university). He is also the editor of many journals.

On August 16, 2010, Alex Lubotzky gave a Leading Edge Lecture entitled *Short Presentations of Finite Simple Groups*, and on August 17, a second Leading Edge Lecture entitled *Sieve Methods in Group Theory*. In this second lecture he presented joint work with Chen Meiri. For more details on the Leading Edge Lectures of Professors Zelmanov and Lubotzky, we refer the reader to an article by Olga Kharlampovich and Nicholas Touikan that appeared in the Fall 2010 issue of *Le Bulletin du CRM*.

Workshop
Topics in Algorithmic and Geometric Group and Semigroup Theory

August 23 – 27, 2010

Organizers:
Olga Kharlampovich (McGill), Robert H. Gilman (Stevens Inst.), Alexei G. Miasnikov (Stevens Inst.), Benjamin Steinberg (Carleton), Nicholas Touikan (UQAM)

Speakers:
Jorge Almeida (Porto), Gilbert Baumslag (CCNY), Ekaterina Blagoveshchenskaya (Petersburg State Transport University), Alexandre V. Borovik (Manchester), Elena Bunina (Moscow State), Alfredo Costa (Coimbra), Elizaveta Frenkel (Moscow State), Sergei Ivanov (UIUC), Mark Kambites (Manchester), Olga Kharlampovich, John Meakin (Nebraska — Lincoln), Alexei G. Miasnikov, Alexander A. Mikhalev (Moscow State), Alexander V. Mikhalev (Moscow State), Andrey Nikolaev (McGill), Luis Ribes (Carleton), Paul E. Schupp (UIUC), Denis E. Serbin (Genève), Lev Shneerson (Hunter Coll., CUNY), Said Sidki (Brasília), Benjamin Steinberg, Nicholas Touikan, Daniel T. Wise (McGill), Pavel Zalesskii (Brasília)

Number of participants: 46

The workshop included two mini-courses. The first, given by Benjamin Steinberg, was entitled *Automata Theory and Algorithmic Problems in Groups*. In this mini-course Ben discussed the membership problems for subgroups, submonoids, and rational subsets of groups. Ben taught us that automata are powerful tools that can also be used to simplify certain proofs in group theory. The second mini-course, entitled *Subgroup Membership Problem in Limit Groups*, was given by Denis Serbin. He described infinite words and the manner in which they could be applied to the study of limit groups; he also presented the Stallings foldings technique used to solve many important algorithmic problems in limit groups.

Although there was an obvious overlap of interests between the first and second workshops of the thematic semester, the second one had a definitely different, perhaps more multidimensional, feel. For example, there were many interesting talks about semigroups and inverse monoids, not-so-distant yet wildly different cousins of groups. Lev Shneerson, John Meakin, and Mark Kambites gave talks that involved techniques of combinatorial and geometric group theory applied to monoids and semigroups; these talks showed the similarities between the fields but also made plain the fact that some things are just a lot harder (but still fun) to do without inversions. Jorge Almeida and Alfredo Costa discussed the symbolic dynamics aspect of semigroups.

Another "group" of people that were underrepresented in the previous workshop were the pro-p group theorists. Luis Ribes gave a very nice survey of virtually free pro-p groups, and Pavel Zalesskii presented an ongoing effort to develop a theory of pro-p limit groups that parallels the theory of limit groups over free groups. Said Sidki also gave two lectures on the automorphism groups of rooted trees, a topic that has deep connections to profinite group theory. There was also an interesting pair of talks. The first one of the pair, given by Gilbert Baumslag, discussed how limited our knowledge of one-relator groups still is and quite eloquently decried the tyranny of geometry in contemporary infinite group theory. The other talk of the pair, by Dani Wise, described his recent work (which uses geometric methods) on quasiconvex hierarchies, giving a positive solution to a conjecture of Baumslag's about one-relator groups. The two of them had memorable exchanges.

Algebraists were also represented. Elena Bunina spoke about isomorphisms and elementary equivalence of Chevalley groups, Ekaterina Blagoveshchenskaya discussed recent advances in the theory of torsion-free abelian groups, and Alexander A. Mikhalev and Alexander V. Mikhalev discussed general problems about algebras. Alexei Miasnikov also gave a talk on how a more algebraic/model-theoretic approach could be used to solve the problem of Krull dimensions for limits of groups. Olga Kharlampovich, Nicholas Touikan, Andrei Nikolaev, and Elizaveta Frenkel gave presentations about various algorithmic properties of certain classes of nonpositively curved and free groups, whereas Alexandre V. Borovik discussed black box groups.

There was also more to this workshop than merely mathematical lectures. At the end of the second day, there was a philosophical debate proposed by Alexandre V. Borovik on the topic: "Can we save mathematics from mathematicians?" Unfortunately no clear consensus was formed. There was a consensus, however, about the picnic on Wednesday evening at Beaver Lake: it was a lot of fun! To close the workshop, we were treated to another presentation by the artist Marina Popova, which was followed by a very interesting discussion on the role of aesthetics in mathematics and an exploration of the strange connection between kitsch and the notion of infinity.

Workshop
Complexity and Group-Based Cryptography

August 30 – September 3, 2010

Organizers:
Robert H. Gilman (Stevens Inst.), Alexei G. Miasnikov (Stevens Inst.), Vladimir Shpilrain (CCNY), Alexander Ushakov (Stevens Inst.)

Speakers:
Simon R. Blackburn (Royal Holloway), Martin R. Bridson (Oxford), Jintai Ding (Cincinnati), Nelly Fazio (CCNY), Benjamin Fine (Fairfield), Robert H. Gilman, Delaram Kahrobaei (City Tech), Arkadius Kalka (Bar-Ilan), Martin Kreuzer (Passau), Juan González-Meneses López (Sevilla), Spyros Magliveras (Florida Atlantic), Alexei G. Miasnikov, Ciaran Mullan (Royal Holloway), Aleksey D. Myasnikov (Stevens Inst.), Sergey I. Nikolenko (St. Petersburg Academic), Wan Ainun Mior Othman (Malaya), Colva M. Roney-Dougal (St. Andrews), Vladimir Shpilrain, Rainer Steinwandt (Florida Atlantic), Boaz Tsaban (Bar-Ilan), Alexander Ushakov, Kok Bin Wong (Malaya), Peng Choon Wong (Malaya)

Number of participants: 49

Building a solid mathematical foundation for the use of infinite groups in cryptography inevitably involves operating with various asymptotic and statistical aspects of infinite groups, and this is where modern group theory finds its important applications. In this workshop we explored "noncommutative ideas" in cryptography. We payed particular attention to what can be called group-based cryptography, i.e., cryptography that uses noncommutative group theory in one way or another.

There is a remarkable feedback from cryptography to combinatorial group theory because some of the problems motivated by cryptography appear to be new to group theory, and they open many interesting research avenues within group theory. We employ complexity theory, notably generic-case complexity of algorithms, for cryptanalysis of various cryptographic protocols based on infinite groups. We also use the ideas and machinery from the theory of generic-case complexity to study asymptotically dominant properties of some infinite groups that have been used in public key cryptography. It turns out that for a given cryptographic scheme to be secure, it is essential that keys be selected from a "very small subset" (relative to the whole group, say) rather than from the whole group. Detecting these subsets ("black holes") for a particular cryptographic scheme is usually a very challenging problem, but it

holds the key to creating secure cryptographic primitives based on infinite noncommutative groups.

Our workshop gathered about 50 mathematicians from Belgium, Canada, Germany, Israel, Malaysia, Poland, the United Kingdom, the USA, Russia, and Spain. It featured two mini-courses: one by Robert Gilman and Alexei Miasnikov on algorithmic group theory and the other by Vladimir Shpilrain and Alexander Ushakov on group-based cryptography. Several international collaboration projects were initiated during the workshop, in particular the international *Symbolic Computations and Post-quantum Cryptography Web Seminar* (to be found at the address stevens.edu/algebraic/SCPQ/). This seminar is held online every two weeks and attracts on average about 40 participants from all over the world.

Workshop
Group Actions and Dynamics

October 4 – 8, 2010

Organizers:
Olga Kharlampovich (McGill), Alexei G. Miasnikov (Stevens Inst.), Denis E. Serbin (Genève)
Speakers:
Mladen Bestvina (Utah), Lisa J. Carbone (Rutgers), Montserrat Casals-Ruiz (Vanderbilt), Indira Lara Chatterji (Orléans), François Dahmani (Joseph Fourier), Tullia Dymarz (Yale), Rostislav Grigorchuk (Texas A&M), Vadim Kaimanovich (Ottawa), Ilya Kazachkov (Vanderbilt), Olga Kharlampovich, Volodymyr Nekrashevych (Texas A&M), Denis Osin (Vanderbilt), Denis E. Serbin, Pedro V. Silva (Porto), Tatiana Smirnova-Nagnibeda (Genève), Zoran Šunic (Texas A&M), Vladimir Trofimov (IMM, Ekaterinburg)
Number of participants: 53

The main goal of the workshop was to introduce major directions in Geometric Group Theory, which is now all about group actions on various spaces, in a manner accessible to graduate students working in the field, and to present some recent advances in these directions. In our opinion, this goal was reached and we would like to thank all the participants for their contributions to the unique atmosphere of the meeting. Self-similar and branch groups were one of the major topics discussed during the workshop. An introduction to the topic was given by Volodymyr Nekrashevych in his mini-course, where he defined self-similar and branch groups as groups of automorphisms of rooted trees (in his first lecture). The second and third lectures were devoted to iterated monodromy groups (which can be viewed as a subclass of self-similar groups), their connections with complex dynamics, and recent results on their properties.

Apart from the mini-course there were several talks on groups of automorphisms of rooted trees given by recognized specialists in this field. Let us first mention the talk of Rostislav Grigorchuk about actions of self-similar groups on the boundaries of rooted trees and the dynamics related to Schreier graphs of level stabilizers. Two talks could be considered as sequels of Grigorchuk's talk: the presentation of Tatiana Smirnova-Nagnibeda about asymptotical properties of group actions on rooted trees, and the talk by Zoran Šunic about the Hanoi Towers group, which is a particular example of a group acting on a rooted tree.

Another mini-course of the workshop was given by Mladen Bestvina on the topology and geometry of Outer space, which can be defined as a space of marked metric graphs modulo equivalence of markings by graph isometries. This space naturally arises in the study of automorphisms of free groups and this is now a classical topic in Geometric Group Theory. The third mini-course, given by Denis Osin, was devoted to a generalization of relative hyperbolicity based on the notion of hyperbolically embedded subgroups. In the course of the lectures it became obvious that this generalization is proper, in the sense that it enables one to prove results using hyperbolic techniques in many groups that are not relatively hyperbolic to any reasonable subgroups. It was stressed by the speaker that a substantial part of the theory of relatively hyperbolic groups can now be generalized in the new context.

The topic of actions on various "nice" spaces was always an effective way to study structural properties of the underlying groups. Some talks can be viewed from this perspective, for example the talk by Olga Kharlampovich on the structure of Λ-free groups and the talk of Montserrat Casals-Ruiz on limit groups of partially commutative groups. In the former case the underlying group acts freely on a Λ-tree, while in the latter case there is a faithful action on an asymptotic cone of a partially commutative group. Other talks relying implicitly on actions to study the structure include the presentations of François Dahmani on interval-exchange groups and of Indira Chatterji on groups acting on median spaces. Some results on the ergodic properties of groups were presented in the talk

of Vadim Kaimanovich (on the Hopf decomposition of the boundary action of a discrete group) and the talk of Denis Serbin (on the description of Poisson boundaries of $\mathbb{Z}^n$-free groups).

Of course, the various topics covered in the workshop talks go beyond the directions outlined above, because the theory of group actions (in its current state) is extremely rich. For example, the talks by Lisa Carbone on symmetries of infinite-dimensional Lie groups, of Tullia Dymarz on bi-Lipschitz vs. quasi-isometric equivalence for finitely generated groups, of Vladimir Trofimov on vertex-transitive groups of automorphisms of graphs, and of Pedro Silva on fixed points of endomorphisms made it possible not only to get familiar with the topics discussed but to see various facets of the field.

Workshop
Equations and First-Order Properties in Groups

October 11 – 15, 2010

Organizers:
Olga Kharlampovich (McGill), Alexei G. Miasnikov (Stevens Inst.), Ilya Kazachkov (Oxford), Vladimir Remeslennikov (Omsk State)
Speakers:
Montserrat Casals-Ruiz (Vanderbilt), François Dahmani (Joseph Fourier), Tara Davis (Vanderbilt), Volker Diekert (Stuttgart), Andrew Duncan (Newcastle, UK), Ilya Kazachkov, Olga Kharlampovich, Igor Lysenok (Steklov Inst.), Alexei G. Miasnikov, Abderezak Ould Houcine (Lyon 1), Chloé Perin (Strasbourg), Boris Plotkin (HUJI), Eugene Plotkin (Bar-Ilan), Alexander A. Razborov (Chicago), Vladimir N. Remeslennikov, Nikolay Romanovskiy (Sobolev Inst.), Mahmood Sohrabi (Montréal), Henry Wilton (Caltech)
Number of participants: 35

Hilbert's 10th problem asks whether there exists an algorithm to solve the Diophantine problem, i.e., to decide whether or not an equation with integer coefficients has an integer solution. This type of problem can be posed for arbitrary structures (rings, groups, etc.) and in a more general setting from the viewpoint of model theory (decidability of the universal/positive/elementary theory of a structure).

In the case of free groups, a famous problem posed by Tarski around 1945, and recently solved by Kharlampovich – Miasnikov and Sela, is to understand their elementary theory. The theory developed over the years to solve Tarski's problem has uncovered deep connections between model theory, geometry, and group theory. The study of first-order theories is closely related to the study of algebraic varieties and their projections. The workshop focused on methods and techniques in algebraic geometry over groups and other algebraic systems.

The workshop gathered 35 mathematicians from Australia, Canada, France, Germany, Israel, the United Kingdom, the USA, Russia, and Spain. It featured two mini-courses: one by Olga Kharlampovich and Alexei Miasnikov on the algebraic theory of equations in free groups and the other by Nikolai Romanovskiy on algebraic geometry over soluble groups. The theme of equations in groups was explored in the talks of Volker Diekert, Igor Lysenok, and Henry Wilton.

Another major theme of the conference was the so-called universal algebraic geometry. Recent progress in algebraic geometry over groups instigated a body of research whose goal is to carry over the results and techniques from classical algebraic geometry and algebraic geometry over groups to arbitrary algebraic structures (using the language of universal algebra, hence the name "universal algebraic geometry"). Two talks on the subject were given by the founders of universal algebraic geometry, Boris Plotkin and Vladimir Remeslennikov. Further, Montserrat Casals-Ruiz presented her results on universal completions of algebraic structures (a construction that plays the role of the ultrapower for the universal theory of a structure).

Finally we had several talks on first-order properties of groups. In his talk Mahmood Sohrabi presented a very fine classification of groups elementarily equivalent to a finitely generated nilpotent group. In their talks Chloé Perin and Abderezak Ould Houcine presented two independent proofs of the homogeneity of the free group, i.e., they showed that if two tuples of elements from the free group have the same type, then they are conjugate by an automorphism. The conference was nicely complemented by a series of lectures given by the Aisenstadt Chairholder Alexander Razborov, who among other things is well known for his work in the theory of equations in free groups.

Workshop
Statistical Methods for Meteorology and Climate Change

January 12 – 14, 2011

Sponsored by Hydro-Québec and the Ouranos consortium

Organizers and scientific committee:
Jean-François Angers (Montréal), Anne-Catherine Favre (Laval), Luc Perreault (IREQ), Richard L. Smith (UNC — Chapel Hill)

Speakers:
Jean-Noël Bacro (Montpellier 2), Jean-Jacques Boreux (Liège), Barbara Casati (Ouranos), Ramón de Elía (Ouranos), Petra Friederichs (Bonn), Reinhard Furrer (Zürich), Joël Guiot (CEREGE), René Laprise (UQAM), Bo Li (Purdue), James Merleau (IREQ), Philippe Naveau (LSCE), Luc Perreault (IREQ), Stephan R. Sain (UCAR), Francis Zwiers (Victoria)

Number of participants: 56

Le premier atelier du semestre thématique sur la statistique portait sur les méthodes statistiques appliquées à la météorologie et à l'analyse des changements climatiques. Il visait à rassembler les statisticiens, les météorologues et les climatologues pour des échanges sur de nouvelles approches en statistique et en probabilités consacrées à l'étude des changements climatiques. Les thèmes abordés durant l'atelier comprenaient notamment l'estimation de l'incertitude des projections climatiques, la configuration spatiale du climat, la reconstruction du climat à partir de la dendrochronologie, la modélisation des évènements climatiques extrêmes et le traitement des problèmes de non-stationnarité des chroniques hydrométéorologiques.

Cet atelier, d'une durée de trois jours, fut organisé de manière à maximiser les échanges scientifiques et techniques entre les participants. C'est pourquoi nous avons opté pour un nombre limité de conférences chaque jour (six conférences d'au moins 45 minutes chacune). Ce format a permis à chaque conférencier de donner suffisamment de détails techniques pour susciter de nombreux échanges scientifiques. L'atmosphère conviviale qui régnait durant l'atelier ne fut pas étrangère aux nombreuses interactions entre les différents participants. Une cinquantaine de chercheurs de différents domaines de recherche et provenant de plusieurs pays (une dizaine environ) ont fait de cet atelier un succès.

Workshop
Statistical Methods in HIV Research

April 14 – 15, 2011

Organizers:
Erica E. M. Moodie (McGill), David A. Stephens (McGill)

Speakers:
Bluma Brenner (Jewish General Hospital), Victor De Gruttola (Harvard), Joseph W. Hogan (Brown), James S. Koopman (Michigan), Zoe Moodie (SCHARP), Janet Raboud (Mount Sinai Hospital), Ethan Romero-Severson (Michigan), Peter Song (Michigan), David A. Stephens, Erik Volz (Michigan)

Number of participants: 37

HIV/AIDS continues to pose many methodological challenges in study design and statistical analysis, from investigations at the molecular level to clinical trials and observational epidemiologic studies. Ongoing development of novel statistical and modelling approaches is required to keep pace with the increasing volume of information from diverse sources, from the molecular level to the population level. The purpose of this interdisciplinary workshop was to provide an overview of quantitative problems and related methodology for junior researchers in the field, to review recent advances in statistical methods arising from real-world data from HIV studies, and to increase the profile of statistics for HIV in Montréal and in Canada.

The workshop opened on April 14 with an introduction to the history of the virology and epidemiology of HIV by Dr. Bluma Brenner of the McGill AIDS Centre. Dr. Brenner has been at the forefront of HIV research since the emergence of the disease in the early 1980s. The first day of the meeting included talks by senior HIV statisticians such as Victor DeGruttola (Chair of Biostatistics, Harvard School of Public Health) and Janet Raboud (one of the primary statisticians in HIV research in Canada). Topics included a variety of methodological challenges, from the selective use of a gold standard in resource-poor countries such as Kenya to challenges arising because of missing confounders and competing risks. The second day of the workshop covered challenges such as merging longitudinal cohorts, assessing correlates of protection in vaccine research, and phylogenetic analyses of sexual networks.

The workshop successfully brought together researchers from Statistics, Epidemiology, and Virology with a common interest in quantitative methods for diverse aspects of HIV research. Participants came from Canada and the United States and represented a range of career stages. The seminars presented were of exceptional quality and participants took advantage of the more intimate size of the meeting to exchange ideas. All invited speakers and many of the participants approached the organizers during the meeting to say how much they enjoyed the workshop. Many of the statisticians particularly noted that the insights provided by Dr. Brenner's questions and ideas following their presentations were of great use. In emails sent after the workshop, a participant stated that the workshop gave her "the opportunity to engage in thought-provoking discussions with several speakers" and another that he was very grateful to the CRM and in particular the workshop for the opportunity to expand his collaborations.

A special issue of the journal *Statistical Communications in Infectious Diseases* will be devoted to publishing research presented at the workshop or developed from the workshop.

Workshop
Computational Statistical Methods for Genomics and Systems Biology

April 18 – 22, 2011

Organizers:
Sandrine Dudoit (UC Berkeley), Raphael Gottardo (FHCRC), Jinko Graham (Simon Fraser), Aurélie Labbe (McGill), Fabrice Larribe (UQAM)

Speakers:
David Balding (Univ. Coll. London), Mark Beaumont (Bristol), Jennifer Bryan (UBC), Shelley B. Bull (Toronto), Peter Donnelly (Oxford), Sandrine Dudoit, Laurent Excoffier (Bern), Mayetri Gupta (Boston), Christopher C. Holmes (Oxford), Steve Horvath (UC Los Angeles), Christina Kendziorski (Wisconsin – Madison), Kun Liang (Wisconsin – Madison), Brad McNeney (Simon Fraser), Mary Sara McPeek (Chicago), Michael A. Newton (Wisconsin – Madison), Vincent Plagnol (Univ. Coll. London), Kenneth Rice (Washington), Sylvia Richardson (Imperial Coll.), Ingo Ruczinski (Johns Hopkins), Mark R. Segal (UC San Francisco), David A. Stephens (McGill), Matthew Stephens (Chicago), Donatello Telesca (UC Los Angeles), Elizabeth A. Thompson (Washington), Jon Wakefield (Washington), Ellen Wijsman (Washington)

Number of participants: 118

Cet atelier a duré 5 jours et rassemblé des conférenciers venant du Canada, des États-Unis et d'Europe. Tous les conférenciers sont reconnus comme étant des chefs de file dans le domaine de la génomique computationnelle. Leurs présentations furent donc, comme les organisateurs l'espéraient, d'un très haut calibre, et tous les commentaires des participants furent très positifs. En plus des présentations, chaque journée comporta une période de discussion à la fin de l'après-midi ; cette période était animée par un invité, qui résumait la journée dans un exposé d'une trentaine de minutes. Ces périodes de discussion furent très appréciées des participants, et les animateurs accomplirent un travail exceptionnel de synthèse et de critique. La réception « vin et fromages » coïncida avec une session d'affiches qui eut beaucoup de succès.

L'atelier fera l'objet d'un numéro spécial de la revue *Statistical Applications in Genetics and Molecular Biology*, dans lequel les conférenciers de l'atelier publieront les travaux présentés à Montréal. Le succès de l'atelier a incité plusieurs chercheurs montréalais à organiser en 2012 un atelier semblable, à l'échelle de Montréal, afin que tous les chercheurs travaillant dans ce domaine soient tenus au courant des travaux de leurs collègues.

Workshop
Statistical Issues in Forest Management

May 2 – 4, 2011

Sponsored by the Ministère des Ressources naturelles et de la Faune of Québec and the Laurentian Forestry Centre

Organizers:
Pierre Bernier (Canadian Forest Service), Gaston Joncas (Canadian Forest Service), Valerie LeMay (UBC), Eliot McIntire (Laval), Ronald E. McRoberts (USDA Forest Service), Jean Opsomer (Colorado State), Frédéric Raulier (Laval), Louis-Paul Rivest (Laval), Erkk O. Tomppo (Metla), Chhun-Huor Ung (Canadian Forest Service)

Speakers:
Bruce Borders (Georgia), Steve Cumming (Laval), Sophie D'Amours (Laval), Jean-Gabriel Élie (Ressources naturelles et Faune Québec), Andrew O. Finley (Michigan State), Mathieu Fortin (INRA), Timothy G. Gregoire (Yale), Juha Heikkinen (Metla), Annika Kangas

(Helsinki), Alain Leduc (UQAM), Valerie LeMay, Jean-Martin Lussier (Canadian Forest Service), Ronald E. McRoberts, Juha Metsaranta (Canadian Forest Service), Gretchen Moisen (USDA Forest Service), Jean Opsomer, Margaret Penner (Forest Analysis Ltd.), Chhun-Huor Ung

Number of participants: 72

L'atelier a débuté par une présentation de la méthodologie statistique utilisée dans le cadre des inventaires forestiers. Il s'agit essentiellement d'un problème d'extrapolation, consistant à estimer les caractéristiques forestières d'un territoire à partir d'un échantillon restreint de placettes établies. T. Gregoire, J. Opsomer et J. Heikinnen mirent l'accent sur l'inférence par rapport au plan de sondage. R. McRoberts a suggéré une approche par le modèle pour une méthode non paramétrique d'estimation, basée sur les plus proches voisins. Finalement A. Finley a montré comment ajuster un modèle qui prend en compte la structure spatiale des données à l'aide de méthodes bayésiennes qui s'appuient sur des techniques de simulation Monte-Carlo.

Les présentations d'inventaires, par G. Élie, G. Moisen et M. Penner, ont fait ressortir la nécessité de produire des estimations à différentes échelles. La méthodologie statistique est bien développée pour le calcul d'estimations agrégées pour de grandes unités géographiques. Le problème est plus complexe si on s'intéresse à un petit territoire qui contient peu de placettes établies, ou même à un simple polygone forestier qui ne contient aucune placette. En effet, ces estimations doivent faire intervenir un modèle statistique et le calcul de leur précision pose des défis importants. Les échanges ont fait ressortir que l'approche bayésienne est particulièrement prometteuse.

En plus d'estimer la ressource ligneuse, un des objectifs de l'inventaire forestier est de prédire la croissance des arbres et d'évaluer l'impact de différents scénarios d'exploitation. La deuxième journée de l'atelier a porté sur ce thème. V. Lemay et M. Fortin ont traité de la prédiction de la croissance. Si on utilise un modèle de croissance par arbres, il faut au préalable « imputer » une liste d'arbres dans un polygone forestier. V. Lemay a étudié ce problème d'imputation. La conférence de M. Fortin a fait ressortir les difficultés d'utiliser des modèles de croissance sur un horizon relativement long. En effet, ces modèles atteignent en général une valeur stationnaire après un certain nombre d'années, peu importe les valeurs de départ. Ils donnent la fausse image d'une forêt très homogène.

A. Leduc et S. Cumming ont traité de la modélisation des perturbations de la forêt, causées par exemple par les feux de forêt, et de leur intégration à l'évaluation de scénarios d'exploitation. Finalement, C.-H. Ung et J.-M. Lussier ont présenté une modélisation intégrée pour un plan d'exploitation d'une petite forêt, basée sur une table de peuplement construite à partir de données d'inventaire, sur un modèle de croissance et sur des hypothèses concernant la valeur du bois ; des algorithmes de recherche opérationnelle permettent alors de mettre en lumière des scénarios d'exploitation optimaux sous certaines contraintes de préservation du milieu.

La troisième journée a débuté par une présentation des problèmes méthodologiques associés à l'établissement d'un bilan annuel de la capture ou de la dissémination du carbone par les forêts canadiennes. J. Metsaranta a souligné les incertitudes associées à ce calcul et présenté les modèles probabilistes utilisés pour les quantifier. Pendant cette journée, une approche économique à l'exploitation de la forêt a aussi été présentée. Il y a un coût associé à la réalisation d'un inventaire ; B. Borders a présenté une étude qui mesurait le coût de ne pas faire d'inventaires. En effet, ceci entraîne une exploitation non optimale de la ressource et donc une perte de revenus.

A. Kangas a suggéré un modèle économique qui permet d'évaluer, en termes monétaires, différentes composantes d'un scénario d'exploitation. Elle a ainsi associé une valeur à un modèle de croissance et au renouvellement fréquent de tels modèles pour bien évaluer la ressource forestière. S. D'Amours a terminé l'atelier en présentant la méthodologie utilisée par le réseau FORAC pour valoriser la production forestière au Canada. Elle a mis l'accent sur l'incertitude associée à l'établissement de scénarios d'exploitation et sur les approches utilisées pour en tenir compte.

Les participants ont apprécié la structure linéaire de l'atelier, qui commença par les inventaires forestiers pour l'estimation de la ressource ligneuse et traita ensuite de l'utilisation des données d'inventaire à des fins d'exploitation et de planification. Une des conclusions de cet atelier est que des développements méthodologiques importants sont nécessaires pour établir des bilans forestiers cohérents, à différentes échelles géographiques, et pour incorporer l'incertitude associée à ces bilans dans les prédictions de croissance et l'évaluation des scénarios d'exploitation.

Workshop
Causal Inference in Health Research

May 9 – 13, 2011
Sponsored by the MITACS network and McGill

Main organizer: Erica E. M. Moodie (McGill)
Other organizers:
Jennifer Hill (NYU), Jay S. Kaufman (McGill), Lawrence McCandless (Simon Fraser), Robert Platt (McGill), Bryan E. Shepherd (Vanderbilt)
Speakers:
Joshua Angrist (MIT), Lauren Cain (Harvard), Bibhas Chakraborty (Columbia), Mike Daniels (Florida), Dean Follmann (NIAID), Sara Geneletti (LSE), Els Goetghebeur (Gent), Tom Green (Utah), Paul Gustafson (UBC), M. Elizabeth Halloran (Washington), Sebastien Haneuse (Harvard), Miguel Hernan (Harvard), Jennifer Hill, Joseph W. Hogan (Brown), Michael Hudgens (UNC — Chapel Hill), Dan Jackson (Cambridge), Nicholas Jewell (UC Berkeley), Marshall Joffe (Pennsylvania), Timothy L. Lash (Aarhus), Rich MacLehose (Minnesota), Lawrence McCandless, Robin Mitra (Southampton), Susan Murphy (Michigan), Thomas S. Richardson (Washington), James Robins (Harvard), Andrea Rotnitzky (Harvard), Jason Roy (Pennsylvania), Daniel O. Scharfstein (Johns Hopkins), Jonathan Schildcrout (Vanderbilt), Bryan E. Shepherd, Dylan Small (Pennsylvania), Elizabeth Stuart (Johns Hopkins), Eric J. Tchetgen Tchetgen (Harvard), Tyler VanderWeele (Harvard)
Number of participants: 124

Causal inference attempts to uncover the structure of the data and eliminate all noncausative explanations for an observed association. The goal of most, if not all, statistical inference is to uncover causal relationships, but it is not in general possible to infer causality from standard statistical inference procedures, merely that the observed association between two variables is not due to chance. The need for causal inference procedures is apparent in many fields, but is perhaps most pressing in the field of health research, where quantifying the efficacy of new therapies, or uncovering the etiology of diseases, is often rendered complicated due to difficulties inherent in observational studies. Even in experimental studies, partial compliance with treatment regimens can compromise a well-designed experiment. The complexity of models, and the corresponding inference procedures, is heightened in the context of longitudinal studies, where time-dependent confounding may be present.

The purpose of this workshop was threefold: first, to review recent advances in the causal inferences in statistics; secondly, to bring together inter-disciplinary researchers including those from quantitative but non-statistical fields who work on causal inference methodology so as to share approaches and knowledge in order to advance research in the health sciences; and finally, to increase the profile of causal inference amongst statisticians in Canada. The workshop opened on May 9 with five speakers on a variety of topics, and following lunch there was a poster session where research was presented by researchers from a range of career stages. Each of the following four days had a theme: time-varying treatments and optimal treatment strategies; randomized trials and vaccine efficacy; multiple bias modelling; and missing data methods. There were eight speakers on each of these days, with the exception of Wednesday, which had only six because of the Aisenstadt lecture in the afternoon.

The workshop successfully brought together researchers from Statistics/Biostatistics, Epidemiology, and Econometrics with a common interest in causal inference. Participants came from universities and institutions in nine countries: Canada, the United States, England, Denmark, Belgium, Australia, Algeria, France, and Cameroon. The lectures were of an exceptionally high quality. Although there were many participants, lively discussions followed most of the presentations and the coffee and lunch breaks provided ample opportunity for informal interactions. Many participants approached the organizers during the meeting to say how much they enjoyed the workshop. In email messages sent after the workshop, some of them mentioned potential collaborations arising from the workshop and wrote that the lessons learned would help them improve their research. A special issue of the *International Journal of Biostatistics* will be devoted to publishing research presented at or arising from the workshop.

Workshop
Analysis of Survival and Event History Data

May 16 – 19, 2011
Sponsored by the CRM and the Fields Institute

Organizers
Richard Cook (Waterloo), Jerry Lawless (Waterloo)

Speakers:
Rebecca Betensky (Harvard), Ornulf Borgan (Oslo), Tianxi Cai (Harvard), Nilanjan Chatterjee (National Cancer Institute), Stephen Cole (UNC — Chapel Hill), Somnath Datta (Louisville), Peter J. Diggle (Lancaster), Patrick Heagerty (Washington), Joseph W. Hogan (Brown), Li Hsu (FHCRC), Joseph Ibrahim (UNC — Chapel Hill), John D. Kalbfleisch (Michigan), Yi Li (Dana-Farber Cancer Institute), Danyu Lin (UNC — Chapel Hill), Roderick J. Little (Michigan), Lyle J. Palmer (Ontario Institute for Cancer Research), Ross Prentice (FHCRC), James Robins (Harvard), Douglas E. Schaubel (Michigan), Richard Simon (National Cancer Institute), Donna Spiegelman (Harvard), Jeremy M. G. Taylor (Michigan), Alice S. Whittemore (Stanford), Robert Wolfe (Michigan)
Number of participants: 69

The participants of the Workshop on Analysis of Survival and Event History Data came from Canada, the United States, the United Kingdom, France, and Norway. The objectives of the workshop were to bring together leading researchers in survival and event history analysis to discuss recent advances, current challenges, and areas requiring new methodology and theory. Many of the world's top researchers in the field presented talks and a wide range of important topics were addressed. Much of the existing theory and methodology for survival and event history analysis was developed over the past 50 years in response to scientific problems arising in fields such as economics, engineering, medicine, public health, and the social sciences. Likewise, new needs and challenges arise constantly from these areas and from newer fields such as genetics and information technology. Day 1 of the workshop was designed to profile high-impact studies in important areas of public health and biomedicine. Subsequent sessions on Days 2 to 4 focused more on specific statistical issues pertaining to design, modelling, and analysis, discussed in a wide range of scientific contexts.

Keynote presentations on Day 1 were given by Ross Prentice, Jack Kalbfleisch and Robert Wolfe, Danyu Lin, and Lyle Palmer. Prentice discussed challenges arising from the Women's Health Initiative, which includes both randomized and observational cohort studies on health risks in postmenopausal women. As a Principal Investigator of this extremely important study, he has developed new methodology and published numerous articles on new statistical challenges that have arisen. The talk highlighted current needs related to the assessment of high-dimensional biomarkers, the monitoring and analysis of multiple outcomes, and the assessment of therapeutic or dietary interventions, all of which must be studied in the presence of imperfect measurement processes.

The talk by Kalbfleisch and Wolfe discussed methods for monitoring outcomes associated with medical procedures. For example, it is commonplace to monitor outcomes in organ transplant recipients, patients receiving knee or hip replacements, or patients undergoing cardiac surgery. This is done to assess the effectiveness of strategies for managing waiting lists, intervention effects, and the quality of care provided by different facilities, each of which is included into cost-benefit analyses. The speakers focused on the important problem of assessing facilities while making adjustment for the varying distribution of risk factors in individuals treated by different facilities. Danyu Lin spoke next on challenges in survival analysis arising from genetic studies in which data are missing for many individuals. This occurs when only a portion of the individuals involved can be genotyped because of the cost involved, and because individuals are genotyped only at specific locations on their genome.

Finally, Lyle Palmer spoke about the Ontario Health Study, a recent initiative that is attempting to build a large voluntary cohort of individuals to be followed from recruitment over their remaining lifetimes, and whose information can be linked to administrative medical records. This raises many new challenges for analysis because of the potential richness of the data, but also because it will be necessary to assess potential biases arising from the voluntary nature of study participation and the accuracy of different types of information to be requested. Day 1 concluded with the second Aisenstadt Lecture from the Aisenstadt Chairholder James Robins, followed by a cocktail reception. A discussion of his talk is given earlier in the current section.

The morning session on Day 2 was devoted to the topic of joint models for longitudinal and event history data. This area is increasingly important as longitudinal life history studies collect more and more data on time-varying variables along with data on specified events. Biomarker data, disease risk measures, and other time-varying covariates, for example, are routinely collected on individuals, in addition to data on events such as disease onset or recurrence. Talks in this session were

given by Peter Diggle, Joseph Hogan, and Jeremy Taylor. Between them they discussed problems arising in the treatment of persons suffering from renal disease, prostate cancer, and infection with the Human Immunodeficiency Virus (HIV). The challenges highlighted included the need to deal with very heterogeneous longitudinal marker profiles, the fact that these markers are measured only intermittently on each individual, and the difficulty of assessing the relationship between treatment effects on marker values and treatment effects on clinical events.

The afternoon session on Day 2 concerned problems associated with incomplete or mismeasured covariates that are potentially informative for health-related events. Many examples of this were given in the Day 1 talks. Rod Little discussed likelihood and Bayes estimation methods for incomplete data and Joe Ibrahim presented diagnostic methods for assessing case influence and model fit in the presence of missing data. Donna Spiegelman discussed risk set calibration methods for handling measurement error, motivated by problems in the measurement of dietary and environmental risk factors for human health.

The two sessions on Day 3 dealt with survival time models. The morning session focused on predictive models for lifetime events, which are widely used to provide risks (probabilities) of disease occurrence according to an individual's age and other risk factors. Tianxi Cai discussed challenges arising from the availability of new biological and genetic markers and illustrated new methodology on a risk prediction model for rheumatoid arthritis. Richard Simon discussed the use of very high-dimensional genomic markers and the evaluation of survival risk models based on them. Patrick Heagerty presented graphical and analytical methods for characterizing the predictive power of biomarkers using measures related to the area under ROC curves.

The afternoon session focused on models and methods for multivariate lifetime data. Rebecca Betensky discussed ways of handling lifetime variables, truncated because of constraints imposed by the sampling or observation of individuals in a study. Li Hsu considered the analysis of studies in which lifetimes for related family members are collected. Yi Li discussed the analysis of multivariate lifetime data when the number of covariates exceeds the number of individuals or units in a study; this situation has become very common with the collection of large amounts of genomic data on relatively small numbers of individuals, as discussed earlier in the day by Richard Simon.

The morning session on Day 4 considered the topic of response-biased sampling, which is an important feature in many epidemiology studies in which genetic factors or other expensive measurements can be taken on only a subset of individuals of interest. Ornulf Borgan gave a comprehensive overview of nested case-control and case-cohort study designs and the associated estimation methodology. Nilanjan Chatterjee reviewed recent developments for multivariate analysis of disease onset times for families with high-risk genetic variants. Alice Whittemore discussed two-stage studies for validating individual risk models and illustrated the methodology on models for ovarian cancer.

The final session on Thursday afternoon addressed issues in the analysis of complex life history processes. Many examples of the complexity of processes associated with health and biomedicine had been seen in earlier talks and a nice bookend to the workshop was provided by the talks in this session. Stephen Cole considered the increasingly popular marginal structural models approach to estimation, drawing for discussion on the effects of antiretroviral therapy on the incidence of AIDS and death in HIV-infected persons. Somnath Datta showed how to estimate various features of a multistate model nonparametrically. Such models are widely used in modelling and analyzing states associated with health, employment, parenthood, education, and other aspects of human lives. Doug Schaubel ended with an excellent talk on estimating the effect of a time-varying factor when censoring (i.e., end of follow-up) of an individual cannot be ignored. He illustrated the issues and proposed some methodology by considering the selection of persons with severe liver disease on a waiting list for a liver transplant.

Feedback on the workshop has been extremely positive, with comments from several people that it was one of the most informative meetings that they had ever attended. Graduate students, postdoctoral fellows, and more senior researchers were all able to learn a great deal about the methodology, theory, and emerging challenges in this key area of statistical science.

