CENTRE
DE RECHERCHES
MATHÉMATIQUES

Annual Report

2006
2007

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Presenting the Annual Report 2006 – 2007

A fecund year at the CRM

In 2006 – 2007, the CRM thematic program was conceived in a new spirit: the two thematic semesters covered two complementary aspects of the same theme, one more applied and the other closer to pure mathematics. The general theme of the year 2006 – 2007 was combinatorics. Since the last ten years have highlighted the impact and depth of combinatorics through the latest developments in mathematics (several of the recent Fields medallists were awarded the Fields medal for research closely related to combinatorics), the CRM was bound to devote a whole year to this subject, given its role in the international network of mathematical institutes.

The first thematic semester was more applied and dealt with combinatorial optimization, while the second one, on recent advances in combinatorics, was closer to algebraic geometry and dealt with algebraic, enumerative, and geometric combinatorics. The second semester covered a very broad spectrum of mathematics, from the interaction between combinatorics and statistical mechanics to the Gromov – Witten invariants in tropical, real and complex geometries.

It was a pleasure for the CRM to organize the semester on recent advances in combinatorics, since Canada has a strong group of mathematicians working in combinatorics and the semester was coordinated by the LaCIM laboratory, based at UQÀM. I wish to thank François Bergeron (UQÀM), Mark Haiman (Berkeley), and many other mathematicians from Canada and abroad, for having organized the schools, workshops, and lectures of this semester. I am grateful to all the LaCIM members for their participation in this world-class event. I would like to thank also Slava Kharlamov (Strasbourg) and Rahul Pandharipande (Princeton), who accepted my invitation to conclude this semester by organizing a workhop on real, complex and tropical enumerative geometry; to my knowledge, this was the first workshop ever to be held on this topic. The thematic semester on recent advances in combinatorics also included the beautiful lectures by the Aisenstadt Chairholder, Richard Stanley, a professor at MIT and one of the foremost researchers in enumerative and algebraic combinatorics.

The first thematic semester, on combinatorial optimization, was also of a very high calibre. Under the direction of Vašek Chvátal (Concordia) and a strong Canadian team including Odile Marcotte, and with the collaboration of Michel Goemans from MIT, the semester included workshops on a broad spectrum of combinatorial optimization, namely: approximation algorithms, network design, hybrid methods, data mining and mathematical programming, and polyhedral computation. The NATO Advanced Study Institute held in Montréal in 2006 (supported through the NATO Science for Peace and Security Programme in Brussels) was also devoted to combinatorial optimization; it was organized by Vašek Chvátal and Najiba Sbihi, from the École Mohammadia d'Ingénieurs in Rabat, Morocco. The thematic semester on combinatorial optimization also featured two series of outstanding lectures by the two Aisenstadt Chairholders, Noga Alon (Tel Aviv) and Paul Seymour (Princeton). One of the hallmarks of the thematic year on combinatorics was the emphasis placed on advanced schools, the NATO Advanced Study Institute on one hand, and the four schools of the semester on recent advances in combinatorics on the other hand. The latter were organized by LaCIM members, who always put a justified emphasis on the training of graduate students and postdoctoral fellows.

In July 2006, the CRM also hosted a short thematic program on geometric group theory, organized and sponsored by the CIRGET laboratory (based at UQÀM). The organizers of this short thematic program were Mladen Bestvina (Utah), Steven Boyer (UQÀM), Tadeusz Januszkiewicz (Ohio), Michah Sageev (Technion) and Daniel T. Wise (McGill).

The CRM general program for the year 2006 – 2007 was also of the highest calibre and included, among other events, the Conference on 3-manifold topology in Honour of Peter Shalen's 60th birthday, the Conference on Combinatorial Optimization in Honour of Vašek Chvátal's 60th birthday, the Workshop on Singularities in PDE and the Calculus of Variations organized by Stan Alama (McMaster), Lia Bronsard (McMaster), and Peter Sternberg (Indiana), the Gilles Fournier Memorial Conference on Classical and Computational Topological Methods, the 10th International Workshop on Differential Equations, Number Theory, Data Analysis Methods and Geometry, held in Havana (Cuba), a beautiful conference honouring John McKay ("Groups and Symmetries: From the Neolithic Scots to John McKay"), organized jointly with Concordia University, and the Workshop on the Geometry of Holomorphic and Algebraic Curves in Complex Algebraic Varieties, organized by Steven Lu (UQÀM). Let us mention also that the CRM supported CanaDAM 2007, the First Canadian Dis-

crete and Algorithmic Mathematics Conference, which took place in Banff in May 2007. The second CanaDAM conference will take place at the CRM in May 2009.

In 2006 – 2007, the multidisciplinary and industrial program included, among other events, the XXIIIrd International Biometrics Conference, the 41st Actuarial Research Conference, the 4th RECOMB Comparative Genomics Satellite Workshop, the NBER/NSF Time Series Conference 2006, and the DIRO – CRM – ncm_2 public lecture by Ralph E. Gomory entitled "Thoughts about integer programming." Dr. Gomory is President Emeritus of the Alfred P. Sloan Foundation and was IBM Senior Vice President for Science and Technology from 1986 to 1989.

The "Grandes Conférences du CRM," geared towards a general audience, were given by three outstanding lecturers in 2006 – 2007: Bart de Smit (Leiden), Jean-Paul Delahaye (Lille), and Francis Clarke (Lyon). I wish to convey my heartfelt thanks to the organizers of those lectures, Christiane Rousseau and Yvan Saint-Aubin, both professors of mathematics at the Université de Montréal. The Accromaαth magazine continues to feature prominently among the mathematical magazines catering to the needs of a general audience. The 5000 copies of Accromaαth are distributed in all parts of the world and Accromaαth has become a focus point for all those with an interest in mathematics in the French-speaking countries. The CRM and ISM regularly receive testimonies from high school principals and high school and college teachers who praise the contents and format of the magazine. The reader may consult the site `www.accromath.ca` for further information.

Each year the CRM awards four prizes. In 2006 – 2007, the CRM – Fields – PIMS Prize and the CAP – CRM Prize were both awarded to Joel Feldman, from the University of British Columbia. Gregory Smith (Queen's University) and Alexander Holroyd (University of British Columbia) were awarded jointly the André-Aisenstadt Prize, and Richard Cook (University of Waterloo) was awarded the CRM – SSC Prize. Congratulations to all!

The year 2006 – 2007 saw the design of the new CRM statutes; as a result, the CRM will become a genuine multi-university institution in 2008. The new statutes give the universities participating in the CRM the impact and decision making power that they deserve; they also give the highest priority to the concerns of researchers coming from all walks of science.

The numerous activities organized by the CRM are made possible through the financial contributions of the CRM partners and sponsors. It is with great pleasure that on behalf of CRM members and my own, I gratefully acknowledge the contributions of NSERC, FQRNT and our academic partners (Université de Montréal, UQÀM, McGill University, Concordia University, Université Laval, University of Ottawa and Université de Sherbrooke). I am also grateful to the National Science Foundation, which supports our thematic and general programs, to NATO, which finances an Advanced Study Institute in Montréal each year, to the Institut des sciences mathématiques, and to MITACS, the ncm_2 and GERAD, a research centre that organized joint workshops with the CRM. The list of these partners and sponsors is a testimony to the crucial role played by the CRM in mathematical research, at the Canadian and international levels.

François Lalonde

Thematic Program

The core of each year's scientific program at the CRM is its thematic program. As explained in the presentation of this annual report, in 2006 – 2007, the thematic program consisted of two semesters covering two complementary aspects of combinatorics. The topic of the first semester (June – December 2006) was combinatorial optimization, and that of the second semester was recent advances in combinatorics.