Workshop
Copula Models and Dependence
June 6 – 9, 2011

Organizers:
Elif Acar (McGill), Debbie Dupuis (HEC Montréal), Christian Genest (McGill), Johanna Nešlehová (McGill), Jean-François Plante (HEC Montréal), Jean-François Quessy (UQTR), Bruno Rémillard (HEC Montréal)
Speakers:
Kjersti Aas (Norwegian Computing Centre), V. Radu Craiu (Toronto), Holger Dette (Ruhr-Universität Bochum), Michael Falk (Würzburg), Yanqin Fan (Vanderbilt), Jean-David Fermanian (ENSAE), Anne-Laure Fougères (Lyon 1), Dominique Guégan (Paris 1), Simon Guillotte (UQAM), Lajmi Lakhal Chaieb (Laval), Johanna Nešlehová, Andrew Patton (Duke), Bruno Rémillard, Matthias Scherer (TU München), Johan Segers (UC Louvain), Noël Veraverbeke (Hasselt), Weijing Wang (NCTU)
Number of participants: 53

Le dernier atelier du semestre thématique a attiré des participants en provenance d'une dizaine de pays d'Amérique, d'Europe et d'Asie. L'évènement a été organisé par un collectif de statisticiens québécois actifs dans le domaine de la recherche sur les copules et la modélisation de la dépendance dans de grands ensembles de données multidimensionnelles. L'étude de la dépendance entre variables aléatoires est aussi ancienne que la statistique, mais l'approche par copules, qui s'est développée au cours des 25 dernières années, a jeté un éclairage nouveau sur la nature de la dépendance stochastique. Elle a surtout pavé la voie à la construction de nouveaux modèles qui facilitent la prise en compte de ce phénomène. Pendant les dix dernières années, la modélisation par copules a connu un essor fulgurant et elle est dorénavant largement employée dans des domaines tels que l'actuariat, la finance ou l'hydrologie, où l'effet conjugué de risques dépendants peut avoir de lourdes conséquences financières ou environnementales.

L'objectif de cet atelier était de faire le point sur les méthodes d'inférence statistique les mieux adaptées à la modélisation par copules et d'identifier, de concert avec des praticiens, les problématiques soulevées par l'emploi de cette méthodologie dans de nouveaux contextes. Le programme comportait 16 exposés en plénière, à raison de quatre par jour, regroupés par problématique : données vectorielles de grande dimension, séries chronologiques, valeurs extrêmes multivariées et données incomplètes.

Des conférences de synthèse de deux heures ont été prononcées par Andrew Patton, Johan Segers et Noël Veraverbeke, et ont été suivies de tables rondes. Treize exposés d'une heure sur des thèmes d'actualité ont aussi été donnés par Kjersti Aas, Lajmi Lakhal Chaieb, Radu Craiu, Holger Dette, Michael Falk, Jean-David Fermanian, Anne-Laure Fougères, Dominique Guégan, Simon Guillotte, Johanna Nešlehová, Bruno Rémillard, Matthias Scherer et Weijing Wang. Comme pour les autres ateliers, de fréquentes pauses avaient été prévues pour faciliter l'interaction entre chercheurs et étudiants. La participation a été élevée en tout temps, y compris lors de la séance d'affichage qui avait été intégrée à un coquetel dînatoire le lundi, en fin de journée. Un repas organisé au restaurant « Le Cercle » de HEC Montréal, le mercredi 8 juin, a aussi été fort apprécié. Les actes de l'atelier seront publiés l'an prochain dans un numéro spécial du *Journal of Multivariate Analysis* dont la direction a été confiée à Christian Genest.

Past Thematic Programs

The Centre de recherches mathématiques has organized thematic activities every year since 1993. From 1987 to 1992, the CRM organized various types of activities, including special semesters, concentration periods, and thematic activities. Here is a list of the main activities organized by the CRM since 1987.

January–April 2010 Number Theory as Experimental and Applied Science

August–December 2009 Mathematical Problems in Imaging Science

2008–2009 Joint CRM–PIMS Program: Challenges and Perspectives in Probability

2008–2009 Probabilistic Methods in Mathematical Physics

January–June 2008 Dynamical Systems and Evolution Equations

June–December 2007 Applied Dynamical Systems

January–June 2007 Recent Advances in Combinatorics

June–December 2006 Combinatorial Optimization

2005–2006 Analysis in Number Theory

2004–2005 The Mathematics of Stochastic and Multiscale Modelling

2003–2004 Geometric and Spectral Analysis

2002–2003 Mathematics in Computer Science

2001–2002 Groups and Geometry

2000–2001 Mathematical Methods in Biology and Medicine

1999–2000 Mathematical Physics

1998–1999 Number Theory and Arithmetic Geometry

1997–1998 Statistics

1996–1997 Combinatorics and Group Theory

1995–1996 Applied and Numerical Analysis

1994–1995 Geometry and Topology

1993–1994 Dynamical Systems and Applications

1992 Probability and Stochastic Control (special semester)

1991–1992 Automorphic Forms in Number Theory

1991 Operator Algebras (special semester)

1990 Nonlinear PDEs and Applications (concentration period)

1988 Shimura Varieties (special semester)

1987 Quantum Field Theory (special semester)

1987–1988 Fractals: Theory and Application

1987 Structural Rigidity (special semester)

General Program

The CRM's general program funds a wide variety of scientific events, both on the premises of the CRM and elsewhere in Canada. Whether it be for specialized workshops attended by a small number of researchers or large meetings attended by hundreds of participants, the general program promotes research in the mathematical sciences at all levels. The program is quite flexible, allowing projects to be considered as they arise. *The reports are presented in the language in which they were submitted.*

CRM activities

Summer School
Séminaire de mathématiques supérieures
Advanced School in Quantum Information Processing and Quantum Cryptography

June 21 – July 2, 2010, CRM

Sponsored by NATO, the CRM, the ISM, and the Department of Mathematics and Statistics of the Montréal

Organizers:

Daniel Gottesman (Perimeter Inst.), Julia Kempe (Tel Aviv), Christiane Rousseau (Montréal), Alain Tapp (Montréal)

Conférenciers:

Scott Aaronson (MIT), Gilles Brassard (Montréal), Richard Cleve (Waterloo), Ronald de Wolf (CWI), Daniel Gottesman, Patrick Hayden (McGill), Esther Hänggi (ETH Zürich), Raymond Laflamme (Perimeter Inst. & Waterloo), Renato Renner (ETH Zürich), Barry Sanders (Calgary), Miklos Santha (Paris-Sud), Alain Tapp, Barbara Terhal (IBM Res.), John Watrous (Waterloo), Stefan Wolf (ETH Zürich)

Number of participants: 75

L'école d'été qui eut lieu dans les locaux de l'Université de Montréal du 21 juin au 2 juillet fut un grand succès. Nous eûmes le plaisir d'accueillir près de 75 participants provenant de toutes les parties du monde (Canada, États-Unis, France, Royaume-Uni, Norvège, Algérie, Israël, Jordanie, Maroc, Tunisie, Arménie, Albanie, Autriche, Suisse, Ukraine, Corée du sud, Mexique et Singapour). La qualité des conférences était absolument exceptionnelle. Les conférenciers qui furent invités à l'école d'été sont tous des chercheurs de très haut calibre et ont donné des preuves de leurs qualités pédagogiques remarquables. Voici la liste des mini-cours donnés pendant le séminaire de mathématiques supérieures.

- *Quantum Complexity Theory* (S. Aaronson)
- *Non-QKD Cryptography* (G. Brassard)
- *Quantum Nonlocality and Communication Complexity* (R. Cleve)
- *Quantum Computing as a Proof Tool* (R. de Wolf)
- *Proving the Threshold Theorem for Fault-Tolerant Quantum Computation* (D. Gottesman)
- *Device-Independent Cryptography* (E. Hänggi et S. Wolf)
- *Decoupling*: *A Building Block for Quantum Information Theory* (P. Hayden)
- *NMR Quantum Computer* (R. Laflamme)
- *Security Proofs in Quantum Cryptography* (R. Renner)
- *Implementations of Quantum Information* (B. Sanders)
- *Quantum Walks and Algorithms* (M. Santha)
- *Quantum Algorithms and the Mathematics of Quantum Information Processing* (A. Tapp)
- *Hamiltonian Problems in Quantum Complexity* (B. Terhal)
- *Semidefinite Programming in Quantum Computation* (J. Watrous)

Non seulement les participants provenaient de lieux géographiques très variées, mais leurs formation étaient assez diversifiées (mathématiques, informatique, physique et ingénierie). Des sujets très diversifiés avec des niveaux de difficulté variables ont contribué à faire du SMS une expérience formatrice pour chacun. Il est à noter que le style de présentation variait beaucoup d'un mini-cours à l'autre. Par exemple, Renato Renner a utilisé ses trois heures pour présenter au tableau noir une preuve très détaillée de la sécurité de la distribution quantique de clés (QKD en anglais) et Barry Sanders a entre autres présenté des vidéos illustrant un point de vue artistique sur le fonctionnement d'un ordinateur quantique.

Ces deux semaines intenses ont aussi été l'occasion pour plusieurs participants de faire des rencontres stimulantes et d'établir des contacts. Plusieurs d'entre eux ont tissé des liens avec des chercheurs provenant d'autres institutions et les conférenciers ont aussi profité de cette rencontre pour travailler ensemble sur différents projets communs.

Tenth International Conference on Mathematics of Program Construction (MPC 2010)

June 21 – 23, 2010, Manoir Saint-Castin (Québec)
Sponsored by the CRM and the Faculty of Sciences and Engineering of Laval

Organizers:
Claude Bolduc (Laval), Jules Desharnais (Laval), Béchir Ktari (Laval)
Invited speakers:
Roland Backhouse (Nottingham), Stephan Merz (INRIA Nancy)
Other speakers:
Eerke Boiten (Kent), Yifeng Chen (Peking), Nils Anders Danielsson (Nottingham), Brijesh Dongol (Queensland), Steve E. Dunne (Teesside), João F. Ferreira (Nottingham), Walter Guttmann (Sheffield), Ralf Hinze (Oxford), Piotr Kosiuczenko (Leicester), Andres Löh (Utrecht), Hugo Daniel Macedo (Minho), Hugo Pacheco (Minho), Peter Pepper (TU Berlin), Florence Plateau (Paris-Sud), Jan Rutten (CWI), Josep Silva (UPV), Georg Struth (Sheffield), Bogdan Tofan (Augsburg), Meng Wang (Oxford)
Number of participants: 46

MPC 2010 a eu lieu au Manoir Saint-Castin, à Lac-Beauport, en banlieue de Québec. Le programme a consisté de deux présentations faites par des conférenciers invités, de 19 présentations d'articles choisis parmi 37 à la suite d'un processus d'évaluation rigoureux, et d'un banquet suivi d'une visite du Vieux-Québec. Le congrès MPC a précédé le congrès AMAST 2010 (13th International Conference on Algebraic Methodology And Software Technology), dont on trouvera un compte rendu ci-dessous. Les deux congrès ont des buts similaires, mais ceux d'AMAST sont plus généraux alors que MPC se concentre principalement sur la construction de programmes. Sur les 46 participants, 22 ont participé aux deux congrès.

Les congrès de la série MPC visent à promouvoir le développement de principes et de techniques mathématiques utiles pour la construction des logiciels et des systèmes informatiques. Les présentations ont porté sur la construction et la vérification des programmes, le raffinement des spécifications, la sémantique des langages de programmation, les algèbres de processus, les théories de la programmation, les systèmes de types, les structures mathématiques utiles et l'automatisation de certaines démarches. Le programme détaillé de MPC 2010 se trouve à l'adresse http://mpc-amast2010.fsg.ulaval.ca/mpc/programme.html.

Lors du banquet, une plaque souvenir a été remise à Roland Backhouse, conférencier invité et l'un des deux initiateurs de la série des congrès MPC, afin de le remercier et de commémorer cette 10e édition de MPC. Les comptes rendus de MPC 2010 constituent le volume 6120 des Lecture Notes in Computer Science de Springer (http://www.springerlink.com/content/978-3-642-13320-6/). Les auteurs des meilleurs articles ont reçu une invitation à soumettre une version plus élaborée de leur article à la revue *Science of Computer Programming*. De nombreux participants ont souligné la qualité de l'organisation et la beauté du site choisi.

Parmi les retombées de MPC 2010, mentionnons les éléments suivants :

- la mise en évidence des progrès dans le développement des mathématiques de la construction de programmes,
- la promotion d'outils facilitant l'automatisation des méthodes,
- l'intégration à la communauté MPC de nouveaux chercheurs (notons que cinq étudiants de doctorat ou stagiaires postdoctoraux ont fait des présentations),
- la possibilité offerte à cinq étudiants ou étudiantes de l'Université Laval de participer à un congrès international près de chez eux,
- le transfert de certaines méthodes au monde de l'entreprise (à moyen terme) et
- la promotion de la ville de Québec comme lieu de travail ou d'étude.

Thirteenth International Conference on Algebraic Methodology and Software Technology (AMAST 2010)

June 23 – 26, 2010, Manoir Saint-Castin (Québec)
Sponsored by the CRM and the Faculty of Sciences and Engineering of Laval

Organizers:
Claude Bolduc (Laval), Jules Desharnais (Laval), Béchir Ktari (Laval)
Invited speakers:
Jane Hillston (Edinburgh), Catuscia Palamidessi (INRIA Saclay)
Other speakers:
Claude Bolduc, Linda Brodo (Sassari), Raul Gutiérrez (UPV), Ralf Hinze (Oxford), Ekaterina Komen-

dantskaya (Dundee), Grigore Rosu (UIUC), Adrián Riesco (Complutense), M. Carmen Ruiz Delgado (Castilla-La Mancha), Mehrnoosh Sadrzadeh (Oxford), Mohamed Nassim Seghir (Freiburg, Germany), Michel Sintzoff (UC Louvain), Julien Tesson (Orléans)
Number of participants: 34

AMAST 2010 était la treizième édition de la série de congrès *International Conference on Algebraic Methodology and Software Technology*. Les congrès MPC et AMAST ont lieu tous les deux ans. En 2008, ils ont eu lieu dans des endroits différents, mais en 2010 les deux congrès ont eu lieu au Manoir St-Castin, en banlieue de Québec. Parmi les 34 participants d'AMAST 2010, 22 ont participé aussi à MPC 2010. Le programme d'AMAST 2010 a consisté de deux présentations faites par des conférencières invitées, de 12 présentations d'articles choisis parmi 30 à la suite d'un processus d'évaluation rigoureux, et d'une visite du site traditionnel huron de Wendake.

Le but principal des congrès AMAST est de promouvoir la recherche visant à donner une base mathématique solide aux technologies de l'information, afin d'assurer de manière démontrable la correction, la sécurité, la portabilité et l'évolution des systèmes logiciels. Les présentations ont porté sur la vérification des programmes et en particulier des propriétés de sécurité, les algèbres de processus, les systèmes de types et les structures algébriques utiles. Deux des présentations ont consisté de démonstrations de systèmes informatiques mettant en oeuvre certaines méthodes formelles. Le programme détaillé se trouve à l'adresse http://mpc-amast2010.fsg.ulaval.ca/amast/programme.html.

On doit souligner une participation féminine importante pour un congrès d'informatique, puisque sur les 14 présentations, 6 présentations (dont deux par les conférencières invitées) ont été faites par des femmes. Les comptes rendus de MPC 2010 constituent le volume 6486 des Lecture Notes in Computer Science de Springer (http://www.springerlink.com/content/978-3-642-17795-8/). Le congrès AMAST 2010 a permis de mettre en évidence les progrès dans les méthodes algébriques pour le développement des logiciels. Il a aussi permis de promouvoir des outils facilitant l'automatisation des méthodes et offert à des étudiants ou stagiaires postdoctoraux la possibilité de participer à un congrès international important. En particulier, six étudiants de doctorat ou stagiaires postdoctoraux ont fait des présentations pendant le congrès AMAST 2010.

Conference
Strong and Electroweak Matter 2010

June 29 — July 2, 2010
Sponsored by the Department of Physics of McGill, the Perimeter Inst., the Institute of Particle Physics, the Canadian Institute of Nuclear Physics, the CRM, and the Mathematical Physics Laboratory

International Advisory Committee:
Peter Arnold (Virginia), Jürgen Berges (TU Darmstadt), Wilfried Buchmüller (Hamburg), Zoltán Fodor (Wuppertal), Mark Hindmarsh (Brighton), Edmond Iancu (CEA/Saclay), Frithjof Karsch (Brookhaven Natl. Lab.), Dmitri Kharzeev (Brookhaven Natl. Lab.), Edwin Laermann (Bielefeld), Mikko Laine (Bielefeld), Cristina Manuel (UA Barcelona), Anton Rebhan (TU Wien), Kari Rummukainen (Oulu), Mikhail Shaposhnikov (EPFL), Edward Shuryak (Stony Brook), Laurence Yaffe (Washington)
Local Organizing Committee (McGill):
Robert Brandenberger, Jim Cline, Keshav Dasgupta, Charles Gale, Sangyong Jeon, Alex Maloney, Guy Moore, Alejandra Castro, Andrew Frey, Omid Saremi, Bjoern Schenke, Marcus Tassler, Bret Underwood
Speakers:
Gert Aarts (Swansea), Yukinao Akamatsu (Tokyo), Jens Andersen (NTNU), Christiana Athanasiou (MIT), Szabolcs Borsányi (Wuppertal), Margaret Carrington (Brandon), Paul Chesler (MIT), Francesco D'Eramo (MIT), Daniel Fernandez-Fraile (Frankfurt am Main), Zoltán Fodor, Mathias Garny (TU München), Jacopo Ghiglieri (TU München), Andreas Hohenegger (MPI Kernphysik), Juhee Hong (Stony Brook), Pasi Huovinen (Frankfurt am Main), Joseph Kapusta (Minnesota), Frithjof Karsch, Volodymyr Konchakovski (Gießen), Chris Kouvaris (ULB), Aleksi Kurkela (ETH Zürich), Roy Lacey (Stony Brook), Olena Linnyk (Frankfurt am Main), Yacine Mehtar-Tani (Santiago de Compostela), Akihiko Monnai (Tokyo), Swagato Mukherjee (Brookhaven Natl. Lab.), Joyce Myers (Swansea), Rob Myers (Perimeter Inst.), Marco Panero (ETH Zürich), Maxim Pospelov (Victoria & Perimeter Inst.), Anton Rebhan, Paul Romatschke (Frankfurt am Main), Thomas Schaefer (NC State), Jürgen Schaffner-Bielich (Heidelberg), Andreas Schmitt (TU Wien), Geraldine Servant (CERN & CEA/Saclay), Mikhail Shaposhnikov, Igor Shovkovy (Arizona State), Derek Teaney (Stony

Brook), Anders Tranberg (Oulu), Kimmo Tuominen (Southern Denmark), Tanmay Vachaspati (Case Western Reserve), Mikko Vepsäläinen (Helsinki), Sergei Voloshin (Wayne State), Aleksi Vuorinen (Bielefeld)
Number of participants: 117

This conference is part of a series of conferences held every two years. It drew 80 external participants and about 35 local ones, including professors, postdoctoral fellows, and students from institutions in 20 different countries. In total there were 15 invited speakers (each of which gave a 45-minute research talk) and 29 researchers who made contributed presentations (28 of which lasted for 30 minutes and one lasted 20 minutes). Also 20 posters were on display during a poster session that took place on the evening of July 1st. Here are some topics covered by the conference.

- The phase diagram and equation of state of quantum chromodynamics (QCD).
- Methods to study dynamics for systems far from equilibrium.
- Non-equilibrium dynamics in the early universe.
- Properties of matter created in heavy-ion collisions.
- Dynamics of dense nuclear matter.
- Holographic models of strongly coupled matter.

One of the highlights of the conference was the presentation of Rob Myers, who showed how the celebrated Viscosity Bound is violated and what its replacement might be. Another highlight was the talk by Zoltán Fodor, who clarified why different groups have obtained inconsistent results for the equation of state of QCD matter and showed that the equation of state is now under much better theoretical control than before.

International Conference on Image and Signal Processing (ICISP 2010)

June 30 – July 2, 2010, UQTR
Sponsored by the CRM, the International Association for Pattern Recognition (IAPR), and the European Association for Signal Processing (EURASIP)

General Chairs
Abder Elmoataz (Caen), Fathallah Nouboud (UQTR)
Program Chairs:
Olivier Lezoray (Caen), Driss Mammass (Ibn Zohr), Jean Meunier (Montréal)
Local Committee (UQTR):
Linda Badri, Mourad Badri, Alain Chalifour (chair)
Invited speakers:
Theo Gevers (Amsterdam), Leo Grady (Siemens, Princeton), Yann LeCun (Courant Inst.)
Number of participants: 80

Le congrès ICISP 2010 était le quatrième congrès de la série *International Conference on Image and Signal Processing* (ICISP). Il avait pour but de fournir aux chercheurs et praticiens du milieu universitaire et du secteur privé un forum où présenter les résultats les plus récents en traitement des images et du signal, en multimédia et en infographie. Voici quelques-uns des thèmes traités pendant le congrès : filtrage et codage d'images, reconnaissance des formes, biométrie, traitement du signal, codage et traitement de vidéos, vision par ordinateur et applications médicales. De plus le congrès inclut une session d'affiches. Le prix du meilleur article fut attribué à Samy Metari et François Deschênes pour l'article intitulé « A novel polychromatic model for light dispersion ». Les actes du congrès ont été publiés par la maison Springer (Lecture Notes in Computer Science, volume 6134).

Workshop on Bifurcation Analysis and its Applications

July 7 — 10, 2010, Concordia
Sponsored by the Applied Mathematics Laboratory, the Centre for Applied Mathematics in Biosciences and Medicine (CAMBAM) at McGill, and the Office of the Vice-President, Research and Graduate Studies of Concordia

Organizers:
Eusebius Doedel (Concordia), Lennaert van Veen (UOIT)
Speakers:
Pablo Aguirre (Bristol), Steven Baer (Arizona State), Roberto Barrio (Zaragoza), Wolf-Jürgen Beyn (Bielefeld), Renato Calleja (McGill), Alan Champneys (Bristol), Harry Dankowicz (UIUC), Gábor Domokos (BUTE), Federico Frascoli (Swinburne), Jorge Galán (Sevilla), Leon Glass (McGill), Willy Govaerts (Gent), George Haller (McGill), Andrew Hazel (Manchester), Robert Hölzel (München), Bill Kalies (Florida Atlantic), Markus Kirkilionis (Warwick), Mark Kramer (Boston), Bernd Krauskopf (Bristol), Rouslan Krechetnikov (UC Santa Barabara), Yuri Kuznetsov (Utrecht), Greg Lewis (UOIT), Bart Oldeman (Concordia), Hinke Osinga (Bristol), Juan Sánchez (UP Catalunya), Tobias Schneider (Harvard), Andrey Schilnikov (GSU)
Number of participants: 30

The Workshop on Bifurcation Analysis and its Applications was in some sense the continuation of a series of highly successful meetings on bifurcation analysis (held in Amsterdam, Bielefeld, Bristol, Ghent, Seville, Utrecht, and Milan in 2009). It attracted about 30 participants from ten different countries. Thanks to the generous support of the CRM, CAMBAM, and Concordia University, the organizers of the workshop were able to offer accommodation for all speakers, waive registration fees, and supply graduate students and postdoctoral fellows with partial travel support.

The workshop featured presentations on recent developments in numerical bifurcation analysis as well as the applications of known methods to open problems in engineering, industry, physiology, fluid dynamics, and classical mechanics. The presentations were grouped around a certain field of application, or the development of algorithms, on each day. Here are the themes that were chosen: Algorithms for ODEs and Conservative Systems (Day 1); Algorithms for PDEs and Fluid Dynamics (Day 2); Biomedical Applications (Day 3); Industrial Applications and Mechanical Systems (Day 4). Each block of presentations on a given theme was introduced by a leader in the field, who gave an overview of recent developments and open problems. At the end of each day, there was a demonstration of recently developed software, as well as time for discussion and code exchange. The workshop website is located at http://cmvl.cs.concordia.ca/baa-2010/ and contains all abstracts and most presentation slides.

Canadian Number Theory Association 11th Meeting (CNTA XI)

July 11 – 16, 2010, Acadia

Sponsored by the Atlantic Association for Research in the Mathematical Sciences (AARMS), the CRM, the National Security Agency (NSA), Acadia, and the Number Theory Foundation (NTF)

Organizing Committee:

Chantal David (Concordia), John Friedlander (Toronto), Eyal Goren (McGill), Andrew Granville (Montréal), Jeff Hooper (Acadia), David McKinnon (Waterloo), Hugh Williams (Calgary)

Plenary speakers:

Michael Bennett (UBC), Jan Bruinier (TU Darmstadt), Kevin Buzzard (Imperial Coll.), Hershey Kisilevsky (Concordia), Stephen Kudla (Toronto), Kristin Lauter (Microsoft Res.), Ken Ono (Wisconsin – Madison), Jonathan Pila (Bristol), Zeev Rudnick (Tel Aviv), K. Soundararajan (Stanford)

Invited speakers:

Nils Bruin (Simon Fraser), Yann Bugeaud (Louis Pasteur), Samit Dasgupta (UC Santa Cruz), Kirsten Eisenträger (Penn State), David Mandell Freeman (Stanford), Jayce Robert Getz (Princeton), Julia Gordon (UBC), Matthew Greenberg (Calgary), Heekyoung Hahn (Albany), Kevin Hare (Waterloo), Roman Holowinsky (Ohio State), Matilde Lalín (Montréal), Aaron Levin (IAS), Yu Ru Liu (Waterloo), Allison Pacelli (Williams Coll.), Michael Rubinstein (Waterloo), Jonathan Sorenson (Butler), Andrew V. Sutherland (MIT), Adrian Vasiu (Binghamton), John Voight (Vermont), Matthew P. Young (Texas A&M)

Number of participants: 130

The Canadian Number Theory Association's biennial meetings are amongst the largest meetings of the world's leading number theorists. The eleventh meeting was no exception, attracting 130 participants from Europe, North America, and Australia. The meeting began on Sunday, July 11, with a plenary talk by Zeev Rudnick entitled *Eigenfunctions and Sums of Squares*, and proceeded through the week with 82 other lectures on a variety of topics in number theory, including o-minimal structures, vanishing of L-functions, rational points on algebraic varieties, and Diophantine approximation.

One of these lectures, on Wednesday, July 14, was given by Valentin Blomer, recipient of the 2010 Ribenboim Prize for distinguished research in number theory by a mathematician who is Canadian or who has close connections to Canadian mathematics. His prize lecture was entitled *On the Ramanujan Conjecture* and described Dr. Blomer's impressive work on generalizations of the conjecture and their proofs. The conjecture, which was proven in 1973 by Deligne, states that if p is prime, then the Fourier coefficient $\tau(p)$ of the cusp form $\Delta(z)$ of weight 12 satisfies $|\tau(p)| \leq 2p^{11/2}$. In his talk, Dr. Blomer described his joint work with Farrell Brumley in proving a natural generalization of the conjecture to the groups GL_n over arbitrary number fields.

Most of the plenary lectures were, of course, not prize lectures. Michael Bennett's lecture featured a novel approach to solving an infinite family of Thue – Mahler equations, extending work of Darmon and Granville. Jan-Hendrik Bruinier gave an impressive algebraic

talk, in which he described the calculation of special values of modular functions associated to Shimura curves. Kevin Buzzard gave an overview of the p-adic Langlands program and recent progress towards some proofs. Hershey Kisilevsky's talk dealt with the variation in the rank of the Mordell–Weil group of an elliptic curve as the number field of definition varies. Kristin Lauter discussed the problem of how to count certain kinds of simultaneous embeddings of certain number rings into quaternion algebras over totally real fields, which relates to a famous formula of Gross and Zagier and the intersection pairing on a Hilbert modular surface.

An application of model theory to number theory was the main theme of Jonathan Pila's plenary lecture. He described a novel idea of Umberto Zannier to use o-minimal structures to solve Diophantine equations, and used it to prove the Andre-Oort conjecture for products of modular curves. Zeev Rudnick, on the other side of number theory, probed the boundary with mathematical physics by using diophantine techniques to describe the set of eigenfunctions of the Laplacian operator on flat tori. In a similar vein, K. Soundararajan's talk described applications of number theory to quantum chaos, including problems that lie in the intersection of the two fields. In particular, Soundararajan discussed the proof of a conjecture of Rudnick and Sarnak that the high-energy eigenfunctions of the Laplacian on the quotient of the complex upper half-plane by an arithmetic subgroup of $\mathrm{SL}_2(\mathbb{R})$ are equidistributed.

In all, the meeting featured ten plenary lectures, in addition to Valentin Blomer's prize lecture and Ken Ono's public lecture on Ramanujan and his discovery of mock theta functions. This sounds fairly technical for a general audience, but Dr. Ono's talk was very accessible, featuring photographs of his research trips to India and a very down-to-earth description of Ramanujan's mathematics. Dr. Ono also gave a plenary lecture aimed at professional number theorists, in which he described the uses of Ramanujan's mock theta functions in the study of special values of L-functions.

There were also 22 invited lectures, each lasting for approximately 35 minutes, and 49 lectures contributed by other participants, each lasting between 15 and 20 minutes. The pace of the meeting was very pleasant, with plenty of mathematical energy generated by the talks, and yet plenty of time before, after, and between the talks to allow for the interesting mathematical exchanges that are some of the greatest fruits of mathematical conferences. There was also a brief meeting in the middle of the conference to discuss the future of CNTA. It had already been decided that the Twelfth Meeting, in 2012, would be held in Lethbridge, but during the week of the 2010 meeting it was also agreed that the Association would return to Ottawa, at Carleton University, for its Thirteenth Meeting in 2014.

Conference
LaCIM 2010: 20th Anniversary of LaCIM

August 29 – 31, 2010, UQAM

Sponsored by UQAM, the CRM, and the Canada Research Chair in Combinatorial Algebra and Mathematical Computing (UQAM)

Organizers:

François Bergeron (UQAM), Srečko Brlek (UQAM), Christophe Hohlweg (UQAM), Christophe Reutenauer (UQAM)

Invited speakers:

François Bergeron, Jean Berstel (Marne-la-Vallée), Alain Denise (Paris-Sud), Adriano Garsia (UC San Diego), Florent Hivert (Rouen), Michel Mendès France (Bordeaux 1)

Other speakers:

Alexandre Blondin Massé (UQAM), Stefano Brocchi (Firenze), Émilie Charlier (ULB), Gabriele Fici (Nice Sophia Antipolis), Jean-Philippe Labbé (FU Berlin), Gilbert Labelle (UQAM), Aaron Lauve (Loyola Chicago), Thierry Monteil (Montpellier 2), Maddelana Poneti (Siena), Xavier Provençal (UQAM), Yuval Roichman (Bar-Ilan), Christian Stump (Hannover)

La conférence LaCIM 2010 avait pour but de célébrer le 20^{e} anniversaire du Laboratoire de combinatoire et d'informatique mathématique. Depuis 20 ans, les membres du LaCIM poursuivent des recherches sur les aspects combinatoires de l'algèbre et en informatique théorique, bioinformatique, physique et théorie des nombres. Pour la conférence LaCIM 2010, les membres du laboratoire ont invité des conférenciers renommés afin qu'ils présentent les progrès récents dans les domaines de recherche auxquels les membres du LaCIM ont contribué pendant les dernières décennies. J. Berstel fit une présentation sur les nombres et les mots, A. Denise une présentation sur la combinatoire pour la bioinformatique des structures moléculaires, A. Garsia une présentation sur les opérateurs de Hall-Littlewood en théorie des « fonctions de parking », F. Hivert une présentation sur la transformée

$(1 - E)$ dans les algèbres de Hopf combinatoires et M. Mendès France une conférence sur l'optique élémentaire et l'arithmétique. Le reste des présentations portaient (entre autres sujets) sur la combinatoire des mots, les arrangements d'hyperplans, les automates, les fonctions symétriques et la reconstruction des matrices binaires.

Conference
GASCom 2010

September 2 – 4, 2010, UQAM
Sponsored by UQAM, the CRM, and the Canada Research Chair in Combinatorial Algebra and Mathematical Computing (UQAM)

Organizing Committee:
Alexandre Blondin Massé (UQAM), Srečko Brlek (UQAM, chair), Ariane Garon (UQAM), Sébastien Labbé (UQAM), Christophe Reutenauer (UQAM, cochair), Lise Tourigny (UQAM, secretary), Jérôme Tremblay (UQAM, technical support)
Scientific Committee:
Srečko Brlek, Jean-Marc Fédou (Nice Sophia Antipolis), Renzo Pinzani (Firenze), Christophe Reutenauer, Gilles Schaeffer (École Polytechnique), Vincent Vajnovszki (Bourgogne)
Invited speakers:
Elena Barcucci (Firenze), Dominique Gouyou-Beauchamps (Paris-Sud), Frank Ruskey (Victoria), Timothy Walsh (UQAM)
Other speakers:
Mohamed Abdo (UQAM), Alain Denise (Paris-Sud), Ariane Garon, Alice Jacquot (Paris 13), Florent Le Gac (Bordeaux 1), Paolo Massazza (L'Insubria), Johan Oudinet (Paris-Sud), Renzo Pinzani, Yann Ponty (École Polytechnique), Olivier Roussel (Marne-la-Vallée), Vincent Vajnovszki, Akka Zemmari (Bordeaux 1)
Number of participants: 45

GASCom 2010 was the seventh conference in a series initiated in 1994 in Bordeaux. The conference topic is the random and exhaustive generation of combinatorial objects and bijective combinatorics with focus on theoretical approaches. In particular the conference emphasizes the combinatorial, algebraic, and algorithmic aspects of combinatorial objects generation. It also considers relations with other parts of mathematics, combinatorics, computer algebra, computer science, physics, and biology.

Participants came from Canada, France, Germany, Italy, and the United States. The friendly environment allowed many exchanges between them. The first session focused on enumeration problems. T. Walsh gave an exhaustive survey of counting maps on surfaces of genus 1. The other sessions were devoted to the generation of combinatorial structures: regular and context-free languages (second session); exhaustive generation by the ECO method (E. Barcucci); RNA secondary structures, unary-k-ary trees (D. Gouyou-Beauchamps); Gray codes and Catalan structures (third and fourth sessions). The topics of the last session were Tatami tilings (F. Ruskey), the generation of special classes of monohedral tilings, and sand piles.

Montréal – Toronto Workshop in Number Theory

September 4 – 5, 2010, CRM
Sponsored by the CRM and the Fields Inst.

Organizers:
Eyal Goren (McGill), Steve Kudla (Toronto)
Speakers:
Dylan Attwell-Duval (McGill), Victoria de Quehen (McGill), Andrew Fiori (McGill), Jayce Getz (McGill), Eyal Goren, Fritz Hörmann (McGill), Steve Kudla, Bahareh Mirza (McGill), Siddarth Sankaran (Toronto), Brian Smithling (Toronto), Patrick Walls (Toronto)
Number of participants: 30 (including 9 from Toronto)

The Montréal – Toronto Workshop in Number Theory is a new joint initiative, conceived by us as a way to foster stronger relations between the active groups in number theory and arithmetic geometry in the two cities. The workshop enjoys financial support from both the CRM in Montréal and the Fields Institute in Toronto. The program of the first workshop was focused on recent developments in the theory of orthogonal Shimura varieties. Among the participants were graduate students, postdoctoral fellows, faculty, and visiting faculty.

The program of the first day consisted of background lectures given by Dylan Attwell-Duval, Andrew Fiori, Patrick Walls, Brian Smithling, Bahareh Mirza, Victoria de Quehen, Jayce Getz, and Siddarth Sankaran. The first day concluded with a lecture by Fritz Hörmann, a new postdoctoral fellow at McGill, on the results contained in his thesis. This series of lectures was out-

standing in its clarity and scope, and that is especially commendable given that many of the speakers were graduate students. Following the day's lectures, we headed for a joint dinner, which provided a fantastic opportunity to follow up on some of the day's topics and foster connections between the two communities.

The program of the second day started at 9:30 and ended in the early afternoon. It consisted of two 90-minute lectures, given by Goren and Kudla (respectively), who surveyed some of the recent progress in the area on which the workshop was focused. Goren surveyed the work done in the last years on generalizing the theorem of Gross and Zagier on singular moduli to the setting of multiplicative averages of Borcherds lifts on CM cycles, and, in a different direction, to the study of primes for which two abelian varieties with CM may have an isomorphic reduction. Kudla devoted his lecture to explaining the recent breakthrough made by Bruinier in generalizing the Borcherds lift to the context of Hilbert modular varieties and orthogonal groups over totally real fields.

Québec – Maine Conference on Number Theory, 2010

October 2 – 3, 2010, Laval

Sponsored by the Department of Mathematics and Statistics of Université Laval, the Number Theory Foundation, the National Science Foundation, and CICMA

Organizers:
Hugo Chapdelaine (Laval), Jean-Marie De Koninck (Laval), Claude Levesque (Laval)

Speakers:
Erwan Biland (Laval), David Bradley (Maine), Francesc Castella (McGill), Mark Colarusso (Laval), Henri Darmon (McGill), Chantal David (Concordia), Daniel Fiorilli (Montréal), Philip Foth (Arizona & Champlain St. Lawrence), Eyal Goren (McGill), Fernando Gouvêa (Colby Coll.), Hester Graves (Queen's), Matthew Greenberg (Calgary), Xevi Guitart (UP Catalunya), Caroline Junkins (Ottawa), Ernst Kani (Queen's), Hershey Kisilevsky (Concordia), Peter Kleban (Maine), Andrew Knightly (Maine), Manfred Kolster (McMaster), Dimitris Koukoulopoulos (McGill), Stephen Kudla (Toronto), Matilde Lalín (Montréal), Michael Lau (Laval), Andreas Malmendier (Colby Coll.), Ali Özlük (Maine), David Roe (Harvard), Ethan Smith (Concordia), Lauren Thompson (Dartmouth), Enrique Treviño (Dartmouth), Jonathan Webster (Bates Coll.)

Number of participants: 48

La Conférence Québec-Maine annuelle en théorie des nombres alterne entre l'Université Laval (dans la ville de Québec) et la University of Maine (dans la ville d'Orono). Parmi les participants de la conférence de 2010, qui se tint à l'Université Laval, on comptait une douzaine d'étudiants, et les 30 conférenciers ont présenté leurs résultats dans une atmosphère de camaraderie. Les pauses-santé (le café se transformant en théorèmes via l'alchimie d'Erdős) et le banquet japonais traditionnel favorisèrent les échanges entre mathématiciens. Pour plusieurs des participants, cette conférence est devenue une rencontre à ne pas manquer. Le lecteur trouvera le programme scientifique de la conférence de 2010 à l'adresse http://www.math.umaine.edu/numbertheory/qm10.html.

Colloquium Contemporary Statistical Methodology

October 6 – 7, 2010, Université de Sherbrooke

Sponsored by the Statistics Laboratory, the ISM, and the Université de Sherbrooke

Organizers:
Éric Marchand (Sherbrooke), Ernest Monga (Sherbrooke), Gilles Ducharme (Montpellier 2)

Speakers:
Taoufik Bouezmarni (Sherbrooke), Gilles Ducharme, Jean-Marie Dufour (McGill), Ali Gannoun (Montpellier 2), Pierre Lafaye de Micheaux (Montréal), Lajmi Lakhal Chaieb (Laval), Jean-Michel Marin (Montpellier 2), Mhamed Mesfioui (UQTR), Jean-François Quessy (UQTR), François Perron (Montréal)

Number of participants: 25

Le colloque se tint au département de mathématiques de l'Université de Sherbrooke et fut un franc succès. Notons en particulier son caractère international et le niveau scientifique élevé des présentations. Parmi les 15 participants qui ne donnaient pas de conférences, il y avait 12 étudiants. Le colloque a aussi donné lieu à de multiples échanges scientifiques et a permis à plusieurs jeunes chercheurs, parmi d'autres, de présenter leurs intérêts et derniers résultats de recherche. L'appui de l'ISM et du Laboratoire de statistique du CRM fut crucial pour la réussite de l'évènement. Même s'il n'y avait pas de thème retenu a priori, les présentations se sont articulées autour des tests d'ajustement, de la modélisation par copules, de la modélisation bayésienne, des

applications en économétrie et des caractérisations en probabilités. Voici la liste des conférences.

- *Un test d'adéquation pour la fonction de répartition conditionnelle* (G. Ducharme)
- *Hodges – Lehmann Sign-Based Estimators and Generalized Confidence Distributions in Linear Median Regressions with Heterogeneous Dependent Errors* (J.-M. Dufour)
- *Ordres dispersifs et « excess-wealth » pour des lois conditionnelles de copules archimédiennes* (M. Mesfioui)
- *Tests d'ajustement basés sur la fonction caractéristique* (P. Lafaye de Micheaux)
- *Médiane et quantiles conditionnels multivariés : application à la modélisation et la prévision des processus* (A. Gannoun)
- *Estimation non paramétrique des mesures de causalité* (T. Bouezmarni)
- *Tests d'hypothèses composites à base de copules* (J.-F. Quessy)
- *La régression de S^2 sur $\overline{X}$ sous forme d'un polynôme* (F. Perron)
- *Importance sampling methods for Bayesian discrimination between embedded models* (J.-M. Marin)
- *Test d'adéquation de copules en présence de censure et de fraction de guérison* (L. Lakhal Chaieb)

Colloquium on Surfaces and Representations

October 6 – 9, 2010, Université de Sherbrooke
Sponsored by the Université de Sherbrooke, the CRM, the ISM, and the RECSUS (Regroupement des Étudiants-Chercheurs en Sciences de l'Université de Sherbrooke)

Organizers:
Ibrahim Assem (Sherbrooke), Thomas Brüstle (Sherbrooke & Bishop's), Virginie Charette (Sherbrooke), Tomasz Kaczynski (Sherbrooke), Christian Mercat (Montpellier 2), Jean-Philippe Morin (Sherbrooke), Vasilisa Shramchenko (Sherbrooke)
Mini-course lecturers:
Ralf Schiffler (Connecticut), Todd Drumm (Howard)
Plenary speakers:
Syed Twareque Ali (Concordia), Steven Boyer (UQAM), Christian Mercat, Konstantin Mischaikow (Rutgers), Maria Julia Redondo (UN del Sur), Christophe Reutenauer (UQAM)
Speakers in the algebra session:
Andrew Carroll (Northeastern), Flavio Ulhoa Coelho (São Paulo), Grégoire Dupont (Sherbrooke), Lutz Hille (Münster), Marcelo Lanzilotta (La República), Alex Lasnier (Sherbrooke), Frédéric Latour (CCSU), Maria Andrea Gatica (UN La Pampa), Marju Purin (Syracuse), Andrea Alejandra Rey (Buenos Aires), Vivien Ripoll (UQAM), David Smith (Bishop's), Kavita Sutar (Northeastern), Hugh Thomas (New Brunswick), Gordana Todorov (Northeastern), Jie Zhang (Sherbrooke)

Speakers in the geometry and topology session:
Leonid Chekhov (Steklov Inst.), Mark Colarusso (Laval), Tatyana Foth (Western Ontario), William Goldman (Maryland), Jacques Hurtubise (McGill), Lisa Jeffrey (Toronto), Ratnadha Kolhatkar (Laval), François Labourie (Paris-Sud), Michael Lau (Laval), Alexandre Odesski (Brock), Eric Schippers (Manitoba)
Number of participants: 67

L'Université de Sherbrooke a des accords de coopération avec plusieurs universités étrangères, dont celle de Montpellier. Du 6 au 8 octobre 2010, l'Université de Sherbrooke a été l'hôte des Troisièmes Rencontres Universitaires Sherbrooke-Montpellier. Notre équipe de recherche, le SAG (Structures algébriques et géométriques), avait été pressentie pour organiser un des colloques qui ont eu lieu à cette occasion. Comme par ailleurs nous organisons chaque année vers la même date une Rencontre de théorie des représentations, nous avons décidé de coupler les deux évènements et d'en faire un colloque de 4 jours, qui a duré du 6 au 9 octobre 2010 et a donc porté le nom de Colloque sur les surfaces et les représentations. Des 67 participants, 30 étaient des étudiants ou stagiaires postdoctoraux.

Notre équipe de recherche, le SAG, s'est formée à partir d'un groupe travaillant sur les algèbres amassées (cluster algebras), domaine en expansion touchant à plusieurs branches des mathématiques comme l'algèbre, la géométrie, la combinatoire et la physique mathématique. Elle rassemble des chercheurs venant d'horizons différents qui, à travers le projet intégrateur que sont les algèbres amassées, explorent les connexions entre divers domaines. Dans le cas de ce colloque, nous avons choisi comme thème l'interaction entre géométrie des surfaces et théorie des représentations des algèbres, cette interaction étant un des outils principaux en théorie des algèbres amassées.

Notre premier objectif, sur le plan scientifique, était d'explorer de nouvelles connexions fructueuses entre algèbre et géométrie. C'est dans cette optique que nous avions choisi les responsables de nos mini-cours,

R. Schiffler et T. Drumm, tous deux spécialistes de l'interaction entre géométrie et algèbre. Chacun des deux mini-cours a duré 3 heures. Le choix des conférenciers pléniers, dont chacun a donné une conférence de 45 minutes, a aussi reflété notre souci de couvrir un éventail aussi large que possible de techniques, tout en restant fidèles à l'objectif de bien comprendre les différents aspects des algèbres amassées. Tant les conférenciers pléniers que les responsables des mini-cours sont des mathématiciens et conférenciers de très grande qualité.

Un autre objectif, tout aussi important, était de contribuer à la formation des étudiants et stagiaires postdoctoraux : ceux-ci ont été initiés à l'interaction entre deux domaines des mathématiques. Nous espérons que ceci leur a permis de dépasser le cloisonnement inhérent aux études de premier cycle. Les mini-cours et les exposés pléniers devaient leur donner une vue synthétique de leurs domaines, et les deux sessions spéciales, une en géométrie et l'autre en algèbre, devaient leur permettre d'écouter des exposés plus spécialisés dans leurs domaines respectifs. L'horaire et les résumés des conférences sont disponibles à l'adresse http://prospero.dmi.usherb.ca/sag/Archives.aspx.

L'ambiance de travail a été relaxée et amicale tout au long de la rencontre. Le niveau d'échanges a été particulièrement élevé, avec de nombreuses questions fécondes permettant de préciser des points et parfois ouvrant de nouvelles pistes de réflexion. La plupart des participants se connaissaient depuis longtemps, et ont l'habitude de travailler ensemble. Parmi les retombées, la plus immédiate concerne les étudiants (québécois, européens, nord-américains et sud-américains). Tous nous ont dit à quel point tant les mini-cours que les exposés ont été formateurs pour eux. Ils ont aussi relevé le fait que ce colloque leur a permis de faire la connaissance de chercheurs étrangers dont ils étudient les travaux et qu'ils n'avaient pas eu l'occasion de rencontrer auparavant, et surtout d'avoir des échanges avec eux, des échanges qu'ils ont qualifiés d'exceptionnellement cordiaux et fructueux.

Parmi les retombées sur le plan scientifique, mentionnons le fait que chacun des participants fut mis au courant des résultats obtenus par les collègues des autres universités et le renforcement des liens de coopération entre les chercheurs présents, qu'ils soient européens, nord-américains ou sud-américains. D'autre part, plusieurs participants ont profité de cette rencontre pour faire avancer leurs propres travaux de recherche.

Workshop
Dark Matter from Every Direction

April 1 – 3, 2011, McGill
Sponsored by the CRM, Lorne Trottier, NSERC, and the Department of Physics of McGill

Organizers:
Robert Brandenberger (McGill), Jim Cline (McGill), Andrew R. Frey (McGill), Pat Scott (McGill)
Speakers:
Kevork Abazajian (Maryland), Brian Batell (Perimeter Inst.), Basudeb Dasgupta (Ohio State), Adrienne Erickcek (Perimeter Inst. & CITA), Andrew R. Frey, Paolo Gondolo (Utah), David Morrissey (TRIUMF), Annika Peter (UC Irvine), Maxim Pospelov (Perimeter Inst. & Victoria), Adam Ritz (Perimeter Inst. & Victoria), Jennifer Siegal-Gaskins (Ohio State), Tracy Slatyer (IAS), Gordana Tesic (McGill), Aaron Vincent (McGill), Wei Xue (McGill)
Number of participants: 27

The identity of dark matter still eludes us. The recent run of hints from various experiments shows that positive identification will require strongly correlated signals from a number of very different messengers. This workshop brought together North American phenomenologists working on dark matter detection from a broad range of directions, to examine how different constraints and detections can be compared and combined in a holistic and self-consistent way. The workshop was roughly divided into sessions on dark matter models, direct and indirect detection of dark matter, with 11 invited speakers and 4 local participants giving talks of half-an-hour apiece. The event was relatively small and informal, resulting in more extensive discussions surrounding each talk than is typical at most workshops. Attendees benefited from the participation of a number of renowned experts in the field, including Paolo Gondolo, Annika Peter, and Tracy Slatyer. Many of the participants reported that existing projects with collaborators were significantly advanced or new collaborations were started during the workshop.

Colloquium
68th Algebra Day

April 9, 2011, Ottawa
Sponsored by the CRM

Organizer: Hadi Salmasian (Ottawa)

Speakers:
Mahdi Asgari (Oklahoma State), Abraham Broer (Montréal), Nikita Karpenko (UPMC), Gordan Savin (Utah), Oded Yacobi (Toronto)
Number of participants: 25

The list of speakers at the 68th Algebra Day included four senior mathematicians and one postdoctoral fellow. The conference began with the lecture by G. Savin, who spoke on his joint work with Chandrasekhar Khare and Michael Larsen on a new method for realization of finite groups of Lie type as Galois groups over rational numbers. N. Karpenko spoke about recent progress on the study of Chow rings and motives of Hermitian Grassmannians. M. Asgari started the afternoon session by discussing his joint work with Werner Müller on a generalization of Weyl's law in the context of automorphic forms on higher rank groups. O. Yacobi talked about a connection between branching laws for the symplectic and the general linear groups using the novel idea of branching algebras. The last lecture was given by A. Broer who explained new results on the cohomology of nilpotent varieties.

The participants (including several graduate students and postdoctoral fellows) came from the two local universities (Carleton University and the University of Ottawa), as well as from places such as London, Ontario. The conference had a wide scope and the talks addressed several topics from algebraic geometry, number theory, and representation theory, three areas where research is conducted at Carleton University and the University of Ottawa. The speakers made their lectures accessible to an audience with a broad range of interests. This was especially beneficial for our graduate students, who had an opportunity to discuss mathematics with the speakers, especially those whose books and articles they had been studying.

2nd Montréal – Toronto Workshop in Number Theory

April 9 – 10, 2011, Fields Inst.
Sponsored by CICMA, the CRM, and the Fields Inst.

Organizers:
Eyal Goren (McGill), Stephen Kudla (Toronto)
Speakers:
Zavosh Amir-Khosravi (Toronto), Dylan Attwell-Duval (McGill), Henri Darmon (McGill), Jayce Getz (McGill), Eyal Goren, Fritz Hoermann (McGill), Stephen Kudla, Kumar Murty (Toronto), Shervin Shahrokhi-Tehrani (Toronto), John Voight (Vermont)

This workshop was devoted to the arithmetic aspects of Hilbert modular varieties. The main focus of the workshop was on the algebraic cycles on Hilbert modular varieties and their integral models, Hirzebruch – Zagier cycles, Tate conjectures, and connections with modular forms and special values of L-functions. The workshop started with a survey, presented by E. Goren. S. Shahrokhi-Tehrani spoke on Hilbert modular forms and cohomology. D. Attwell-Duval spoke on Chern numbers of Hilbert modular varieties. Z. Amir-Khosravi spoke on integral models. F. Hoermann gave a lecture on toroidal compactifications and J. Voight a lecture on the computing of Hilbert modular forms. H. Darmon gave a talk on the algebraic cycles on Hilbert modular varieties, K. Murty a talk on Tate conjectures, and S. Kudla a talk on arithmetic special cycles and quartic CM points. J. Getz presented joint work with Mark Goresky.

GERAD Spring School 2011 on Evolutionary Games

May 4 – 7, 2011, HEC Montréal
Sponsored by GERAD, the Chair in Game Theory and Management (HEC Montréal), and the CRM

Organizer: Georges Zaccour (HEC Montréal)
Speakers:
Ross Cressman (Wilfrid Laurier), Josef Hofbauer (Wien), Sabin Lessard (Montréal), Bill Sandholm (Wisconsin – Madison), Sylvain Sorin (UPMC), Jörgen Weibull (SSE)
Number of participants: 59

La théorie des jeux évolutionnaires s'intéresse aux différents types d'interactions sociales dans des populations de joueurs. Il s'agit d'un outil mathématique idéal pour ramener l'analyse des phénomènes sociaux à l'étude des actions individuelles. La dynamique d'un jeu évolutionnaire combine le point de vue stratégique de la théorie des jeux (où des joueurs rationnels prennent en compte les comportements stratégiques des autres joueurs) avec la dynamique de populations (où les stratégies gagnantes sont observées plus fréquemment).

L'objectif de ce cours était d'introduire les concepts fondamentaux des jeux évolutionnaires et de présenter leurs applications courantes. Le cours a aussi fourni un compte rendu des avancées récentes dans le domaine

des jeux évolutionnaires. Ross Cressman présenta une introduction aux jeux évolutionnaires et donna un cours sur les jeux à espaces de stratégies continus. Josef Hofbauer donna un cours sur la dynamique de la meilleure réponse et un autre sur la non-convergence. Jörgen Weibull donna deux cours sur la stabilité évolutionnaire. Bill Sandholm parla de la géométrie des jeux de populations et de la dynamique stochastique des jeux évolutionnaires. Sylvain Sorin parla de la dynamique de la meilleure réponse et de dynamique adaptative globale et unilatérale. Finalement, Sabin Lessard donna un cours sur l'évolution de la coopération dans les populations finies et une présentation sur les avenues de recherche.

The Bellairs Workshop in Number Theory, 2011
Tropical and Non-Archimedean Geometry

May 6-13, 2011, Bellairs Research Institute
Sponsored by CICMA

Organizers:
Xander Faber (Georgia), Jayce Getz (McGill, head organizer)
Principal speaker: Matthew Baker (Georgia Tech)
Other speakers:
Antoine Chambert-Loir (Rennes 1), Fillip Cools (KU Leuven), Antoine Ducros (UPMC), Diane Maclagan (Warwick), Sergey Norin (Princeton), Mihran Papikian (Penn State), Joseph Rabinoff (Harvard), Amaury Thuillier (Lyon 1), Filippo Viviani (Roma Tre)
Number of participants: 33

The workshop was aimed at explaining connections between non-Archimedean geometry, especially the study of Berkovich spaces, and tropical geometry. Its main motivation was the presentation of a recent paper of Baker, Payne, and Rabinoff that has gone a long way towards elucidating this connection. The principal speaker, Matthew Baker, handled the scientific organization of the conference and asked the other speakers to talk on specific topics that either motivated or complemented his lectures. We heard only positive comments on the lectures, and the participants were especially happy about the expository nature of the material, which ensured that everyone at the conference could follow, in spite of the diversity of the participants' mathematical backgrounds. In addition, despite the wonderful weather and the many distractions Barbados offers, the participants were constantly talking about topics suggested by the workshop speakers. Overall the workshop was a smashing success. To conclude we mention that the CRM is planning to publish the proceedings of the conference, which should be a valuable addition to the literature.

CanaDAM 2011
3rd Canadian Discrete and Algorithmic Mathematics Conference

May 31 – June 3, Victoria
Sponsored by the CRM, the Fields Inst., MITACS, PIMS, the Canadian Mathematical Society, and the Victoria

Program Committee:
Nick Wormald (Waterloo, chair), Pavol Hell (Simon Fraser), Nantel Bergeron (York), Jim Geelen (Waterloo), Valerie King (Victoria), Neal Koblitz (Washington), Karen Meagher (URegina), Janos Pach (EPFL & Rényi Inst.), Andrew Rechnitzer (UBC), Bruce Shepherd (McGill), Angelika Steger (ETH Zürich), Carsten Thomassen (DTU), Sue Whitesides (Victoria), Avi Wigderson (Princeton)
Executive Committee:
Pavol Hell (Simon Fraser), Odile Marcotte (CRM & UQAM), Ortrud Oellermann (Winnipeg, chair), David Pike (Memorial), Bruce Richter (Waterloo), Frank Ruskey (Victoria)
Local Arrangements Committee:
Gary MacGillivray (Victoria, chair), Odile Marcotte, Peter Dukes (Victoria), Jing Huang (Victoria), Kieka Mynhardt (Victoria), Jacobus Swarts (Vancouver Island)
Plenary Speakers:
Anne Bergeron (UQAM), Sara Billey (Washington), Allan Borodin (Toronto), Chandra Chekuri (UIUC), Jacob Fox (MIT), Jeff Kahn (Rutgers), Alice Silverberg (UC Irvine), Stéphan Thomassé (Montpellier 2)
Number of participants: 307

This conference was part of the CanaDAM series, which consists of conferences on discrete and algorithmic mathematics held every two years (in odd years). In principle a CanaDAM conference is held in Western Canada if the previous one was held in Eastern Canada (and vice versa). The CanaDAM series was created by Derek Corneil, Daniel Panario, and Pavol Hell, who were helped by researchers in discrete mathematics from all Canadian regions (see http://canadam.math.ca). The format of CanaDAM is similar to that of the SIAM Conferences on Discrete Mathematics,

which are held in even years. CanaDAM enjoys an excellent international reputation and is considered a first-rate conference in discrete mathematics.

The scientific program of CanaDAM 2011 consisted of 8 plenary lectures, 39 invited minisymposia talks, 117 contributed minisymposia talks, and 72 contributed talks. The titles of the plenary lectures are given below.

- *The Combinatorial Beauty of Genome Evolution* (A. Bergeron).
- *An Introduction to k-Schur Functions and QSYM* (S. Billey).
- *When is it Good to be Greedy* (*in Algorithm Design*)? (A Borodin).
- *Submodular Set Function Maximization via the Multilinear Relaxation and Dependent Randomized Rounding* (C. Chekuri).
- *Intersection Graphs, Drawings, Posets, and Separators* (J. Fox).
- *Thresholds and Expectation Thresholds* (J. Kahn).
- *Counting Points on Elliptic Curves, from Gauss to the Present* (A. Silverberg).
- *Applications of VC Dimension for Graphs and Hypergraphs* (S. Thomassé).

In addition to these plenary talks there was a well-received one-hour popular lecture on the mathematics of Origami given by Joseph O'Rourke (from Smith College). This lecture was preceded by a reception hosted in part by Elsevier. The 307 persons who participated in CanaDAM 2011 came from 19 countries, and 129 of the registered participants (i.e., more than 40% of participants) were graduate students or postdoctoral fellows. In order to receive financial support graduate students were encouraged to contribute talks. The organizers are very grateful to the three Canadian institutes (CRM, Fields, and PIMS) and to MITACS for their financial support, which enabled many graduate students and postdoctoral fellows to attend the conference.

Colloquium Series

The CRM, together with the Institut des sciences mathématiques du Québec (the Québec universities graduate mathematics consortium), runs two Montréal colloquium series, one in mathematics and the other in statistics (the latter jointly with GERAD, an operations research centre located in the André-Aisenstadt building). During the academic year, these series offer survey talks on topics of current interest by distinguished mathematicians and statisticians.

CRM – ISM Mathematics Colloquium

In 2010 – 2011 the colloquium coordinators were Rustum Choksi and Jayce Getz, both from McGill University.

September 17, 2010
Jean-Pierre Aubin (Paris-Dauphine)
Régulation d'évolutions « viables » dans un environnement en avenir incertain

September 24, 2010
Björn Sandstede (Brown)
Pointwise Estimates and Nonlinear Stability of Waves

October 1st, 2010
Eliot Fried (McGill)
Some Features and Challenges of the Navier – Stokes-alpha-beta Equation

October 8, 2010
Manjul Bhargava (Princeton)
The Average Rank of Elliptic Curves

October 22, 2010
Claude LeBris (ÉNPC)
Stochastic Homogenization and Related Problems

October 29, 2010
Mathieu Lewin (Cergy-Pontoise)
The Thermodynamic Limit of Coulomb Quantum Systems

November 19, 2010
Bruce Berndt (UIUC)
Ramanujan Reaches his Hand from his Grave and Snatches your Theorems from You

November 26, 2010
Adrian Lewis (Cornell)
Semi-algebraic Optimization Theory

January 14, 2011
Gilles Francfort (Paris 13)
Revisiting Fracture Mechanics — The Variational Standpoint

January 28, 2011
Alejandro Ádem (UBC & PIMS)
Homotopy Theory and Spaces of Representations

February 4, 2011
Matilde Lalín (Montréal)
Mahler Measure as Special Values of L-functions

February 11, 2011
Richard Schwartz (Brown)
The 5-Electron Case of Thompson's Problem

March 4, 2011
Dan Stroock (MIT)
Some Random Thoughts about Cauchy's Functional Equation

March 11, 2011
Irene Fonseca (Carnegie Mellon)
Variational Methods in Materials and Imaging

March 18, 2011
Tatiana Toro (Washington)
Geometry of Measures

March 25, 2011
Leonid Polterovich (Chicago)
Function Theory on Symplectic Manifolds

April 1st, 2011
Joseph Silverman (Brown)
Number Theory and Dynamical Systems: A Survey

April 15, 2011
Morley Davidson (Kent State)
Rubik's Cube in Twenty Moves or Less

May 6, 2011
Dusa McDuff (Barnard Coll. & Columbia)
Embedding Questions in Symplectic Geometry

June 10, 2011
Claude Viterbo (École Polytechnique)
Symplectic Homogenization

CRM – ISM – GERAD Statistics Colloquium

In 2010 – 2011 the organizing team of the Statistics Colloquium included Geneviève Lefebvre (UQAM), Mylène Bédard (Montréal), Lea Popovic (Concordia), and Russell Steele (McGill).

September 24, 2010
Alexandra M. Schmidt (UFRJ)
Modelling Multivariate Counts Varying Continuously in Space

October 1st, 2010
Vahid Partovi Nia (McGill)
A Stopping Rule for MCMC Clustering

October 8, 2010
Elif F. Acar (McGill)
Nonparametric Estimation and Inference for the Copula Parameter in Conditional Copulas

October 15, 2010
Paul Jenkins (UC Berkeley)
A New Approach to Computing Sampling Probabilities in Population Genetics Models with Recombination

October 29, 2010
Ahad Jamalizadeh (Shahid Bahonar)
Skew-Elliptical Distributions and their Relationship with Order Statistics

November 5, 2010
Hanna Jankowski (York)
On the Grenander Estimator at Zero

November 12, 2010
Ji Zhu (Michigan)
Extracting Communities from Networks

November 19, 2010
Marc Hallin (ULB & Princeton)
Local Bilinear Multiple-Output Quantile Regression: From L_1 Optimization to Regression Depth

November 26, 2010
Louis-Paul Rivest (Laval)
Modèles de capture-recapture avec applications en épidémiologie

January 21, 2011
Marco Carone (Johns Hopkins & UC Berkeley)
The Statistical Analysis of Cross-Sectional Survival Data with Applications for the Study of Dementia

January 28, 2011
Jean-François Quessy (UQTR)
Testing for Bivariate Extreme-Value Dependence

February 4, 2011
Peter X. K. Song (Michigan)
Composite Joint Estimating Functions and Applications in Spatio-temporal Models

February 11, 2011
Sanjib Basu (Northern Illinois)
A Unified Competing Risks Cure Rate Model with Applications to Cancer Survival Data

February 18, 2011
Noureddine El Karoui (UC Berkeley)
Some Remarks on Random Matrix Theory and its Applications to Multivariate Statistics

March 4, 2011
Lajos Horváth (Utah)
Limit Theorems of Functional Data Analysis with Some Applications

March 11, 2011
Brani Vidakovic (Georgia Tech & Emory)
Wavelet-based 2-D Spectra and Applications

March 18, 2011
Subhashis Ghosal (NC State)
Combining Forward Selection and Shrinkage Techniques for Variable Selection in Regression and Classification

March 25, 2011
Mark van der Laan (UC Berkeley)
Targeted Maximum Likelihood Estimation: Assessing Effects in RCT and Observational Studies

April 1st, 2011
Renming Song (UIUC)
Sharp Estimates on the Heat Kernels and Green Functions of Subordinate Brownian Motions in Smooth Domains

April 8, 2011
Yutaka Yasui (Alberta)
Applying Statistical Principles in Large-Scale Biological Data Analysis: Why Is It Rare and What Should We Do about It?

Multidisciplinary and Industrial Program

The main vehicles for the CRM's efforts in this area are the research networks to which it belongs, principally MITACS, a national network focusing on the mathematics of information technology and complex systems, and the National Institute on Complex Data Structures (NICDS). In 2010-2011 the CRM initiated the Climate Change and Sustainability Program in partnership with the North American Mathematics Institutes (see the Fall 2010 issue of the Bulletin du CRM). *The reports are presented in the language in which they were submitted.*

Activities of the Climate Change and Sustainability Program

This program is distinct from the thematic, general, and multidisciplinary programs, but two of its workshops were also part of the thematic program on statistics, i.e., the Workshop on Statistical Methods for Meteorology and Climate Change and the Workshop on Statistical Issues in Forest Management. The reports on these workshops are included in the section Thematic Program. The reader will find below the reports on the three other workshops in the Climate Change and Sustainability Program.

Course
Micromacroscopic Systems: A Viability Approach

September 20 – 24, 2010, CRM

Sponsored by GERAD and the MITACS network

Ce cours fut donné par le professeur Jean-Pierre Aubin, de l'Université Paris-Dauphine. Les chercheurs travaillant en théorie de la viabilité conçoivent et développent des algorithmes pour étudier l'adaptation à des contraintes de viabilité d'évolutions (pas forcément déterministes) provenant de systèmes complexes avec incertitude. La théorie de la viabilité peut prendre en compte des évolutions diverses, incluant celles qui proviennent des équations différentielles ordinaires et des systèmes de commande. Le cours du professeur Aubin porta sur les aspects théoriques et algorithmiques de cette théorie. Les objets fondamentaux de la théorie de la viabilité sont des ensembles. Parmi les notions fondamentales de cette théorie, mentionnons les noyaux de viabilité et les bassins de capture. La notion de bassin de capture est fort utile lorsqu'il y a un but à atteindre. On étudie les propriétés topologiques de ces ensembles sous l'hypothèse que les systèmes évolutionnaires sont semi-compacts supérieurement ou semi-continus inférieurement. Le professeur Aubin accorda une importance particulière aux applications à la finance et aux systèmes dynamiques.

Workshop
Decision Analysis and Sustainable Development

September 27 – 28, 2010, CRM

Sponsored by GERAD, the CRM, the MITACS network, ncm_2, and the Chair in Game Theory and Management (HEC Montréal)

Organizers:
Michèle Breton (HEC Montréal), Odile Marcotte (CRM & UQAM), Christiane Rousseau (Montréal), Georges Zaccour (HEC Montréal)

Invited Speakers:
Jean-Pierre Aubin (Paris-Dauphine), Graciela Chichilnisky (Columbia), Alain Haurie (ORDECSYS), Gerhard Sorger (Wien)

Other Speakers:
Olivier Bahn (HEC Montréal), Michèle Breton, Robert Cairns (McGill), Pablo Andrés Domenech (HEC Montréal), Jacek B. Krawczyk (VUW), Denis Lavigne (CMR Saint-Jean), Ngo Van Long (McGill), Jesús Marín-Solano (Barcelona), Vincent Martinet (INRA), Robeny Bruno Nkuiya Mbakop (Montréal), Emmanuel Prados (INRIA Grenoble), Patrick Saint-Pierre (Paris-Dauphine & VIMADES), Troy Savage (Yale)

Number of participants: 31

Les objectifs de cet atelier étaient de réunir des experts de différentes disciplines afin de présenter les plus récentes avancées en modélisation du développement durable des points de vue climatique, environnemental, social et économique. Les contributions étaient théoriques ou appliquées et portaient sur des outils et des méthodes d'analyse de décision (par exemple l'optimisation, la recherche opérationnelle, la théorie des jeux, les systèmes dynamiques ou l'analyse de risque). Dans sa conférence invitée, Jean-Pierre Aubin présenta une méthode dynamique pour affecter les droits d'émission de substances polluantes. Graciela Chichilnisky introduisit les fondations des probabilités et statistiques comportant des cygnes noirs (c'est-à-dire des évènements très rares pouvant entraîner des risques catastrophiques). Alain Haurie présenta une analyse basée sur la théorie des jeux pour décrire les

mécanismes internationaux d'échanges d'émissions (incluant tous les aspects bancaires et les emprunts). Gerhard Sorger parla des implications de l'équité intergénérationnelle pour l'étude des quasi-ordres des flux infinis d'utilité satisfaisant les axiomes forts de Pareto. L'atelier fut immédiatement suivi d'une table ronde, décrite ci-dessous.

Panel
Sustainable Development and the Contribution of Scientists

September 28, 2010, CRM
Sponsored by ncm_2

Organizer: Christiane Rousseau (Montréal)
Panelists:
Jean-Pierre Aubin (Paris-Dauphine), Graciela Chichilnisky (Columbia), Jean-Pierre Blanchet (UQAM)
Moderator: Sophie-Andrée Blondin (Radio-Canada)

La table ronde aborda le rôle des scientifiques, et plus particulièrement celui des mathématiciens, dans les questions reliées au développement durable. Les panélistes décrivirent l'arrimage de leur recherche à leur intérêt pour le développement durable, envisagé sous ses aspects climatique, environnemental, social et économique. Le lecteur trouvera un article sur cette table ronde dans le *Bulletin du CRM* de l'automne 2010 (à l'adresse http://www.crm.math.ca/rapports/bulletin/bulletin16-2.pdf).

Workshop on Mathematical Challenges for Sustainability

November 15 – 17, 2010, DIMACS, Rutgers
Sponsored by the CRM, DIMACS, IPAM, NIMBioS, PIMS, and SAMSI

Organizers:
Alejandro Ádem (PIMS), Russell Caflisch (IPAM), Lou Gross (NIMBioS), Iain Johnston (président, MPSAC, NSF), Simon Levin (co-author of *Toward a Science of Sustainability*), Fred Roberts (DIMACS), Christiane Rousseau (Montréal), Richard Smith (SAMSI)

This workshop, sponsored by four American institutes and two Canadian ones, was part of the Climate Change and Sustainability Program and a broader program called Mathematics of Planet Earth. These two programs were proposed and initiated by Christiane Rousseau. The CRM was represented at the workshop by two of its members, Christiane Rousseau herself and Jacques Bélair (from the Université de Montréal). The organizers of the workshop had chosen five themes, each of which was studied during the workshop by a subgroup of participants. The resulting white papers have been published in a report by the American Mathematical Society (see http://dimacs.rutgers.edu/SustainabilityReport).

Activities of the Multidisciplinary and Industrial Program

Workshop
Missing Data Approaches in the Health and Social Sciences: A Modern Survey

October 22, 2010, UQAM
Sponsored by the Statistics Laboratory

Organizers:
Geneviève Lefebvre (UQAM), Russell Steele (McGill)
Speakers:
James Carpenter (LSHTM), Ofer Harel (Connecticut), David Haziza (Montréal), Michael Regier (McGill), Grace Yi (Waterloo)
Number of participants: 70

Une grande partie de la recherche moderne en médecine et en sciences sociales nécessite l'analyse de grandes bases de données. Bien que de telles bases de données soient extrêmement précieuses en raison de leur immense quantité d'informations, elles posent des défis aux analystes de données quand la fiche d'un sujet contient de l'information incomplète ou manquante. Il existe un grand clivage entre la communauté de recherche statistique et la communauté de recherche non-statistique en ce qui concerne les méthodes utilisées pour l'analyse de ces données. Bien que les statisticiens aient conçu des méthodes statistiquement correctes et efficaces, plusieurs de ces approches ne sont pas répandues dans la communauté générale. Les statisticiens ont proposé deux types différents d'approches : l'imputation des données manquantes et les méthodes de pondération. Ces deux types d'approches ont des avantages et des inconvénients, mais ils n'ont pas souvent été abordés ensemble dans des publications de recherche. Les désaccords au sein de la communauté statistique ont mené à de

la confusion lors de l'utilisation de ces méthodes, et même les statisticiens appliqués se demandent quelles sont les approches correctes et pratiques pour les problèmes complexes de données manquantes.

Cet atelier inclut cinq présentations qui couvrirent les approches les plus répandues pour l'analyse de données manquantes dans les sciences médicales et sociales. Grace Yi est la récipiendaire du prix CRM-SSC 2010 et a contribué de manière significative au développement des méthodes statistiques pour les études longitudinales et pour l'analyse des données de survie, particulièrement pour le traitement des observations manquantes et les erreurs de mesure. James Carpenter a réalisé un travail extrêmement important, non seulement en statistique, mais également dans le secteur de la santé publique au Royaume-Uni, en démystifiant des méthodes statistiques avancées pour les données manquantes. Il est notamment coauteur d'un rapport du National Institute for Health Research au Royaume-Uni sur l'analyse de données manquantes dans les essais cliniques randomisés. Ofer Harel est un expert en méthodes d'imputation multiple pour les données manquantes et les erreurs de mesure et a un grand intérêt pour les applications à la médecine. Deux chercheurs de Montréal firent également des présentations pendant l'atelier. David Haziza travaille sur les données manquantes dans les analyses d'enquêtes et Michael Regier sur des méthodes de maximum de vraisemblance pour les observations manquantes.

Voici les titres des cinq conférences.

- *Imputation calée robuste dans les enquêtes* (D. Haziza)
- *Données manquantes : questions, méthodes et exemples* (J. Carpenter)
- *Inférences sur l'information manquante sous l'imputation multiple et l'imputation multiple en deux étapes* (O. Harel)
- *Une approche paramétrique générale pour les modèles linéaires généralisés avec des structures de données incomplètes complexes* (M. Regier)
- *Analyse de données incomplètes : quelques questions et méthodes* (G. Yi)

Conference
First North American Meeting on Industrial and Applied Mathematics (NAMIAM10)

December 7 – 10, 2010, Universidad del Mar, Huatulco (Mexico)

Sponsored by the CRM, the Fields Institute, the MITACS network, PIMS, CAIMS, the Sociedad Matemática Mexicana (SMM), SIAM, Conacyt, and the Red de Modelos Matemáticos y Computacionales

Steering Committee:
Gilberto Savillo (UNAM), Isidore Gitler (Cinvestav), Pedro González-Casanova (UNAM), L. Héctor Juárez (UAM Iztapalapa), Uri Ascher (UBC), Barbara Keyfitz (Ohio State), Michael Mackey (McGill), Robert D. Russell (Simon Fraser), Margaret Cheney (Rensselaer), Steve Cox (Rice), Jim Crowley (SIAM), Juan Meza (Berkeley Lab.), Victor Pereyra (Weidlinger Assoc.)

Scientific Committee:
Carlos Coello (Cinvestav), David Romero (UNAM), Uri Ascher, Robert D. Russell, Juan Meza, Victor Pereyra

Local Arrangements Committee:
Victor Ibarra (ESFM-IPN), José Antonio Muñoz Gómez (Guadalajara), Edgar Possani (ITAM), Abel R. Vargas López (UMAR), Yolanda Olvera (UMAR), Martín Zuñiga (UMAR)

Minisymposia Speakers:
V. V. Alexandrov (BUAP), Uri Ascher, Pablo Barrera-Sanchez (UNAM), Olivier Barrière (Montréal), Julian T. Becerra-Sagredo (EPFL & UNAM), Mogens Bladt (UNAM), Gerard Brunick (UT Austin), Gilberto Calvillo (UNAM), Marcos A. Capistrán (CIMAT), Jose Castillo (San Diego State), Xiao-Wen Chang (McGill), M. Chávez (UNAM), Daniel Coombs (UBC), Luis Miguel de la Cruz Salas (UNAM), Alejandro De los Santos (Banco de México), Eric De Sturler (Virginia Tech), Gerda De Vries (Alberta), Carlos Díaz Avalos (UNAM), Eusebius Doedel (Concordia), Tony Drummond (Berkeley Lab.), Mark Embree (Rice), Antonio Flores (Iberoamericana), A. Fraguela (BUAP), Eliot Fried (McGill), Omar Ghattas (UT Austin), Roland Glowinski (Houston), Martin Golubitsky (Ohio State), Susana Gómez (UNAM), José Luís González Velarde (Tecnológico de Monterrey), Alexandre Grebennikov (BUAP), Chen Greif (UBC), Boyce Griffith (NYU), Chun-Hua Guo (Regina), Robert D. Guy (UC Davis), Eldad Haber (UBC), Meng Han (Toronto), Martin B. Haugh (Columbia), Onésimo Hernández (Cinvestav), Diego Hernández Rangel (ITAM), Marco Arieli Herrera-Valdez (Arizona State), Huaxiong Huang (York), Tom Hurd (McMaster), Nicholas Kevlahan (McMaster), Drew Kouri (Rice), Michael P. Lamoureux (Calgary), Juan Carlos Leyva López (Occidente Culiacán), Humberto Madrid (UA Coahuila), Patrice Marcotte (Montréal), Susan Margulies (Rice), Oumar Mbodji (McMaster), David McDonald (Ottawa), Ramsés H. Mena (UNAM), Rafael Mendoza-Arriaga (UT Austin), Stephen J. Merrill (Marquette),

Michael Minion (UNC — Chapel Hill), Miguel Ángel Moreles (CIMAT), Fahima Nekka (Montréal), Monika Nitsche (New Mexico), Daniel Olmos Liceaga (Sonora), Pablo Padilla (Complutense), Victor Pereyra, Francis Poulin (Waterloo), Maurice Queyranne (UBC), Eduardo Ramos (UNAM), Juan M. Restrepo (Arizona), Vicente Rico-Ramírez (IT Celaya), Roger Z. Ríos-Mercado (UA Nuevo León), Yasmín A. Ríos Solís (UA Nuevo León), Marianito R. Rodrigo (ITAM), Eliane R. Rodrígues (UNAM), Steve Ruuth (Simon Fraser), Patricia Saavedra (UAM Iztapalapa), Thomas S. Salisbury (York), Moisés Santillán (Cinvestav), Gilles Savard (Polytechnique Montréal), Volker Schulz (Trier), Luis Seco (Toronto), Michael Siegel (New Jersey IT), John Stockie (Simon Fraser), Bruce R. Sutherland (Alberta), Daniel B. Szyld (Temple), Brenda Tapia Santos (Veracruzana), Jose-Gerardo Tinoco-Ruiz (UMSNH), Ekaterina Todorova Kolkovska (CIMAT), Erick Treviño-Aguilar (Guanajuato), Gunther Uhlmann (Washington), Kees van den Doel (UBC), Luis Verde-Star (UAM Iztapalapa), Karen Willcox (MIT), Hao Xing (LSE), Ruriko Yoshida (Kentucky), Ana Cecilia Zenteno (Columbia)

In August, 2008, officials from the Mexican Mathematical Society (SMM) expressed interest in organizing a joint SMM/CAIMS/SIAM meeting in Mexico in 2010. As a result, Professor Bob Russell was approached by Alejandro Ádem and in turn approached the CAIMS Board in early Fall about the proposed meeting. The CAIMS Board gave unanimous approval to proceed with plans for the meeting. A Steering Committee was struck, with equal representation from each of the 3 participating countries. The Canadian representatives were Uri Ascher, Barbara Keyfitz, Michael Mackey, and Robert D. Russell. The result of this Steering Committee's planning was the First North American Meeting on Industrial and Applied Mathematics. The following description is based on a report by Professor Bob Russell.

The primary intention of the meeting was to bring together applied computational scientists, mathematicians, researchers, and students with interdisciplinary interests, from Canada, the United States, and Mexico. Among the purposes of the meeting was the enhancement and strengthening of academic relations between the three countries with respect to applied and industrial mathematics. The meeting was organized around eight minisymposia on research topics in applied mathematical fields (chosen by the local organizers, largely to highlight research strengths in Mexico). Additional topics were discussed in the general session and the poster session. For all minisymposia on the chosen topics, the talks were by invitation. We refer the reader to the meeting website (http://www.smm.org.mx/namiam10/).