The CRM is very grateful to the National Science Foundation for providing generous financial support to the young American mathematicians who attended the activities of the two thematic semesters. The CRM is also grateful to MITACS for providing financial support for one of the workshops of the Thematic Semester on Combinatorial Optimization. *The reports are presented in the language in which they were submitted.*

Thematic Semesters of the Year 2006 – 2007: Combinatorial Optimization and Recent Advances in Combinatorics

Combinatorial optimization has grown tremendously in the past few decades, because of its numerous applications to real-life problems arising in transportation and telecommunications planning, scheduling, industrial engineering, and many other fields. It has links to both pure mathematics and operations research, and indeed the GERAD and CIRRELT centres, which specialize in operations research, have collaborated with the CRM within the framework of the thematic semester, either through financial contributions or through the participation of their members to the workshops of the semester. The thematic semester on combinatorial optimization featured a NATO Summer School, five workshops, and series of lectures by two André-Aisenstadt Chairholders. Its organizing committee consisted of David Avis (McGill), David Bremner (New Brunswick), Vašek Chvátal (Concordia), Bill Cunningham (Waterloo), Michel Goemans (MIT), Pierre Hansen (HÉC Montréal), Odile Marcotte (GERAD and UQÀM), Tom McCormick (UBC), and Adrian Vetta (McGill).

Since the last ten years have highlighted the impact and depth of combinatorics through the latest developments in mathematics (several of the recent Fields medallists were awarded the Fields medal for research closely related to combinatorics), the CRM was bound to devote a thematic semester to recent advances in combinatorics, especially advances in algebraic, enumerative, and geometric combinatorics. This thematic semester, from January to June 2007, covered a very broad spectrum of mathematics, from the interaction between combinatorics and statistical mechanics to the Gromov – Witten invariants in tropical, real, and complex geometries. It featured 6 workshops, four schools, and a series of lectures by an André-Aisenstadt Chairholder. François Bergeron (UQÀM), Srecko Brlek (UQÀM), Pierre Leroux (UQÀM), and Christophe Reutenauer (UQÀM) were the main organizers of the thematic semester on recent advances in combinatorics; Marcelo Aguiar (Texas A&M), Mireille Bousquet-Mélou (Bordeaux 1), Nantel Bergeron (York), Sara Faridi (Dalhousie), Anthony Geramita (Queen's), Anthony J. Guttmann (Melbourne), Mark Haiman (Berkeley), Slava Kharlamov (IRMA, Strasbourg 1), Allen Knutson (UC San Diego), Rahul Pandharipande (Princeton), Bruce Sagan (Michigan State), Alan Sokal (New York), Ravi Vakil (Stanford), and Stephanie van Willigenburg (UBC) were also members of the organizing committee.

Aisenstadt Chairholders in 2006 – 2007: Noga Alon, Paul Seymour, and Richard Stanley

The two André-Aisenstadt Chairs for the thematic semester on combinatorial optimization were Noga Alon, from Tel Aviv University, and Paul Seymour, from Princeton University. The André-Aisenstadt Chair for the thematic semester on recent advances in combinatorics was Richard Stanley, from the Massachusetts Institute of Technology. Noga Alon is one of the foremost experts in the world in extremal and probabilistic combinatorics, Paul Seymour one of the foremost experts in graph theory and matroid theory, and Richard Stanley one of the foremost experts in enumerative and algebraic combinatorics. The lectures given by each of these world-renowned mathematicians provided a broad view of his field; for this reason, in the texts that follow, we focus on the contents of the lectures to give the flavour of each of those

three areas of combinatorics (probabilistic combinatorics, graph theory, and enumerative and algebraic combinatorics, respectively).

Noga Alon

The first two lectures by Noga Alon dealt with approximation results for combinatorial optimization problems. The topic of the first lecture was the approximation of a quantity known as the cut-norm of a matrix. Given a real matrix $A = (a_{ij})_{i\in R, j\in S}$, the *cut-norm* $\|A\|_C$ of A is defined as the maximum absolute value of a submatrix sum, i.e.,

$$\max_{\substack{I\subset R\\ J\subset S}} \left|\sum_{\substack{i\in I\\ j\in J}} a_{ij}\right|.$$

Finding sets I and J for which the maximum is achieved is a difficult combinatorial problem. Indeed, unless the most important question in complexity theory ("Is P equal to NP?") has an affirmative answer, it is impossible to compute efficiently sets I and J such that

$$\left|\sum_{\substack{i\in I\\ j\in J}} a_{ij}\right| \geq \rho\|A\|_C,$$

for any ρ greater than $16/17$.

Thus one is led to consider a related optimization problem, formulated as the following integer program (called IP):

$$\text{maximize} \sum_{\substack{i\in R\\ j\in S}} a_{ij}x_iy_j$$

subject to $x_i \in \{-1,1\}$, $y_j \in \{-1,1\}$ for all i, j.

The optimal value of IP will be denoted by $v(\text{IP})$. The program IP being difficult to solve, one is led to replace the constraint "$x_i \in \{-1,1\}$" by "x_i is an m-dimensional vector of unit norm," and the constraint "$y_j \in \{-1,1\}$" by "y_j is an m-dimensional vector of unit norm." In order to extend the definition of the objective function, one then replaces the product x_iy_j by the scalar product $x_i \cdot y_j$. The resulting optimization problem is equivalent to a semidefinite program, denoted by SDP and whose optimal value is denoted by $v(\text{SDP})$.

The relaxation SDP is useful in two ways. First, a near-optimal solution of SDP (i.e., a solution of value greater than $v(\text{SDP}) - \epsilon$) can be computed in time that is polynomial in the input length and $\log(1/\epsilon)$. Second, $v(\text{SDP})$ provides an upper bound for $v(\text{IP})$ since SDP is a relaxation of IP and IP is a maximization problem. In a beautiful article, Noga Alon and Assaf Naor show that the matrix version of Grothendieck's inequality (which is a fundamental tool in functional analysis) implies that $v(\text{SDP})/v(\text{IP})$ is bounded by a constant (*Grothendieck's constant*), whose precise value is not known but is comprised between $\pi/2$ and $\pi/\left(2\ln(1+\sqrt{2})\right)$. They also describe rounding techniques that can be used to transform an optimal solution of SDP into a feasible (integral) solution of IP whose value is not too far from $v(\text{SDP})$. By using these techniques and the relationship between $v(\text{IP})$ and $\|A\|_C$ ($\|A\|_C \leq v(\text{IP}) \leq 4\|A\|_C$), Alon and Naor designed an efficient deterministic algorithm for approximating the cut-norm. They also designed efficient randomized algorithms producing approximate solutions, but with better approximation ratios.

In his second lecture, Noga Alon considered *edge-deletion problems*. These are a special type of graph modification problems, which have applications in numerical linear algebra and the physical mapping of DNA. Let G be an undirected graph, consisting of a finite set of vertices and a finite collection of pairs of vertices (called edges). A graph property is *monotone* if the removal of a vertex or an edge from a graph G preserves the property. For instance, the property of being triangle-free is monotone. Note that the obvious algorithm for verifying that G is triangle-free or transforming G into a triangle-free graph takes time proportional to n^3, since it enumerates all subsets of three vertices. Noga Alon, Asaf Shapira and Benny Sudakov have given an $\mathcal{O}(n^2)$ algorithm for the latter problem, not only for the property of being triangle-free but for any monotone property.

More precisely, for any graph G and any monotone property $\mathcal{P}$, let $E'_{\mathcal{P}}(G)$ denote the smallest number of edges that must be deleted from G to transform it into a graph satisfying $\mathcal{P}$. Alon, Shapira and Sudakov have shown that for any fixed $\epsilon > 0$ and any monotone property $\mathcal{P}$, there is an $\mathcal{O}(n^2)$ deterministic algorithm that, given a graph G on n vertices, computes a real number r satisfying $|r - E'_{\mathcal{P}}(G)/n^2| \leq \epsilon$. Such an algorithm was not even known for the property of being triangle-free. Alon and his coauthors have also proved that if all bipartite graphs satisfy $\mathcal{P}$, then it is NP-hard to approximate $E'_{\mathcal{P}}(G)/n^2$ to within an additive error of $n^{-\delta}$ for any fixed $\delta > 0$. This is also a startling result, since prior to their article it was not even known that computing $E'_{\mathcal{P}}(G)$ precisely was NP-hard, even when $\mathcal{P}$ is the property of being triangle-free!

The topic of Noga Alon's third lecture was graph property testing, a topic related to the

graph modification problems we have just described. The study of combinatorial property testing was first motivated by issues arising in program checking. A graph G with n vertices is said to be ϵ-far from satisfying the property $\mathcal{P}$ if the number of edge insertions or deletions needed to transform G into a graph satisfying $\mathcal{P}$ is at least ϵn^2. A graph property $\mathcal{P}$ is *testable* if there exists a randomized algorithm making at most $q(\epsilon)$ edge queries that can distinguish with high probability between graphs satisfying $\mathcal{P}$ and graphs that are ϵ-far from satisfying $\mathcal{P}$. Note that $q(\epsilon)$ does not depend upon n or the size of the input. In his third lecture, Noga Alon surveyed the main results on graph property testing, especially the recent ones, and outlined the relationship between these results and Szemerédi's regularity lemma.

Biography

Noga Alon is a Baumritter Professor of Mathematics and Computer Science at Tel Aviv University in Israel. He received his Ph.D. in Mathematics at the Hebrew University of Jerusalem in 1983 and held visiting positions in various research institutes including MIT, The Institute for Advanced Study in Princeton, IBM Almaden Research Center, Bell Laboratories, Bellcore and Microsoft Research. He serves on the editorial boards of more than a dozen international technical journals and has given invited lectures at many conferences, including plenary addresses at the 1996 European Congress of Mathematics and the 2002 International Congress of Mathematicians, and an invited lecture at the 1990 International Congress of Mathematicians. He has published one book and more than three hundred research articles, mostly in combinatorics and theoretical computer science. He has been a member of the Israel National Academy of Sciences since 1997 and received the Erdős prize in 1989, the Feher prize in 1991, the George Pólya Prize in 2000, the Bruno Memorial Award in 2001, the Landau Prize in 2005 and the Gödel Prize in 2005.

Paul Seymour

In his first lecture, geared towards a broad audience, Paul Seymour gave an overview of some of the most important structure theorems in graph theory. Paul Seymour beginned his lecture by reminding the audience that given two graphs G and H, the phrase "G does not contain H" may have several meanings. The first meaning, "G does not contain H as a subgraph", has received comparatively little attention from graph theorists investigating the structure of graphs. The second meaning, "G does not contain H as an induced subgraph", has received much more attention. For instance, *Berge graphs* are the graphs that do not contain any odd hole or antihole as an induced subgraph (where a hole is a cycle with at least four vertices and an antihole is the complement of a hole). In 1961, Claude Berge posed the *Strong Perfect Graph Conjecture*, that is, the conjecture that a graph G is Berge if and only if G is *perfect*, i.e., the chromatic number of any induced subgraph H of G is equal to the clique number of H. In 2002, Paul Seymour and his collaborators (Maria Chudnovsky, Neil Robertson, and Robin Thomas) announced a proof of the Strong Perfect Graph Conjecture, an achievement that is comparable to the proof of the four-colour theorem!

The third meaning of the phrase "G does not contain H" is that G does not contain H as a minor. We say that H is a *minor* of G if H is obtained from G by deleting edges or vertices or contracting edges (contracting the edge $\{u, v\}$ amounts to identifying the vertices u and v). Minor containment is often encountered in topological graph theory, because it is closely related to topological containment. The best-known example in this regard is the strong version of Kuratowski's theorem given by Klaus Wagner: a graph G is planar if and only if it does not contain K_5 (the complete graph on five vertices) or $K_{3,3}$ (the complete bipartite graph with three vertices in each part) as a minor. Another example is Tutte's conjecture (1966), a generalization of the four-colour theorem: the edges of any cubic 2-connected graph not containing the Petersen graph as a minor can be coloured with three colours. Tutte's conjecture was proved by Paul Seymour and Neil Robertson in 1997.

Given a notion of graph containment and a fixed graph H, one may ask the following question: how does one construct explicitly all the graphs not containing H? After giving examples of such constructions, Paul Seymour argued that the phrase "explicit construction" still lacks a clear definition, as shown by the example of claw-free graphs. The graph G is *claw-free* if for any v, the set of neighbours of v does not contain three pairwise nonadjacent vertices. Here is an obvious way of constructing a claw-free graph: given a claw-free graph G and a subset X not containing three pairwise nonadjacent vertices, add a vertex to G whose set of neighbours is X. The resulting graph is claw-free. This inductive definition yields a polynomial-time algorithm,

but has the drawback that one has to "guess" the set X of neighbours of the new vertex. Maria Chudnovsky and Paul Seymour recently proved a deep structure theorem for claw-free graphs, and a likely by-product of this theorem is an explicit construction for claw-free graphs that avoids such "guesses". Paul Seymour concluded his first lecture by raising the possibility that one could use mathematical logic to give a precise meaning to the phrase "explicit construction".

In his second lecture, Paul Seymour turned to the algorithmic aspect of induced graph containment. Let $\mathcal{F}$ be a fixed family of graphs, and for any graph G and any subset U of vertices of G, let $G[U]$ denote the subgraph induced by U. Consider the following problem: given a graph G and a subset S of vertices of G, does G have an induced subgraph $G[U]$ belonging to $\mathcal{F}$ and such that U contains S? Most problems of this sort seem to be NP-complete. Maria Chudnovsky and Paul Seymour, however, gave a polynomial-time algorithm to solve the above problem when $\mathcal{F}$ is the family of trees and S a set of three vertices. They called this special case the "three-in-a-tree" problem, because it consists of deciding whether a graph G has an induced tree containing three specified vertices. The algorithm of Chudnovsky and Seymour can be used to decide whether or not a graph G contains an induced subgraph isomorphic to a theta, i.e., a subgraph consisting of three vertex-disjoint paths between the vertices a and b.

The topic of Paul Seymour's third lecture was the Caccetta – Häggkvist conjecture. In 1978, Caccetta and Häggkvist made the conjecture that every simple digraph (i.e., a digraph with no loop or digon) with n vertices and minimum out-degree at least equal to r contains a directed cycle of length at most $\lceil n/r \rceil$. Many special cases of this conjecture are known to be true; in particular, Jian Shen proved in 2003 that the Caccetta – Häggkvist conjecture holds if r is at most $\sqrt{n/2}$. The case where r is equal to $n/3$ (among others) seems to be difficult, and researchers have tried to determine the smallest constant c such that G contains a directed triangle if its minimum out-degree is at least cn. The best result so far, due to Jian Shen, is that c is at most $3 - \sqrt{7}$ (it is conjectured that c is equal to $1/3$). In a similar vein, Seymour, de Graaf, and Schrijver proposed to determine the smallest constant β such that G contains a directed triangle if its minimum out-degree and its minimum in-degree are at least βn. They proved that β is at most 0.3487; Jian Shen used their work and one of his previous results to show that β is at most 0.3477.

Finally, the formulation of the Caccetta – Häggkvist conjecture can be slightly modified to include the minimum in-degree; for instance, does every simple digraph whose minimum out-degree and minimum in-degree are at least $n/3$ contain a directed triangle? This special case would be implied by the following conjecture (*Seymour's Second Neighbourhood Conjecture*): any simple digraph has a vertex v whose second neighbourhood is at least as large as its first neighbourhood. The second (resp. first) neighbourhood of v is the set of vertices u such that there is a shortest path of length 2 (resp. 1) between v and u.

Biography

Paul Seymour is Professor of Mathematics at Princeton University. After obtaining a D.Phil. from the University of Oxford, he held positions at the Universities of Oxford and Waterloo and at the Ohio State University. He was a Member of Technical Staff and a Senior Scientist at Bellcore from 1984 to 1996 and has been a Professor at Princeton University since 1996. He has published more than 150 research articles and is Editor-in-Chief for the *Journal of Graph Theory* (jointly with Carsten Thomassen). He is also editor for *Combinatorica* and the *Journal of Combinatorial Theory, Series B*. He was awarded the most prestigious prize in combinatorial optimization, the D.R. Fulkerson Prize, in 1979, 1994 and 2006 (jointly with Neil Robertson and Robin Thomas in 1994 and jointly with Neil Robertson in 2006). He was also awarded the Ostrowski Prize in 2004 and the George Pólya Prize in 1983 and 2004 (jointly with Neil Robertson in 2004).