The meeting began with welcoming remarks from representatives of the three participating countries (in the Canadian case, Michael Mackey), after which people were feted by our hosts at an outdoor reception on the beautiful university campus. The opening talk (on Separable Least Squares) was given by Victor Pereyra. The other scheduled invited talks were from Canadians Mary Pugh (on Fluids) and Eldad Haber (on Inverse Problems), Mexicans Onésimo Hernández (on Applied Probability) and Gilberto Calvillo (on Financial Mathematics), and Americans Roland Glowinski (on PDEs) and Gunther Uhlmann (on Inverse Problems). Mary Pugh was at the last minute unable to attend, and Barbara Keyfitz kindly filled in and spoke about some of her own work on PDEs. These invited talks were well attended and of a very high standard.

There were two special sessions, one in which John Stockie gave an animated presentation on industrial mathematics and the Canadian experience through MITACS. It was met with great interest from the participants, particularly the Mexicans. The other session brought together a panel of individuals from each of the three countries who discussed opportunities in applied mathematics from a general perspective. As one colleague pointed out, it was intriguing to note that Mexican applied mathematicians and statisticians suffer from the same constraints as those in Canada. Since the Mexican economy is to some extent a branch plant economy, the local industry tends to look to the United States for research and development, and in spite of the favourable treatment of mathematicians and statisticians under the free trade agreement, it is still hard to overcome this prejudice.

There was a clear consensus that the minisymposia were of very high quality. They were organized in parallel streams, which often made it difficult for the participants to have much time for discussions; nevertheless, it was possible to attend several minisymposia. One colleague having attended the sessions in CFD, Numerical Analysis, and Mathematical Biology commented that while covering a pretty broad range of topics, the minisymposia still focused on a couple of specific areas, which kept them interesting.

Here is a list of the minisymposia and their Canadian organizers (each minisymposium also had an SMM organizer and a SIAM organizer): *Optimization and Operations Research* (Patrice Marcotte); *Inverse Problems and Control* (Uri Ascher); *Oil, Weather and Geoscience Modelling* (Nicholas Kevlahan); *Biomathematics* (Michael Mackey); *Applied Probability and Statistics* (David McDonald); *Financial Mathematics and Economy* (Tom Salisbury); *Computational Fluid Dynamics* (John Stockie); *Numerical Analysis and Linear Algebra* (Chen Greif and Robert D. Russell).

There were cancellations of talks by some lecturers in certain minisymposia (in part because of the bankruptcy of the main Mexican airline…). In spite of this, the talks given in the optimization and operations research minisymposium were of very high quality and those in attendance commented that the minisymposium was a thoroughly enjoyable one. In the minisymposium on inverse problems and control, U. Ascher reported that some excellent talks were given, including those by K. van den Doel and O. Ghattas, and that he had very fruitful discussions with those speakers as well as with N. Kevlahan, S. Gómez, and V. Pereyra.

In the minisymposium on oil, weather, and geo-science modelling, N. Kevlahan spoke about a new dynamically adaptive wavelet method being developed for the dynamical core of the next generation of climate models, and Francis Poulin gave a talk on the three-dimensionalization of a barotropic instability in ocean flows. The Mexican participants concentrated on the geo-science part of the minisymposium, and it was interesting to see the strengths of Mexican applied mathematics in modelling earthquakes and oil reservoirs. M. Moreles presented a problem related to porous medium diffusion in oil well reservoirs, M. Chávez showed impressive supercomputer 3-D simulations of earthquakes, and S. Gómez showed how optimization techniques can be used to characterize the structure of fractured oil reserves. The two U.S. participants were J. Castillo, who described a new general curvilinear coastal ocean model, and T. Drummond, who presented new software tools for geophysical applications.

For the biomathematics minisymposium, M. Mackey reported that the Canadian contingent (consisting of D. Coombs, G. De Vries, and O. Barrière) provided three extremely interesting lectures about quite diverse areas. The minisymposium was of particular value since it offered a chance to learn about the work of previously unfamiliar Mexican colleagues and about the recent work of U.S. colleagues. In the minisymposium on applied probability and statistics, the presentations by Mexican researchers were of a high level. They included a presentation on the construction of a continuous-parameter sequence of random probability measures and its application in continuous-time nonparametric modelling; a presentation concerned with the goal of reducing the number of pollution alerts in the whole of Mexico City when the excess levels were concentrated in specific problem areas; and a presentation on a spatio-temporal model for lightning-caused forest fire ignitions. The talk by Mogens Bladt on classical phase-time distributions and the extension to heavy-tailed distributions was particularly clear and interesting.

The minisymposium on financial mathematics and economy featured 12 talks. The audience was lively and engaged the speakers in discussion. Despite some cancellations, there were four speakers from Canada: two professors (T. Hurd and T. Salisbury) and two students (Meng Han and O. Mbodji). In the minisymposium on computational fluid dynamics, there were two speakers from Canada (F. Poulin and J. Stockie). F. Poulin's presentation described an application of spectral methods in the simulation of shear flows in the atmosphere to the study of the nonlinear stability of vortical structures. J. Stockie presented a porous medium model for sap flow in trees, along with numerical simulations that are used to assist the Canadian maple syrup industry in developing optimal harvesting methods. Other talks in the CFD minisymposium focused on immersed boundary simulations for fluid-structure interaction, algorithms for interfacial flows, flow in porous media, and parallel algorithms.

The themes of the minisymposium on numerical analysis and linear algebra were centred around recent developments in numerical analysis, scientific computing, and numerical linear algebra. It included 14 talks, presented in 5 sessions spanning the course of two days. The sessions were very well attended and the talks featured a remarkably diverse range of topics, from numerical linear algebra, to various flavours of the numerical solution of differential equations, to challenging applications. Each session featured speakers from each of the three participating countries and the sessions were scheduled to ensure that there was a high level of diversity in each of the individual ses-

sions, which contributed to the good attendance level. In summary there was a consensus that the meeting had been a great success and that it would be worthwhile to hold similar meetings in the future.

1st Québec – Ontario Workshop on Insurance Mathematics

January 28, 2011, UQAM
Sponsored by the Statistics Laboratory, the CRM, the ISM, UQAM, and the MITACS network

Organizers:
Andrei L. Badescu (Toronto), David Landriault (Waterloo), Manuel Morales (Montréal), Jean-François Renaud (UQAM)
Speakers:
Jean-Philippe Boucher (UQAM), Arthur Charpentier (Rennes 1), Edward Furman (York), Lan Gong (Toronto), Cody Hyndman (Concordia), Joseph Kim (Waterloo), Ghislain Léveillé (Laval), Romuald Hervé Momeya Ouabo (Montréal), David Stanford (Western Ontario), Gordon E. Willmot (Waterloo), Amin Hassan Zadeh (Western Ontario)
Number of participants: 63

Le but de cet atelier était d'établir un point de rencontre pour les chercheurs et les étudiants de l'Est canadien. En effet, la communauté de recherche en mathématiques actuarielles a rarement l'occasion de se réunir au Canada, ce qui limite les interactions entre des groupes qui sont géographiquement proches. Notez que des 63 participants, 30 étaient des étudiants ou stagiaires postdoctoraux.

L'atelier a été un franc succès et correspondu à nos attentes et à celles des participants. La première activité liée à l'atelier a eu lieu la veille sous la forme d'un cocktail de bienvenue pour les conférenciers invités. La première journée de l'atelier proprement dit a commencé à 9h00 et consisté de deux sessions en avant-midi et deux autres en après-midi. La conférence d'ouverture a été donnée par le professeur Gordon Willmot, un des chercheurs les plus reconnus au Canada en théorie de la ruine. Il représentait un des plus grands programmes universitaires d'actuariat au Canada, celui de l'Université de Waterloo. L'atelier a aussi bénéficié de la participation de chercheurs de toutes les grandes universités ontariennes et québécoises. Les conférences portaient sur différents problèmes à la fine pointe des mathématiques de l'assurance. En particulier, mentionnons (entre autres) des problèmes divers en finance, mortalité, modélisation statistique et tarification de produits, allocation de capital, et crédibilité. Les chercheurs participants représentaient un échantillon assez varié de chercheurs travaillant sur les aspects pratiques ou théoriques des mathématiques actuarielles.

L'ambiance décontractée et le nombre raisonnable de participants ont encouragé les étudiants à participer davantage aux échanges et leur a permis de rencontrer des chercheurs reconnus ainsi que d'autres étudiants, en particulier pendant le déjeuner (à midi). Un moment émouvant a eu lieu juste avant la pause-café de l'après-midi. Le comité organisateur a décidé de rendre hommage à un doctorant de l'Université Laval décédé tragiquement en décembre dernier. Florent Toureille était sur le point de terminer sa thèse de doctorat sous la direction de notre collègue Hélène Cossette et il était censé participer à l'atelier. Nous avons voulu qu'il soit présent symboliquement. Hélène Cossette a prononcé quelques mots qui ont permis à tous de connaître un peu qui était Florent. Juste après ces quelques mots, l'auditoire a observé une minute de silence en l'honneur de Florent, suivie d'une minute d'applaudissements en soutien de sa veuve qui était dans la salle. Cette parenthèse dans la journée a donné une dimension plus humaine à l'atelier.

Voici les titres des conférences données pendant l'atelier.

- *Past and Present Trends in Aggregate Claims Analysis* (G. Willmot)
- *Evaluation of Participating Insurance Policies* (C. Hyndman)
- *A Statistical Use of Discrete Data in Actuarial Sciences* (J.-P. Boucher)
- *Recursive Methods for Two-Dimensional Risk Processes with Common Shocks* (L. Gong)
- *On the CTE-based Risk Capital Allocation Rule for Dependent Risks* (E. Furman)
- *One-year Uncertainty in Claims Reserving* (A. Charpentier)
- *The Use of Phase-Type Models for Disability Insurance Calculations* (A. Zadeh)
- *Moments and Joint Moments of Bivariate Discounted Compound Renewal Sums* (G. Léveillé)
- *Visualizing Risk Contribution, Performance, and Diversification in a Financial Conglomerate* (J. Kim)
- *The Minimal Entropy Martingale Measure* (*MEMM*) *for a Markov-Modulated Exponential Lévy Model* (R. Momeya)

- *Credibility and Phase-Type Distributions* (D. Stanford)

En conclusion, la petite communauté de chercheurs et d'étudiants en mathématiques actuarielles de l'Est canadien a pu se réunir pour la première fois afin d'échanger sur des sujets d'intérêt commun. Les premières retombées de cette activité sont déjà visibles. En effet, les étudiants des cycles supérieurs ayant participé à l'atelier ont pu se parler de leurs progrès et expériences individuelles et ont aussi eu la possibilité d'échanger avec des chercheurs plus expérimentés. Deux étudiants ont pu présenter leurs travaux à l'auditoire, ce qui leur a permis de profiter des commentaires de l'auditoire (qu'ils pourront intégrer à leurs thèses). Des retombées à plus long terme sont aussi attendues. Nous souhaitons que cet atelier se tienne chaque année et qu'il devienne le point de rencontre par excellence en mathématiques actuarielles au Canada. Le groupe de l'Université de Toronto s'est d'ailleurs porté volontaire pour organiser la deuxième édition de cet atelier.

MITACS Day on the Practice of Actuarial Science (Finsurance Project)

March 16, 2011, DMS, Montréal

Sponsored by the Statistics Laboratory, the CRM, and the MITACS network

Organizers:

Jean-François Angers (Montréal), Manuel Morales (Montréal)

Speakers:

Clément Brunet (Cooperators), Nicolas Chapados (APSTAT Technologies), Frédéric Godin (HEC Montréal), Guillaume Lemire (Montréal), Sylvain Pannetier-Lebeuf (Montréal), Catherine Paradis-Therrien (TD Assurance)

Number of participants: 35

Les étudiants constituaient la majorité des participants de cette journée, dont le but était d'établir un point de rencontre pour les chercheurs industriels et les étudiants en actuariat et statistique. Cette journée de conférences a rassemblé non seulement les différents partenaires et étudiants du projet Finsurance mais aussi des personnes s'intéressant à la pratique actuarielle et financière. Le projet Finsurance de MITACS est un projet interuniversitaire de recherche en mathématiques financières et actuarielles. Le projet est financé par MITACS et il rassemble quatre universités canadiennes : l'Université de Montréal, la University of Toronto, la York University et la University of Waterloo. Le projet Finsurance promeut des initiatives pour que les étudiants approfondissent leur connaissance de la pratique actuarielle ayant lieu dans les milieux universitaires et industriels. Le lecteur désirant en savoir plus sur le projet Finsurance peut consulter la page http://www.math.yorku.ca/finsurance/.

Le programme de la journée consistait de trois présentations de 50 minutes chacune, faites par des praticiens de l'actuariat, et de trois présentations de 30 minutes chacune, faites par d'anciens stagiaires. Les praticiens ont parlé des défis qu'ils rencontrent et des outils mathématiques et statistiques qu'ils utilisent. Les anciens stagiaires ont parlé de leurs expériences respectives au sein du projet. La journée a été un franc succès et a répondu aux attentes des organisateurs et des participants.

CRM Prizes

The CRM created and administers, either alone or jointly, four of the eight major national prizes in the mathematical sciences, namely: the CRM – Fields – PIMS Prize, the Prize for Theoretical Physics awarded in collaboration with the Canadian Association of Physicists (CAP), the Prize for young researchers in Statistics awarded jointly with the Statistical Society of Canada (SSC), and the CRM André-Aisenstadt Prize awarded to rising young Canadian stars, selected by the CRM's Scientific Advisory Panel. The CRM has invested enormous time, effort, and resources to propel leading Canadian scientists into the spotlight, helping them gain international recognition when they most need it.

CRM – Fields – PIMS Prize 2011 Awarded to Mark Lewis

Mark Lewis

Mark Lewis holds a Canada Research Chair in Mathematical Biology and is the Director of the Centre for Mathematical Biology at the University of Alberta. His research involves mathematical modelling of biological processes and is an example of the best interplay of science and mathematics, where ideas from each discipline lead to advances in the other. Mark Lewis's work develops techniques in stochastic processes, dynamical systems, and partial differential equations and has led to significant advances, for example, in modelling territorial pattern formation in wolf populations, in predicting population spread in biological invasions like the West Nile virus, and in assessing the effect of habitat fragmentation on species survival.

A report on the CRM – Fields – PIMS Prize lecture given by Professor Lewis may be found in *Le Bulletin du CRM* (Fall 2011).

The CRM – Fields – PIMS Prize

This prize was established in 1994 as the CRM – Fields Prize to recognize exceptional research in the mathematical sciences. In 2005, PIMS became an equal partner in the awarding of the prize and its name was changed to the CRM – Fields – PIMS Prize. A committee appointed by the three institutes chooses the recipient. The previous recipients of the prize are H. S. M. (Donald) Coxeter (1995), George A. Elliott (1996), James Arthur (1997), Robert V. Moody (1998), Stephen A. Cook (1999), Israel Michael Sigal (2000), William T. Tutte (2001), John B. Friedlander (2002), John McKay (2003), Edwin Perkins (2003), Donald A. Dawson (2004), David Boyd (2005), Nicole Tomczak-Jaegermann (2006), Joel S. Feldman (2007), Allan Borodin (2008), Martin Barlow (2009), and Gordon Slade (2010).

André-Aisenstadt Prize 2011 Awarded to Joel Kamnitzer

Dr. Kamnitzer obtained his B.Sc. in Mathematics at the University of Waterloo in 2001 and his Ph.D. at the University of California, Berkeley in 2005, under the supervision of Allen Knutson. He held a prestigious AIM Five-Year Fellowship as well as postdoctoral positions at MIT, MSRI, and the University of California, Berkeley. He has been a professor at the University of Toronto since 2008. Dr. Kamnitzer has made substantial and deep contributions to the field of geometric representation theory and related topics. We mention here three of his more important contributions, on rather different topics. In his thesis, recently published in the *Annals of Mathematics*, he relates formulae developed in representation theory by Berenstein – Zelevinsky to the theory of Mirkovic – Vilonen polytopes as introduced by Anderson. In the process he elucidates a number of enigmatic features of these important topics.

Joel Kamnitzer

A second impressive body of work is carried out mainly in collaboration with S. Cautis but also with A. Licata. It has appeared in *Inventiones Mathematicae* and the *Duke Mathematical Journal*. This work is part of a program to pursue the cate-

gorification of Khovanov's knot invariants. It sheds light on the potential categorification of the geometric Satake equivalence and is also related to mirror symmetry problems. Finally, together with P. Etingof, A. Henriques, and E. Rains (in a contribution recently published in the *Annals of Mathematics*), he has explored the algebraic topology of the real locus of the moduli space of stable curves of genus 0 with marked points. In particular this article computes the rational cohomology of this space as well as the 2-local torsion in its cohomology.

An article of Joel Kamnitzer on his research work may be found in *Le Bulletin du CRM* (Fall 2011).

The André-Aisenstadt Prize

Created in 1991, the André-Aisenstadt Mathematics Prize is intended to recognize and reward research achievements in pure and applied mathematics by talented young Canadian mathematicians. This prize consists of a $3,000 award and a medal. The recipient is chosen by the International Scientific Advisory Committee of the CRM. At the time of consideration, candidates must be Canadian citizens or permanent residents of Canada, and no more than seven years from their Ph.D.

The previous recipients of the André-Aisenstadt Prize are Niky Kamran (1992), Ian Putnam (1993), Michael Ward (1995), Nigel Higson (1995), Adrian S. Lewis (1996), Lisa Jeffrey (1997), Henri Darmon (1997), Boris Khesin (1998), John Toth (1999), Changfeng Gui (2000), Eckhard Meinrenken (2001), Jinyi Chen (2002), Alexander Brudnyi (2003), Vinayak Vatsal (2004), Ravi Vakil (2005), Iosif Polterovich (2006), Tai-Peng Tsai (2006), Alexander E. Holroyd (2007), Gregory G. Smith (2007), József Solymosi (2008), Jonathan Taylor (2008), Valentin Blomer (2009), and Omer Angel (2010).

CAP – CRM Prize 2011 Awarded to Robert Brandenberger

Robert Brandenberger

Professor Brandenberger (McGill University) was awarded the CAP – CRM Prize 2011 for his pioneering contributions in the area of theoretical cosmology, especially the interplay of particle physics and cosmology. He is one of the leading theoretical cosmologists in the world and is well known for his contributions to areas such as String Cosmology (a field where he is considered a founding father), cosmological fluctuations, preheating, and trans-Planckian physics. Observational and experimental cosmology has over the past years entered a "golden age," because of an unprecedented data acquisition rate on the structure of our Universe. Robert Brandenberger has remained at the forefront of this revolution and has in fact generated a large portion of this excitement through his very own research effort. It is remarkable that his theoretical work remains closely connected with the rapid pace of experimental developments. Robert Brandenberger has authored an abundance of authoritative articles on the many facets of theoretical cosmology, including several that have become classic references. With over 200 published articles, Robert Brandenberger's extensive work straddles particle physics and astrophysics and is consistently of very high quality. He is a creative and prolific scientist and one of Canada's most cited theoretical physicists. Professor Brandenberger's work was also recognized by a Killam Research Fellowship, a Canada Research Chair, and a Fellowship of the American Physical Society.

The CAP – CRM Prize

The Centre de recherches mathématiques (CRM) and the Canadian Association of Physicists (CAP) created in 1995, on the occasion of the 50th anniversary of the CAP, a joint prize for recognizing exceptional achievements in theoretical and mathematical physics. The prize consists of a $2,000 award and a medal.

The previous recipients of the prize are Werner Israel (1995), William G. Unruh (1996), Ian Affleck (1997), J. Richard Bond (1998), David J. Rowe (1999), Gordon W. Semenoff (2000), André-Marie Tremblay (2001), Pavel Winternitz (2002), Matthew Choptuik (2003), Jiří Patera (2004), Robert Myers (2005), John Harnad (2006), Joel S. Feldman (2007), Richard Cleve (2008), Hong Guo (2009), and Clifford Burgess (2010).

CRM – SSC Prize 2011 Awarded to Edward Susko

Edward Susko

Edward Andrew Susko, Professor in the Department of Mathematics and Statistics at Dalhousie University, is the 2011 winner of the CRM – SSC Prize. Edward Susko has been at the forefront of the development of probabilistic and statistical methods across the fields of genetics and computational biology, and is recognized as an international leader. Alongside work published in the mainstream statistics literature, his articles have appeared in some of the most influential journals in the field (*Proceedings of the National Academy of Sciences*, *Molecular Biology and Evolution*, *Journal of Theoretical Biology*). His important contributions, highly cited and recognized as foundational by world-leading experts, include work on statistical phylogenetics, comparative genomics, and molecular evolution. His recent results concerning the application of the bootstrap to phylogenetics (where it is perhaps the most widely used computational tool) and the development of theoretical results related to likelihood estimation have the potential of changing completely the way that molecular phylogenetics is practiced and interpreted worldwide.

A native of the Windsor area in Ontario, Edward Susko earned a B.A. in Mathematics from the University of Windsor in 1990. He then moved to the University of British Columbia where he earned a M.Sc. in Statistics in 1992. His Ph.D. in Statistics was completed in 1996 at the University of Waterloo. His Ph.D. thesis won the Pierre-Robillard Award of the SSC in 1996. Edward Susko has continually produced research work of the highest quality. In 2001 he received the *Canadian Journal of Statistics* Award from the SSC. More recently, he was nominated Fellow of the CIAR Program in Evolutionary Biology (2005 – 2007). Edward Susko credits much of his success to fruitful and enjoyable collaborations with Andrew Roger and other members of the vibrant evolutionary bioinformatics community at Dalhousie.

A detailed description of the contributions of Professor Susko may be found in *Le Bulletin du CRM* (Fall 2011).

The CRM – SSC Prize

The SSC, founded in 1977, is dedicated to the promotion of excellence in statistical research and practice. The prestigious CRM – SSC Prize, jointly sponsored by the SSC and the CRM, is given each year to a Canadian statistician in recognition of outstanding contributions to the discipline during the recipient's first 15 years after earning a doctorate.

Edward Susko is the thirteenth recipient of the CRM – SSC Prize. The previous winners of the award are Christian Genest (1999), Robert J. Tibshirani (2000), Colleen D. Cutler (2001), Larry A. Wasserman (2002), Charmaine B. Dean (2003), Randy Sitter (2004), Jiahua Chen (2005), Jeffrey Rosenthal (2006), Richard Cook (2007), Paul Gustafson (2008), Hugh Chipman (2009), and Grace Y. Yi (2010).

The CRM Outreach Program

The CRM is eager to fulfill the public's desire for understanding the latest developments in the mathematical sciences. To this end, the CRM initiated in the spring of 2006 a series of lectures called the *Grandes Conférences du CRM*, which feature outstanding lecturers able to convey the beauty and power of mathematical research to a wide audience. The *Grandes Conférences du CRM* are now well established and there were three lectures geared towards a general audience in 2010 – 2011: a lecture by Professor Cédric Villani on November 5, 2010, a lecture by Professor Andrew Granville on March 29, 2011, and a lecture by Professor Doug Arnold on May 6, 2011. The three lectures took place at the Université de Montréal. The reader will find summaries of these lectures below. Each Grande Conférence attracted hundreds of people of all ages, and was followed by a "vin d'honneur" that enabled the participants to ask questions, reconnect with friends and colleagues, and meet people interested in mathematics and science in general.

In 2010 – 2011, the *Grandes Conférences* program was under the stewardship of Christiane Rousseau and Yvan Saint-Aubin, professors at the Département de mathématiques et de statistique of the Université de Montréal.

When the Earth Was Too Young for Darwin

Cédric Villani (Institut Henri-Poincaré & Université Claude Bernard Lyon 1)

by Christiane Rousseau (Université de Montréal)

Cédric Villani

Cédric Villani's lecture attracted a record audience, including many college students. Its topic was the history of computations for determining the age of the Earth. Cédric Villani introduced the various protagonists in this field, beginning with James Usscher, an Anglican prelate, then going on to de Buffon and Newton, and focusing in the end on a period starting in the middle of the 19th century. He introduced William Thomson, better known as Lord Kelvin, the greatest physicist of his time and a great inventor. Among other inventions let us mention Kelvin's harmonic analyzer and Kelvin's galvanometer. Kelvin's work on the age of the Earth lasted from 1862 to 1897. To evaluate the age of the Earth, he used the following argument: when the Earth was formed, it was a mass in fusion. As time went on the Earth cooled and its crust became thicker.

In order to compute the time required for the observed cooling, Lord Kelvin used the heat equation due to Joseph Fourier. The lecturer introduced this equation and succeeded admirably in conveying to his audience the concepts of partial derivative and partial derivative of order 2. How does one use this equation? Joseph Fourier showed that one could compute its exact solution provided the following assumptions held: the Earth's curvature is negligible; there is no heat source; the Earth is a solid uniform ball; the initial temperature is uniform; the surface temperature is uniform. Lord Kelvin decided to use this model for computing the age of the Earth. The mining industry enables one to estimate the temperature gradient across the Earth's crust. By making assumptions about the initial values of conductivity and heat, Kelvin concluded that the Earth was between 40 million and 200 million years old. This estimate was corroborated by Kelvin's estimate of the age of the Sun, based on an energy balance.

Cédric Villani then resumed his historical survey by describing the various controversies between physicists (principally Lord Kelvin), geologists, and Darwin, the founder of the Theory of evolution. A major scientific crisis was the result of those controversies. Indeed Darwin's theory required the age of the Earth to be at least 500 million years. Geologists had also reached the conclusion that the Earth had a much greater age than that advanced by Kelvin. In front of an audience glued to his words, Cédric Villani painted portraits of the scientists involved and gave detailed accounts of the controversies.

The lecturer then returned to the heart of the matter, namely the true age of the Earth. He explained that

Kelvin's first error lay in not taking account of the convective movements with the Earth's mantle. These movements, which take place continually within the magma, bring the magma (which has a very high temperature) into contact with the Earth's crust, which is cooling. This process slows down the formation of the crust and ensures that a steep temperature gradient persists across the crust. John Perry, a former assistant of Kelvin, revised his computations by assuming that the Earth's solid crust lay above a fluid mantle of almost constant temperature (because of convective movements). With those assumptions, the computations allowed him to conclude that the age of the Earth was between 2 and 3 billion years and to reconcile the physicists' estimation and that of geologists.

Perry's results were published in the journal Nature in 1895 but were not well received. The proposal of a fluid mantle was a revolutionary one during that period and most scientists believed that the Earth was solid until the 1960s. The idea of continental drift was finally accepted in the 1960s. In 1904 the work of Rutherford revealed that another of Kelvin's hypotheses was wrong, namely the hypothesis that there is no heat source. Indeed radioactive decay in the Earth's mantle raises the temperature of the mantle. Rutherford's computations, which were based on radioactive decay but ignored convective movements, enabled him to conclude that the age of the Earth was 4.6 billion years.

Cédric Villani's lecture was dazzling and the audience was mesmerized by it. At the end of the lecture, many young people approached him to ask questions and had their pictures taken with him. Cédric Villani is known for his popularization of mathematics and presentations geared toward a broad audience may be found on his web site. We are very grateful to him for having shared his passion for mathematics and science with the Montréal public.

MSI: Anatomy of Integers and Permutations
Andrew Granville (Université de Montréal)

by Benoit Larose (Champlain College Saint-Lambert & Concordia University)

Andrew Granville

On March 29, 2011, we had the pleasure to attend a *Grande Conférence du CRM* given by Andrew Granville, from the Université de Montréal. Yvan Saint-Aubin, one of the co-organizers of the *Grandes Conférences*, reminded us of the highlights of Andrew Granville's career. Born in England, Granville studied at the University of Cambridge and then obtained his Ph.D. from Queen's University in Kingston, Ontario, where his advisor was Paolo Ribenboim. After spending two years at the University of Toronto and the two following years at the Institute for Advanced Study, he became a professor at the University of Georgia and then, in 2002, at the Université de Montréal (where he holds a Canada Research Chair in Number Theory). He was elected a Fellow of the Royal Society of Canada in 2006 and was awarded the Hasse Prize (1995), the Lester R. Ford Prize (2007), and the Chauvenet Prize (2008) of the Mathematical Association of America.

Recently Andrew Granville wrote a play entitled *MSI* (*Mathematical Science Investigation*): *Anatomy of Integers and Permutations*, in collaboration with his sister Jennifer Granville. This play is a mathematical and scientific "crime play" and it was presented at the Institue for Advanced Study in Princeton. The play was conceived during a Banff Centre workshop attended by scientists and artists in 2004 and was also performed on April 29, 2011, at MSRI (Berkeley, California). A cartoon version of the play, realized with Robert J. Lewis (an illustrator from Toronto), will be published in 2013 by Princeton University Press. The *Grande Conférence* by Andrew Granville consisted of a presentation, intended for a broad audience, of the mathematical ideas underlying his play.

In the play, two cadavers are discovered: that of Arnie Integer, a political candidate, and that of Daisy Per-

mutation, a ballerina. A team of medico-legal experts is given the task of analyzing the bodies: Professor Gauss and his assistants will dissect the integer and the permutation in order to determine their structure. But what can an integer and a permutation have in common? The fundamental theorem of arithmetic asserts that each integer can be decomposed in a unique way as a product of prime numbers. One can think of this decomposition as the DNA of the integer. On the other hand, any permutation can be decomposed in disjoint cycles, and again the decomposition is essentially unique (and can be viewed as the DNA of the permutation). Are we witnessing an analogy or is there something deeper to investigate?

In order to try to answer this question, one must first find the right calibration: what is the proportion of indecomposable integers, i.e., of prime numbers? And what is the proportion of indecomposable permutations, i.e., of cycles? It is not difficult to see that the proportion of cycles among permutations on N symbols is $1/N$. The analogous question for prime numbers is much more difficult: in 1793, when he was 16 years old, Gauss conjectured that the number of primes that are at most x is approximately $1/\log x$, a result that was proved independently by Hadamard and de la Vallée Poussin in 1896. Hence the proposed calibration is the following: N in the case of permutations and $\log x$ in the case of integers. Granville then presented a series of results using this thread. First one computes the proportion of permutations that can be decomposed into exactly k cycles. One obtains the formula

$$\sim \frac{1}{N}\frac{(\log N)^{(k-1)}}{(k-1)!}.$$

For integers N must be replaced by $\log x$ and one obtains the formula

$$\sim \frac{1}{\log x}\frac{(\log\log x)^{(k-1)}}{(k-1)!},$$

which turns out to be the proportion of integers with exactly k prime factors (a result proved by Hardy and Ramanujan in 1917).

The typical permutation on N symbols can be decomposed into approximately $\log N$ disjoint cycles; as expected a typical integer has approximately $\log\log x$ prime factors. Of course some permutations have one cycle only in their decomposition, others have N cycles, and in a similar fashion some integers have few prime factors while others (for instance $2\times 3\times 5\times 7\times\cdots$) have many prime factors. What is then the *distribution* of the number of disjoint cycles for permutations and the distribution of prime factors for integers? In the case of permutations the number of disjoint cycles follows a normal distribution with a mean and variance approximately equal to $\log N$; the number of prime factors follows a normal distribution with a mean and variance approximately equal to $\log\log x$ (this last result is known as the Erdős – Kac theorem).

One may also ask about the length of cycles in the decomposition of a permutation or about the prime numbers in the factorization of an integer. If we have $\log N$ cycles whose lengths add up to N, what can we say about their lengths? It turns out that the "logarithm" of the cycle length follows a Poisson point process (on the interval $[0,\log N]$), the distribution that arises in the modelling of the spacing of random numbers on the real line or cars on the highway, the modelling of customers' arrival times in a queue, or the modelling of radioactivity in a specific radioactive material. The logarithm of the logarithm of a prime in the factorization of a typical integer also follows a Poisson process distribution on $[0,\log\log x]$.

Andrew Granville then observed that the results presented so far in his lecture, which highlight the similarities between the anatomy of permutations and the anatomy of the integers, concerned the number and size of the components, which follow a random distribution. Therefore these similarities need not surprise us. What about the properties of permutations and integers that are not as standard as "number" and "size"? One still find similarities, for instance when considering permutations that do not contain small cycles. The proportion of permutations on N symbols that do not contain a cycle of length less than N/u equals $u\omega(u)/N$, where $\omega(u)$ denotes the Buchstab function (used in the modelling of the brain). In the same fashion the proportion of integers that are at most x and have no prime factor p with $\log p < (\log x)/u$ equals $u\omega(u)/\log x$. If one considers the permutations with no large cycle and the integers with no large prime factor, the similarity between distributions can also be observed: in that case the distributions are related to the Dickman function, used in cryptography.

After his lecture Andrew Granville answered a few questions skillfully and the evening ended with a "vin d'honneur" in the beautiful hall of the Jean-Coutu Pavilion.

Mathematics that Swings: The Math behind Golf
Doug Arnold (University of Minnesota)
by Christiane Rousseau (Université de Montréal)

Doug Arnold

Doug Arnold's lecture was part of a popularization activity called 24 *heures de science*. In 2011 the CRM and the ISM took part for the second time (the first time being 2010) in this day of activities related to science and technology and geared towards all age groups (children, teenagers, young adults, families, retirees, etc.). The "24 hours of science" start at noon on a Friday and include activities during the evening and the night. Between Friday, May 6, at noon and Saturday, May 7, at noon, at least 260 scientific activities took place in the province of Québec, including the *Grande Conférence* by Doug Arnold, which followed some mathematical animations. Hélène Péloquin-Tessier commented Doug Arnold's video (entitled *Möbius transformations*). Philippe Carphin presented his video on the completion of Escher's engraving (*Exposition d'Estampes*). Christian Côté illustrated the mathematics of juggling and Jean-François Gagnon commented an animation by Yvan Saint-Aubin on Hopf fibration.

In his lecture Doug Arnold discussed three aspects of golf that can be addressed through mathematical modelling: the golfer's movement, the impact of the golf club on the ball, and the movement of the ball. The golfer's movement can be modelled by a double pendulum, in which the first arm of the pendulum is the golfer's stretched arm and the second arm is the golf club. Doug Arnold had brought a double pendulum with him and the audience was able to admire its chaotic movement and the unpredictable sequences of 4 or 5 consecutive spins of the terminal arm. The acceleration of the clubhead may be more than 20 g and its speed more than 190 km/h at the time it comes into contact with the ball. Doug Arnold concluded the first part of his lecture by a striking quote: "All models are wrong, but some are useful." He then spoke briefly of the impact of the club on the ball and demonstrated, with the aid of photographs, the significant deformation of the ball. Doug Arnold also presented the formula giving the speed of the ball, first under the assumption of kinetic energy conservation and then with an improved model including a coefficient of restitution.

In the second part of his lecture Doug Arnold dwelt at length on the flight of the ball. He showed that the ball's trajectory is very far from being the parabola contained in a plane that is presented in elementary courses on mechanics. One must consider not only gravity but two other forces: the "lift" and the "drag." Doug Arnold spoke only about the drag, which arises because of the friction of the air on the ball and the difference between the pressure on the front of the ball and the pressure on the rear. The combined effect of friction and pressure difference can be roughly modelled by a single number, the Reynolds number, whose usefulness was demonstrated on many examples. The speaker then moved on to explain Eiffel paradox, also called the "drag crisis." Indeed Gustave Eiffel observed that the drag is not a monotonic function of the Reynolds number. This phenomenon was explained by L. Prandtl with his boundary-layer theory. Prandtl was able to solve an approximation of Navier – Stokes equations in the vicinity of the boundary layer, thus explaining the separation of the boundary layer. This part of the lecture was illustrated by many pictures and photographs in order for the audience to grasp this phenomenon well.

The last part of the lecture dealt with the optimization of the ball surface and the fact that far better results were obtained by scientific computing than by trial-and-error methods. Doug Arnold stressed that there is an infinity of cases to test since the holes may have varied shapes and their placement on the ball surface is critical for ball performance. In the case of rough balls the drag crisis occurs precisely for Reynolds numbers achieved during the ball flight, a fact that enables one to increase considerably the scope of a ball throw. This part of the lecture was punctuated with old films

demonstrating the phenomenon in experiments with bellows.

Doug Arnold's lecture was outstanding. He succeeded in awakening the interest of all the persons in the audience, those who had been trained in engineering as well as the others. His lecture conveyed a crucial message on the role of mathematics in solving golf problems and similar problems. The members of the audience showed their gratefulness by staying for the "vin d'honneur" during a long time.

CRM Partnerships

The CRM is strongly committed to its national mission and takes measures to ensure that as many Canadian scientists as possible benefit from its activities and become involved in their planning. For instance, it appoints to its Scientific Advisory Committee eminent Canadian scientists from various parts of the country; it is present in all important forums where the future directions of the Canadian mathematical sciences are discussed; it urges its organizers to ensure that Canadian specialists are included in their activities; it organizes and supports scientific events across the country; it collaborates with Canadian institutes, societies, and associations. A specific budget is set aside each year for the participation of Canadian graduate students in its programs. The CRM is the only national institute that operates in the two official languages of Canada and it is highly visible on the international scene. In keeping with its national role, it coordinates its activities with the Fields Institute, PIMS, the Canadian Mathematical Society (CMS), MITACS, the Canadian Applied and Industrial Mathematics Society (CAIMS), the Statistical Society of Canada (SSC), the Canadian Association of Physicists (CAP), as well as other societies and institutes abroad.

CRM Partners

The Fields Institute (FI) and the Pacific Institute for the Mathematical Sciences (PIMS)

Since the early 1990s two other research institutes have joined the CRM on the Canadian scene: Toronto's Fields Institute (FI) and the Pacific Institute for the Mathematical Sciences (PIMS). As well as coordinating their scientific activities, the three institutes have worked closely on a variety of initiatives, the most important of which is the Mathematics of Information Technology and Complex Systems network (MITACS). The three institutes are also involved in other initiatives, such as the CRM – Fields – PIMS Prize awarded in recognition of outstanding accomplishments in the mathematical sciences in Canada. It was created in 1994 as the CRM – Fields Prize and became the CRM – Fields – PIMS Prize in 2006. The administrative responsibility for this prize rotates between the three institutes.

International and National Collaborations

The CRM collaborates with research centres in the Montréal area, especially GERAD (Group for Research in Decision Analysis). The CRM, the ISM, and GERAD jointly organize a weekly statistics colloquium (see the section General Program). In 2010 – 2011 the CRM and GERAD organized the Workshop on Decision Analysis and Sustainable Development (see the section Multidisciplinary and Industrial Program) and the GERAD Spring School on Evolutionary Games (see the section General Program). The Ministère des Ressources naturelles et de la Faune of Québec and the Canadian Forest Service were also CRM partners for the statistics thematic semester. The CRM is a partner of the Banff International Research Station (BIRS).

The researchers belonging to the CRM or a CRM laboratory enjoy close collaborations with French colleagues, in particular CNRS and INRIA researchers. In 2010 – 2011 some CRM members and researchers from the Université de Cergy-Pontoise prepared the Summer School on Non-equilibrium Statistical Mechanics, which was held in July 2011. Also in 2010 – 2011, the CRM and CNRS started planning the creation of an Unité Mixte Internationale (UMI) of CNRS at the CRM. The UMI was formally created in October 2011.

The CRM has signed agreements with the European Union. For instance, in 2006 the CRM and the ISM signed an agreement with the ALGANT consortium (where ALGANT stands for Algebra, Geometry, Number Theory) to further the exchange of graduate students. In 2010 the CRM was one of the 12 partners to sign an agreement with SISSA (an Italian centre) to promote exchanges of visiting researchers specializing in mathematical physics. SISSA (International School for Advanced Studies, in English) is based in Trieste and is a university dedicated to the training of graduate students.