Paul Seymour has made fundamental contributions to the study of regular matroids, to matroid theory in general, to graph colourings (especially Hadwiger's conjecture), and to graph minors. His work on graph minors is published in a series of more than twenty articles in the *Journal of Combinatorial Theory, Series B*, and in particular the twentieth article contains the proof of a celebrated conjecture of Klaus Wagner (1970) asserting that "for every infinite set of finite graphs, one of its members is isomorphic to a minor of another."

Richard Stanley

In his first lecture Richard Stanley surveyed the theory of increasing and decreasing subsequences of permutations. A permutation of the set $\{1, 2, 3, \ldots, n\}$ can be represented by the word (or sequence) $w = a_1 a_2 a_3 \ldots a_n$, where a_i

is the image of i under the permutation. An *increasing subsequence* of this permutation is a subsequence $a_{i_1}a_{i_2}\dots a_{i_k}$ satisfying $a_{i_1} < a_{i_2} < \cdots < a_{i_k}$; for instance, 367 is an increasing subsequence of the permutation 4326571. A *decreasing subsequence* is defined in a similar fashion. Increasing subsequences have a nice interpretation in terms of the one-person card game *patience sorting*, and through that game, they have connections with airplane boarding times and disk scheduling, respectively.

In his lecture, Richard Stanley presented the famous RSK algorithm (named after Robinson, Schensted and Knuth) for computing a bijection between the set of permutations of $\{1, 2, 3, \dots, n\}$ and ordered pairs of standard Young tableaux of shape $\lambda \vdash n$. He discussed the relation of the RSK algorithm to a theorem of Erdős and Szekeres and a fundamental result of Schensted, from which one can derive a formula for the number of permutations of the set $\{1, 2, 3, \dots, pq\}$ (where $p \leq q$) for which the maximum length of an increasing subsequence (denoted by $\mathrm{is}(w)$) equals p and the maximum length of a decreasing subsequence equals q. It turns out that the entire limiting distribution of $\mathrm{is}(w)$ as $n \to \infty$, determined by Baik, Deift, and Johansson in 1999, is the (suitably scaled) Tracy–Widom distribution, which first arose as the distribution of the largest eigenvalue of a random Hermitian matrix.

In the last part of his talk, Richard Stanley considered complete matchings instead of permutations. A *complete matching* M on the set $\{1, 2, 3, \dots, 2n\}$ is a partition of this set into n two-element blocks. In the case of matchings, one should consider crossings and nestings instead of permutations. A *crossing* of M is a pair $\{ij, kl\}$ of blocks satisfying $i < k < j < l$, and a *nesting* of M a pair $\{ij, kl\}$ of blocks satisfying $i < k < l < j$. Finally, let $f_n(i, j)$ denote the number of matchings for which the maximum number of mutually crossing pairs equals i and the maximum number of mutually nesting pairs equals j. A key theorem states that this function is symmetric, i.e., $f_n(i, j) = f_n(j, i)$; the proof of this theorem relies on the notion of *oscillating tableau* and an "oscillating" analogue of Schensted's theorem.

After his first lecture, much enjoyed by the audience, Richard Stanley gave two further lectures that were more technical. The topic of the second lecture was alternating permutations. A permutation $w = a_1a_2a_3\dots a_n$ of $\{1, 2, 3, \dots, n\}$ is *alternating* if $a_1 > a_2 < a_3 > a_4 < \cdots$ holds. By analogy with increasing and decreasing subsequences, the maximum length of an alternating subsequence of the permutation w is denoted by $\mathrm{as}(w)$. In this lecture, Richard Stanley discussed recent work on the distribution of $\mathrm{as}(w)$ and on the enumeration of various classes of alternating permutations (such as those that are involutions). In his third lecture, he surveyed some classical and recent results concerning the group $\mathrm{GL}(n, q)$ and $\mathrm{Mat}(n, q)$, the space of all $n \times n$ matrices over the field $\mathbb{F}_q$. His lecture addressed the following questions: how many orbits are there in the action of $\mathrm{GL}(n, q)$ on $\mathrm{Mat}(n, q)$ by conjugation, and what is the cardinality of $\mathrm{GL}(n, q) \cap H$, where $\mathrm{GL}(n, q)$ is regarded as a subset of $\mathrm{Mat}(n, q)$ and H is a hyperplane in $\mathrm{Mat}(n, q)$?

Biography

Richard Stanley is the Norman Levinson Professor of Applied Mathematics at the Massachusetts Institute of Technology. He received his Ph.D. from Harvard University in 1971 and has held several visiting positions, in particular positions at Harvard University in 2000–2001 and at the Institut Mittag-Leffler (Sweden) in 2005. Among other awards, he was awarded the SIAM George Pólya Prize in 1975, a Guggenheim Fellowship in 1983–1984, the American Mathematical Society 2001 Leroy P. Steele Prize for Mathematical Exposition, and the Rolf Schock Prize in Mathematics in 2003. In 2007, he received an Honorary Doctorate in Mathematics from the University of Waterloo and an Honorary Professorship from Nankai University. He is a Fellow of the American Academy of Arts and Sciences and a Member of the National Academy of Sciences. Richard Stanley has supervised more than 45 doctoral students and has given many prestigious invited talks; in particular he was Erdős Lecturer at the Hebrew University (Jerusalem) in 1999 and Plenary Speaker at the International Congress of Mathematicians in Madrid (2006).

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, 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, and Terence Tao.

Activities Held During the Two Thematic Semesters

SMS – NATO ASI 2006 Summer School Combinatorial Optimization: Methods and Applications

June 19 – 30, 2006, Université de Montréal
Sponsored by NATO, the CRM, ISM and the Département de mathématiques et de statistique de l'Université de Montréal

Organizers: Vašek Chvátal (Concordia), Najiba Sbihi (École Mohammadia d'Ingénieurs, Morocco)
Speakers: Gérard Cornuéjols (Carnegie Mellon), Sanjeeb Dash (IBM T.J. Watson Research Center), Friedrich Eisenbrand (Max-Planck-Institut für Informatik), Lisa K. Fleischer (IBM T.J. Watson Research Center), Michel X. Goemans (MIT), Yuri Kochetov (Russian Academy of Sciences), Stephan Held (Bonn), Gleb Koshevoy (Russian Academy of Sciences), Shmuel Onn (Technion), Dieter Rautenbach (Bonn), Najiba Sbihi (École Mohammadia d'Ingénieurs, Morocco), Jens Vygen (Bonn)
Number of participants: 12 speakers and 55 students and young researchers

In 2006, the NATO ASI Summer School brought together outstanding researchers and students from NATO and partner countries. Because of its very broad range of applications, combinatorial optimization is a disparate field, and the series of lectures given by the speakers reflected the whole range of the subject. During the first week, Eisenbrand spoke about his favorite problems in integer programming: estimating the integrality gap for the cutting stock problem, recognizing a Hilbert basis in polynomial time, and finding a linear (incremental) algorithm for integer programming in fixed dimension. Onn gave a series of lectures on convex combinatorial optimization and convex integer programming, including applications to packing, partitioning and clustering problems and multiway transportation problems. Dash spoke on mixed integer rounding cuts and cyclic group polyhedra, Sbihi on the mathematics of supply chain management, and Koshevoy on discrete convexity.

Three of the School speakers were researchers from the University of Bonn working on computer chip design: Rautenbach, who spoke during the first week, and Vygen and Held (replacing Bernhard Korte), who spoke during the second week. The design of computer chips is one of the nicest applications of combinatorial optimization (if not the nicest). Indeed, many of the classical topics of combinatorial optimization (minimum cost flows, multicommodity flows, shortest paths, Steiner trees and so on) occur as subproblems of the VLSI placement and routing problem; to solve the latter, one must also solve more general problems and design algorithms fast enough to deal with current and future orders of magnitude (e.g., one billion transistors). Vygen gave a series of lectures on this topic, state-of-the-art algorithms for the problems in VLSI layout. Held lectured on ways to minimize the cycle time of logic chips and microprocessors, once the placement and routing problem has been solved, and Rautenbach lectured on algorithms that improve the timing of a chip or other aspects of chip design (such as placement or power consumption).

During the second week, there were four series of lectures apart from those of Held and Vygen. Kochetov spoke about discrete models and local search methods for facility location problems; Cornuéjols about recent developments in mixed integer programming (including branching rules, preprocessing and heuristics); Goemans about approximation algorithms (including local search methods, integral characterizations, the embedding of finite metric spaces and various rounding schemes for linear, convex or semidefinite programming); and Fleischer about generalized congestion games, including a discussion of the "price of anarchy". Overall, the lectures of the Summer School provided all the

participants with a broad view of almost all recent developments in combinatorial optimization.

Workshop
Approximation Algorithms
June 12 – 14, 2006, CRM

Organizers: Joseph Cheriyan (Waterloo), Michel Goemans (MIT)
Speakers: Matthew Andrews (Bell Labs), Sanjeev Arora (Princeton), Sylvia Boyd (Ottawa), Moses Charikar (Princeton), Chandra Chekuri (Illinois at Urbana-Champaign), Uriel Feige (Microsoft Research), Lisa Fleischer (IBM T.J. Watson Research Center), Naveen Garg (Indian Institute of Technology), Michel Goemans (MIT), Anupam Gupta (Carnegie Mellon), Kamal Jain (Microsoft Research), Subhash Khot (Georgia Tech), Jochen Könemann (Waterloo), Guy Kortsarz (Rutgers), Robert Krauthgamer (IBM Almaden Research Center), Lap Chi Lau (Toronto), Yuval Rabani (Technion), R. Ravi (Carnegie Mellon), Mohammad R. Salavatipour (Alberta), Andreas S. Schulz (MIT), Bruce Shepherd (Bell Labs), David B. Shmoys (Cornell), Adrian Vetta (McGill), Jan Vondrak (Microsoft Research), David Williamson (Cornell)
Number of participants: 70

The topic of the first workshop of the combinatorial optimization semester was "approximation algorithms." Many combinatorial optimization problems, such as the famous Traveling Salesman Problem and various network design problems, are NP-hard, which means that it is unlikely that one will find a polynomial-time algorithm to solve them. One must then look for efficient approximation algorithms, that is, polynomial-time algorithms providing solutions whose value is relatively close to the optimal value. Finding and proving an upper bound on the difference between the approximate value and the optimal value is often a challenge, requiring the use of sophisticated techniques from combinatorics and mathematical programming. One important problem for which approximation algorithms have been proposed is the *Steiner Tree Problem*, for which Michel Goemans and David Williamson gave an approximation algorithm in a famous 1994 article: given an undirected graph G, a weight for each edge of G, and a subset R of vertices of G, find a subtree of G that includes all the vertices in R and is of minimum total weight.

Among the 25 lecturers of the workshop, 7 lecturers (Fleischer, Goemans, Gupta, Könemann, Kortsatz, Lau, Ravi) presented algorithms for variants of the Steiner Tree Problem or other network design problems. Two lectures (by Arora and Krauthgamer) dealt with the design of approximation algorithms in specific settings, and the remaining lectures with approximation algorithms for problems in the following areas: graph homomorphisms (Rabani), graph connectivity (Boyd, Vetta), welfare maximization (Feige, Vondrak), inventory control (Shmoys), submodular set functions (Chekuri), routing (Andrews, Shepherd), cycle packing (Salavatipour), lattices (Khot), machine scheduling (Garg), clustering (Williamson), feedback arc sets (Jain), and game theory (Charikar, Schulz). Generally speaking, the workshop was very lively. Many of the foremost experts on approximation algorithms were present in the audience, the lectures were very well prepared, and the participants did not hesitate to ask questions when they did not understand the speakers' assertions!

Workshop
Network Design: Optimization and Algorithmic Game Theory
August 14 – 16, 2006, CRM

Organizers: Shie Mannor (McGill), Adrian Vetta (McGill)
Speakers: Elliot Anshelevich (Rensselaer), Mohammad Taghi Hajiaghayi (Carnegie Mellon), Jason Hartline (Microsoft Research), Nicole Immorlica (Microsoft Research), Kamal Jain (Microsoft Research), Ramesh Johari (Stanford), Jochen Könemann (Waterloo), Kate Larson (Waterloo), Yishay Mansour (Tel Aviv), Peter Marbach (Toronto), Sean Meyn (Illinois at Urbana-Champaign), Vahab Mirrokni (Microsoft Research), Seffi Naor (Technion), Tim Roughgarden (Stanford), Andreas Schulz (MIT), Nahum Shimkin (Technion), Gordon Wilfong (Bell Labs)
Number of participants: 63

This workshop brought together academic and industrial researchers from mathematics, computer science, engineering and economics. Its goal was to discuss the fundamental mathematical issues affecting network design and applications. Highlights included: theoretical studies on the evolution of networks such as the Internet; algorithmic approaches for efficient routing under restrictive network protocols; mechanism designs and algorithms for online auctions; a mathematical model explaining that dramatic price change is an inherent characteristic of dynamic spot electricity markets; investigations into game theoretic considerations such as

multiple ownership, contracts, limited information, equilibria, etc.

Overall, the workshop was very successful in highlighting key areas of research and encouraging cross-disciplinary work. The workshop led to the statement of many new open problems and was the catalyst for new collaborations. Here is an example of the problems that were discussed. Suppose that Internet bids, say, are made over time for an object or objects. When the bid is made, the seller must make a decision (accept or reject or announce an alternative price). What is the best strategy for the seller? An open question in this area is the following: suppose the set of bids that can be accepted has a specific structure, for instance, the accepted bids form an independent set in a given matroid M (several types of matroids have nice applications, e.g., to selling airline seats belonging to several classes). If the bids arrive in a random order, what is the best online algorithm for this problem? It is conjectured that a factor e competitive algorithm exists.

Workshop
Hybrid Methods and Branching Rules in Combinatorial Optimization

September 18 – 22, 2006, CRM

Organizer: Vašek Chvátal (Concordia)
Speakers: Tobias Achterberg (ZIB Berlin), Fahiem Bacchus (Toronto), Alexander Bockmayr (FU Berlin), Endre Boros (Rutgers), John Chinneck (Carleton), Vašek Chvátal (Concordia), Joe Culberson (Alberta), Sophie Demassey (École des Mines de Nantes), Michel Gendreau (Montréal), Carla Gomes (Cornell), Pierre Hansen (HÉC Montréal), Alain Hertz (Polytechnique Montréal), Brigitte Jaumard (Concordia), Chu Min Li (Picardie), Jeff Linderoth (Lehigh), Andrea Lodi (Bologna), Inês Lynce (Universidade Técnica de Lisboa), Ming Ouyang (University of Medicine and Dentistry of New Jersey), Karem Sakallah (Michigan), Tuomas Sandholm (Carnegie Mellon), Laurent Simon (Paris-Sud), Klaus Truemper (Texas at Dallas), Stefan Voss (Hamburg), Toby Walsh (South Wales), Weixiong Zhang (Washington University)
Number of participants: 67

Combinatorial optimization problems, especially those that must be solved in practice, tend to be "intractable." As a result, diverse heuristic and exact methods to solve them have been proposed by researchers belonging to several communities. For instance, the problem Satisfiability or SAT (the archetypal NP-complete problem) has been studied by researchers in mathematical programming and researchers in constraint satisfaction programming. The goal of the workshop was to bring those two communities of researchers together in order to foster exchanges on branching rules (used in most algorithms to solve intractable problems) and hybrid methods (combining heuristic search and branch-and-bound algorithms).

Seven lecturers (Achterberg, Bacchus, Gomes, Li, Lynce, Sakallah, Simon) gave presentations on SAT or related problems and algorithms. The other lectures dealt with resolution search (Chvátal, Demassey, Ouyang), heuristic search methods (Hansen, Voss, Zhang), mixed integer programming (Chinneck, Linderoth, Sandholm), branching strategies (Boros, Gendreau, Lodi, Sandholm, Walsh), efficient search for Golomb rulers (Jaumard), use of heuristic methods in exact algorithms (Hertz), methods combining constraint programming and integer programming (Bockmayr), logic and intelligent systems (Truemper), and design of difficult instances of constraint satisfaction problems (Culberson). Four of the lecturers (Bockmayr, Lynce, Ouyang and Zhang) applied combinatorial optimization to problems arising in biology; indeed, biology is providing more and more problems that can be tackled by combinatorial optimization techniques.