The CRM has signed two agreements with the TIFR (Tata Institute of Fundamental Research), a prestigious research centre in India. The scope of the first agreement was applied mathematics and it was signed in 2006 between the CRM and the TIFR Centre for Applicable Mathematics in Bangalore. The first project (within this agreement) concerned some applications of mathematics to medical equipment and was financed by the Ministère du Développement économique, de l'Innovation et de l'Exportation of Québec;

the Université de Montréal; and the École Polytechnique de Montréal. This project included an internship for a Bangalore doctoral student and a visit by Professor Vivek Borkar, dean of the TIFR School of Technology and Computer Science in Mumbai. Three members of the CRM (Michel Delfour, from the Université de Montréal, and Frédéric Lesage and André Garon, both from the École Polytechnique) visited the Bangalore TIFR in order to teach mini-courses. The scope of the second agreement was pure mathematics and it was signed in 2011 between the CRM and the Mumbai TIFR. In 2010 – 2011 a student who had just obtained a doctorate from TIFR spent one year at the CRM as a postdoctoral fellow.

In its publishing activities, the CRM is continuing its partnership with the American Mathematical Society (AMS), in particular through its two series of joint publications, the CRM Monograph Series and the CRM Proceedings & Lecture Notes. A CRM series, in mathematical physics, is published by Springer. The CRM has exchange agreements with the Fields Institute, PIMS, MSRI, the Institute for Mathematics and its Applications (IMA), the École Normale Supérieure (France), the Isaac Newton Institute, the Institut des Hautes Études Scientifiques (IHÉS, France), and BIRS.

Associations and Professional Societies

The CRM maintains close ties with the different professional societies in the mathematical sciences: CMS, CAIMS, SSC, and CAP. The president of the CMS is an ex-officio member of the CRM International Scientific Advisory Committee. The CRM has also supported financially certain initiatives of the CMS, such as the mathematical camps. Together with the other institutes, the CRM organizes or sponsors special sessions at the CMS, CAIMS, and SSC meetings. The CRM awards a prize each year jointly with the SSC; similarly, it awards a prize each year with the CAP in mathematical and theoretical physics.

The Mathematics of Information Technology and Complex Systems Network (MITACS)

MITACS (Mathematics of Information Technology and Complex Systems) is a pan-Canadian network for mathematics whose creation was proposed by the three Canadian mathematical sciences institutes, the CRM, Fields, and PIMS. MITACS was officially launched on February 19, 1999. By March 1999, all 21 initial research projects were under way. MITACS leads Canada's effort in the generation, application, and commercialization of new mathematical tools and methodologies within a world-class research program. In order to do so, MITACS initiates and fosters linkages with industrial, governmental, and not-for-profit organizations. The only network of centres of excellence for the mathematical sciences, MITACS currently involves more than 300 scientists and 600 students (from almost 50 universities) working on approximately 30 projects. MITACS research focuses on five key sectors of the economy: biomedical and health sector; environment and natural resources; information processing; risk and finance; and communication, networks, and security.

MITACS also extends financial support to some events organized by the CRM and other institutions. For example, in 2010 – 2011 it supported in part the Workshop on Causal Inference in Health Research (see the section Thematic Program) and four activities described in the section Multidisciplinary and Industrial Program: the Course on Micromacroscopic Systems, the Workshop on Decision Analysis and Sustainable Development, the First Québec – Ontario Workshop on Insurance Mathematics, and the MITACS Day on the Practice of Actuarial Science.

Atlantic Association for Research in the Mathematical Sciences (AARMS)

AARMS was founded in March 1996 at a time when the National Network for Research in the Mathematical Sciences was being discussed and planned. AARMS exists to encourage and advance research in all mathematical sciences (including statistics and computer science) in the Atlantic region. In addition AARMS acts as a regional voice in discussions of the mathematical sciences on a national level. Since its inception, AARMS has played an important role in the research activities in the Atlantic region, sponsoring or co-sponsoring numerous meetings and workshops. In the summer of 2002, AARMS initiated an annual Summer School for graduate students and promising undergraduates. AARMS is grateful to Canada's three mathematical institutes, the Centre de recherches mathématiques, the Fields Institute, and the Pacific Institute for the Mathematical Sciences, as well as to the member universities, for providing funding for its activities. Its member universities are Acadia University, Cape Bre-

ton University, Dalhousie University, Memorial University, Mount Allison University, St. Francis Xavier University, Saint Mary's University, the Université de Moncton, the University of New Brunswick, and the University of Prince Edward Island. Finally AARMS receives some financial support from the provinces of New Brunswick and Nova Scotia. One can find information on the activities of AARMS on the following web site: http://www.aarms.math.ca.

Academic Partners

The activities of the CRM rest on a solid basis of cooperation with regional universities, in particular the Montréal universities, and most particularly the Université de Montréal, whose support for the CRM has been unfailing. The Université de Montréal releases five of its faculty members to work at the CRM each year, and the support of these faculty members is an essential asset for the CRM's scientific activities. There is in addition a regular program of teaching releases for the other Montréal universities, bringing the equivalent of another two positions to the CRM each year. On an ad-hoc basis linked to the thematic program, the CRM has also been arranging the release of research personnel from nearby universities such as Laval, Sherbrooke, Queen's, and Ottawa. The partnerships of the CRM with the other research institutes in the Montréal area have been very profitable.

With the financial support of the Université de Montréal, McGill University, the Université du Québec à Montréal, Concordia University, and Université Laval, as well as grants from NSERC and the Fonds québécois de recherche sur la nature et les technologies (FQRNT), the CRM finances the activities of its ten laboratories, which collectively represent the most active branches of the mathematical sciences. These laboratories are the perfect illustration of scientific vitality and serve to feed the national and international scientific programs of the CRM. The reader may refer to the section on research laboratories for a description of the activities of each of these laboratories.

Association with the University of Ottawa

In 2003, the Department of Mathematics and Statistics of the University of Ottawa became a member of the Centre de recherches mathématiques (CRM). In partnership with the University of Ottawa, the CRM co-finances the CRM – University of Ottawa Distinguished Lecture Series, postdoctoral fellowships, and teaching releases so that University of Ottawa faculty members can undertake research with colleagues in the CRM's laboratories or participate in the scientific activities of the CRM.

CRM – University of Ottawa Distinguished Lecture Series

The series features talks by prominent mathematicians from Canada and abroad on topics at the forefront of today's mathematical research. In 2010 – 2011 there were two such talks at the University of Ottawa.

- Nolan Wallach (University of California, San Diego), *Levels of Entanglement*, September 24, 2010
- Rostislav Grigorchuk (Texas A&M University), *Aspects of Growth in Algebra*, April 1st, 2011

Network for Computing and Mathematical Modeling (ncm_2)

The CRM is one of the founding members of the Network for Computing and Mathematical Modeling (ncm_2), a network created by several research centres in order to respond to the needs of industry in fields related to computing and mathematical modelling. The research of the network focuses on five major themes: risk management, information processing, imaging and parallel computing, transport and telecommunications, and health and electronic commerce. The ncm_2 was founded by the CRM, the Centre de recherche en calcul appliqué (CERCA), the Center for Interuniversity Research and Analysis of Organizations (CIRANO), the Center for Research on Transportation (CRT), the Centre de Recherche Informatique de Montréal (CRIM), and the Institut National de la Recherche Scientifique – Télécommunications (INRS-Télécom). At the present time the following centres are members of the ncm_2: CIRANO, CRM, CIRRELT, INRS-ÉMT, and GERAD.

Québec Neuroimaging Initiative (RNQ)

In recent years, CRM's PhysNum laboratory has developed a strong collaborative network with various partners in neuroimaging in the Montréal area. This network became an officially recognized network with the founding of the Regroupement Neuroimagerie/Québec (RNQ), under the umbrella of the Institut universitaire

de gériatrie de Montréal. RNQ, with its 70 researchers, has recently purchased some key equipment in neuroimaging thanks to a very large grant ($11M). One of the strongest alliances of the CRM within that network is its association with the INSERM laboratory for brain imaging at FMPMC Pitié-La Salpêtrière (Paris), whose director is Dr. Habib Benali.

Joint Initiatives

The annual meetings of the CMS, SSC, and CAIMS, as well as some of their training and promotion activities, are jointly sponsored by the CRM, the Fields Institute, PIMS, and MITACS. The annual meetings of the societies allow Canadian mathematicians and statisticians to keep abreast of their colleagues' work, to organize sessions on emerging topics, and attend lectures given by world-renowned mathematicians or prize winners. One can find more information on the societies by consulting their respective web sites (www.cms.math.ca, www.ssc.ca, and www.caims.ca).

38th Annual Meeting of the SSC
May 23 – 26, 2010, Université Laval
http://www.ssc.ca/en/meetings/2010/2010-annual-meeting-québec-city

2010 CMS Summer Meeting
June 4 – 6, 2010, University of New Brunswick – Fredericton
http://cms.math.ca/Events/summer10/

CAIMS 2010
July 17 – 20, 2010, Memorial University of Newfoundland
http://www.math.mun.ca/~caims/

2010 CMS Winter Meeting
December 4 – 6, 2010, University of British Columbia
http://cms.math.ca/Events/winter10/

Mathematical Education

As part of its mandate to promote and stimulate research in the mathematical sciences, at every level, the CRM provides funding and support for many activities and programs related to mathematical education and the training of researchers. Many of these activities and programs are carried out jointly with the ISM (Institut des sciences mathématiques). As a result, much of the information contained in the present section is taken from the ISM annual report.

Institut des sciences mathématiques (ISM)

Created in 1991 by the departments of mathematics and statistics of the four Montréal universities, the ISM is a consortium of seven Québec universities (Concordia, Laval, McGill, Université de Montréal, UQAM, UQTR, and Université de Sherbrooke), six of which offer a Ph.D. program in Mathematics. As an institute to which belong almost all the Québec researchers in the mathematical sciences, the ISM has at its disposal vast material and intellectual resources, and as a result, Montréal and Québec itself have become one of the main centres of training and research in the mathematical sciences in North America. The ISM is funded by the Ministère de l'Éducation, du Loisir et du Sport du Québec and by the seven universities in the consortium.

The reader will find below an overview of the activities and programs of the ISM.

- Coordination and harmonization of graduate programs

The ISM was created to bring together the strengths of its member departments, in order to turn them into a great school of mathematics. Thus the ISM coordinates the graduate studies of the mathematics departments, supports the sharing of expertise among its researchers, and facilitates student mobility between the Montréal universities.

- Scholarships and financial support

The ISM helps students and beginning researchers carry out their research activities in several ways, for instance through the ISM Scholarships for Graduate Studies, the Carl Herz Scholarship (financed by the Carl Herz Foundation), the Travel Bursaries, the Undergraduate Summer Scholarships and the CRM – ISM postdoctoral fellowships.

- Scientific activities

Since its creation, the ISM has initiated several activities that are by now an integral part of the Québec scientific scene: the CRM – ISM Mathematics Colloquium, the CRM – ISM – GERAD Statistics Colloquium, the ISM Graduate Student Conference, and the ISM Graduate Student Seminar.

- Promotion of the mathematical sciences

The ISM produces the *Accromath* journal and distributes it freely in all the cégeps and secondary schools in Québec. In this way, it contributes to spreading mathematical knowledge among teachers, young students, and the general public. Each year, ISM professors give talks attended by thousands of cégep students; these talks present the latest breakthroughs in mathematics and the careers available to mathematics graduates.

As the above list demonstrates, the CRM has several joint activities with the ISM, in particular two colloquia, a joint program of postdoctoral fellowships, and the planning of graduate courses related to the thematic programs of the CRM. Since the summer of 2003, the CRM has also supported the Undergraduate Summer Scholarships program, which allows postdoctoral fellows to supervise undergraduate students doing research.

CRM – ISM Postdoctoral Fellowships

The CRM-ISM postdoctoral fellowships enable promising young researchers to devote themselves to their research work. The ISM organizes a single competition on behalf of the seven universities of the consortium, and it receives a large number of applications, which are then evaluated by the 150 ISM professors. The selection of the fellows is rigorous and only one in forty applicants is awarded a fellowship. The applications are handled electronically in order to streamline the selection process and economize the resources consumed during the selection. The postdoctoral fellows play a crucial role in the Montréal universities: they collaborate with the established researchers, stimulate their work, and bring new ideas from other great centres of mathematical research. Also they are a vital link between the professors and the students, especially when

they organize on their own study groups on emerging topics.

2010 – 2011 Postdoctoral Fellows

Mattia Cafasso (Ph.D., SISSA) is working with Marco Bertola and John Harnad (Concordia) in mathematical physics. During his stay in Montréal he published three articles, including one with Professor Bertola, and submitted three more articles, including two with Professor Bertola.

Grégoire Dupont (Ph.D., Lyon 1) has been working in the field of algebra with Professors Ibrahim Assem, Virginie Charette, and Thomas Brüstle of the Université de Sherbrooke. G. Dupont is now a postdoctoral fellow in the ANR group "Géométrie tropicale et algèbres amassées" (Université Paris Diderot). He wrote eight articles while at the Université de Sherbrooke, including one with his Sherbrooke colleagues (Ibrahim Assem and David Smith). He also organized several working groups during his stay in Québec and supervised an ISM summer student.

Tiago Fonseca (Ph.D., UPMC) works with Marco Bertola, John Harnad (Concordia), and Jacques Hurtubise (McGill) on algebraic and enumerative combinatorics and integrable quantum systems.

Nabil Kahouadji (Ph.D., Paris Diderot) works with Niky Kamran (McGill). His research is on differential geometry, Cartan – Kähler theory, conservation laws, geometric aspects of PDEs, and mathematical physics. In 2010 – 2011 he gave a lecture in the CIRGET seminar.

Dimitris Koukoulopoulos (Ph.D., UIUC) works with Andrew Granville (Montréal) on analytic, probabilistic, and additive number theory. He published two articles during his stay in Montréal and is preparing four more, including one written in collaboration with Andrew Granville. He gave a lecture in the analytic number theory seminar and another one at the Québec – Maine Number Theory Conference (which took place at Université Laval in October 2010). During the summer of 2011 he supervised Philippe Charron, an ISM summer student.

Guyslain Naves (Ph.D., Joseph Fourier) is working with Bruce Shepherd (McGill). His research is in combinatorial optimization, graph theory, and approximation algorithms. He published two articles during his stay in Montréal and is preparing three more articles.

Vivien Ripoll (Ph.D., Paris Diderot) is working with François Bergeron and Christophe Hohlweg (UQAM). He carries out research mostly in combinatorics and the geometry of Coxeter groups and real and complex reflection groups. He published one article during his stay in Montréal and is preparing three more articles.

Christian Stump (Ph.D., Wien) is working in combinatorics and theoretical computer science with François Bergeron, Christophe Reutenauer, and Christophe Hohlweg (UQAM). In 2010 – 2011 he was a co-organizer of the combinatorics seminar and published three articles.

ISM Doctoral Fellowships

In 2007 – 2008 the ISM initiated a doctoral fellowship program in order to recruit outstanding Ph.D. students. The doctoral fellowships provide financial support for four years to outstanding, new students to pursue a doctoral program at one of the ISM member universities. The students fill an application form online and the applications are made available to all the ISM professors. An inter-university selection committee, which takes the department recommendations into account, makes the final selection of scholars.

In 2010 – 2011 two scholarships were awarded: one to Kirill Shmakov, who holds a master's degree from the St. Petersburg State University (Russia) and is currently a Ph.D. student in mathematical physics at Concordia University, and the other one to Erwan Biland, who is from Paris and will be co-supervised by a professor at Université Laval and a professor at Université Paris Diderot. E. Biland is working in number theory. For the academic year 2011 – 2012 a scholarship was awarded to Mohsen Yousefnezhad, who will be supervised by Professor Javad Mashreghi at Université Laval.

Undergraduate Summer Scholarships

In collaboration with the CRM and the ISM professors, the ISM awards summer scholarships to promising undergraduates who want to do research during the summer and plan to study mathematics at the graduate level. These undergraduates are supervised by postdoctoral fellows, who in general are supervising students for the first time. The reader will find below the list of the undergraduate scholars.

Nicolas Bouchard (Montréal)
Scholarship co-financed by Matilde Lalín
Supervisor: Ethan Smith
Topic: *Congruent numbers and their generalizations*
Duration: 3 months

Crystel Bujold (McGill)
Scholarship co-financed by Henri Darmon
Supervisor: Shabnam Akhtari
Topic: *Questions in Galois theory*
Duration: 3 months

Myriam Chabot (Sherbrooke)
Scholarship co-financed by Ibrahim Assem
Supervisor: Grégoire Dupont
Topic: *Polynômes continuants et frises*
Duration: 2 months

Philippe Charron (Montréal)
Scholarship co-financed by Andrew Granville
Supervisor: Dimitris Koukoulopoulos
Topic: *Introduction to basic concepts of number theory*
Duration: 3 months

Zhe Chen (McGill)
Scholarship co-financed by Gantumur Tsogtgerel
Supervisor: Marco Veneroni
Topic: *Applied convex analysis*
Duration: 2 months

Jean-Philippe Fortin (McGill)
Scholarship co-financed by Dmitry Jakobson
Supervisor: Nikolay Dimitrov
Topic: *Random regular graphs*
Duration: 3 months

Robert Gibson (McGill)
Scholarship co-financed by Rustum Choksi
Supervisor: Marco Veneroni
Topic: *Variational analysis and partial differential equations*
Duration: 3 months

Namdar Homayounfar (McGill)
Scholarship co-financed by Antony R. Humphries
Supervisor: Renato Calleja
Topic: *Numerical study of a family of state-dependent delay equations close to a singular limit*
Duration: 3 months

Édith Viau (UQAM)
Scholarship co-financed by André Joyal
Supervisor: Mathieu Anel
Topic: *Catégorie de faisceaux abéliens*
Duration: 3 months

ISM Graduate Student Conference

The 13th ISM Graduate Student Conference ("Colloque panquébécois annuel des étudiants") was held on May 20 to 22, 2011 at the Université de Montréal. It was attended by around 76 participants representing all the ISM universities. The Conference was organized by Daniel Fiorilli, Louis-Xavier Proulx, Alexandre Desfossés Foucault, Isabelle Ascah-Coallier, Colin Jauffret, Lenka Háková, François Charette, Guillaume Roy-Fortin, and Pierre-Luc Ramier. The plenary lectures were given by Jean-Christophe Nave (McGill), Carl Pomerance (Dartmouth College), Christiane Rousseau (Montréal), and Morwen Thistlethwaite (Tennessee).

The following students made presentations during the Conference: Samir Raouafi (Laval), François Charette (Montréal), Kael Dixon (McGill), Sophie Léger (Laval), Raphaël Clouâtre (IU Bloomington), Dione Ibrahima (Laval), Noé Aubin-Cadot (Montréal), Jean-Philippe Fortin (McGill), Yasser Farhat (Laval), Patrick Lacasse (Laval), Ludovic Gagnon (Laval), Juan Ignacio Restrepo (McGill), Mohammad Bardestani (Montréal), Lenka Háková (Montréal), Jérôme Fortier (UQAM), Colin Jauffret (Montréal), Daniel Fiorilli (Montréal), Laurent Delisle (Montréal).

Promotion of the Mathematical Sciences

Produced by the ISM and financed by the ISM, the CRM, the MITACS network, and the Canadian Mathematical Society, the Accromαth magazine aims to draw more young people to the mathematical sciences. Accromαth, whose editor-in-chief is André Ross, has two issues per year and is available free of charge in all the high schools and cegeps of Québec. Accromαth is designed by an exceptional team of researchers and instructors with a broad experience in the promotion of mathematics; it provides high school and cegep teachers with stimulating and topical articles on the most recent discoveries and applications, as well as articles on the history of mathematics and its links with the arts.

Currently 1800 persons or institutions (mostly teachers from Québec) subscribe to the magazine. In 2010 – 2011 Accromαth joined the Climate Change and Sustainability Program, which was launched by Professor Christiane Rousseau and includes 13 North American Research Institutes. The Winter 2011 issue of Accromαth was devoted to climate change and sustainability. We refer the reader to the site www.accromath.ca for more information on Accromαth.

Other Joint Initiatives

Workshop on Technology Integration in Teaching Undergraduate Mathematics Students

October 1st, 2010, CRM

The goal of this workshop was to foster exchanges on the integration of technology into the teaching of postsecondary mathematics, especially for students enrolled in the mathematics programs. The workshop was geared principally towards mathematicians working within mathematics departments and graduate students teaching undergraduate courses. Mathematics teachers from other departments and institutions (for instances cegeps) were invited to take part in the workshop in order to broaden the exchanges. The language of the workshop was mostly French but an "English" version of the workshop took place at the Fields Institute. Both workshops were organized within the framework of the following project: *Computer Algebra Systems (CAS) in University Instruction: An International Research Study in CAS Usage and Sustainability* (http://casresearch.nipissingu.ca/).

The following lectures were given during the CRM workshop.

- *Technology and Postsecondary Mathematics Teaching and Learning*: *A Mathematician's Perspective* (Bernard Hodgson, Laval).
- *Report on a Canadian Survey (Spring 2009) Regarding the Computer Algebra Systems Integration in Postsecondary Mathematics Teaching* (Chantal Buteau, Brock; Daniel Jarvis, Nipissing; Zsolt Lavicza, Cambridge).
- *Integration of a Course on a Symbolic Computation (SC) Software*: *Challenges and Impact on the Curriculum* (Yvan St-Aubin, Montréal; Laurent Delisle, Montréal; Janse Van Rensburg, York).
- *Rethinking the Undergraduate Mathematics Curriculum*: *What is the Role of Technology*? (Walter Whiteley, York; Franco Saliola, UQAM; Jane Heffernan, York).
- *Evaluating Students in Mathematics Courses with a Technological Component*: *Technical and Pedagogical Challenges and Considerations on the Curriculum* (France Caron, Montréal; Hichem Ben-El-Mechaiekh, Brock).

54th Conference of the Association mathématique du Québec

October 22 – 24, 2010, Cégep de Rimouski

Sponsored by the CRM, the ISM, the Canadian Mathematical Society, the Fondation du Cégep de Rimouski, the Commission scolaire des Phares, the ÉTS, the Cégep de Rimouski Teachers' Union, the Université du Québec à Rimouski, the Alphabet bookstore, and the National Assembly of Québec

The Conference theme was "Mathematics and the Environment, It Is All Very Natural". The conference included a lecture by Hubert Reeves on the importance of science and mathematics for the environment, workshops for grade school teachers (which took place on Friday), and rich and interesting workshops for high school and college teachers, university lecturers, and college and university students.

SUMM 2011
Seminars in Undergraduate Mathematics in Montréal, 2nd Edition

February 5-6, 2011, Concordia

Sponsored by Concordia, McGill, Montréal, UQAM, ISM, CAIMS, and the following students' associations: AESSUQAM, AGÉÉM (UQAM), MASSA (Concordia), and SUMS (McGill)

Organizing team:

Sami Dellah (UQAM), Bruno Joyal (Concordia), Vincent Létourneau (Montréal), Frédéric Paquin-Lefebvre (Montréal), Jifeng Shen (McGill), Cathryn Supko (McGill), David Thibodeau (McGill), Édith Viau (UQAM)

SUMM 2011 was attended by more than 50 participants. SUMM is a conference series that allows undergraduate students to give lectures on various topics of modern mathematics. SUMM 2011 consisted of 4 keynote lectures and 15 students' talks. Here are the titles of the keynote lectures.

- *Discrete Mathematics of Paul Erdős*, Vašek Chvátal (Concordia)
- *Chirurgie, nœuds et homologie de Floer*, Olivier Collin (UQAM)
- *Predicting the Unpredictable*: *Extreme-value Theory*, Christian Genest (McGill)

- *L'aléatoire et l'invariance conforme*, Yvan Saint-Aubin, (Montréal)

Here are the titles of the students' talks.

- *Linguistics for Mathematicians, a Brief Introduction*, Joshua Aaron (McGill)
- *Jewels and Algebra*, Maxime Bergeron (McGill)
- *Mathématiques et sport*, Philippe Charron (Montréal)
- *Resolution of ODEs in Particle Physics*, Long Chen (McGill)
- *Nombres à la règle et au compas*, Patrick Da Silva (Montréal)
- *An Introduction to Elliptic Curves*, Dieter Fishbein (McGill)
- *Indéterminisme et système newtonien*, Feisal Ben Hassel (UQAM)
- *Les corps gauches finis sont des corps*, Vincent Létourneau (Montréal)
- *Constructing Cryptographic Hash Functions*, François Séguin (Montréal)
- *A Brief Introduction to Topology*, Jifeng Shen (McGill)
- *The Symmetric Group*, Michael Snarski (McGill)
- *Introduction à l'informatique quantique*, Martin Thériault (Montréal)
- *Comportement des nombres premiers dans les progressions arithmétiques*, Louis-Philippe Thibault (Montréal)
- *Introduction aux catégories*, Édith Viau (UQAM)
- *Introduction au calcul des variations*, Alexandre Vincart-Émard, (Montréal)

"Sciences et mathématiques en action" and "Association québécoise des jeux mathématiques"

The CRM contributes to the "Sciences et mathématiques en action" program, created by Professor Jean-Marie De Koninck from Université Laval in order to popularize mathematics and science for high school students and the general public. We refer the reader to the site www.smac.ulaval.ca for more information. The CRM also supports the Association québécoise des jeux mathématiques (aqjm.fsg.ulaval.ca).

Research Laboratories

In 2010 – 2011 the CRM was encompassing ten research laboratories at the heart of the Québec mathematical community. These research groups act as focal points for local scientific activity and participate actively in the scientific programs of the CRM.

Applied Mathematics

Description

The CRM Applied Mathematics Laboratory is a research network of some 21 applied mathematicians, engineers, computer scientists, and chemists, based in Montreal. The Laboratory exists primarily to stimulate research and collaboration in the applied mathematical research areas of its members by fostering discussion and the creation of ideas through conferences, workshops, and seminars, and the furtherance of research through its visitors' program and the appointment of talented postdoctoral fellows. The Laboratory is also very concerned with the training of young researchers and supports travel and conference attendance of its postdoctoral fellows.

The research interests of the Laboratory members are quite diverse although there are a number of common threads that make interchange and collaboration both possible and fruitful. Active areas of research represented within the Laboratory include, for example, the application of dynamical systems theory to complex phenomena, high-dimensional chaos, and biology. There is an interest in numerical linear algebra and its applications, including the design, analysis, and implementation of effective computer algorithms. Amongst the membership one will also find expertise in numerical simulation, applied dynamical systems, quantum chemistry, turbulence, combustion, biomechanics, numerical methods in fluid mechanics and electromagnetism, hp-finite element methods, molecular dynamics, control, optimization, preconditioners, and large-scale eigenvalue problems.

News and highlights

André Bandrauk was appointed an Officer of the Order of Canada "for his pioneering work in attosecond science". In 2010 he was awarded the Marie-Victorin Prize from the Government of Québec. In 2010 Tony Humphries was elected Member at large of the board of the Canadian Applied and Industrial Mathematics Society (CAIMS). All told, at least 95 book chapters and refereed journal publications bearing the names of members of the laboratory appeared in 2010 – 2011. In addition André Bandrauk coedited the two books entitled respectively *Progress in Ultrafast Intense Laser Science* VI and *Quantum Dynamic Imaging*. Beyond the usual NSERC discovery grants, some significant grant money was obtained by several members of the laboratory. In 2010 André Bandrauk was awarded a 9-million-dollar CFI grant for a project entitled *Infrastructure for Molecular Modelling, Visualisation, Imaging*. The amount awarded included the cost of a CAVE (Computer Assisted Virtual Environment). Jacques Bélair and Fahima Nekka are the coinvestigators of an FQRNT three-year project entitled *Développement de pharmacométriques pour la variabilité issue de la prise et de la disposition médicamenteuse*, for which they will receive $47,000 per year. Finally Jean-Christophe Nave was awarded an NSERC Discovery Accelerator Supplement of $120,000 for the period 2011 – 2014.

The laboratory members gave a large number of seminar and contributed conference presentations in 2010 – 2011. We mention here only some of the presentations given by laboratory members as keynote or plenary speakers. Peter Bartello was a keynote speaker at the Geophysical Turbulence Program Workshop entitled *Topics in Rotating Stratified Turbulence* (at the National Center for Atmospheric Research in Boulder, Colorado). In 2010 he gave an invited talk in the Center for Marine and Climate Research Workshop entitled *Below the Rossby Radius — Workshop on small-scale variability in the general circulation of the atmosphere and oceans* (at the Klima Campus of the Universität Hamburg, in Germany). In April of 2011, at the University of Cambridge, Peter Bartello also gave an invited talk entitled "Balance (or lack thereof) from a turbulence perspective" at the 4*th Meeting of wave-flow interactions — a network in mathematics*. In 2010 – 2011 we also note that André Bandrauk was invited 12 times to deliver a keynote address and Tucker Carrington received 13 plenary or keynote speaker invitations to international conferences.

Students, postdoctoral fellows, and visitors

A priority area for the applied mathematics laboratory has always been the training of young applied mathematicians. Over the past year the laboratory has provided significant funds to support two postdoctoral fellows. Some of the fellows are also supported through NSERC Discovery Grants or other sources of funding. In 2010 – 2011 members of the Applied Mathematics Laboratory supervised or cosupervised 11 M.Sc. students, 25 Ph.D. students, and 14 postdoctoral fellows.

Seminars

Although the research interests of the laboratory members are broad and diverse, the weekly seminar series continues to be well attended and to be a stimulating source of research ideas and fruitful mathematical exchanges and collaborations. In 2010 – 2011 the CRM – McGill Applied Mathematics Seminar featured 24 presentations.

Workshops, special sessions, and others

In 2010 André Bandrauk was an organizer of a symposium entitled *Ultrafast Intense Laser Chemistry* in PACIFICHEM 2010 in Hawaii. The conference took place from December 15 to 20. He was also an organizer in May 2011 of a session on attosecond science at the Kavli Institute of Theoretical Physics in Beijing. Finally André Bandrauk was on the organizing committee of a symposium on *Science laser ultrarapide* at the 79th Congrès de l'Acfas, held at the Université de Sherbrooke on May 9 – 13.

The Applied Mathematics Laboratory sponsored the following workshop (see the section General Program, p. 27).

Workshop on Bifurcation Analysis and its Applications
July 7 – 10, 2010, Concordia University
Sponsored by the Applied Mathematics Laboratory, the Centre for Applied Mathematics in Biosciences and Medicine (CAMBAM) at McGill University, and the Office of the Vice-President, Research and Graduate Studies of Concordia University
Organizers: Eusebius Doedel (Concordia), Lennaert van Veen (Concordia)

Members of the Laboratory

Regular members

Robert G. Owens (Montréal), Director
Mechanics, numerical simulation of complex fluids

Paul Arminjon (Montréal)
Numerical methods in fluid mechanics

André D. Bandrauk (Sherbrooke)
Quantum chemistry

Peter Bartello (McGill)
Turbulence, CFD

Jacques Bélair (Montréal)
Dynamical systems in physiology

Anne Bourlioux (Montréal)
Modelling, numerical simulation in turbulent combustion

Xiao-Wen Chang (McGill)
Numerical linear algebra and applications

Rustum Choksi (McGill)
Calculus of variations, nonlinear partial differential equations, problems arising in materials science, self-assembly of diblock copolymers, magnetic domain formation in type-1 superconductors and ferromagnets

Eusebius J. Doedel (Concordia)
Numerical analysis, dynamical systems, differential equations, bifurcation theory, scientific software

Eliot Fried (McGill)
Mechanics and thermodynamics of continuous media

Antony R. Humphries (McGill)
Numerical analysis, differential equations

Sherwin A. Maslowe (McGill)
Asymptotic methods, fluid mechanics

Jean-Christophe Nave (McGill)
Numerical analysis, PDE, interface problems, level set methods, fluid mechanics, computer graphics

Gantumur Tsogtgerel (McGill)
Applied mathematics, partial differential equations, general relativity

Jian-Jun Xu (McGill)
Asymptotics and numerical analysis, nonlinear PDEs, materials science

Associate members

Tucker Carrington (Queen's)
Chemical dynamics

Martin J. Gander (Genève)
Domain decomposition, preconditioning

Nilima Nigam (Simon Fraser)
Applied analysis, numerical methods in electromagnetism

Paul F. Tupper (Simon Fraser)
Numerical analysis, stochastic processes, statistical mechanics

Thomas P. Wihler (Bern)
Numerical analysis, computational methods for PDEs

Jean-Paul Zolésio (INRIA Sophia Antipolis)
Control, optimization

CICMA

Description

CICMA brings together researchers working in number theory, group theory, and algebraic geometry. Contemporary number theory follows two major trends. On one hand, there is the theory of special values of L-functions attached to arithmetic objects, originating in the work of Gauss and Dirichlet and leading to the modern conjectures of Deligne, Beilinson, and Bloch – Kato. On the other hand, the Langlands program postulates a close link between arithmetic L-functions and automorphic representations.

An area where these two currents intersect is the study of elliptic curves. This area is particularly well represented in the laboratory with Darmon, Iovita, and Kisilevsky. A leader in his field, Andrew Granville brings to the laboratory an expertise in many aspects of analytic number theory. On the group theory side, Olga Kharlampovich is a world-renowned specialist of group varieties and John McKay is one of the instigators of the moonshine program.

News and highlights

Youness Lamzouri was awarded the 2011 CMS Doctoral Prize for his Ph.D. thesis on Riemann's zeta function, written at the Université de Montréal under the supervision of CICMA member Andrew Granville. The 2010 – 2011 academic year saw many members of CICMA involved in the organization of prestigious instructional conferences at the local, national, and international level (see below).

Students and postdoctoral fellows

In 2010 – 2011 members of CICMA supervised or cosupervised 22 M.Sc. students, 41 Ph.D. students, and 18 postdoctoral fellows.

Seminars

The Québec – Vermont Number Theory Seminar, CICMA's main scientific activity, is held every second Thursday for a full day and is attended by about 30 participants from Montréal, Vermont, Québec City, and Ottawa. In 2010 – 2011, John Voight, Chantal David, and Jayce Getz were the organizers of the Seminar, which included many well-attended lectures. Information on the Québec-Vermont Seminar can be found at http://www.dms.umontreal.ca/~andrew/QVNTS/.

Workshops, special sessions, and others

During the week of March 12 – 16, 2011, CICMA member Henri Darmon gave, in collaboration with Victor Rotger, a mini-course on Star – Heegner points at the annual Arizona Winter school. This annual instructional conference was solely devoted to this theme, which grew out of a conjectural construction of global points on elliptic curves that Darmon proposed roughly 12 years ago.

In 2010 – 2011 Eyal Goren organized, in collaboration with Stephen Kudla, two Montréal – Toronto workshops in number theory. The Toronto – Montréal workshop series initiated by Goren and Kudla has grown into a regular and reliably successful bi-annual event. CICMA member Jayce Getz and former CICMA postdoctoral fellow Xander Faber ran the annual Bellairs Workshop in Number Theory at McGill's Bellairs Research Center. One can find reports on these three workshops, as well as on the Québec – Maine Conference, in the section General Program.

1st Montréal – Toronto Workshop in Number Theory
September 4 – 5, 2010, CRM
Sponsored by the CRM and the Fields Institute
Organizers: Eyal Goren (McGill), Stephen Kudla (Toronto)

Québec – Maine Conference on Number Theory, 2010
October 2 – 3, 2010, Université Laval

Sponsored by the Department of mathematics and statistics of Université Laval, the Number Theory Foundation, the National Science Foundation, and CICMA
Organizers: Hugo Chapdelaine (Laval), Jean-Marie De Koninck (Laval), Claude Levesque (Laval)

2nd Montréal – Toronto Workshop in Number Theory
April 9 – 10, 2011, Fields Institute
Sponsored by CICMA, the CRM, and the Fields Institute
Organizers: Eyal Goren (McGill), Stephen Kudla (Toronto)

The Bellairs Workshop in Number Theory
Tropical and Non-Archimedean Geometry
May 6 – 13, 2011, Bellairs Research Institute
Sponsored by CICMA
Organizers: Xander Faber (Georgia, Co-organizer), Jayce Getz (McGill, Head Organizer)

Regular members of the Laboratory

Henri Darmon (McGill), Director
Algebraic number theory, arithmetic geometry, L-functions, Diophantine equations, elliptic curves

Hugo Chapdelaine (Laval)
Algebraic number theory, algebraic geometry

Chris Cummins (Concordia)
Group theory, modular functions, moonshine

Chantal David (Concordia)
Analytic number theory, L-functions

Jean-Marie De Koninck (Laval)
Analytic number theory: distribution of prime numbers, factorization of numbers, asymptotic behaviour of arithmetic functions, Riemann zeta function

David S. Dummit (Vermont)
Algebraic number theory, arithmetic algebraic geometry, computational mathematics

David Ford (Concordia)
Computational number theory, algorithmic number theory

Jayce Robert Getz (McGill)
Number theory

Eyal Z. Goren (McGill)
Arithmetic geometry, algebraic number theory, moduli spaces of abelian varieties, Hilbert modular forms, p-adic modular forms

Andrew Granville (Montréal)
Analytic number theory, arithmetic geometry, combinatorics

Heekyoung Hahn (McGill)
Eisenstein series, L-functions, trace formula, q-series, theta functions and partitions

Adrian Iovita (Concordia)
Number theory, p-adic cohomology

Olga Kharlampovich (McGill)
Combinatorial group theory and Lie algebras

Hershy Kisilevsky (Concordia)
L-functions, Iwasawa theory, elliptic curves, class field theory

John Labute (McGill)
Pro-p-groups, Lie Algebras, Galois Theory

Matilde Lalín (Montréal)
Mahler measures, L-functions, zeta functions

Claude Levesque (Laval)
Algebraic number theory, units, class number, cyclotomic fields

Michael Makkai (McGill)
Mathematical logic

John McKay (Concordia)
Computational group theory, sporadic groups, computation of Galois groups

M. Ram Murty (Queen's)
Number theory: Artin's conjecture, elliptic curves, modular forms, automorphic forms, Langlands program, Selberg's conjectures, sieve methods, cryptography

Damien Roy (Ottawa)
Transcendental number theory

Peter Russell (McGill)
Algebraic geometry

Francisco Thaine (Concordia)
Cyclotomic fields, cyclotomy, rational points on curves

CIRGET

Description

Geometry and topology are fundamental disciplines of mathematics whose richness and vitality, evident throughout human history, reflect a deep link to our experience of the universe. They are a focal point of modern mathematics and indeed several domains of mathematics have recently shown a strong trend to-

wards a geometrization of ideas and methods: two cases in point are mathematical physics and number theory.

CIRGET, based at UQAM, is composed of fifteen full members, three associate members, and a large number of postdoctoral fellows and graduate students working in this broad field. The main themes to be pursued in the coming years include the topological classification of 3-dimensional manifolds; quantization of Hitchin systems and the geometric Langlands program; classification of special Kähler metrics; the study of symplectic invariants, especially in dimension 4; nonlinear partial differential equations in Riemannian geometry, convex geometry, and general relativity; and Hamiltonian dynamical systems. The fields of algebraic geometry (in which Steven Lu and Peter Russell are working) and geometric group theory (in which Daniel Wise is working) are also represented at CIRGET.

News and highlights

This year CIRGET was most pleased to welcome Johannes Walcher as a new member. Walcher was recruited by McGill University and cross-appointed by the Department of Mathematics and Statistics and the Department of Physics. His research interests include mirror symmetry for open strings and nongeometric string compactifications. Moreover, in January 2012, CIRGET shall be welcoming Frédéric Rochon, our new Tier 2 Canada Research Chair. Rochon is one of the top young experts in the field of global analysis on singular spaces, notably index theory on manifolds with boundary. In collaboration with Richard Melrose, Rochon has established an impressive program of generalizing the K-theoretic approach of the Atiyah – Patody – Singer theorem to the case of manifolds with boundary. We look forward to working with him.

CIRGET members also received several awards this year: Vestislav Apostolov was awarded an NSERC Accelerator Grant, and Steven Boyer was awarded the "Prix de la recherche" by the Faculty of Science at UQAM.

Students, postdoctoral fellows, and visitors

Graduate students and postdoctoral fellows are an integral part of CIRGET scientific life, organizing working groups and seminars, mentoring undergraduate students, and occasionally giving specialized courses. In 2010 – 2011, CIRGET members supervised 20 postdoctoral fellows, 26 doctoral students, and 23 master's students. In addition, CIRGET members supervised 10 summer research students in 2011.

Many of our postdoctoral fellows are still at CIRGET in 2010 – 2011, but those who have completed their stays at CIRGET are moving on to good positions. Hongnian Huang won a 2-year Hadamard postdoctoral fellowship, which he will begin in Paris in January 2012. Frédéric Palési accepted a "maître de conférences" position at the Université de Provence. Nicholas Touikan left in December 2010 to take up a postdoctoral position at the University of Oxford. Abraham Smith became an Assistant Professor at Fordham University in New York (starting in July 2011), Francis Valiquette has been an AARMS postdoctoral fellow at Dalhousie University since September 2011, and Clément Hyvrier took up a postdoctoral position at Uppsala University. Alok Maharana is currently at Oberwolfach and shall be continuing his postdoc in India and Germany with positions at Tata and Max Planck (respectively).

Our former doctoral students have also found good positions. Michael Wong, who finished his Ph.D. in 2011, has taken up a postdoctoral position at the Tata Institute in Mumbai, funded by a FQRNT postdoctoral fellowship. Rémi Leclercq (who obtained his Ph.D. in 2009) was offered a "maître de conférences" position at Université Paris-Sud, while Éveline Legendre (who obtained her Ph.D. in 2010) was hired as a "maître de conférences" at the Université Paul Sabatier in Toulouse. É. Legendre is spending the fall of 2011 as an invited researcher at MIT. CIRGET members also greatly benefit from the many international visitors who come to work with them. In the 2010 – 2011 academic year 24 visitors stayed for short periods at the centre.

Seminars

In 2010 – 2011 CIRGET invited four colloquium speakers within the CRM – ISM mathematics colloquium lecture series: Alejandro Ádem (UBC), Leonid Polterovich (Chicago & Tel Aviv), Dusa McDuff (Barnard College), and Claude Viterbo (École Polytechnique, Paris).

CIRGET's everyday scientific life revolves around its weekly seminars and working groups where professors, postdoctoral fellows, and students meet on a regular basis. The CIRGET Geometry and Topology Sem-

inar, organized by Vestislav Apostolov, is a general seminar series attended by all CIRGET members. Of the 24 talks given this year, 20 were given by invited speakers who stayed at the centre for short research visits. The Algebraic Geometry Seminar, organized by Steven Lu, Peter Russell, and Karol Palka, hosted 12 talks, with 5 speakers coming from outside of Montréal. André Joyal and Mathieu Anel also organized a seminar on Triangular Categories.

CIRGET working groups meet on a regular basis to explore specific topics over a period of several months or more. This year one working group was organized by Steven Boyer on low-dimensional topology.

Workshops, special sessions, and other

Virginie Charette, a member of CIRGET, was one of the organizers of the Colloquium on Surfaces and Representations held at the Université de Sherbrooke on October 6 – 9, 2010 (see the section General Program, p. 32).

Members of the Laboratory

Regular members

Vestislav Apostolov (UQAM), Director
Complex geometry, Kähler geometry

Steven Boyer (UQAM)
Topology of manifolds, low-dimensional geometry and topology

Abraham Broer (Montréal)
Algebraic transformation groups, invariant theory

Virginie Charette (Sherbrooke)
Discrete group actions on affine varieties, Lorentz manifolds, Riemann surfaces discretization, discrete differential geometry

Olivier Collin (UQAM)
Invariants of knots and 3-manifolds arising from global analysis

Octavian Cornea (Montréal)
Algebraic topology, dynamical systems

Pengfei Guan (McGill)
Partial differential equations, geometric analysis, several complex variables

Jacques Hurtubise (McGill)
Algebraic geometry, integrable systems, gauge theory, moduli spaces

André Joyal (UQAM)
Algebraic topology, category theory

Niky Kamran (McGill)
Geometric approach to partial differential equations

François Lalonde (Montréal)
Symplectic topology and geometry, global analysis on manifolds, infinite dimensional transformation groups

Steven Lu (UQAM)
Chern number inequalities, semistability of tensorial sheaves, log jets, log and hyperbolic geometry, algebraic degeneracy

Iosif Polterovich (Montréal)
Geometric analysis, spectral theory, functional analysis, differential geometry, partial differential equations

Peter Russell (McGill)
Algebraic geometry

Daniel T. Wise (McGill)
Geometric group theory, low-dimensional topology

Associate members

Syed Twareque Ali (Concordia)
Coherent states, wavelets, quantization techniques, harmonic analysis, Wigner functions

John Harnad (Concordia)
Mathematical physics, classical and quantum physics, geometrical methods, integrable systems, group theoretical methods, random matrices, isomonodromic deformations, isospectral flows

John A. Toth (McGill)
Microlocal analysis, partial differential equations

Johannes Walcher (McGill)
Mirror symmetry for open strings, nongeometric string compactifications

GIREF

Description

The recent advances in computer hardware and software allow researchers to model and simulate physical phenomena whose complexity is unheard of. These problems are characterized by nonlinear laws, non-differentiable friction laws, large-deformation geometries, complex solid-solid or fluid-solid interactions,

problems in multiphysics, etc. Such problems can be found everywhere in industrial environments, especially in the design and fabrication of high-technology products. Thus the members of GIREF ("Groupe Interdisciplinaire de Recherche en Éléments Finis", or in English "Interdisciplinary Research Group in Finite Element Methods") aim to develop original numerical methods for solving cutting-edge industrial problems in nonlinear mechanics. Their work concern pure mathematics, computer science, software engineering, and engineering. The GIREF members propose general methods that can be used for diverse industrial applications. The some 27 member researchers reflect the interdisciplinary nature of the Laboratory and are based at Université Laval, the École Polytechnique de Montréal, as well as the Universities of Moncton, Ottawa, and Alberta.

News and highlights

GIREF continued to enjoy a partnership with tire manufacturer Michelin through the development of MEF++, a joint modelling tool. Numerous functionalities that are essential for the production of tires have already been implemented. The MEF++ software is now an integral part of Michelin's development strategy for its numerical modelling tools and Michelin is considering using MEF++ as a common tool in its world-wide academic collaborations. Here is a list of the projects currently pursued at GIREF; the reader will find more details on the GIREF web site (giref.ulaval.ca). The names of investigators are given within parentheses.

- The MEF++ project (A. Fortin, M. Fortin, R. Guénette, J. Urquiza, A. Cloutier)
- NSERC Research Chair in high performance scientific computing (A. Fortin, principal investigator, and J. Urquiza, associate investigator)
- Numerical modelling in the wood sciences (P. Blanchet, M.-L. Dano, A. Cloutier, A. Fortin, Y. Fortin, G. Gendron, D. Pelletier)
- Modelling of flows in natural environments (J.-L. Robert, R. Therrien, Y. Secretan)
- Biomedical modelling (A. Garon, M. Delfour, A. Fortin, Y. Bourgault, Y. Belhamadia)
- Numerical modelling in biology (L. Buono, G. Daigle, A. Fortin, D. Fortin, M. Fréchette, J. Urquiza)
- Parallel computing (all the members of GIREF)
- Design of bistable structures (M.-L. Dano, A. Fecteau, M. Jean Saint-Laurent)
- Modelling of thermally-induced torsion within composite tubes (M.-L. Dano, N. Verreault)

Students, postdoctoral fellows, and visitors

An article arising from the thesis of Zanan Kavazovic won the Marra Prize 2010. This prize was awarded by the Society of Wood Science and Technology to the two best articles published in the journal *Wood and Fiber Science* in 2010 (the article in question was in second place). Training highly qualified personnel is at the core of our mission. In the 2010 – 2011 academic year 3 postdoctoral fellows, 14 Ph.D. students, and 13 master's students were carrying out research at GIREF.

Seminars

In 2010 – 2011 the GIREF's seminar included 11 talks.

Members of the Laboratory

Regular members

André Fortin (Laval), Director
Finite elements method, instationary viscous flows, mixing problems

André Garon (Polytechnique Montréal), Deputy Director
Thermohydraulics, fluid mechanics, finite elements method, hydraulic turbines, mechanics of biofluids: stents and pumps

Youssef Belhamadia (Alberta)
Mathematical modelling and numerical simulation of phase change problems, adaptive meshing for instationary problems in 2 and 3 dimensions, numerical modelling of cryosurgery, numerical modelling of the electromechanical wave in the heart

Yves Bourgault (Ottawa)
Computational fluid dynamics, numerical methods, finite elements method, mathematical modelling, mechanics of continuous media

Michel C. Delfour (Montréal)
Control, optimization, design, shells, calculus, biomechanics

Michel Fortin (Laval)
Numerical analysis of partial differential equations, numerical methods in fluid mechanics, optimization and optimal control for partial differential equations

Robert Guénette (Laval)
Numerical methods in non-Newtonian fluid mechanics, rheological models, Hamiltonian formulation

Hassan Manouzi (Laval)
Numerical analysis, applications of mathematics to engineering

Dominique Pelletier (Polytechnique Montréal)
Fluid mechanics and heat transfer, finite elements method, adaptive finite elements methods for compressible and incompressible flows, modelling and simulation of laminar and turbulent viscous flows, modelling and simulation of fluid-structure interactions

Roger Pierre (Laval)
Numerical analysis of partial differential equations

José Urquiza (Laval)
Numerical analysis, control of partial differential equations

Associate members

Pierre Blanchet (FPInnovations)
Nanotechnology for wood products

Alain Charbonneau (UQO)
Numerical simulation of optical wave guides, finite elements method, numerical methods, statistical machine translation, automated text categorization

Alain Cloutier (Laval)
Forestry, forest engineering

Marie-Laure Dano (Laval)
Mechanics and production of composite materials, intelligent mechanical systems

Claire Deschênes (Laval)
Axial hydraulic turbines

Guy Dumas (Laval)
Mechanical engineering, physics of fluids

Mohamed Farhloul (Moncton)
Finite elements and finite volumes method, partial differential equations, applications of the mixed finite elements method to fluid mechanics, numerical analysis

Marie-Isabelle Farinas (UQAC)
Modelling, numerical simulation, computational fluid mechanics, design of turbo engines (cardiac pump), optimization

Vincent François (UQTR)
Integration of the finite elements method into computer-aided design

Yves Fortin (Laval)
Forestry, forest engineering

Augustin Gakwaya (Laval)
Aerospatial and aeronautical engineering, numerical modelling, computer-assisted design

Guy Gendron (Laval)
Composite materials, optimization and modelling of structures

Jean-François Hétu (NRC-IMI)
Numerical modelling of processes

Jean-Loup Robert (Laval)
Numerical models of free surface flows, transport and diffusion models with stochastic components, unified modelling in a saturated and aerated environment

Yves Secretan (INRS-ETE)
Numerical methods for finite elements, mesh generation and adaptation, error estimation, hydrodynamics in 2 dimensions, advection-diffusion phenomena

René Therrien (Laval)
Underground water flows, hydrology, geothermics

INTRIQ

Description

The INstitute for Transdisciplinary Research In Quantum computing (INTRIQ) brings together researchers in quantum information processing coming from physics, computer science, and engineering. The Institute has 25 members from McGill, the Université de Montréal, the École Polytechnique de Montréal, and the Université de Sherbrooke. Quantum information is the generalization of the classical notion of information, obtained by including the most fundamental law of physics, i.e., quantum mechanics. Indeed, classical information can be derived from quantum information when decoherence is present. Until now, in most fields related to information, quantum effects have often been neglected. For instance, when information is transmitted through optical fibers, the transmitted information is classical because the number of photons used to transmit this information is so large that quantum effects barely enter the picture and can easily be neglected. However, thanks to the impressive recent advances in the development of optical communication and fiber technologies, it has become possible to send single photons, so that an understanding at

the quantum level becomes necessary. In fact, nowadays, commercial devices can be acquired that transmit quantum information (for example, id Quantique and MagiQ). A very similar pattern is starting to emerge in the field of information processing, where the increasing miniaturization of our electronic components will result in information being processed not by billions of electrons at a time but by only a small number. This implies that the quantum nature of devices will become more and more important. The same is true of magnetic memories, which might ultimately be based on single spins. Hence it is no longer unreasonable to think that parts of our information support will soon be of a quantum nature.

Research in quantum computing and quantum information in Québec goes back to the seminal work by Charles Bennett and Gilles Brassard on quantum cryptography (at the beginning of the 80s) and the discovery of quantum teleportation by several researchers, including two INTRIQ members (at the beginning of the 90s). Shortly after 2000, several physicists and engineers joined the initial group of researchers, consisting mostly of computer scientists, and they created the CIQ2 (*Calcul et Information Quantique au Québec*). In 2006 Gilles Brassard transformed the CIQ2 centre into an institute called INTRIQ, which is now a "strategic cluster" financed by FQRNT and includes 25 members belonging to eight departments in four universities.

News and highlights

INTRIQ has now two new members: William Coish (assistant professor in the Department of Physics at McGill University) and Bertrand Reulet (who holds a Canada Excellence Research Chair in Quantum Signal Processing at the Université de Sherbrooke). INTRIQ members have received many awards in 2010 – 2011. Olivier Landon-Cardinal (a Ph.D. student supervised by David Poulin at the Université de Sherbrooke) was awarded a Vanier Canada Graduate Scholarship in 2010. Alexandre Blais was awarded a E.W.R. Steacie Memorial Fellowship by NSERC on June 1st, 2010. He was also honoured by the Canadian Association of Physicists, which awarded him the Herzberg Medal in 2011. Gilles Brassard received a Doctorate honoris causa from ETH in Zürich in 2010 and the Killam Prize for Natural Sciences in 2011. The Killam Prize is Canada's most distinguished annual award.

Students and postdoctoral researchers

In 2010 – 2011 INTRIQ included 164 students. Numerous visitors were welcomed by INTRIQ members in their laboratories, for stays lasting up to a whole year.

Seminars

The following laboratories hold weekly seminars:

- the Cryptography and Quantum Information Laboratory at McGill University;
- the Theoretical and Quantum Informatics Laboratory at the Université de Montréal;
- the Quantum Information Research Group at the Université de Sherbrooke; and
- the Optical Fibers Laboratory at the École Polytechnique de Montréal.

Workshops, special sessions, and others

INTRIQ members gather regularly for workshops where students, invited speakers, and themselves give talks, with the goal of fostering exchanges. In 2010 – 2011 there were two such workshops: one at the Manoir St-Sauveur, on June 7 – 8, 2010, and the other at the Grand Hôtel Times of Sherbrooke, on September 16 – 17, 2010. In 2010 the SMS Summer School was devoted to quantum information processing and quantum cryptography. The reader will find a report on this event in the section General Program (p. 24).

Summer School
Séminaire de mathématiques supérieures
Advanced School in Quantum Information Processing and Quantum Cryptography
June 21 – July 2, 2010, CRM
Sponsored by NATO, the CRM, the ISM, and the Department of mathematics and statistics of the Université de Montréal
Organizers: Daniel Gottesman (Perimeter Inst.), Julia Kempe (Tel Aviv), Christiane Rousseau (Montréal), Alain Tapp (Montréal)

Members of the Laboratory

Quantum information brings together many different fields, including computer science, engineering, and physics, which are all represented in INTRIQ. Here is a list of members, by university.

Université de Montréal

Michel Boyer (Computer Science)
Gilles Brassard (Computer Science)
Richard Mackenzie (Physics)
Louis Salvail (Computer Science)
Alain Tapp (Computer Science)

École Polytechnique de Montréal

José Fernandez (Computer engineering)
Nicolas Godbout (Engineering physics)
Suzanne Lacroix (Engineering physics)

Université de Sherbrooke

Alexandre Blais (Physics)
Patrick Fournier (Physics)
David Poulin (Physics)
Michel Pioro-Ladrière (Physics)
Bertrand Reulet (Physics)

McGill University

David Avis (Computer Science)
Aashish Clerk (Physics)
William Coish (Physics)
Claude Crépeau (Computer Science)
Guillaume Gervais (Physics)
Peter Grütter (Physics)
Hong Guo (Physics)
Patrick Hayden (Computer Science)
Michael Hilke (Physics), director
Zetian Mi (Electrical Engineering)
Prakash Panangaden (Computer Science)
Thomas Szkopek (Electrical Engineering)

LaCIM

Description

LaCIM (French acronym meaning "Combinatorics and Mathematical Computer Science Laboratory") is home to mathematics and theoretical computer science researchers whose interests comprise discrete mathematics and the mathematical aspects of computer science. Founded in 1989, LaCIM includes 16 regular members, 5 associate members, and 14 collaborating members. It welcomes postdoctoral fellows and its regular members supervise or cosupervise many M.Sc. or Ph.D. students, as well as undergraduate and cegep summer research students. Many renowned mathematicians visit LaCIM and collaborate with its members in the following areas: enumerative and bijective combinatorics, theory of species, algebraic combinatorics, combinatorics of finite and infinite words, discrete geometry, theory of languages and automata, Gray codes, bioinformatics, and combinatorial optimization.

News and highlights

Franco Saliola is now a professor at UQAM and a new member of LaCIM. Srečko Brlek played a large role in the creation of a CNRS *Laboratoire International Associé*. This laboratory is a joint endeavour with the LaBRI laboratory in Bordeaux. Srečko Brlek and Odile Marcotte also played an important role in the creation of a CNRS *Unité Mixte Internationale* at the CRM. Pierre Leroux, a founding member of LaCIM, was named posthumously a *Bâtisseur* of the Faculty of Sciences at UQAM.

Several LaCIM members were invited to give lectures at international conferences. Anne Bergeron was one of the plenary speakers at the CanaDAM 2011 conference in Victoria, British Columbia. Srečko Brlek gave an invited lecture at the Colloquium to honour Dominique Gouyou-Beauchamps on his 60th anniversary (at Orsay, France, in 2010). François Bergeron gave an invited lecture at the FPSAC 2011 conference in Reykjavík, Iceland.

Christophe Reutenauer has also published two books in the collection *Encyclopedia of Mathematics and its Applications* (Cambridge University Press). The first one, with Jean Berstel, is entitled "Noncommutative Rational Series with Applications." The second one, with Jean Berstel and Dominique Perrin, is entitled "Codes and Automata." François Bergeron was one of the distinguished scientists who handed out prizes at the 12^{e} *Gala des Concours scientifiques Montmorency*. François Bergeron and Gilbert Labelle gave introductory mathematics lectures to cégep students on a regular basis.

Students, postdoctoral fellows, and visitors

In 2010 – 2011 LaCIM members supervised or cosupervised 28 M.Sc. students, 37 Ph.D. students, and 11 post-

doctoral fellows. In particular LaCIM hosts four new postdoctoral fellows: Juan Carlos Bustamante, Chris Berg, Grégoire Dupont, and Vivien Ripoll. Many long-term visitors spend part of the year at LaCIM, in particular Guillaume Chapui (LIAFA), Loïc Foissy (Université de Reims Champagne-Ardenne), Jim Haglund (University of Pennsylvania), Carsten Lange (Freie Universität Berlin), Vincent Pilaud (Université Paris Diderot and Fields Institute for Research in Mathematical Sciences), Nicolas Thiéry (Université Paris-Sud), and Laurent Vuillon (Université de Savoie).

Seminars

The Combinatorics Seminar, held every Friday afternoon, was attended regularly by the majority of Laboratory members, students, and postdoctoral fellows, as well as other members of the CRM. Most of the lectures were given by visitors.

Workshops, special sessions, and others

In 2010 – 2011, the LaCIM organized two conferences whose reports may be found in the section General Program.

LaCIM 2010: 20*th Anniversary of LaCIM*
August 29 – 31, 2010, UQAM
Sponsored by UQAM, the CRM, and the Canada Research Chair in Combinatorial Algebra and Mathematical Computing (UQAM) Organizers: François Bergeron (UQAM), Srečko Brlek (UQAM), Christophe Hohlweg (UQAM), Christophe Reutenauer (UQAM)

GASCom 2010
September 2 – 4, 2010, UQAM
Sponsored by UQAM, the CRM, and the Canada Research Chair in Combinatorial Algebra and Mathematical Computing (UQAM)
Organizing Committee: Alexandre Blondin Massé (UQAM), Srečko Brlek (UQAM, general chair), Ariane Garon (local arrangements), Sébastien Labbé (UQAM), Christophe Reutenauer (UQAM, general cochair), Lise Tourigny (secretary), Jérôme Tremblay (technical support)

Between these two conferences, on September 1st, 2010, was held *Sage Day 25.5: Introduction to Sage and Combinatorics* (also at UQAM). This Day was organized by Alexandre Blondin Massé, Sébastien Labbé, and Franco Saliola (all three from UQAM), who also gave lectures during the day. The fourth speaker was Florent Hivert, from the Université Paris-Est Marne-la-Vallée. The audience included participants of the LaCIM 2010 and GASCom 2010 conferences, as well as high school and cégep teachers wishing to incorporate the Sage software into their teaching. The general lectures were followed by tutorials given by Franco Saliola and Sébastien Labbé. During the afternoon, several libraries of interest to the audience (for instance those related to word combinatorics or species of structures) were presented to the participants.

Ibrahim Assem and Thomas Brüstle, two members of LaCIM, were among the organizers of the following colloquium, whose report is included in the section General Program (p. 32).

Colloquium on Surfaces and Representations
October 6 – 9, 2010, Université de Sherbrooke
Sponsored by Université de Sherbrooke, the CRM, the ISM, and the RECSUS (Regroupement des Étudiants-Chercheurs en Sciences de l'Université de Sherbrooke)
Organizers: Ibrahim Assem (Sherbrooke), Thomas Brüstle (Sherbrooke & Bishop's), Virginie Charette (Sherbrooke), Tomasz Kaczynski (Sherbrooke), Christian Mercat (Montpellier 2), Jean-Philippe Morin (Sherbrooke), Vasilisa Shramchenko (Sherbrooke)

Ibrahim Assem, Thomas Brüstle, and Shiping Liu organized a session entitled *Representation Theory of Algebras* at the 2010 CMS Summer Meeting held in Fredericton, New Brunswick. Srečko Brlek was a member of the Steering Committee of the 16th IAPR International Conference on Discrete Geometry for Computer Imagery, which took place on April 6 – 8 in Nancy, France.

Members of the Laboratory

Regular members

Srečko Brlek (UQAM), Director
Combinatorics of words, algorithmics

Ibrahim Assem (Sherbrooke)
Representation theory

Anne Bergeron (UQAM)
Bioinformatics

François Bergeron (UQAM)
Combinatorics, algebra, representations of finite groups

Robert Bédard (UQAM)
Representations of finite groups, Lie theory

Thomas Brüstle (Sherbrooke & Bishop's)
Algebraic combinatorics, cluster algebras, triangulations of surfaces, stochastic differential equations, mathematical models in finance

Cedric Chauve (Simon Fraser & UQAM)
Enumerative combinatorics, trees, bioinformatics

Alain Goupil (UQTR)
Combinatorics, algebra, linear representations of groups, symmetric group

Sylvie Hamel (Montréal)
Bioinformatics and algorithms, theory of languages and automata, algebraic combinatorics

Christophe Hohlweg (UQAM)
Algebra, algebraic combinatorics, convex geometry

Gilbert Labelle (UQAM)
Enumerative combinatorics, analysis

Shiping Liu (Sherbrooke)
Representation theory

Vladimir Makarenkov (UQAM)
Computational biology, mathematical classification

Marni Mishna (Simon Fraser)
Algorithms and enumerative, analytical, and algebraic combinatorics

Christophe Reutenauer (UQAM)
Algebraic combinatorics, noncommutative algebra, automata theory, coding theory, free algebras

Franco Saliola (UQAM)
Algebraic combinatorics, group representations

Timothy R.S. Walsh (UQAM)
Algorithmics, enumerative combinatorics, graph theory

Associate members

Pierre Lalonde (Maisonneuve)
Enumerative and bijective combinatorics, alternating sign matrices, enumeration of involutions with respect to various parameters, use of Pfaffians and determinants in enumeration

Cédric Lamathe (UQAM)
Combinatorics of tree-like structures, theory of species, indicator series of partially labeled structures and asymmetric structures

Luc Lapointe (Talca)
Algebraic combinatorics, symmetric functions, integrable systems, supersymmetries

Odile Marcotte (UQAM & CRM)
Combinatorial optimization, integer programming, graph theory

Dominic Rochon (UQTR)
Complex analysis, hypercomplex numbers

Collaborating members

Marcello Aguiar (Texas A&M)
Algebraic combinatorics, noncommutative algebra, Hopf algebras and quantum groups, category theory

Luc Bélair (UQAM)
Mathematical logic, model theory

Nantel Bergeron (York)
Applied algebra

Pierre Bouchard (UQAM)
Commutative algebra, algebraic geometry and combinatorics

Michel Bousquet (Vieux-Montréal)
Enumeration of combinatorial structures, planar maps and cacti, theory of species, Lagrange inversion formulas

Yves Chiricota (UQAC)
Computer graphics, mathematical methods in computer graphics, combinatorics, computational geometry, symbolic computation

Sylvie Corteel (LIAFA & CNRS)
Enumerative and bijective combinatorics, partitions of integers, q-series

Adriano Garsia (UC San Diego)
Algebraic combinatorics, symmetric functions, harmonic and coinvariant spaces, quasiharmonic and quasi-invariant functions

André Joyal (UQAM)
Algebraic topology, category theory

Jacques Labelle (UQAM)
Combinatorics, topology

Louise Laforest (UQAM)
Data structures, combinatorics, asymptotic analysis, quaternary trees

Daniel Lemire (TÉLUQ)
Database theory, data warehousing, multidimensional databases (OLAP), data mining, time series, collaborative filtering, information retrieval

Simon Plouffe
Integer sequences, generalized expansions of real numbers

Xavier G. Viennot (Bordeaux 1)
Enumerative, algebraic, and bijective combinatorics, interactions between combinatorics, theoretical informatics, and theoretical physics

Mathematical Analysis

Description

At the same time classical and central to modern mathematics, analysis involves the study of continuous systems, from dynamical systems to solutions of partial differential equations and spectra of operators. In 2010 – 2011 the Laboratory included 28 regular and 10 associate members working at eight different universities in Québec, the United Kingdom, and France. The members of the Laboratory work in the following areas: harmonic analysis, complex analysis and several complex variables, potential theory, functional analysis, Banach algebras, microlocal analysis, analysis on manifolds, nonsmooth analysis, spectral theory, partial differential equations, geometric analysis, ergodic theory and dynamical systems, control theory, mathematical physics, applied mathematics, probability, nonlinear analysis, nonlinear differential equations, topological methods in differential equations, fluid dynamics, and turbulence.

News and highlights

Alexey Kokotov and Robert Seiringer joined the Mathematical Analysis Laboratory in 2010 – 2011. Alexander Shnirelman presented a plenary talk at the 2010 International Congress of Mathematicians: congratulations! Robert Seiringer was awarded an NSERC Discovery Accelerator Grant in 2011. Iosif Polterovich was awarded the 2011 Coxeter-James Prize for Research Excellence by the Canadian Mathematical Society.

Students, postdoctoral fellows, and visitors

Altogether, in 2010 – 2011, 6 postdoctoral fellows, 30 Ph.D. students, and 33 M.Sc. students were supervised or cosupervised by members of the laboratory.

Seminars

The members of the Mathematical Analysis Laboratory organize several seminars at four main locations. Laval University hosts an Analysis Seminar, which featured 16 talks in 2010 – 2011. Galia Dafni (Concordia University), Alexander Shnirelman (Concordia University), and Dmitry Jakobson (McGill University) jointly organize the McGill/Concordia Analysis Seminar, which featured 40 talks in 2010 – 2011. A Seminar on Dynamical Systems, featuring 1 talk, was also held at Concordia. At the Université de Montréal, Paul Gauthier (Université de Montréal) and Richard Fournier (Dawson College and CRM) organize an Analysis Seminar that featured 4 talks in 2010 – 2011, and Christiane Rousseau organizes the Nonlinear Analysis and Dynamic Systems Seminar, which featured 1 speaker.

Dmitry Jakobson and Iosif Polterovich organized a Seminar in Spectral Theory featuring 16 meetings during the Spring of 2011. In addition, three CRM-ISM Colloquium speakers were invited by Laboratory members.

Workshops, special sessions, and others

The following colloquium, whose report is included in the section on the CRM general program, was organized in part by members of the Mathematical Analysis Laboratory.

Colloquium on surfaces and representations
October 6 – 9, 2010, Université de Sherbrooke
Sponsored by the Université de Sherbrooke, the CRM, the ISM, and the RECSUS (Regroupement des Étudiants-Chercheurs en Sciences de l'Université de Sherbrooke)
Organizers: Ibrahim Assem (Sherbrooke), Thomas Brüstle (Sherbrooke & Bishop's), Virginie Charette (Sherbrooke), Tomasz Kaczynski (Sherbrooke), Christian Mercat (Montpellier 2), Jean-Philippe Morin (Sherbrooke), Vasilisa Shramchenko (Sherbrooke)

Members of the Mathematical Analysis Laboratory were also involved in the Second Bavaria – Québec Mathematical Meeting, held at the Universität Würzburg on November 22 – 25, 2010 (see http://www.mathematik.uni-wuerzburg.de/~mathbq/). The organizers were Stephan Ruscheweyh, Oliver Roth, Daniela Kraus (all from Würzburg), and Richard Fournier (Dawson College and CRM). Apart from Richard Fournier, there were five participants from Québec: Serge Dubuc, Paul Gauthier, Q. I. Rahman (all from the Université de Montréal), and Thomas Ransford and Javad Mashreghi (both from Université Laval). Each of these five participants gave a lecture. Ilia Binder (from Toronto) and Eric Schippers (from Winnipeg) also gave invited lectures. The organizers of the meeting also organized the "Tag der Funktionentheo-

rie 2010," which took place on November 26 – 27, 2010, and was attended by all the aforementioned Canadians.

Members of the Laboratory

Regular members

Dmitry Jakobson (McGill), Director
Pure mathematics, global analysis, spectral geometry, quantum chaos, harmonic analysis, eigenvalues and eigenfunctions

Line Baribeau (Laval)
Complex and functional analysis, Banach algebras, holomorphic iterations, discrete groups

Abraham Boyarsky (Concordia)
Dynamical systems

Francis H. Clarke (Lyon 1)
Nonlinear and dynamic analysis, control theory, calculus of variations

Galia Dafni (Concordia)
Harmonic analysis, partial differential equations, complex variables

Donald A. Dawson (Carleton)
Probability, stochastic processes

S. W. Drury (McGill)
Harmonic analysis, matrix theory

Richard Fournier (Dawson)
Complex analysis, function theory

Marlène Frigon (Montréal)
Nonlinear analysis, differential equations, fixed point theory, critical point theory, multivalent analysis

Paul M. Gauthier (Montréal)
Complex analysis, holomorphy, harmonicity, analytic approximation

Pawel Gora (Concordia)
Ergodic theory, dynamical systems, fractal geometry

Frédéric Gourdeau (Laval)
Banach algebras, cohomology, amenability, functional analysis

Vojkan Jakšić (McGill)
Mathematical physics, quantum statistical mechanics, random Schrödinger operators

Tomasz Kaczynski (Sherbrooke)
Topological methods, Conley index, applications to dynamical systems

Ivo Klemes (McGill)
Harmonic analysis, trigonometric series

Alexey Kokotov (Concordia)
Spectral geometry of Riemann surfaces, hyperbolic partial differential equations

Paul Koosis (McGill)
Harmonic analysis

Javad Mashreghi (Laval)
Complex analysis, harmonic analysis, Hardy spaces

Iosif Polterovich (Montréal)
Geometric analysis, spectral theory, functional analysis, differential geometry, partial differential equations

Thomas J. Ransford (Laval)
Complex and harmonic analysis, functional analysis and theory of operators, spectral analysis, potential theory

Dominic Rochon (UQTR)
Complex analysis, hypercomplex numbers

Jérémie Rostand (Laval)
Complex analysis, experimental mathematics

Christiane Rousseau (Montréal)
Dynamical systems, bifurcations, qualitative theory, polynomial systems, analytic invariants, integrable systems

Dana Schlomiuk (Montréal)
Global analysis, dynamical systems, singularities, bifurcations, algebraic curves, primary integral

Robert Seiringer (McGill)
Many-body quantum systems, Bose-Einstein condensates

Alexander Shnirelman (Concordia)
Applications of geometric analysis to fluids and "weak" solutions of the Euler and Navier-Stokes equations

Alina Stancu (Concordia)
Geometric analysis

Ron J. Stern (Concordia)
Functional analysis and theory of operators, linear and nonlinear systems, nonsmooth analysis, stability, optimal order

John A. Toth (McGill)
Spectral theory, semi-classical analysis, microlocal analysis, Hamiltonian mechanics

Associate members

Octavian Cornea (Montréal)
Algebraic topology, dynamical systems

Richard Duncan (Montréal)
Ergodic theory, martingale theory, probability theory in Banach spaces

Kohur Gowrisankaran (McGill)
Potential theory

Pengfei Guan (McGill)
Partial differential equations, geometric analysis, several complex variables

John Harnad (Concordia)
Mathematical physics, classical and quantum physics, geometrical methods, integrable systems, group theoretical methods, random matrices, isomonodromic deformations, isospectral flows

Niky Kamran (McGill)
Geometric approach to partial differential equations

Dmitry Korotkin (Concordia)
Integrable systems, isomonodromic deformations, classical and quantum gravity, Frobenius varieties

Nilima Nigam (Simon Fraser)
Applied analysis, numerical methods in electromagnetism

Yiannis N. Petridis (Univ. Coll. London)
Automorphic forms and their spectral theory, analytic number theory, spectral and scattering theory of manifolds

Samuel Zaidman (Montréal)
Functional analysis and differential equations in abstract spaces, pseudo-differential operators

Mathematical Physics

Description

The mathematical physics group is one of the oldest and most active at the CRM. It consists of 18 regular members, 9 local associate members, all full-time faculty members at one of the participating universities, and 5 external associate members working permanently at universities and research laboratories in Europe or the U.S. The group carries out research in many of the most active areas of mathematical physics: coherent nonlinear systems in fluids, optics, and plasmas; classical and quantum integrable systems; the spectral theory of random matrices; percolation phenomena; conformal field theory; quantum statistical mechanics; spectral and scattering theory of random Schrödinger operators; quasi-crystals; relativity; spectral transform methods; foundational questions in quantization; asymptotics of eigenstates; coherent states; wavelets; supersymmetry; the symmetry analysis of PDEs and difference equations; representation theory of Lie groups and quantum groups; and the mathematical structure of classical and quantum field theories.

News and highlights

In 2010 – 2011 Keshav Dasgupta, Robert Seiringer, and Johannes Walcher became regular members of the Mathematical Physics Laboratory. (R. Seiringer is also a member of the Mathematical Analysis Laboratory and J. Walcher a member of CIRGET.) During the year, laboratory members were invited to give many lectures, were awarded many prizes and distinctions, and organized many activities. We give here a sample of these events.

• Syed Twareque Ali was co-organizer of the International Workshop on the Mathematical Foundations of Quantum Mechanics, held at the IISER (Kolkata, India, in December 2010) and co-organizer of the XIV International Workshop on Wavelets, Quantization and Differential Equations (University of Havana, February 21 – 25, 2011).

• Marco Bertola was an invited speaker at the workshop on Integrable Systems in Pure and Applied Mathematics (Alghero, Italy, June 8 – 12, 2010) and an invited participant at the minisymposia "Nonlinear Waves in Integrable Systems II" and "Recent Advances in Nonlinear Integrable Systems I" of the SIAM Conference on Nonlinear Waves and Coherent Structures (Philadelphia, August 2010).

• Robert Brandenberger currently holds a Killam Research Fellowship (awarded for a period of two years starting in September 2009). He was awarded the 2011 CAP/CRM Prize for Mathematical Physics. R. Brandenberger gave numerous invited lectures and organized several workshops and conferences in Montréal (see below). He was also an organizer (among other events) of the Parallel Session B5 on Theoretical and Mathematical Cosmology at GR-19 (Mexico City, July

5 – 9, 2010) and of the Focus Week on String Cosmology (IPMU, Tokyo, October 4 – 10, 2010).

• Robert Conte helped organize the conference on "Modélisation physique et numérique d'écoulements turbulents et multiphasiques" in Cargèse, France, on September 13 – 17, 2010.

• Bertrand Eynard was a plenary speaker at the STATPHYS 24 conference (Cairns, Australia, August 19 – 23, 2010).

• Alfred Michel Grundland was Visiting Researcher at the École normale supérieure (CMLA) from June to August 2010.

• John Harnad was named Fellow of the Science College at Concordia University in January 2011. J. Harnad gave numerous invited lectures in 2010 – 2011, including the opening plenary talk at the five-day BIRS workshop entitled "New perspectives in univariate and multivariate orthogonal polynomials" (October 10 – 15, 2010). He also co-organized a five-day BIRS workshop entitled "Integrable and Stochastic Laplacian Growth in Modern Mathematical Physics" (October 31 – November 5, 2010).

• Jacques Hurtubise was an invited lecturer at the LMS Summer School in Leeds (in the summer of 2010).

• Véronique Hussin gave three invited lectures in 2010 – 2011 and co-organized the 28th International Colloquium on Group-Theoretical Methods in Physics (Northumbria University, July 26 – 30, 2010) and the workshop entitled "Supersymmetric Quantum Mechanics and Spectral Design" (Benasque, Spain, July 18 – 30, 2010).

• Robert Seiringer was co-organizer of the joint semester on "Frontiers in Mathematical Physics" that took place at Cergy, France, and the CRM (May 2 – 27, 2011 and July 1 – 29, 2011). He was also an organizer of the workshop entitled ¨¨Current Topics in Mathematical Physics" (Erwin-Schrödinger Institute, Vienna, August 16 – 24, 2011).

• Luc Vinet was made a Chevalier de l'Ordre de la Pléiade in 2010 and gave numerous invited lectures in Hong Kong, Spain, the Czech Republic, Ukraine and Japan.

• Johannes Walcher was awarded a Canada Research Chair (Tier II) in Mathematical String Theory at McGill in May 2011. He was also an organizer of the CERN Winter School on Supergravity, Strings and Gauge Theory 2011 and the Oberworlfach workshop on "Real Enumerative Questions in Complex and Tropical Geometry" (April 17 – 23, 2011).

• Pavel Winternitz won the "Ceska Hlava" Prize and spoke at the special session on "Integrability and Non-integrability in Hamiltonian Systems" at the 7th International Conference on Differential Systems and Dynamical Systems (Tampa, Florida, December 15 – 18, 2010). P. Winternitz was also an organizer of three workshops, including SIDE 9 (Varna, Bulgaria, June 14 – 19, 2010).

Students, postdoctoral fellows, and visitors

In 2010 – 2011 the laboratory members supervised or cosupervised 16 M.Sc. students, 35 Ph.D. students, and 25 postdoctoral fellows. A complete list of fellows, students, and visitors can be found at the archived 2010 – 2011 Laboratory web site. Here are some news of our former fellows and students. Former doctoral student Oksana Yermolayeva (Marie Curie Fellow) received a renewal of her Marie Curie Research Fellow position for 2010 – 2012 at Université Pierre et Marie Curie. Robert Buckingham was appointed to a tenure track position as Assistant Professor at the Syracuse University. Seung-Yeop Lee obtained a five-year appointment as Research Associate at the California Institute of Technology. Dong Wang obtained a similar extended research appointment at the University of Michigan. Benjamin Young spent the period from September to December 2010 as a Member of the Mathematical Sciences Research Institute in Berkeley, and has now an extended postdoctoral appointment in Stockholm at the Royal Institute of Technology. Olivier Marchal, who completed his doctorate in December 2010 under the joint supervision of J. Harnad, M. Bertola, and B. Eynard, obtained a postdoctoral position at the University of Alberta (starting in January 2011).