Each day of the workshop ended with a round table and the workshop fostered interactions between researchers from several communities, as well as generating much interest in the Montréal operations research community. According to many of the participants, the workshop was a tremendous success, in part because it is one of the few workshops to date to have brought together experts from both areas (constraint programming and integer programming).

Workshop
Data Mining and Mathematical Programming

October 10 – 13, 2006, CRM
Sponsored by MITACS and the CRM

Organizers: Pierre Hansen (HÉC Montréal), Panos Pardalos (Florida)
Speakers: Jean-Pierre Barthélémy (ENST Bretagne), Yoshua Bengio (Montréal), Kristin Bennett (Rensselaer), Sergiy Butenko (Texas A&M), Gilles Caporossi (HÉC Montréal), Emilio Carrizosa (Sevilla), Art Chaovalitwongse (Rutgers), Khalid Chenguiti (Sherbrooke), Pando G. Georgiev (Cincinnati), Mario Guarracino (ICAR-

CNR), Peter L. Hammer (Rutgers), Pierre Legendre (Montréal), Vladimir Makarenkov (UQÀM), Musa Mammadov (Ballarat), Olvi L. Mangasarian (Wisconsin – Madison), Boris Mirkin (Birkbeck College, University of London), Nenad Mladenovic (Brunel University), Fionn Murtagh (Royal Holloway, University of London), Carlos Oliveira (Oklahoma State), Panos Pardalos (Florida), Jiming Peng (McMaster), Dolores Romero Morales (Oxford), Onur Seref (Florida), Steve Smale (Toyota Technological Institute, Chicago)

Number of participants: 84

The goal of the new and active field of data mining is to find interesting, useful or profitable information in very large databases. The main tasks of data mining, i.e., discrimination, clustering and relation finding, have already been explored in other fields, but the challenge resides in the huge size of the problems considered nowadays. Thus it is necessary to revise and streamline traditional methods and to devise new ones. Mathematical programming plays a key role in this endeavor, since it leads to rigorous formulations of the problems considered in data mining and provides powerful mathematical tools for solving them.

Most of the 24 workshop lectures were one-hour lectures on a wide variety of topics and applications, including machine learning (Bengio, Bennett, Guarracino), clustering (Mirkin, Pardalos, Butenko, Georgiev, Murtagh, Peng, Barthélémy), network optimization (Oliveira), functional data analysis (Chenguiti), support vector machines (Mangasarian, Romero Morales, Seref), classification (Carrizosa, Mammadov), and applications to biology and neuroscience (Legendre, Makarenkov, Chaovalitwongse). Gilles Caporossi spoke about data mining techniques and the discovery of relations between graph invariants, and Nenad Mladenovic about the solution of large p-median problems.

Professor Steve Smale, a Fields medallist, gave a fascinating lecture on patterns in data, showing how it is possible to "learn" the homology of a submanifold when data arises from a probability distribution whose support is on or near a submanifold of Euclidean space. The participants of the workshop also had the honour of attending one of the last lectures of Professor Peter L. Hammer, one of the pillars of operations research, who died in December of 2006. Professor Hammer gave a wonderful lecture on the logical analysis of data and its applications to medicine. Overall, the workshop was a resounding success, in that it brought together mathematicians from different horizons who apply data mining techniques to many kinds of problems.

Workshop
Polyhedral Computation

October 17 – 20, 2006, CRM
Sponsored by GERAD

Organizers: David Avis (McGill), David Bremner (New Brunswick), Antoine Deza (McMaster)
Speakers: Charles Audet (Polytechnique Montréal), Roberto Bagnara (Parma), Endre Boros (Rutgers), René Brandenberg (TU München), Jesús De Loera (UC Davis), Antoine Deza (McMaster), Mathieu Dutour Sikiric (Rudher Boskovic Institute), Khaled Elbassioni (Max-Planck-Institut für Informatik), Matthias Franz (Siemens AG), Komei Fukuda (ETH Zürich), Vladimir Gurvich (Rutgers), Alexander Hulpke (Colorado State), Hiroshi Imai (Tokyo), Masakazu Kojima (Tokyo Institute of Technology), Jean-François Maurras (Aix-Marseille 2), Brendan D. McKay (Australian National University), Pablo A. Parrilo (MIT), Gerhard Reinelt (Heidelberg), Günter Rote (FU Berlin), Achill Schürmann (Magdeburg), Tamon Stephen (Simon Fraser), Thorsten Theobald (TU Berlin), Frank Vallentin (Centrum voor Wiskunde en Informatica)

Number of participants: 39

The Workshop on Polyhedral Computation consisted mainly of 40-minute talks by the invited speakers. They came from various fields: polyhedral combinatorics, computational algebra, lattice theory, semi-definite programming and applications of polyhedral computation. The goal of the workshop was to explore the use of symmetry and algebra to allow the extension of current computational methods to large scale symmetric polyhedra. All participants were mathematicians who actively design, implement or use computer software in their work, and many of the principal authors of such software were present at the workshop. For example, Mathieu Dutour spoke on vertex enumeration under symmetry, and reported on work where he used codes developed by six people in the audience.

The participants were able to get a sample of the wide variety of mathematical problems for which their software is now used, its current limitations, and ideas for future extensions. The talks were very well prepared, so that participants outside of the speaker's area could understand the contributions to the theme of the workshop, i.e., polyhedral computation. The

workshop included an open problems session on the first day and various free discussion periods throughout the four days. The workshop is thought to be the first ever on the topic of polyhedral computation, and a follow-up meeting is planned for 2008 in Europe.

Workshop
Algebraic Combinatorics meets Inverse Systems
January 19 – 21, 2007, CRM

Organizers: François Bergeron (UQÀM), Kia Dalili (Dalhousie), Sara Faridi (Dalhousie), Aaron Lauve (UQÀM)
Speakers: Roberta Basili (Perugia), Nantel Bergeron (York), Anthony V. Geramita (Queen's), Anthony Iarrobino (Northeastern), Rosa C. Orellana (Dartmouth), Mercedes H. Rosas (Sevilla), Yong Su Shin (Sungshin Women's University), Gregory G. Smith (Queen's), Hugh Thomas (New Brunswick), Jerzy Weyman (Northeastern), Alexander Yong (Minnesota)
Number of participants: 38

The focus of this workshop, a continuation of a sequence of successful such workshops held in Kingston (2004), Ottawa (2005), and Toronto (2006), is to unite two research communities whose interests are overlapping with increasing regularity. Each year has brought new connections and this year continued this trend. On the first day we heard about research from both communities on nilpotent matrices, while the second day saw quivers applied to questions relevant to each community.

As this sequence of workshops is an attempt to get two communities with different languages and different interests to talk to one another, the tone and spirit has been (by necessity) friendly, patient, and cooperative. This year was no exception; it is hard to count the number of times during a lecture when a question from the audience evolved into an impromptu mini-school within the mini-workshop (given by the speaker or other audience members), before a gradual return to the speaker's intended lecture.

Though we toil apart, the unity of mathematics is ever present. The impact of workshops such as this one, which remind us of this fact and encourage us to acquire new languages, cannot be overstated. In measuring its success, one can return to the anecdotes outlined above, or the concluding one below. As an organizer, I payed attention to the "non-lecture" interactions of the participants as well. On numerous occasions, I witnessed new acquaintances being formed between participants, each surely offering the individuals new insights into their own questions.

School
Statistical Mechanics and Combinatorics
February 12 – 16, 2007, Val-Morin

Organizers: Mireille Bousquet-Mélou (Bordeaux 1), Anthony J. Guttmann (Melbourne), Pierre Leroux (UQÀM), Alan Sokal (New York)
Speakers: Mireille Bousquet-Mélou (Bordeaux 1), Anthony J. Guttmann (Melbourne), Gilbert Labelle (UQÀM), Alan Sokal (New York), Xavier Viennot (Bordeaux 1)
Number of participants: 45

The goal of this mini-course was to introduce the basic methods of enumerative combinatorics and the concepts of statistical mechanics that underlie the interactions between these two areas. The school was intended for graduate students, postdocs and researchers wishing to be introduced to these questions. It was held in the Laurentians region, at the Far Hills Inn (Val-Morin, Québec). Here is the plan of the lectures. Note that each lecturer spoke for 3.75 hours in total.