Sarah Post, one of our postdoctoral fellows, gave a lecture on "Symmetry, Superintegrability and Special Functions" at the Conference in honor of Professor Willard Miller, Jr.'s retirement (Minneapolis, September 17 – 20, 2010). Ferenc Balogh won the Distinguished Doctoral Dissertation Prize in Engineering and Natural Sciences at Concordia University in 2011 for his thesis carried out under the supervision of John Harnad.

Seminars

The usual weekly Seminar Series in Mathematical Physics took place at the CRM every Tuesday afternoon from September 2010 to May 2011, with active participation by members, visitors, postdoctoral fellows, and students. The organizer during the 2010 – 2011 academic year was Yvan Saint-Aubin. Approximately half the talks were given by visiting invited speakers, the rest by regular and associate Laboratory members, postdoctoral fellows, and visitors. In addition, the Working Seminar on Integrable Systems, Random Matrices, and Random Processes continued, taking place again every Thursday afternoon at Concordia, with active participation of many Laboratory members, postdoctoral fellows, students, and visitors. The organizer in 2010 – 2011 was Tiago Dinis da Fonseca (CRM). Details about these seminar series for 2010 – 2011 can be found at the archived 2010 – 2011 Laboratory web site.

Workshops and Special Sessions

The following events were organized in part by members of the Mathematical Physics Laboratory. Their reports can be found in the section General Program.

Conference
Strong and Electroweak Matter 2010
June 29 – July 2, 2010
Sponsored by the Department of Physics of McGill University, the Perimeter Institute for Theoretical Physics, the Institute of Particle Physics, the Canadian Institute of Nuclear Physics, the CRM, and the Mathematical Physics Laboratory
Local Organizing Committee (McGill): Robert Brandenberger, Jim Cline, Keshav Dasgupta, Charles Gale, Sangyong Jeon, Alex Maloney, Guy Moore, Alejandra Castro, Andrew Frey, Omid Saremi, Bjoern Schenke, Marcus Tassler, Bret Underwood

Colloquium on Surfaces and Representations
October 6 – 9, 2010, Université de Sherbrooke
Sponsored by the Université de Sherbrooke, the CRM, the ISM, and the RECSUS (Regroupement des Étudiants-Chercheurs en Sciences de l'Université de Sherbrooke)
Organizers: Ibrahim Assem (Sherbrooke), Thomas Brüstle (Sherbrooke & Bishop's), Virginie Charette (Sherbrooke), Tomasz Kaczynski (Sherbrooke), Christian Mercat (Montpellier 2), Jean-Philippe Morin (Sherbrooke), Vasilisa Shramchenko (Sherbrooke)

Workshop
Dark Matter from Every Direction
April 1 – 3, 2011, McGill
Sponsored by the CRM, Lorne Trottier, NSERC, and the Department of Physics of McGill University
Organizers: Robert Brandenberger (McGill), Jim Cline (McGill), Andrew R. Frey (McGill), Pat Scott (McGill)

Members of the Laboratory

Regular members

John Harnad (Concordia), Director
Mathematical physics, classical and quantum physics, geometrical methods, integrable systems, group theoretical methods, random matrices, isomonodromic deformations, isospectral flows

Syed Twareque Ali (Concordia)
Coherent states, wavelets, quantization techniques, harmonic analysis, Wigner functions

Marco Bertola (Concordia)
Axiomatic quantum field theory, invariant theory of discrete groups, random matrices, isomonodromic deformations

Robert Brandenberger (McGill)
Theoretical Cosmology

Keshav Dasgupta (McGill)
Heavy ion collision theory in the energy range 30MeV/nucleon to many GeV/nucleon

Alfred Michel Grundland (UQTR)
Symmetry of differential equations in physics

Richard L. Hall (Concordia)
Spectra of Schrödinger, Klein-Gordon, Dirac and Salpeter operators, many-body problems, relativistic scattering theory, iterative solution to ODEs and boundary-value problems

Jacques Hurtubise (McGill)
Algebraic geometry, integrable systems, gauge theory, moduli spaces

Véronique Hussin (Montréal)
Group theory, Lie algebras and applications in physics, supersymmetries in classical and quantum mechanics

Dmitry Korotkin (Concordia)
Integrable systems, isomonodromic deformations, classical and quantum gravity, Frobenius varieties

Pierre Mathieu (Laval)
Conformal field theory, classical and quantum integrable systems, affine Lie algebras

Manu Paranjape (Montréal)
Theoretical particle physics: field theory, solitons, noncommutative geometry, alternative gravity

Jiří Patera (Montréal)
Applications of group theory, quasi-crystals, Lie algebras

Yvan Saint-Aubin (Montréal)
Conformal field theory, statistical mechanics, 2-dimensional phase transition model

Robert Seiringer (McGill)
Quantum many-body systems, Bose–Einstein condensates, Ginzburg–Landau theory, Gross-Pitaevskii theory, bosons

Vasilisa Shramchenko (Sherbrooke)
Frobenius manifolds, integrable systems, Riemann–Hilbert problems, isomonodromic deformations of systems of linear differential equations, function theory on Riemann surfaces

Luc Vinet (Montréal)
Symmetry properties of systems, special functions

Johannes Walcher (McGill)
Mirror symmetry for open strings, nongeometric string compactifications

Pavel Winternitz (Montréal)
Methods of group theory in physics, nonlinear phenomena, symmetries of difference equations, superintegrability

Associate members

Robert Conte (CEA/Saclay)
Integrable and partially integrable systems, Painlevé analysis, exact solutions, finite difference equations

Chris Cummins (Concordia)
Group theory, modular functions, moonshine

Stéphane Durand (Édouard-Montpetit)
Classical and quantum physics, mathematical physics, symmetries, parasupersymmetries, fractional supersymmetries, KdV equations, quantum mechanics, relativity

Bertrand Eynard (CEA/Saclay)
Matrix models, integrable systems, string theory, relationship between matrix models, integrability, and algebraic geometry

Jean-Pierre Gazeau (Paris Diderot)
Coherent states, wavelets, relativistic quantum frames, symmetry groups for beta-lattices

Alexander Its (IUPUI)
Soliton theory, integrable systems, special functions, mathematical physics

Dmitry Jakobson (McGill)
Pure mathematics, global analysis, spectral geometry, quantum chaos, harmonic analysis, eigenvalues and eigenfunctions

Vojkan Jakšić (McGill)
Mathematical physics, quantum statistical mechanics, random Schrödinger operators

Niky Kamran (McGill)
Geometric approach to partial differential equations

François Lalonde (Montréal)
Symplectic topology and geometry, global analysis on manifolds, Hamiltonian systems

Decio Levi (Roma Tre)
Symmetries of differential and difference equations, integrable nonlinear equations on the lattice and reductive perturbation theory on the lattice

Alexander Shnirelman (Concordia)
Applications of geometrical analysis to fluids and "weak" solutions of the Euler and Navier-Stokes equations

John A. Toth (McGill)
Spectral theory, semi-classical analysis, microlocal analysis, Hamiltonian mechanics

Carolyne M. Van Vliet (Montréal & Miami)
Non-equilibrium statistical mechanics, fluctuations and stochastic processes, quantum transport in condensed matter, electronic behavior in submicron quantum devices

PhysNum

Description

The PhysNum laboratory was created by physicists (hence its acronym, which means "Physique numérique"). At the present time its members conduct research in medical imaging and pharmacokinetics. The researchers whose field is medical imaging take part in the activities of the Laboratoire International de Neuroimagerie et Modélisation (LINeM), which was created in 2008 by three institutions: the Institut na-

tional de la santé et de la recherche médicale (Inserm), the Université Pierre et Marie Curie, and the Université de Montréal. In particular, PhysNum researchers have ongoing collaborations with researchers from the Centre de recherche de l'Institut universitaire de gériatrie de Montréal (CRIUGM) and from Unité UMR-S 678 (Inserm). The goal of LINeM is to develop the best mathematical models and tools in diverse areas of neuroimaging. Here are the topics studied by LINeM researchers:

- Physiological and biochemical sources of functional brain imaging signals;
- Cerebral activation networks;
- Haemodynamic responses in optical imaging;
- Inverse problems and wavelets;
- Functional neuroanatomy of the spinal cord;
- Intrinsic optical imaging of the spinal cord and the brain and data analysis;
- Quantitative imaging of aging; and
- Seizure prediction for epileptic patients with implants.

Fahima Nekka and her team conduct research in pharmacometrics, a discipline whose goal is to interpret and describe pharmacological phenomena in a quantitative manner. Pharmacometrics consists of the study of measurement, regression analysis (data fitting), and system reproduction (modelling and simulation) for the estimation, evaluation, understanding, and prediction of pharmaceutical processes in terms of their general trends and variability.

Within this area, Fahima Nekka's group is working on the efficient integration of different drug-related aspects and mechanisms. The group's modelling approach, whether driven by hypotheses or data, aims to increase our understanding and to explain the complex relationship between drugs and living systems. The team is working on the following topics:

- Compliance metrics and ranking;
- Metrics to evaluate the clinical impact of variable drug intake behaviour;
- Pharmacometrics and mechanistic modelling in animal drug use;
- Objective evaluation of a treatment efficacy through the extension of classical breakpoint estimation methods to the case of variable pharmacokinetic profiles;
- Development of physiology-based pharmacokinetic (PBPK) models to predict drug-drug interactions; and
- Development and use of global sensitivity approaches for PBPK models.

News and highlights

The links between PhysNum and the Odyssée group (at INRIA Sophia Antipolis) have been reinforced through a French Government grant to foster the collaboration with PhysNum members (in particular J.-M. Lina, M. Descoteaux, and C. Grova). Here is a list of the current research areas of the medical imaging group: multimodal imaging of the spinal cord (H. Benali and F. Lesage); multiresolution and multimodal imaging in magneto-electrophysiology (J.-M. Lina and C. Grova); models of anatomical and functional connectivity (H. Benali and M. Descoteaux); neuro-vascular models in epilepsy (C. Grova and H. Benali); inverse problems and wavelets (J.-M. Lina); parsimonious sampling (M. Descoteaux, F. Lesage, and J.-M. Lina).

In 2010 – 2011 Fahima Nekka's group was working on pharmacometrics of drug intake behaviour, PK/PD modelling in presence of drug intake variability, physiologically based pharmacokinetics (PBPK) modelling, and the relationship between drug efficacy guidelines established under *in vitro* conditions and the variability observed *in vivo*. Fahima Nekka is the coauthor of two presentations at the American Conference on Pharmacometrics 2011, which took place in San Diego, California, in April 2011.

Students

In 2010 – 2011 the members of PhysNum supervised or cosupervised 22 M.Sc. students, 12 Ph.D. students, and 6 postdoctoral fellows. A. Blanc, a student at the École Polytechnique (France), did an internship in Montréal under the supervision of C. Grova and J.-M. Lina. G. Girard, a master's student working with M. Descoteaux at the Université de Sherbrooke, is the ambassador of the FiberNavigator software, a tool for brain surgery and the study of brain connectivity.

Members of the Laboratory

Regular members

Jean-Marc Lina (ÉTS), Director
Wavelets, statistical modelling and brain imaging, machine learning

Alain Arnéodo (ÉNS Lyon & CNRS)
Fractals and wavelets

Habib Benali (UPMC)
Quantitative analysis in brain imaging, medical imaging and multimodal systems

Maxime Descoteaux (Sherbrooke)
Medical imaging, image analysis and processing, computer vision, applied mathematics

Christophe Grova (McGill)
Statistical signal processing, localization of epileptic spikes using distributed sources modelling, and multimodal analysis of EEG source localization and simultaneous EEG-fMRI data analysis

Frédéric Lesage (Polytechnique Montréal)
Conformal theory, integrable systems, inverse problems, optical imaging

Fahima Nekka (Montréal)
Pharmacokinetics, development of mathematical tools from fractal geometry and harmonic analysis for extracting information, applications to pharmacology and medicine

Statistics

Description

Statistics is central to many endeavours in society. Be it through surveys from sampling, clinical trials to study various biomedical treatments, or experimental designs in agriculture or industry, statistical methodology can be found everywhere in science. Recently, statistics has undergone a revolution in its techniques and approaches. This revolution has been driven by the need to analyze very large data sets and data with more complex structure, and by the advent of powerful computers. For example, statistical methodology is now addressing problems whose structure is very complex, such as the analysis of brain images or genome data, and new methodology is being developed, such as data mining, for large data sets.

One of the aims of the Laboratory is to structure the Québec statistical community so that it can participate in this revolution at a time when an important renewal of academic personnel is taking place. This structure allows the Québec community to benefit from a recently created Canada-wide program for complex data structures (NICDS), organized by the three Canadian mathematics institutes. The Laboratory is formed of the leaders of the Québec school of statistics, who work on topics such as statistical learning and neural networks, survey sampling, analysis of functional data, statistical analysis of images, dependence structures, Bayesian analysis, analysis of time series and financial data, and resampling methods. Actuarial science and applied probability are also well represented in the Statistics Laboratory.

News and highlights

Many Laboratory members have been honoured in 2010 – 2011. Christian Genest has been awarded a Canada Research Chair in Stochatic Dependence Modelling and the Gold Medal of the Statistical Society of Canada. This medal was awarded because of his contributions to multivariate analysis and nonparametric statistics, especially through the "development of models and methods of inference for studying stochastic dependence, synthesizing expert judgments and multicriteria decision making, as well as for his applications thereof in various fields such as insurance, finance, and hydrology" (SSC citation). Yoshua Bengio was awarded the NSERC-Ubisoft industrial chair and David Stephens was named a James McGill Professor in 2010 – 2011. Louis-Paul Rivest became the first honorary member of the *Association des statisticiens et statisticiennes du Québec* in recognition of his contribution to the development of statistics.

Members of the Statistics Laboratory continue to be influential in the statistical community. Christian Léger was elected President of the Statistical Society of Canada for 2012 – 2013. Fabrice Larribe was invited to give a lecture at the 73th Annual Meeting of the Institute of Mathematical Statistics in Gothenburg (Sweden). Brenda MacGibbon gave an invited lecture at "A Conference in Honor of Larry Brown's 70th Birthday" (held at the Wharton School of the University of Pennsylvania). Christian Genest and Johanna Nešlehová have organized training workshops on the use of copulas for the modelling of financial data in Québec City, Montréal, Paris, and Prague. Each workshop consisted of courses (lasting from 12 to 16 hours in total) and was attended by 20 to 30 participants. J. Nešlehová has just

been elected a member of the International Statistical Institute.

This year the Statistics Laboratory welcomed three new associate members (all of which are professors at UQAM): Simon Guillotte, Jean-François Renaud, and Jean-Philippe Boucher. S. Guillotte's advisor was François Perron (from the Université de Montréal). He had a position in Prince Edward Island before coming back to Montréal. J.-F. Renaud's advisor was Bruno Rémillard. He was a postdoctoral fellow in Austria and then a professor at the University of Waterloo before coming back to Montréal.

Students, postdoctoral fellows, and visitors

Laboratory members are deeply involved in the training of HQP. This year at least 10 students obtained their doctorate degree. Vahid Partovi Nia, a postdoctoral fellow supervised by David Stephens and Masoud Asgharian, is now a professor at the École Polytechnique de Montréal. Approximately 25 laboratory students have obtained a master's degree and are now working in the public service, research centres, or industry. A Case Studies Award was given by the Statistical Society of Canada to the students Zhihui Liu, Mireille Schnitzer, and Esther Perez Trejo, who worked under the supervision of Professors Robert Platt, Aurélie Labbe, and James Hanley.

In 2010 – 2011 Laboratory members supervised or co-supervised 79 M.Sc. students, 66 Ph.D. students, and 9 postdoctoral fellows.

Seminars

The scientific life of the Laboratory revolves around the weekly CRM – ISM – GERAD Statistics Colloquium in Montréal, the Statistics Seminar at Université Laval in Québec, and the Université de Sherbrooke Statistics Seminar in Sherbrooke. The Statistics Laboratory also supports the Montreal Seminar of Actuarial and Financial Mathematics and the McGill – Université de Montréal – MPrime Machine Learning Seminar.

Workshops, special sessions, and others

From January to June 2011 the CRM held a thematic program on statistics that included seven workshops (among other activities). We refer the reader to the section on the CRM thematic program for reports on these activities. In addition the Laboratory sponsored four workshops in 2010 – 2011. The report on the first one may be found in the section on the CRM general program and the reports on the three other workshops in the section Multidisciplinary and Industrial Program.

Colloquium
Contemporary Statistical Methodology
October 6 – 7, 2010, Université de Sherbrooke
Sponsored by the Statistics Laboratory, the ISM, and the Université de Sherbrooke
Organizers: Éric Marchand (Sherbrooke), Ernest Monga (Sherbrooke), Gilles Ducharme (Montpellier 2)

Workshop
Missing Data Approaches in the Health and Social Sciences: A Modern Survey
October 22, 2010, UQAM
Sponsored by the Statistics Laboratory
Organizers: Geneviève Lefebvre (UQAM), Russell Steele (McGill)

1*st Québec – Ontario Workshop on Insurance Mathematics*
January 28, 2011, UQAM
Sponsored by the Statistics Laboratory, the CRM, the ISM, UQAM, and the MITACS network
Organizers: Andrei L. Badescu (Toronto), David Landriault (Waterloo), Manuel Morales (Montréal), Jean-François Renaud (UQAM)

MITACS Day on the Practice of Actuarial Science (*Finsurance Project*)
March 16, 2011, Université de Montréal (Department of Mathematics and Statistics)
Sponsored by the Statistics Laboratory, the CRM, and the MITACS network
Organizers: Jean-François Angers (Montréal), Manuel Morales (Montréal)

Members of the Laboratory

Regular members

Louis-Paul Rivest (Laval), Director
Linear models, robustness, directional data, sampling, applications in finance

Belkacem Abdous (Laval)
Biostatistics, health research methodology, construction and validation of measuring tools in the health sector

Jean-François Angers (Montréal)
Decision theory, Bayesian statistics, robustness with respect to prior information, function estimation

Masoud Asgharian (McGill)
Survival analysis, change-point problems, simulated annealing and its variants, optimization

Yoshua Bengio (Montréal)
Statistical learning algorithms, neural networks, nucleus models, probabilistic models, data mining, applications in finance and statistical language modelling

Martin Bilodeau (Montréal)
Multivariate analysis, decision theory, asymptotic methods

Yogendra P. Chaubey (Concordia)
Sampling, linear models, resampling, survival analysis

Pierre Duchesne (Montréal)
Time series, sampling, multivariate analysis

Thierry Duchesne (Laval)
Survival analysis, longitudinal data analysis, missing data, modelling of losses, insurance of catastrophic incidents, nonparametric inference, model selection, warranty

Charles Dugas (Montréal)
Actuarial science, finance, learning algorithms, neural networks, universal approximation, survival analysis

Debbie J. Dupuis (HEC Montréal)
Extreme values, robustness

Sorana Froda (UQAM)
Nonparametric methods in function estimation, applications of stochastic modelling in biology and medicine

Christian Genest (Laval)
Multidimensional data analysis, dependence measures, nonparametric statistics, decision theory, applications in actuarial science, finance and psychology

Nadia Ghazzali (Laval)
Multidimensional data analysis, neural networks and genetic algorithms, applications in astrophysics and biostatistics

Aurélie Labbe (Laval)
Biostatistics and statistical genetics

Fabrice Larribe (UQAM)
Statistical genetics and biostatistics

Christian Léger (Montréal)
Resampling methods, adaptive estimation, model selection, robustness, applications in data mining

Brenda MacGibbon (UQAM)
Mathematical statistics, decision theory, biostatistics

Éric Marchand (Sherbrooke)
Statistical inference, Bayesian statistics, multivariate analysis and probability

Alejandro Murua (Montréal)
Data mining, machine learning, object recognition, signal processing, and various applications of statistics and probability to bioinformatics and the social and health sciences

François Perron (Montréal)
Decision theory, multidimensional data analysis, Bayesian statistics

James Ramsay (McGill)
Functional data analysis, smoothing and nonparametric regression, curve registration

Bruno Rémillard (HEC Montréal)
Probability theory, empirical processes, time series, nonlinear filtering, applications in finance

Roch Roy (Montréal)
Time series analysis, predictive methods, applications in econometrics and epidemiology

Arusharka Sen (Concordia)
Statistical inference of truncated data, nonparametric function estimation

Russell Steele (McGill)
Bayesian approaches to mixing modelling, multiple imputation

David Stephens (McGill)
Bayesian statistics, Markov Chain Monte Carlo and applications to bioinformatics, statistical genetics, and time series analysis

Wei Sun (Concordia)
Nonlinear filtering and its applications, stochastic analysis, statistical inference, stochastic modelling

Alain C. Vandal (McGill)
Biostatistics, nonparametric survival estimation and graph theory, imaging, capture-recapture models

David B. Wolfson (McGill)
Change-point problems, survival analysis, Bayesian statistics, optimal design, applications in medicine

Associate members

Juli Atherton (McGill)
Biostatistics, optimal Bayesian design, change-point problems, survival analysis, applications to genetics

Mylène Bédard (Montréal)
Optimal scaling, Metropolis-Hastings algorithms

Anne-Catherine Favre (Laval)
Statistical hydrology, analysis and modelling of time series

José Garrido (Concordia)
Risk theory, insurance statistics

David Haziza (Montréal)
Sampling theory, inference with missing data, robust inference

Lajmi Lakhal Chaïeb (Laval)
Multidimensional analysis of survival data, analysis of recurrent events, semi-parametric models and incomplete data

Geneviève Lefebvre (UQAM)
Bayesian and computational statistics, biostatistics

Erica Moodie (McGill)
Causal inference, optimal dynamic treatment regimes, longitudinal data, dose-response relationships

Manuel Morales (Montréal)
Mathematical finance, applied stochastic processes, ruin theory, actuarial science, Lévy processes, mathematics of insurance

Johanna Nešlehová (McGill)
Multivariate analysis, dependence modelling, nonparametric and asymptotic statistics, multivariate extreme value theory, empirical processes, applications to biostatistics, neuroscience and risk management

Robert Platt (McGill)
Biostatistics and statistical methods for pediatric and perinatal epidemiology.

Lea Popovic (Concordia)
Probability theory and its applications to evolutionary biology, population genetics, and cell biology

Publications

The CRM publishes monographs, lecture notes, proceedings, software, videos, and research reports. It has several collections. The in-house collection (Les Publications CRM) offers titles in both English and French. The CRM also has publishing agreements with the American Mathematical Society (AMS) and Springer. Since 1992, two collections, edited by the CRM, have been published and distributed by the AMS. They are the *CRM Monograph Series* and the *CRM Proceedings and Lecture Notes*. Springer publishes the *CRM Series in Mathematical Physics*. An asterisk preceding a publication indicates that its author is an Aisenstadt chairholder.

Recent Titles

The following list of recent titles contains books that appeared in 2010 – 2011 or that will be published soon.

American Mathematical Society
CRM Monograph Series

Joseph H. Silverman, *Moduli Spaces and Arithmetic Dynamics* (to appear).

Marcelo Aguiar & Swapneel Mahajan, *Monoidal Categories, Species and Hopf Algebras*, vol 29, 2010.

American Mathematical Society
CRM Proceedings & Lecture Notes

Daniel Daigle, Richard Ganong & Mariusz Koras (eds.), *Affine Algebraic Geometry: The Russell Festschrift* (to appear).

Bradd Hart, Thomas G. Kucera, Anand Pillay, Philip J. Scott & Robert A. G. Seely (eds.), *Models, Logics, and Higher-Dimensional Categories*, vol. 53, 2011.

Dmitry Jakobson, Stéphane Nonnenmacher & Iosif Polterovich (eds.), *Spectrum and Dynamics*, vol. 52, 2010.

Springer
CRM Series in Mathematical Physics

John Harnad (ed.), *Random Matrices, Random Processes and Integrable Systems*, 2011.

Previous Titles

American Mathematical Society
CRM Monograph Series

Saugata Ghosh, *Skew-Orthogonal Polynomials and Random Matrix Theory*, vol. 28, 2009.

Jean Berstel, Aaron Lauve, Christophe Reutenauer & Franco V. Saliola, *Combinatorics on Words: Christoffel Words and Repetitions in Words*, vol. 27, 2008.

Victor Guillemin & Reyer Sjamaar, *Convexity Properties of Hamiltonian Group Actions*, vol. 26, 2005.

*Andrew J. Majda, Rafail V. Abramov & Marcus J. Grote, *Information Theory and Stochastics for Multiscale Nonlinear Systems*, vol. 25, 2005.

Dana Schlomiuk, Andrei A. Bolibrukh, Sergei Yakovenko, Vadim Kaloshin & Alexandru Buium, *On Finiteness in Differential Equations and Diophantine Geometry*, vol. 24, 2005.

Prakash Panangaden & Franck van Breugel (eds.), *Mathematical Techniques for Analyzing Concurrent and Probabilistic Systems*, vol. 23, 2004.

Montserrat Alsina & Pilar Bayer, *Quaternion Orders, Quadratic Forms, and Shimura Curves*, vol. 22, 2004.

Andrei Tyurin, *Quantization, Classical and Quantum Field Theory and Theta Functions*, vol. 21, 2003.

Joel Feldman, Horst Knörrer & Eugene Trubowitz, *Riemann Surfaces of Infinite Genus*, vol. 20, 2003.

*Laurent Lafforgue, *Chirurgie des grassmanniennes*, vol. 19, 2003.

*George Lusztig, *Hecke Algebras with Unequal Parameters*, vol. 18, 2003.

Michael Barr, *Acyclic Models*, vol. 17, 2002.

*Joel Feldman, Horst Knörrer & Eugene Trubowitz, *Fermionic Functional Integrals and the Renormalization Group*, vol. 16, 2002.

Jose I. Burgos, *The Regulators of Beilinson and Borel*, vol. 15, 2002.

Eyal Z. Goren, *Lectures on Hilbert Modular Varieties and Modular Forms*, vol. 14, 2002.

Michael Baake & Robert V. Moody (eds.), *Directions in Mathematical Quasicrystals*, vol. 13, 2000.

Masayoshi Miyanishi, *Open Algebraic Surfaces*, vol. 12, 2001.

Spencer J. Bloch, *Higher Regulators, Algebraic K-Theory, and Zeta Functions of Elliptic Curves*, vol. 11, 2000.

James D. Lewis, *A Survey of the Hodge Conjecture*, 2nd edition, vol. 10, 1999 (with an appendix from B. Brent Gordon).

*Yves Meyer, *Wavelets, Vibrations and Scaling*, vol. 9, 1997.

*Ioannis Karatzas, *Lectures on Mathematics of Finance*, vol. 8, 1996.

John Milton, *Dynamics of Small Neural Populations*, vol. 7, 1996.

*Eugene B. Dynkin, *An Introduction to Branching Measure-Valued Processes*, vol. 6, 1994.

Andrew M. Bruckner, *Differentiation of Real Functions*, vol. 5, 1994.

*David Ruelle, *Dynamical Zeta Functions for Piecewise Monotone Maps of the Interval*, vol. 4, 1994.

V. Kumar Murty, *Introduction to Abelian Varieties*, vol. 3, 1993.

Maximilian Ya. Antimirov, Andrei A. Kolyshkin & Rémi Vaillancourt, *Applied Integral Transforms*, vol. 2, 1993.

*Dan V. Voiculescu, Kenneth J. Dykema & Alexandru Nica, *Free Random Variables*, vol. 1, 1992.

American Mathematical Society CRM Proceedings & Lecture Notes

Javad Mashreghi, Thomas Ransford & Kristian Siep (eds.), *Hilbert Spaces of Analytic Functions*, vol. 51, 2010.

P. Robert Kotiuga (ed.), *A Celebration of the Mathematical Legacy of Raoul Bott*, vol. 50, 2009.

Miguel Abreu, François Lalonde & Leonid Polterovich (eds.), *New Perspectives and Challenges in Symplectic Field Theory*, vol. 49, 2009.

David Avis, David Bremner & Antoine Deza (eds.), *Polyhedral Computation*, vol. 48, 2009.

John Harnad & Pavel Winternitz (eds.), *Groups and Symmetries: From Neolithic Scots to John McKay*, vol. 47, 2009.

Jean-Marie De Koninck, Andrew Granville & Florian Luca (eds.), *Anatomy of Integers*, vol. 46, 2008.

Panos M. Pardalos & Pierre Hansen (eds.), *Data Mining and Mathematical Programming*, vol. 45, 2008.

Stanley Alama, Lia Bronsard & Peter Sternberg (eds.), *Singularities in PDE and the Calculus of Variations*, vol. 44, 2007.

Andrew Granville, Melvyn B. Nathanson & Jozsef Solymosi (eds.), *Additive Combinatorics*, vol. 43, 2007.

Donald A. Dawson, Vojkan Jakšić & Boris Vainberg (eds.), *Probability and Mathematical Physics: A Volume in Honor of Stanislav Molchanov*, vol. 42, 2007.

André Bandrauk, Michel C. Delfour & Claude Le Bris (eds.), *High-Dimensional Partial Differential Equations in Science and Engineering*, vol. 41, 2007.

Vestislav Apostolov, Andrew Dancer, Nigel Hitchin & McKenzie Wang (eds.), *Perspectives in Comparison, Generalized and Special Geometry*, vol. 40, 2006.

Pavel Winternitz, David Gomez-Ullate, Arieh Iserles, Decio Levi, Peter J. Olver, Reinout Quispel & Piergiulio Tempesta (eds.), *Group Theory and Numerical Analysis*, vol. 39, 2005.

Jacques Hurtubise & Eyal Markman (eds.), *Algebraic Structures and Moduli Spaces*, vol. 38, 2004.

Piergiulio Tempesta, Pavel Winternitz, John Harnad, Willard Miller Jr., George Pogosyan & Miguel A. Rodriguez (eds.), *Superintegrability in Classical and Quantum Systems*, vol. 37, 2004.

Hershy Kisilevsky & Eyal Z. Goren (eds.), *Number Theory*, vol. 36, 2004.

H. E. A. Eddy Campbell & David L. Wehlau (eds.), *Invariant Theory in All Characteristics*, vol. 35, 2004.

Pavel Winternitz, John Harnad, C. S. Lam & Jiří Patera (eds.), *Symmetry in Physics*, vol. 34, 2004.

André D. Bandrauk, Michel C. Delfour & Claude Le Bris (eds.), *Quantum Control: Mathematical and Numerical Challenges*, vol. 33, 2003.

Vadim B. Kuznetsov (ed.), *The Kowalevski Property*, vol. 32, 2002.

John Harnad & Alexander R. Its (eds.), *Isomonodromic Deformations and Applications in Physics*, vol. 31, 2002.

John McKay & Abdellah Sebbar (eds.), *Proceedings on Moonshine and Related Topics*, vol. 30, 2001.

Alan Coley, Decio Levi, Robert Milson, Colin Rogers & Pavel Winternitz (eds.), *Bäcklund and Darboux Transformations*, vol. 29, 2001.

John C. Taylor (ed.), *Topics in Probability and Lie Groups*: *Boundary Theory*, vol. 28, 2001.

Israel M. Sigal & Catherine Sulem (eds.), *Nonlinear Dynamics and Renormalization Group*, vol. 27, 2001.

John Harnad, Gert Sabidussi & Pavel Winternitz (eds.), *Integrable Systems*: *From Classical to Quantum*, vol. 26, 2000.

Decio Levi & Orlando Ragnisco (eds.), *SIDE* III — *Symmetry and Integrability of Difference Equations*, vol. 25, 2000.

B. Brent Gordon, James D. Lewis, Stefan Müller-Stach, Shuji Saito & Noriko Yui (eds.), *The Arithmetic and Geometry of Algebraic Cycles*, vol. 24, 2000.

Pierre Hansen & Odile Marcotte (eds.), *Graph Colouring and Applications*, vol. 23, 1999.

Jan Felipe van Diejen & Luc Vinet (eds.), *Algebraic Methods and q-Special Functions*, vol. 22, 1999.

Michel Fortin (ed.), *Plates and Shells*, vol. 21, 1999.

Katie Coughlin (ed.), *Semi-Analytic Methods for the Navier – Stokes Equations*, vol. 20, 1999.

Rajiv Gupta & Kenneth S. Williams (eds.), *Number Theory*, vol. 19, 1999.

Serge Dubuc & Gilles Deslauriers (eds.), *Spline Functions and the Theory of Wavelets*, vol. 18, 1999.

Olga Kharlampovich (ed.), *Summer School in Group Theory in Banff,* 1996, vol. 17, 1998.

Alain Vincent (ed.), *Numerical Methods in Fluid Mechanics*, vol. 16, 1998.

François Lalonde (ed.), *Geometry, Topology and Dynamics*, vol. 15, 1998.

John Harnad & Alex Kasman (eds.), *The Bispectral Problem*, vol. 14, 1998.

Michel Delfour (ed.), *Boundaries, Interfaces and Transitions*, vol. 13, 1998.

Peter G. Greiner, Victor Ivrii, Luis A. Seco & Catherine Sulem (eds.), *Partial Differential Equations and their Applications*, vol. 12, 1997.

Luc Vinet (ed.), *Advances in Mathematical Sciences*: *CRM's 25 Years*, vol. 11, 1997.

Donald E. Knuth, *Stable Marriage and Its Relation to Other Combinatorial Problems*, vol. 10, 1996.

Decio Levi, Luc Vinet & Pavel Winternitz (eds.), *Symmetries and Integrability of Difference Equations*, vol. 9, 1995.

Joel S. Feldman, Richard Froese & Lon M. Rosen (eds.), *Mathematical Quantum Theory* II: *Schrödinger Operator*, vol. 8, 1995.

Joel S. Feldman, Richard Froese & Lon M. Rosen (eds.), *Mathematical Quantum Theory* I: *Field Theory and Many-Body Theory*, vol. 7, 1994.

Guido Mislin (ed.), *The Hilton Symposium* 1993, vol. 6, 1994.

Donald A. Dawson (ed.), *Measure-Valued Processes, Stochastic Partial Differential Equations and Interacting Systems*, vol. 5, 1994.

Hershy Kisilevsky & M. Ram Murty (eds.), *Elliptic Curves and Related Topics*, vol. 4, 1994.

Andrei L. Smirnov & Rémi Vaillancourt (eds.), *Asymptotic Methods in Mechanics*, vol. 3, 1993.

Philip D. Loewen, *Optimal Control via Nonsmooth Analysis*, vol. 2, 1993.

M. Ram Murty (ed.), *Theta Functions*, vol. 1, 1993.

Springer
CRM Series in Mathematical Physics

Marc Thiriet, *Biology and Mechanics of Blood Flows*, 2008 (2 volumes).

David Sénéchal, André-Marie Tremblay & Claude Bourbonnais (eds.), *Theoretical Methods for Strongly Correlated Electrons*, 2003.

*Roman Jackiw, *Lectures on Fluid Dynamics*, 2002.

Yvan Saint-Aubin & Luc Vinet (eds.), *Theoretical Physics at the End of the Twentieth Century*, 2001.

Yvan Saint-Aubin & Luc Vinet (eds.), *Algebraic Methods in Physics*, 2000.

Jan Felipe van Diejen & Luc Vinet (eds.), *Calogero – Moser – Sutherland Models*, 1999.

Robert Conte (ed.), *The Painlevé Property*, 1999.

Richard MacKenzie, Manu B. Paranjape & Wojciech J. M. Zakrzewski (eds.), *Solitons*, 1999.

Luc Vinet & Gordon Semenoff (eds.), *Particles and Fields*, 1998.

Springer
Lecture Notes in Statistics (subseries CRM)

Marc Moore (ed.), *Spatial Statistics*: *Methodological Aspects and Applications*, vol. 159, 2001.

S. Ejaz Ahmed & Nancy Reid (eds.), *Empirical Bayes and Likelihood Inference*, vol. 148, 2001.

Les Publications CRM

Laurent Guieu & Claude Roger, *L'Algèbre et le Groupe de Virasoro*, 2007.

Luc Lapointe, Ge Mo-Lin, Yvan Saint-Aubin & Luc Vinet, *Proceedings of the Canada – China Meeting on Theoretical Physics*, 2003.

Armel Mercier, *Fonctions de plusieurs variables* : *Différentiation*, 2002.

Nadia El-Mabrouk, Thomas Lengauer & David Sankoff (eds.), *Currents in Computational Molecular Biology*, 2001.

James G. Huard & Kenneth S. Williams (eds.), *The Collected Papers of Sarvadaman Chowla.* Volume I: 1925 – 1935; Volume II: 1936 – 1961; Volume III: 1962 – 1986, 2000.

Michael Barr & Charles Wells, *Category Theory for Computing Science*, 1999.

Maximilian Ya. Antimirov, Andrei A. Kolyshkin & Rémi Vaillancourt, *Mathematical Models for Eddy Current Testing*, 1998.

Xavier Fernique, *Fonctions aléatoires gaussiennes, vecteurs aléatoires gaussiens*, 1997.

Faqir Khanna & Luc Vinet (eds.), *Field Theory, Integrable Systems and Symmetries*, 1997.

Paul Koosis, *Leçons sur le théorème de Beurling et Malliavin*, 1996.

David W. Rand, *Concorder Version Three*, 1996 (software and user guide).

Jacques Gauvin, *Theory of Nonconvex Programming*, 1994.

Decio Levi, Curtis R. Menyuk & Pavel Winternitz (eds.), *Self-Similarity in Stimulated Raman Scattering*, 1994.

Rémi Vaillancourt, *Compléments de mathématiques pour ingénieurs*, 1993.

Robert P. Langlands & Dinakar Ramakrishnan (eds.), *The Zeta Functions of Picard Modular Surfaces*, 1992.

Florin N. Diacu, *Singularities of the N-Body Problem*, 1992.

Jacques Gauvin, *Théorie de la programmation mathématique non convexe*, 1992.

Pierre Ferland, Claude Tricot & Axel van de Walle, *Analyse fractale*, 1992 (software and user guide).

Stéphane Baldo, *Introduction à la topologie des ensembles fractals*, 1991.

Robert Bédard, *Groupes linéaires algébriques*, 1991.

Rudolf Beran & Gilles R. Ducharme, *Asymptotic Theory for Bootstrap Methods in Statistics*, 1991.

James D. Lewis, *A Survey of the Hodge Conjecture*, 1991.

David W. Rand & Tatiana Patera, *Concorder*, 1991 (software and user guide).

David W. Rand & Tatiana Patera, *Le Concordeur*, 1991 (software and user guide).

Véronique Hussin (ed.), *Lie Theory, Differential Equations and Representation Theory*, 1990.

John Harnad & Jerrold E. Marsden (eds.), *Hamiltonian Systems, Transformation Groups and Spectral Transform Methods*, 1990.

M. Ram Murty (ed.), *Automorphic Forms and Analytic Number Theory*, 1990.

Wendy G. McKay, Jiří Patera & David W. Rand, *Tables of Representations of Simple Lie Algebras.* Volume I*: Exceptional Simple Lie Algebras*, 1990.

Anthony W. Knapp, *Representations of Real Reductive Groups*, 1990.

Wendy G. McKay, Jiří Patera & David W. Rand, *SimpLie*, 1990 (software and user guide).

Francis H. Clarke, *Optimization and Nonsmooth Analysis*, Montréal, 1989.

Samuel Zaidman, *Une Introduction à la théorie des équations aux dérivées partielles*, 1989.

*Yuri I. Manin, *Quantum Groups and Noncommutative Geometry*, 1988.

Lucien Le Cam, *Notes on Asymptotic Methods in Statistical Decision Theory*, 1974.

Les Presses de l'Université de Montréal
Chaire Aisenstadt

*Laurent Schwartz, *Semimartingales and their Stochastic Calculus on Manifolds*, 1984.

*Yuval Ne′eman, *Symétries, jauges et variétés de groupe*, 1979.

*R. Tyrrell Rockafellar, *La théorie des sous-gradients et ses applications à l'optimisation, fonctions convexes et non convexes*, 1979.