- Mireille Bousquet-Mélou spoke on "Asymptotics in combinatorics and statistical mechanics."
- Tony Guttmann gave an "An introduction to statistical mechanics for combinatorialists."
- Gilbert Labelle spoke on "Combinatorial species, labelled and unlabelled enumeration and Mayer graph weights."
- Alan Sokal spoke on "Tutte polynomials and statistical mechanics."
- Xavier Viennot spoke on "Enumerative combinatorics and physics."

Workshop
Combinatorial Problems Raised by Statistical Mechanics
February 19 – 23, 2007, CRM

Organizers: Mireille Bousquet-Mélou (Bordeaux 1), Anthony J. Guttmann (Melbourne), Pierre Leroux (UQÀM), Alan Sokal (New York)
Speakers: Abdelmalek Abdesselam (Paris 13), Roger E. Behrend (Cardiff), Olivier Bernardi (CRM, Barcelona), Mireille Bousquet-Mélou (Bordeaux 1), Mihai Ciucu (Georgia Tech), Sylvie Corteel (LRI, Paris-Sud), Johannes de Gier (Melbourne), Philippe Di Francesco (CEA Saclay), Eric Fusy (INRIA Rocquencourt), Anthony J. Guttmann (Melbourne), Christian Krattenthaler (Wien), Gilbert Labelle (UQÀM), Pierre Mathieu (Laval), Marni Mishna (Simon Fraser), Soichi Okada (Nagoya), Andrew Rechnitzer (UBC),

Gordon Slade (UBC), Alan Sokal (New York), Chris E. Soteros (Saskatchewan), E.J. Janse van Rensburg (York), Xavier Viennot (Bordeaux 1), David G. Wagner (Waterloo), Stu Whittington (Toronto), Doron Zeilberger (Rutgers)
Number of participants: 72

This workshop featured 24 expository and specialized talks on combinatorial problems raised by statistical mechanics, as well as poster presentations by Juan Alvarez (Saskatchewan), Arvind Ayyer (Rutgers), Patrick Desrosiers (Montréal), Gary Iliev (Toronto), Ming-Shr Lin (Caltech), and David Ridout (Laval). Among the topics covered by the workshop let us mention the following: enumerative problems related to the classical models of statistical mechanics, self-avoiding walks, tilings, asymmetric exclusion processes, alternating sign matrices, plane partitions, multiple partitions, polymers and copolymers, Mayer's theory and graph weights, Potts model on graphs and Feynman diagrams.

The workshop took place in a cordial and intense atmosphere and gave rise to numerous interactions between the participants; these interactions should lead to new research ideas and collaborations.

School
Combinatorics on Words
March 5 – 9, 2007, CRM

Organizers: Srecko Brlek (UQÀM), Christophe Reutenauer (UQÀM), Bruce Sagan (Michigan State)
Speakers: Jean Berstel (Marne-la-Vallée), Christophe Reutenauer (UQÀM)
Number of participants: 48

Chacun des deux conférenciers (Jean Berstel et Christophe Reutenauer) a donné dix heures de cours. Le professeur Berstel est un spécialiste mondialement reconnu en combinatoire des mots et poursuit des recherches sur ce sujet depuis trente ans. Son cours était intitulé « Répétitions dans les mots » et un de ses thèmes principaux était le fameux mot infini de Prouhet-Thue-Morse, introduit par ces trois mathématiciens (indépendamment et pour des raisons très différentes) en 1851, 1912 et 1921, respectivement. Prouhet voulait résoudre un problème d'arithmétique (appelé plus tard problème de Tarry et Escott), Thue introduisit ce mot pour des raisons esthétiques et pour considérer des problèmes difficiles, et Morse l'introduisit à cause de sa relation avec les systèmes dynamiques. Le mot de Prouhet-Thue-Morse est un mot sans chevauchement, c'est-à-dire sans facteur de la forme $uvuvu$. Il est aussi utilisé dans l'étude du problème des tours de Hanoï et des carrés magiques ; il permet de calculer certains d'entre eux, notamment celui qu'on retrouve dans la gravure *Melencolia* de Dürer, et c'est un exemple typique de suite automatique à la Cobham. Il est donc lié aux séries algébriques en caractéristique p.

Le mot de Prouhet-Thue-Morse permet, par un codage obtenu de diverses façons par Braunholtz, Thue et Morse-Hedlund, de construire un mot infini sans carré. Cette construction est une étape cruciale dans la démonstration, par Adjan, que le problème de Burnside pour les groupes de torsion a une solution négative. Jean Berstel présenta son théorème sur les morphismes préservant les mots sans carré, lequel permet de simplifier de nombreuses constructions. Il présenta aussi avec brio et clarté les travaux de Crochemore caractérisant algorithmiquement les morphismes sans carré et les mots sans carré, ainsi que la factorisation de Crochemore d'un mot. Il donna aussi la preuve complète de son lemme des trois carrés. Ce lemme permet de borner par $2n$ le nombre de carrés distincts dans un mot de longueur n, et par $n \log n$ le nombre d'occurrences de carrés de mots primitifs. Jean Berstel a conclu son cours par les notions de motif et de carré abélien et par un survol des résultats de Dekking, redémontrés par Currie et Visentin.

Le cours de Christophe Reutenauer portait sur les mots de Christoffel. Il a d'abord présenté leur définition par discrétisation de segments finis, à la Borel-Laubie, Berstel, et Osborne-Zieschang. Il a ensuite présenté leur définition (équivalente à la précédente) par graphe de Cayley d'un groupe à la Christoffel, et il a introduit les morphismes de Christoffel, lesquels préservent les classes de conjugaison des mots de Christoffel et forment un monoïde. Christophe Reutenauer a aussi présenté le théorème de Mignosi-Séébold et Wen-Wen, qui donne des générateurs de ce monoïde et montre que ce sont les automorphismes positifs du groupe libre à deux générateurs F_2. Il a montré que les mots de Christoffel pouvaient être construits par palindromisation, à la de Luca, et que l'arbre de Christoffel (dû à Berstel et de Luca) permet d'engendrer tous ces mots ; l'arbre de Stern-Brocot, qui en est un cas particulier, est lié aux suites de Farey. Finalement, Christophe Reutenauer a montré que les conjugués des mots de Christoffel sont précisément les éléments primitifs positifs de F_2, parlé de la relation entre fractions continues et mots de Christoffel, et présenté de manière originale la théorie de Markoff des approximations des réels et des formes qua-

dratiques, en utilisant les mots de Christoffel et la condition de Markoff. Dans toutes les preuves qu'il a données, le conférencier a privilégié les approches tirées de la géométrie discrète.

Workshop
Recent Progress in Combinatorics on Words

March 12 – 16, 2007, CRM

Organizers: Srecko Brlek (UQÀM), Christophe Reutenauer (UQÀM), Bruce Sagan (Michigan State)
Speakers: Petr Ambroz (Czech TU), Pierre Arnoux (Aix-Marseille 2), Lubomira Balkova (Czech TU), Jean Berstel (Marne-la-Vallée), Valérie Berthé (Montpellier 2), Alexandre Blondin-Massé (UQÀM), Julien Cassaigne (Aix-Marseille 2), Sébastien Ferenczi (Aix-Marseille 2), Aviezri Fraenkel (Weizmann Institute), Anna Frid (Sobolev Institute, Novosibirsk), Amy Glen (Adelaide), Arye Juhasz (Technion), Aldo de Luca (Federico II, Naples), Alexei G. Miasnikov (McGill), Gregg Musiker (UC San Diego), Dominique Perrin (Marne-la-Vallée), Xavier Provençal (UQÀM), Denis E. Serbin (McGill), Benjamin Steinberg (Carleton), Laurent Vuillon (Chambéry)
Number of participants: 65

Chaque journée de l'atelier consistait de deux séances, et chaque séance de deux exposés d'une heure. Cette formule a été appréciée des participants, ainsi que l'a exprimé le doyen des participants, Aviezri Fraenkel, dans un discours improvisé à la fin de l'atelier ; les participants ont disposé de suffisamment de temps pour des échanges informels. La plupart des participants de l'école sur la combinatoire des mots tenue la semaine précédente participèrent également à l'atelier ; vingt autres participants se joignirent à eux pour l'atelier.