*Jacques-Louis Lions, *Sur quelques questions d'analyse, de mécanique et de contrôle optimal*, 1976.

*Donald E. Knuth, *Mariages stables et leurs relations avec d'autres problèmes combinatoires*, 1976.

*Robert Hermann, *Physical Aspects of Lie Group Theory*, 1974.

*Mark Kac, *Quelques problèmes mathématiques en physique statistique*, 1974.

*Sybreen de Groot, *La transformation de Weyl et la fonction de Wigner : une forme alternative de la mécanique quantique*, 1974.

Other Collaborations with Publishers

Marc Moore, Sorana Froda & Christian Léger (eds.), *Mathematical Statistics and Applications: Festschrift for Constance van Eeden*, Lecture Notes – Monograph Series, vol. 42, 2003 (a collaboration with the Institute of Mathematical Statistics).

Duong H. Phong, Luc Vinet & Shing-Tung Yau (eds.), *Mirror Manifolds and Geometry*, AMS/IP Studies in Advanced Mathematics, vol. 10, 1998 (a collaboration with the AMS and International Press).

Pierre Ferland, Claude Tricot & Axel van de Walle, *Fractal Analysis User's Guide*, 1994 (a collaboration with the AMS).

Hedy Attouch, Jean-Pierre Aubin, Francis Clarke & Ivar Ekeland (eds.), *Analyse non linéaire*, 1989 (a collaboration with Gauthier-Villars).

Videos

Efim Zelmanov, *Abstract Algebra in the 20th Century*, 1997.

Serge Lang, *Les grands courants*, 1991.

Robert Bédard, *Brouiller les cartes*, 1991.

Serge Lang, *Les équations diophantiennes*, 1991.

Laurent Schwartz, *Le mouvement brownien*, 1990.

Laurent Schwartz, *Une vie de mathématicien*, 1989.

Scientific Personnel

CRM Members in 2010 – 2011

In contrast with most other mathematics institutes around the world, the CRM can count on the solid foundation of regular, associate, and invited members. Each regular member is also a professor at one of the partner institutions: Montréal, Concordia, McGill, UQAM, Laval, Sherbrooke, and Ottawa. Other members are researchers affiliated with the CRM in 2010 – 2011 as part of exchange agreements with neighbouring universities and industry or are long-term visitors from Canadian and foreign institutions. The presence at the CRM of such an active group of researchers has brought many benefits to the Centre. In particular, the CRM's national program is greatly facilitated by having on hand a large reserve of willing organizers, who even contribute financially to the organization of activities. The largest partnership is with the Université de Montréal, which grants the equivalent of five full-time teaching positions in release time to the CRM. Release agreements with the other Montréal area universities afford the equivalent of two more full-time positions. Facilities are also provided to researchers affiliated with junior colleges. Several members are affiliated to the CRM through industrial agreements.

Regular members

Syed Twareque Ali, Concordia
Jean-François Angers, Montréal
Vestislav Apostolov, UQAM
Paul Arminjon, Montréal
Ibrahim Assem, Sherbrooke
André D. Bandrauk, Sherbrooke
Line Baribeau, Laval
Peter Bartello, McGill
Robert Bédard, UQAM
Jacques Bélair, Montréal
Habib Benali, UPMC & Inserm
Yoshua Bengio, Montréal
François Bergeron, UQAM
Marco Bertola, Concordia
Yves Bourgault, Ottawa
Anne Bourlioux, Montréal
Steven P. Boyer, UQAM
Gilles Brassard, Montréal
Srečko Brlek, UQAM
Thomas Brüstle, Sherbrooke & Bishop's
Virginie Charette, Sherbrooke
Cédric Chauve, Simon Fraser
Vašek Chvátal, Concordia
Francis H. Clarke, Lyon 1
Olivier Collin, UQAM
Octav Cornea, Montréal
Miklós Csűrös, Montréal
Chris J. Cummins, Concordia
Galia Dafni, Concordia
Henri Darmon, McGill
Chantal David, Concordia
Jean-Marie De Koninck, Laval
Michel C. Delfour, Montréal
Maxime Descoteaux, Sherbrooke
Eusebius J. Doedel, Concordia
Pierre Duchesne, Montréal
Thierry Duchesne, Laval
Nadia El-Mabrouk, Montréal
André Fortin, Laval
Richard Fournier, Dawson & Montréal
Marlène Frigon, Montréal
André Garon, Polytechnique Montréal
Paul M. Gauthier, Montréal
Christian Genest, McGill
Eyal Z. Goren, McGill
Andrew Granville, Montréal
Christophe Grova, McGill
Alfred Michel Grundland, UQTR
Pengfei Guan, McGill
Geňa Hahn, Montréal
Richard L. Hall, Concordia
Sylvie Hamel, Montréal
John Harnad, Concordia
Tony R. Humphries, McGill
Jacques Hurtubise, McGill
Véronique Hussin, Montréal
Adrian Iovita, Concordia

Dmitry Jakobson, McGill
Vojkan Jakšić, McGill
André Joyal, UQAM
Tomasz Kaczynski, Sherbrooke
Niky Kamran, McGill
Olga Kharlampovich, McGill
Hershy Kisilevsky, Concordia
Paul Koosis, McGill
Dmitry Korotkin, Concordia
Gilbert Labelle, UQAM
John Labute, McGill
François Lalonde, Montréal
Benoît Larose, Champlain St-Lambert & Concordia
Christian Léger, Montréal
Frédéric Lesage, Polytechnique Montréal
Sabin Lessard, Montréal
Claude Levesque, Laval
Jean-Marc Lina, ÉTS
Shiping Liu, Sherbrooke
Steven Lu, UQAM
Brenda MacGibbon, UQAM
Michael C. Mackey, McGill
Vladimir Makarenkov, UQAM
Michael Makkai, McGill
Javad Mashreghi, Laval
Sherwin A. Maslowe, McGill
Pierre Mathieu, Laval
John McKay, Concordia
Manuel Morales, Montréal
M. Ram Murty, Queen's
Fahima Nekka, Montréal
Nilima Nigam, Simon Fraser
Robert G. Owens, Montréal
Manu Paranjape, Montréal
Jiří Patera, Montréal
François Perron, Montréal
Iosif Polterovich, Montréal
Lea Popovic, Concordia
James O. Ramsay, McGill
Thomas J. Ransford, Laval
Bruno Rémillard, HEC Montréal
Christophe Reutenauer, UQAM
Louis-Paul Rivest, Laval
Ivo G. Rosenberg, Montréal
Christiane Rousseau, Montréal
Damien Roy, Ottawa
Peter Russell, McGill
Yvan Saint-Aubin, Montréal
David Sankoff, Ottawa
Dana Schlomiuk, Montréal
Robert Seiringer, McGill
Alexander Shnirelman, Concordia
Vasilisa Shramchenko, Sherbrooke
Alina Stancu, Concordia
Ron J. Stern, Concordia
Alain Tapp, Montréal
Francisco Thaine, Concordia
John A. Toth, McGill
Paul F. Tupper, Simon Fraser
Lennaert van Veen, UOIT
Luc Vinet, Montréal
Timothy R. S. Walsh, UQAM
Thomas P. Wihler, Bern
Pavel Winternitz, Montréal
Daniel T. Wise, McGill
Xiaowen Zhou, Concordia

Associate members

Nantel Bergeron, York
Robert Conte, CEA/Saclay
Stéphane Durand, Collège Édouard-Montpetit
Bertrand Eynard, CEA/Saclay
Martin J. Gander, Genève
Pierre Ille, Institut de mathématiques de Luminy
Marc Laforest, Polytechnique Montréal
Decio Levi, Roma Tre
Jun Li, Pharsight
Emmanuel Lorin de la Grandmaison, Carleton
Yiannis N. Petridis, Univ. Coll. London
Elisa Shahbazian, OODA Technologies

Marc Thiriet, UPMC & INRIA Rocquencourt
Pierre Valin, Defence R&D Canada
Carolyne M. Van Vliet, Montréal & Miami
Jean-Paul Zolésio, INRIA Sophia Antipolis

Invited members

Mylène Bédard, Montréal
Toni Bourama, Virginia State
Louis Doray, Montréal
David Haziza, Montréal

Postdoctoral Fellows

Each year the CRM plays host to a great number of postdoctoral fellows. Their funding is provided through the NSERC and FRQNT postdoctoral programs, the NATO international program administered by NSERC, the CRM (usually in collaboration with the ISM), the CRM's research laboratories, and individual research grants from CRM members. The list below includes postdoctoral fellows in residence at the CRM and those co-funded by the CRM. Some of the fellows were in residence at the CRM for only part of the year. The affiliation given is the institution where the doctorate was obtained.

Elif Fidan Acar, Toronto
Shabnam Akhtari, UBC
Mathieu Anel, Paul Sabatier
Ferenc Balogh, Concordia
Mounir Bennoune, Paul Sabatier
Mattia Cafasso, SISSA
Renato Calleja, UT Austin
Emmanuel Delsinne, Caen
Nikolai Dimitrov, Cornell
Tiago Dinis da Fonseca, UPMC
Norman Nam Van Do, Melbourne
Grégoire Dupont, Lyon 1
Abdelkrim El Basraoui, Ottawa
Xander Faber, Columbia
François Fillion-Gourdeau, McGill
Igor Gorelyshev, Russian Academy of Sciences
Melita Hadzagic, McGill
Benoit Hamelin, Polytechnique Montréal
Alexander J. Hariton, Montréal
Eric Harper, Miami
Alexander E. Hoffnung, UC Riverside
Hongnian Huang, Wisconsin – Madison
Duc Khiem Huynh, Bristol
Nabil Kahouadji, Paris Diderot
Abdoulaye Kane, Laval
Dimitris Koukoulopoulos, UIUC
Ruochuan Liu, MIT
Pawel Lorek, Wrocław
Alok Kumar Maharana, Tata Inst.
Guyslain Naves, Joseph Fourier
Karol Palka, Warsaw
Prim Plansangkate, Cambridge
Sarah Post, Minnesota
Aleix Prats-Ferrer, Barcelona
Cornelius Reinfeldt, Heriot-Watt
David Ridout, Adelaide
Vivien Ripoll, Paris Diderot
Brian Seguin, Carnegie Mellon
Ethan C. Smith, Clemson
Mahmood Sohrabi, Carleton
Christian Stump, Wien
Diane Vavrichek, Michigan
Driss Yacoubi, UPMC
Benjamin Young, UBC
El Miloud Zaoui, Sherbrooke

Visitors

Each year the CRM hosts a large number of visitors. The majority come to the Centre to participate in scientific activities organized or co-organized by the CRM. In 2010 – 2011 there were 776 participants in the thematic

program activities and 199 participants in the activities of the multidisciplinary and industrial program. Furthermore 711 participants were registered in those activities of the general program that took place at the CRM or its partner institutions, and the CRM supported in part two conferences hosting 437 participants (CNTA XI and CanaDAM 2011).

Long-term visitors

The following list only includes visitors who were in residence for at least four weeks.

Montserrat Casals-Ruiz, Vanderbilt
Rupert L. Frank, Princeton
Christian Hainzl, Tübingen
Zdenek Kabat, TU Prague
Dalibor Karasek, TU Prague
Ilya Kazachkov, Vanderbilt
Decio Levi, Roma Tre
Mathieu Lewin, Cergy-Pontoise
Adam Logan, Liverpool & Waterloo
Joel Louwsma, Caltech
Alexei G. Miasnikov, Stevens Inst.
Djordje Milicevic, Michigan
Michael Monastyrsky, ITEP
Antonella Perucca, EPFL
Vladimir Shpilrain, CCNY
Libor Šnobl, TU Prague
Ramesh Sreekantan, ISI Bangalore
Sumati Surya, ITEP
Marc Thiriet, UPMC
Nicholas Touikan, UQAM
Sébastien Tremblay, UQTR
Enric Ventura, UP Catalunya
Nicolae Vulpe, Academy of Sciences of Moldova
Yuanli Zhang, unaffiliated
Oleksiy Zhedanov, Donetsk IPE

Short-term visitors

The following visitors were in residence for less than four weeks.

Alain Arnéodo, ÉNS Lyon
Douglas N. Arnold, Minnesota
Joan Carles Artés, UA Barcelona
Jean-Pierre Aubin, École Polytechnique
Alina Bucur, UC San Diego
Goce Chadzitaskos, Doppler Inst.
Robert Conte, CEA/Saclay
Aka Bile Frederic Edoukou, Nanyang Tech.
Bertrand Eynard, CEA/Saclay
Brooke Feigon, East Anglia
Roman Golovko, Montréal
Matthew Greenberg, Calgary
Mo Hendon, Georgia
Jiří Hrivnák, Montréal
Francesco Iachello, Yale
François Légaré, INRS-ÉMT
Frank Lemire, Windsor
Michael Levitin, Cardiff
Willard Miller Jr., Minnesota
Robert V. Moody, Alberta
Aleksander Yu. Orlov, Inst. Shirshov
Denis Osin, Vanderbilt
Alexei V. Penskoi, Independent Univ. of Moscow
Vladimir N. Remeslennikov, Omsk State
Nikolay Romanovskiy, Sobolev Inst.
Yuri Safarov, King's Coll. London
Avinash Sathaye, Kentucky
Kaneenika Sinha, IISER Kolkata
Gerhard Sorger, Wien
Marzena Szajewska, Bialystok
Zora Thomova, SUNYIT
Alexander Turbiner, UNAM
Elena Vedmedenko, Hamburg
Esther Widiasih, Minnesota
Vladimir E. Zakharov, Arizona
Jean-Paul Zolésio, INRIA Sophia Antipolis

List of Students Having Graduated in 2010 – 2011

The CRM members supervise a large number of graduate students. In this section we give information on the students supervised by CRM members who graduated in 2010 – 2011. The name of the student is followed by the name of his or her supervisor (or names of his or her supervisors), his or her institution, and his or her program. Some names may be missing from this list, because we have only included those that have been brought to our attention.

Ph.D. Students

Waldo Arriagada-Silva
Christiane Rousseau
Université de Montréal
Mathematics (applied mathematics option)

Ferenc Balogh
John Harnad
Concordia University
Mathematics

Noomen Ben Ghorbal
Christian Genest
Université Laval
Mathematics (statistics option)

Alix Boc
Vladimir Makarenkov
Université du Québec à Montréal
Bioinformatics

Abdelhafid Chekkal
Christophe Reutenauer
Université du Québec à Montréal
Mathematics

Effat Dehghanian
André D. Bandrauk
Université de Sherbrooke
Chemistry

Elena Alice Dragomir
Sylvie Perreault; Jean-François Angers
Université de Montréal
Pharmaceutical sciences

Dumitru Ehran
Yoshua Bengio
Université de Montréal
Computer science

Cameron Franc
Henri Darmon
McGill University
Mathematics

Tristan Freiberg
Andrew Granville
Université de Montréal
Mathematics (pure mathematics option)

Alexandre Goguin
Habib Benali, Frédéric Lesage
Université Pierre et Marie Curie
Neuroscience

Alexandre Hocquard
Nicolas Papageorgiou; Bruno Rémillard
HEC Montréal
Financial engineering

Benoit Huard
Alfred Michel Grundland
Université de Montréal
Mathematics (applied mathematics option)

Félix Labrecque-Synnott
Jean-François Angers
Université de Montréal
Statistics

Caroline Lambert
Christiane Rousseau
Université de Montréal
Mathematics (pure mathematics option)

Éveline Legendre
Vestislav Apostolov
Université du Québec à Montréal
Mathematics

Mehdi Lejmi
Vestislav Apostolov
Université du Québec à Montréal
Mathematics

Geva Maimon
Russell Steele
McGill University
Statistics

Olivier Marchal
John Harnad; Marco Bertola; Bertrand Eynard
Université de Montréal
Mathematics (applied mathematics option)

James Merleau
Jean-François Angers; Luc Perreault
Université de Montréal
Statistics

Andrey Nikolaev
Alexei G. Miasnikov
McGill University
Mathematics

Milton Nogueira da Silva Junior
Fernando Duda; Eliot Fried
Universidade Federal de Rio de Janeiro; McGill University
Mechanical engineering

Ivo Panayotov
Xiao-Wen Chang
McGill University
Mathematics

Charles Paquette
Shiping Liu
Université de Sherbrooke
Mathematics

Quentin Rajon
Thomas J. Ransford; Jérémie Rostand
Université Laval
Mathematics

Antonio Rieser
Octav Cornea; François Lalonde
Université de Montréal
Mathematics (pure mathematics option)

Frédérick Tremblay
Pavel Winternitz
Université de Montréal
Mathematics (applied mathematics option)

Pascal Turbis
Anne Bourlioux
Université de Montréal
Mathematics (applied mathematics option)

Michael Lennox Wong
Jacques Hurtubise; Peter Russell
McGill University
Mathematics

Yu Zhao
Henri Darmon
McGill University
Mathematics

M.Sc. Students

Maxime Abran
Frédéric Lesage
École Polytechnique de Montréal
Electrical Engineering

Adil Arqib
Louis-Paul Rivest
Université Laval
Statistics

Dylan Attwell-Duvall
Eyal Z. Goren
McGill University
Mathematics

Janine Bachrachas
Alina Stancu
Concordia University
Mathematics

Raymond Bastien-Ferland
Louis-Paul Rivest
Université Laval
Statistics

Marc-Olivier Bélisle
Virginie Charette
Université de Sherbrooke
Mathematics

Louis Philip Benoit Brouvette
Miklós Csűrös; Sylvie Hamel
Université de Montréal
Bioinformatics

Véronique Boiteau
Nadia Ghazzali; Belkacem Abdous
Université Laval
Mathematics

Olivier Breuleux
Yoshua Bengio
Université de Montréal
Computer science

Leila Bridgeman
Tony Humphries; Thomas P. Wihler
McGill University
Mathematics

Ruth Bruno
Éric Marchand
Université de Sherbrooke
Biostatistics

Luca Candelori
Henri Darmon
McGill University
Mathematics

Éric Charland
Thomas Brüstle
Université de Sherbrooke
Mathematics

Hugo Cloutier
Alain Goupil
Université du Québec à Trois-Rivières
Mathematics

François D'Auteuil-Potvin
Louis-Paul Rivest
Université Laval
Statistics

Félix Desrochers-Guérin
Steven Shin-Yi Lu
Université du Québec à Montréal
Mathematics

Bastien Ferland-Raymond
Louis-Paul Rivest
Université Laval
Statistics

Maxime Fortier-Bourque
Thomas J. Ransford
Université Laval
Mathematics

Jérôme Fortier
Line Baribeau; Jérémie Rostand
Université Laval
Mathematics

Jérôme-Melville Giguère
Richard Fournier
Université de Montréal
Mathematics

Frédéric Godin
Manuel Morales
Université de Montréal
Mathematics

Alexandre Gougeon
Bruno Rémillard; Nicolas Papageorgiou
HEC Montréal
Management sciences

Kaveh Hamidya
Bruno Rémillard
HEC Montréal
Management sciences

Fanny Harvey
Christian Genest; Thierry Duchesne
Université Laval
Statistics

Gilbert Honnouvo
David B. Wolfson
McGill University
Mathematics

Aymen Jendoubi
André Fortin
Université Laval
Mathematics

Anne-Sophie Julien
Louis-Paul Rivest
Université Laval
Biostatistics

Jean-Philippe Labbé
Srečko Brlek
Université du Québec à Montréal
Mathematics

Étienne Lareau
Frédéric Lesage
École Polytechnique de Montréal
Biomedical engineering

James-Michael Leahy
Henri Darmon
McGill University
Mathematics

Maude Lepage
Christian Genest
Université Laval
Statistics

Patrick Letendre
Claude Levesque; Jean-Marie De Koninck
Université Laval
Mathematics

Aziz Lmoudden
Louis-Paul Rivest
Université Laval
Statistics

Jonathan Lortie
Christophe Hohlweg
Université du Québec à Montréal
Mathematics

Ying Lu
Thierry Duchesne
Université Laval
Statistics

Omid Makhmali
Niky Kamran
McGill University
Mathematics

Zia Mohaddes
Sylvie Hamel; Andreea-Ruxandra Schmitzer
Université de Montréal
Bioinformatics

Marcela Molinie
Jacques Bélair
Université de Montréal
Mathematics

Christian Olivier Nambeu
David Haziza
Université de Montréal
Statistics

Cheikhe Ndongo
Alfred Michel Grundland
Université du Québec à Trois-Rivières
Mathematics

Annick Joëlle Nembot Simo
Alejandro Murua
Université de Montréal
Statistics

Herbert Nkwimi Tchahou
Pierre Duchesne
Université de Montréal
Statistics

Hassan Omidi Firouzi
Manuel Morales
Université de Montréal
Mathematics

Sylvain Pannetier Lebeuf
Yoshua Bengio; Manuel Morales
Université de Montréal
Mathematics

Valérie Patenaude
Jean-François Angers; Louis G. Doray; Serge Dubuc
Université de Montréal
Statistics

Benoît Pouliot
André Fortin
Université Laval
Mathematics

Louis-Xavier Proulx
Anne Bourlioux
Université de Montréal
Mathematics

William Phillip Rempel
Niky Kamran
McGill University
Mathematics

Juan Ignacio Restrepo
Henri Darmon
McGill University
Mathematics

Márcio Ribeiro
Christian Léger
Université de Montréal
Statistics

Mariolys Rivas
Marni Mishna
Simon Fraser University
Mathematics

Marc-André Rousseau
David A. Stephens
McGill University
Statistics

Alaa Shawli
Russell Steele; Masoud Asgharian
McGill University
Mathematics

Alexandre St-Onge
Line Baribeau
Université Laval
Mathematics

Julia Thorpe
Erica E. M. Moodie
McGill University
Epidemiology

Stéphane Turcotte
Louis-Paul Rivest
Université Laval
Biostatistics

Geneviève Vézina
Nadia Ghazzali; Belkacem Abdous
Université Laval
Mathematics

Gauthier Webanck
Bruno Rémillard
HEC Montréal
Management sciences

Governance and Scientific Guidance

The CRM structure consists of a Board of Directors, an Assembly of Members, an International Scientific Advisory Committee, a Local Scientific Committee, an Executive Committee, and a Committee of Directors of Laboratories. In 2010-2011, the members of the Local Scientific Committee were Steven P. Boyer (Université du Québec à Montréal), Gilles Brassard (Université de Montréal), André Fortin (Université Laval), Andrew Granville (Université de Montréal), Dmitry Jakobson (McGill University), and Peter Russell (McGill University; Director of the CRM). The Executive Committee consists of the CRM Director and the Deputy Directors. For more information, the reader may consult the web site crm.math.ca/apropos/CRM_structure_an.shtml.

Board of Directors

The Board of Directors is composed of:

- The Director (ex officio);
- A member of the Executive Committee nominated by the Board for a two-year mandate;
- Two regular members nominated by the Assembly for three-year mandates, normally renewable once;
- A Laboratory Director, nominated by the Committee of Directors of Laboratories for a two-year mandate, normally renewable once;
- The Vice-Principal, Research, of each of the main partner universities of the CRM, or his representative;
- A Vice-Principal, Research, of one of the other partner universities of the CRM, chosen by these universities on a rotating basis for a two-year mandate.

Here are the members of the Board of Directors for 2010 – 2011.

Jacques Beauvais, Vice-Rector (Research)
Université de Sherbrooke

Olivier Collin
Université du Québec à Montréal

Louise Dandurand, Vice-President (Research)
Concordia University

Rose Goldstein, Vice-Principal (Research)
McGill University (from January 1st, 2011)

Andrew Granville
Université de Montréal

John Harnad
Concordia University

Joseph Hubert, Vice-Rector (Research)
Université de Montréal

Yves Mauffette, Vice-Rector (Research)
Université du Québec à Montréal

Robert G. Owens
Université de Montréal

Rima Rozen, Vice-Principal (Research)
McGill University (until December 31, 2010)

Peter Russell, Director of the CRM
McGill University

Chantal David (Concordia University) and **Odile Marcotte** (Université du Québec à Montréal), Deputy Directors of the CRM, were invited members.

International Scientific Advisory Committee

The International Scientific Advisory Committee consists of distinguished researchers from Canada and abroad. Its members are either mathematicians or scientists with close ties to the mathematical sciences. The Advisory Committee is kept informed regularly of the activities of the Centre through the Director. The Committee makes recommendations about the general scientific orientations of the CRM and gives advice about proposed scientific activities.

Martin Barlow received his undergraduate degree from the University of Cambridge in 1975 and completed his doctoral degree with David Williams at the University College of Swansea in Wales (1978). Since then he has been a leading researcher in probability theory, in particular diffusion in fractals and other disordered media. He held a Royal Society University Research Fellowship at the University of Cambridge from 1985 to 1992, when he joined the Mathematics Department at the University of British Columbia. He is currently Professor of Mathematics at UBC. He has held a number of visiting professorships at leading universities. Martin Barlow gave an invited lecture at the 1990 ICM in Kyoto and was an invited lecturer at the prestigious Saint-Flour Summer School in 1995. In 2008 he received the Jeffery-Williams Prize of the Canadian Mathematical Society and in 2009 the CRM – Fields – PIMS Prize. Other distinctions include the Rollo Davidson Prize from the University of Cambridge and the Junior Whitehead Prize from the London Mathematical Society. He has been a leader of the international probability community as a lead organizer of numerous conferences, Associate Editor of all the top probability journals, and Editor-in-Chief of the Electronic Communications in Probability. He has been a Fellow of the Institute of Mathematical Statistics since 1995 and of the Royal Society of Canada since 1998. In 2006 he was elected Fellow of the Royal Society (London).

James Berger is the Arts and Sciences Professor of Statistics at the Institute of Statistics and Decision Sciences of Duke University and Director of the Statistical and Applied Mathematical Sciences Institute (SAMSI). He received a Ph.D. in mathematics from Cornell University in 1974 and is a past recipient of the Guggenheim and Sloan Fellowships. He was elected to the National Academy of Sciences in 2003. His research has primarily been in Bayesian statistics, foundations of statistics, statistical decision theory, simulation, model selection, and various interdisciplinary areas of science and industry. He has supervised 30 Ph.D. dissertations, published over 140 articles, and written or edited 13 books or special volumes.

Allan Borodin received his B.A. in Mathematics in 1963 (from Rutgers University), his M.Sc. in Electrical Engineering and Computer Science in 1966 (from Stevens Institute of Technology), and his Ph.D. in Computer Science in 1969 (from Cornell University). He was a systems programmer at Bell Laboratories in New Jersey from 1963 to 1966, and a Research Fellow at Cornell from 1966 to 1969. Since 1969, he has been a professor in the Department of Computer Science at the University of Toronto, where he became a full professor in 1977. He was department chair from 1980 to 1985. Professor Borodin is a world leader in the mathematical foundations of computer science and has made fundamental contributions to many areas, including algebraic computations, resource tradeoffs, routing in interconnection networks, parallel algorithms, on-line algorithms, and adversarial queuing theory. Professor Borodin has been the editor of many journals, including the SIAM Journal on Computing. He has held positions on, or been active in, dozens of committees and organizations, both inside and outside the University, and has held several visiting professorships internationally. In 1991 Professor Borodin was elected a Fellow of the Royal Society of Canada and in 2008 he received the CRM – Fields – PIMS Prize.

Susan Friedlander is currently Director of the Center for Applied Mathematical Sciences and Professor of Mathematics at the University of Southern California. She obtained her Doctoral degree at Princeton University in 1972. She has published extensively in the areas of differential equations and fluid mechanics. She has been very active on numerous committees and evaluation panels, including the Council of the American Mathematical Society and the Board on Mathematical Sciences and Their Applications of the National Academies. She has also been involved continuously in the organization of conferences and workshops; in particular she was a member of the AMS-Shanghai Joint Meeting Program Committee. She has served on numerous AMS

editorial boards and university committees. She has been honoured with several academic awards, including the Institut Henri-Poincaré Medal, the Gauthier-Villars Prize for Nonlinear Analysis, and the University of Illinois Scholar Award (in 2003). Over the years, she has been a frequent invited lecturer in the United States and around the world

Mark Goresky has been a member of the Institute for Advanced Study in Princeton since 1994. He received his B.Sc. from the University of British Columbia in 1971 and a Ph.D. from Brown University in 1976. In 1986 he was elected to the Royal Society of Canada. He was awarded the Jeffery-Williams Prize of the Canadian Mathematical Society in 1996 and the Steele Prize of the American Mathematical Society in 2002 (jointly with R. MacPherson). He was a member of the editorial board of the Canadian Journal of Mathematics from 1997 to 2000 and is currently a member of the editorial board of the Bulletin of the American Mathematical Society. He is a world expert in geometric representation theory.

Mark L. Green has been a professor in the UCLA Department of Mathematics since 1982. He received his Ph.D. from Princeton University in 1972 and was Director of the Institute for Pure and Applied Mathematics from 2001 to 2008. Mark Green has received numerous honours during his career. In particular, he was an invited speaker at the International Congress of Mathematicians in Berlin in 1998. He was a plenary speaker at the Abel Centennial held in Oslo in 2002 and the Hodge Centennial held in Edinburgh in 2003. Professor Green's services to the mathematical community are extensive. He was a member of the Board of Trustees at the Claremont Center for the Mathematical Sciences and a member of the Board of Directors of the Center for Mathematics and Teaching. Professor Green also served on the NSERC Major Resources Support Committee and was the editor of the Journal of Algebraic Geometry. His research interests are in commutative algebra, algebraic geometry, and applied mathematics.

Alice Guionnet is "directrice de recherche" at the CNRS and teaches at the École normale supérieure de Lyon. She received a Ph.D. from the Université Paris-Sud in 1995. In 1999 she was awarded the Oberwolfach Prize (for a young European mathematician under 35 years of age) and in 2009 she received the Loève Prize in Probability. She was an invited speaker at ICIAM 2003 and ICM 2006. Alice Guionnet was a member of the editorial board of *Stochastic Processes and their Applications* and is currently editor-in-chief of the *Annales de l'Institut Henri Poincaré B, Probability and Statistics*. Her research interests focus mainly on probability theory in relation to mathematical physics.

Jacques Hurtubise obtained a B.Sc. in mathematics in 1978 from the Université de Montréal and a Ph.D. in mathematics in 1982 from the University of Oxford, where he was a Rhodes scholar. From 1982 to 1988 he was a professor at UQAM. Since 1988 he has been a professor in the Department of Mathematics and Statistics of McGill University (of which he has been the chairman since 2009). His research interests are in gauge theory, algebraic geometry, integrable systems, and mathematical physics. He was a Fellow of the Institute for Advanced Study at Princeton in 1987 – 1988 and a Centennial Fellow of the American Mathematical Society in 1993 – 1994. In 1993 Jacques Hurtubise was awarded the Coxeter – James Prize by the Canadian Mathematical Society. In 2004 he became a Fellow of the Royal Society of Canada. From 2010 to 2012 he was the President of the Canadian Mathematical Society. Jacques Hurtubise was or is a member of numerous committees of NSERC, FQRNT, and the Council of Canadian Academies.

Barbara Lee Keyfitz has been a professor at the Ohio State University since January 2009. She served as Director of the Fields Institute for the Mathematical Sciences from 2004 to 2008. From 2000 to 2008, she was John and Rebecca Moores Professor of Mathematics at the University of Houston, which she joined in 1987, following appointments at Columbia, Princeton, and

Arizona State University. She studied at the University of Toronto and obtained her Ph.D. at the Courant Institute (NYU). Barbara Keyfitz is a Fellow of the American Association for the Advancement of Science and the recipient of the 2005 Krieger – Nelson Prize of the Canadian Mathematical Society. She serves as Treasurer of the International Council of Industrial and Applied Mathematics and has been a member of several editorial boards. Her research interests are in the field of nonlinear partial differential equations.

Claude Le Bris obtained his doctorate from the École Polytechnique in France and his accreditation to supervise research from the Université Paris Dauphine in 1997. His research interests include mathematical analysis and numerical methods for partial differential equations and their applications to molecular simulation, multiscale problems, materials science, and continuum mechanics. He is a world-renowned expert in the mathematics of quantum chemistry and the computation of the electronic structure in quantum physics. Claude Le Bris received the Blaise Pascal Prize from the Académie des Sciences in 1999, the "CS 2002 Prize in Scientific Computing," and the Giovanni Sacchi-Landriani Prize from the Istituto Lombardo in 2002. He was Civil-Engineer-in-Chief and Research Scientist at the École Nationale des Ponts et Chaussées and scientific leader of the MICMAC project at INRIA. Claude Le Bris has been a member of several program committees of international conferences and thematic years organized by research centres. He was co-editor of *Mathematical Modelling and Numerical Analysis* and editor of the *Applied Mathematics Research eXpress*. He has supervised 12 Ph.D. students and authored five books, 80 articles published in international journals, and 20 articles included into books or conference proceedings. He has given 90 invited lectures at international conferences and a series of Aisenstadt lectures at the CRM (in the fall of 2009).

Peter Russell obtained his Ph.D. from the University of California, Berkeley in 1966 under the direction of Maxwell Rosenlicht. After spending three years as a Benjamin Pierce Instructor at Harvard University, he joined the Department of Mathematics and Statistics at McGill University, from which he retired in 2009. He served as chair of that department from 1988 to 1994 and as director of the Institut des Sciences Mathématiques in 1995 – 1996 and from 2000 to 2004. His area of interest is algebraic geometry. Since the 1970s Professor Russell has been active in affine algebraic geometry, which around that time became recognized as a full-fledged subdiscipline of mathematics with close links to algebra, algebraic geometry, and topology.

Akshay Venkatesh has been a professor at Stanford University since September 2008. He obtained his Ph.D. from Princeton University in 2002, was C.L.E. Moore Instructor at MIT from 2002 to 2004, and a professor at the Courant Institute (NYU) from 2004 to 2008. Akshay Venkatesh has received many prizes and fellowships since the beginning of his career, in particular the Sloan Foundation Fellowship (2007), the Salem Prize (2007), the David and Lucile Packard Foundation Fellowship (2007 – 2012), and the SASTRA Ramanujan Prize (2008). In 2010 he was Aisenstadt Chair lecturer at the CRM, within the framework of the thematic semester on Number Theory as Experimental and Applied Science. His research interests are in number theory and automorphic forms, including representation theory, dynamics on homogeneous spaces, and arithmetic algebraic geometry.

Joseph Hubert, Vice-Principal (Research), Université de Montréal, is an ex-officio member of the International Scientific Advisory Committee. **Chantal David** (Concordia University), **Andrew Granville** (Université de Montréal), and **Odile Marcotte** (Université du Québec à Montréal), all Deputy Directors of CRM, are invited members of the Committee.

CRM Administrative and Support Staff

The Director's Office

Peter Russell
Director

Chantal David
Deputy Director, *Le Bulletin du CRM* and joint publications with the AMS and Springer

Andrew Granville
Deputy Director, CRM Prizes

Odile Marcotte
Deputy Director, Annual Report and Coordination with Related Fields

Administration

Vincent Masciotra
Head of Administration

Muriel Pasqualetti
Administrative Assistant

Julie Labbé
Secretary

Gaëlle Géraldine Prigent
Secretary

Guillermo Martinez-Zalce
Research Laboratories Administrative Coordinator

Diane Brulé-De Filippis
Administrative Assistant

Scientific Activities

Louis Pelletier
Coordinator

Louise Letendre
Administrative Assistant

Sakina Benhima
Project Manager

Computer Services

Daniel Ouimet
Systems Administrator

André Montpetit
Office Systems Manager (half-time)

Publications

André Montpetit
TEX Expert (half-time)

Communications

Suzette Paradis
Communications Officer and Webmaster

Mandate of the CRM

The Centre de recherches mathématiques (CRM) is one of the first and foremost institutes of mathematical research in the world. Indeed it was the first international institute to introduce the famous thematic programs (in 1984, at the same time as MSRI). These programs were created independently by the two institutes and were an inspiration for the tens of institutes that were created in Europe and Asia after 1984. This model turned out to be the most creative and efficient means of fostering research and its applications to state-of-the-art technology. Although the initial programs were concentrated in pure and applied mathematics, they are now much broader and include all the fields that use sophisticated mathematical methods: theoretical physics, classical and quantum information, medical imaging, statistics, probabilistic methods on large-scale networks, etc.

The CRM was created in 1969 by the Université de Montréal through a special grant from the National Research Council of Canada. It became an NSERC national research centre in 1984. It is currently funded by NSERC (Natural Sciences and Engineering Research Council), by the Government of Québec through the FQRNT (Fonds québécois de la recherche sur la nature et les technologies), by the Université de Montréal, as well as McGill University, the Université du Québec à Montréal, Concordia University, the University of Ottawa, Université Laval, the Université de Sherbrooke, and by private donations. The mission of the CRM is to support research in mathematics and closely related disciplines and to provide leadership in the development of the mathematical sciences in Canada.

The CRM carries on its mission and national mandate in several ways:

- it organizes each year a series of scientific events on a specific theme (high-profile lectures, workshops, summer schools, etc.);
- its general program and its multidisciplinary and industrial program provide funding for conferences and special events at the CRM and across the country;
- each year it invites, through the Aisenstadt Chair, one or more distinguished mathematicians, to give advanced courses as part of its thematic program;
- it awards four prizes yearly: the CRM – Fields – PIMS Prize recognizing major contributions to mathematics, the André-Aisenstadt Prize given for outstanding work carried out by a young Canadian mathematician, the CAP – CRM Prize for exceptional achievement in theoretical and mathematical physics, and the CRM – SSC Prize for exceptional contributions to statistics in early career;
- it publishes technical reports and several books per year (and some of its collections are published jointly with the AMS and with Springer);
- it has an extensive postdoctoral fellowship program, with more than thirty postdoctoral fellows on site, funded in partnership with other organizations and researchers;
- it informs the community of its activities through its newsletter, *Le Bulletin du CRM*, and its web site at http://crm.math.ca/;
- it participates, with the other two Canadian institutes, in groundbreaking national initiatives, for instance the MITACS network (Mathematics of Information Technology and Complex Systems). The institutes sponsor the Annual Meetings of the Mathematical Sciences Societies (CMS, SSC, CAIMS), the development of the mathematical sciences in the Atlantic provinces through AARMS, and other activities organized outside the three institutes. They also participate in the National Institute for Complex Data Structures jointly with the Canadian statistical community.

This national mandate is complemented by, and indeed supported by, a long-standing vocation of promoting research in the mathematical sciences in Québec. For instance,

- the CRM supports research through its ten research laboratories spanning most of the important areas of the mathematical sciences;
- it supports, through partnership agreements, a group of local researchers chosen mainly from departments of mathematics and statistics, but also computer science, physics, economics, engineering, etc.;
- it organizes series of regular seminars and lecture courses on different areas of the mathematical sciences;
- it sponsors joint activities with the Institut des sciences mathématiques (ISM) including the weekly CRM – ISM colloquia, graduate courses offered by distinguished visitors, and a program of postdoctoral fellowships;
- it works actively at developing contacts with industry. Its joint activities with liaison and research centres (CIRANO, CRIM, and MITACS) and research centres doing applied research (CIRRELT, GERAD, INRS-ÉMT, and INSERM) led to the creation of in-

dustrial networks. The most recent ones involved, in 2004 – 2005, Bombardier Aerospace and the CRM – IUGM – INSERM Brain Imaging Unit.

The CRM fulfils its national mission by involving the largest possible number of Canadian mathematicians in its scientific programs, both as participants and as organizers. It also supports many events taking place outside Montréal and the Province of Québec. The CRM is reaching out to the general public through two ongoing programs: the *Accromath* magazine, which was created jointly by the CRM and the ISM and won many international prizes and the Prix spécial de la Ministre de l'Éducation (in 2008), and the Grandes Conférences du CRM, which allow a broad public to attend lectures given by outstanding international scientists.

The director of the CRM is assisted by two managerial structures: the Board of Directors and the International Scientific Advisory Committee. The Advisory Committee is a group of internationally renowned mathematicians from Canada and abroad, who approve scientific programs and thematic years, choose recipients of the André-Aisenstadt Prize, and suggest new scientific avenues to explore.