L'exposé d'ouverture fut donné par Jean Berstel, qui parla de mots sturmiens et de leur généralisation aux arbres. Les mots sturmiens et leurs variantes sont apparus aussi dans les exposés de Valérie Berthé, Amy Glen, Pierre Arnoux, Sébastien Ferenczi, Aldo de Luca et Laurent Vuillon. La théorie des groupes, examinée du point de vue des techniques de la combinatoire des mots, a été illustrée par les exposés d'Alexei Miasnikov, Denis Serbin et Arie Juhasz. Les ensembles de mots ont été illustrés par les exposés de Gregg Musiker (fonctions zêta des langages et des courbes), Benjamin Steinberg (topologie pro-finie du monoïde libre) et Dominique Perrin (codes synchronisants). Les mots infinis classiques étaient le sujet des exposés d'Alexandre Blondin-Massé, Lubomira Balkova, Anna Frid, Petr Ambroz et Julien Cassaigne. Xavier Provençal a parlé de pavages du plan par des polyominos, et finalement, Aviezri Fraenkel a appliqué la combinatoire des mots à un problème de théorie des jeux.

School
Combinatorial Hopf Algebras and Macdonald Polynomials

April 30 – May 4, 2007, CRM

Organizers: Marcelo Aguiar (Texas A&M), François Bergeron (UQÀM), Nantel Bergeron (York), Mark Haiman (Berkeley), Stephanie van Willigenburg (UBC)
Speakers: Marcelo Aguiar (Texas A&M), François Bergeron (UQÀM), Mark Haiman (Berkeley)
Number of participants: 68

The goal of this mini-course was to introduce the basic methods of Hopf algebras and their interactions with algebraic combinatorics. The topics presented were: combinatorial Hopf algebras, symmetric and quasisymmetric functions, Macdonald polynomials and ties with group representation theory. Marcelo Aguiar and François Bergeron each gave lectures lasting five hours in total, and Mark Haiman gave lectures lasting seven and a half hours. Marcelo Aguiar spoke on tensor categories, the theory of species, and graded Hopf algebras. François Bergeron spoke on symmetric functions, the representation theory of finite groups, invariant theory, coinvariant spaces, harmonic polynomials, and diagonal coinvariant spaces. Mark Haiman spoke on the Weyl character formula, algebraic representations of $\mathrm{GL}(n)$, Macdonald polynomials, Lascoux – Leclerc – Thibon polynomials, and combinatorial models for Macdonald polynomials. Handwritten lecture notes are available on the following web site: `karin.math.yorku.ca/~nantel/HopfAndMacdonald/index.html`.

Workshop
Combinatorial Hopf Algebras and Macdonald Polynomials

May 7 – 11, 2007, CRM

Organizers: Marcelo Aguiar (Texas A&M), François Bergeron (UQÀM), Nantel Bergeron (York), Mark Haiman (Berkeley), Stephanie van Willigenburg (UBC)
Speakers: Sami Assaf (UC Berkeley), Louis J. Billera (Cornell), Emmanuel Briand (Sevilla), Adriano M. Garsia (UC San Diego), Iain Gor-

don (Edinburgh), Jim Haglund (Pennsylvania), Florent Hivert (Rouen), Friedrich Knop (Rutgers), Thomas Lam (Harvard), Luc Lapointe (Talca), Alain Lascoux (Marne-la-Vallée), Cristian Lenart (SUNY Albany), Nicholas Loehr (College of William and Mary), Peter McNamara (Bucknell), Jennifer Morse (Drexel), Jean-Christophe Novelli (Marne-la-Vallée), Rosa Orellana (Dartmouth), Frédéric Patras (Nice), T. Kyle Petersen (Michigan), Kevin Purbhoo (UBC), Pavlo Pylyavskyy (MIT), Jeffrey Remmel (UC San Diego), Mercedes Rosas (Sevilla), Anne Schilling (UC Davis), Mark Shimozono (Virginia Tech), Jean-Yves Thibon (Marne-la-Vallée), Monica Vazirani (UC Davis), Gregory S. Warrington (Wake Forest)

Number of participants: 102

The goal of this workshop was to take stock of ongoing work and of the many rich problems that still need to be addressed in two areas naturally linked through the combinatorics behind the study of Macdonald polynomials. Recently one has seen a marked interest in the study of graded Hopf algebras, in part because of their fundamental interactions with algebraic combinatorics, but also because of their importance for theoretical physics. In particular, it has recently been made apparent that Hopf algebras play a crucial role in the study of renormalizations in quantum electrodynamics. On the other hand, in the realm of symmetric and quasisymmetric functions, Hopf algebras also appear to play a significant role, with surprising repercussions in representation theory, algebraic geometry, mathematical physics, and the combinatorics of Macdonald polynomials. From another perspective, there has been a lot of recent developments regarding combinatorial models for Macdonald polynomials and their link to diagonal coinvariant spaces. Many important advances in these subjects were presented for the first time at this workshop, and several collaborative projects resulted from it. Slides of presentations and handwritten notes are available at the following address: `karin.math.yorku.ca/~nantel/HopfAndMacdonald/index.html`.

School
Algebraic Geometry and Algebraic Combinatorics

May 21 – 25, 2007, CRM

Organizers : François Bergeron (UQÀM), Sara Faridi (Dalhousie), Anthony V. Geramita (Queen's), Allen Knutson (UC Berkeley), Ravi Vakil (Stanford)

Speakers: Ezra N. Miller (Minnesota), Gregory G. Smith (Queen's), Monica Vazirani (UC Davis)

Number of participants: 56

The goal of this mini-course was to introduce some of the basic methods of algebraic geometry for which there is a natural interaction with algebraic combinatorics, as well as tools of algebraic combinatorics that are of special interest for algebraic geometry. Experimental aspects, involving computer algebra, were also covered in these introductory lectures. Monica Vazirani spoke on affine Hecke algebras and their representation theory, and on combinatorics of S_n, $\widehat{\mathrm{sl}}_n$ and crystals. Ezra Miller spoke on toric ideals, binomial primary decomposition, D-modules, hypergeometric systems and Euler – Koszul homology. Gregory Smith spoke on polytopes and their associated toric varieties, f-vectors and Hilbert functions, and Minkowski sums and defining equations for toric varieties.

Workshop
Algebraic Geometry and Algebraic Combinatorics

May 28 – June 1, 2007, CRM

Organizers: François Bergeron (UQÀM), Sara Faridi (Dalhousie), Anthony V. Geramita (Queen's), Allen Knutson (UC Berkeley), Ravi Vakil (Stanford)

Speakers: Arkady Berenstein (Oregon), Emmanuel Briand (Sevilla), Anders Buch (Rutgers), Mahir Can (Western Ontario), Mark Haiman (UC Berkeley), Valerie Hower (Georgia), Asia Matthews (San Francisco State), Laura Matusevich (Texas A&M), Leonardo Mihalcea (Duke), Ezra N. Miller (Minnesota), Diane Maclagan (Rutgers), Ahad Rahimi (Duisburg – Essen), Richard Rimanyi (UNC Chapel Hill), Joe Rusinko (Georgia), Gregory Smith (Queen's), Hugh Thomas (New Brunswick), Lauren Williams (Harvard), Alexander Yong (Minnesota), Paul Zinn-Justin (Paris-Sud)

Number of participants: 81

This workshop included expository talks as well as presentations on current research on interactions between algebraic combinatorics, algebraic geometry and group representation theory, with an emphasis on the study of subjects such as the cohomology of Schubert varieties, Hilbert schemes, Gromov – Witten invariants, group invariant theory, coinvariant spaces and their diagonal analogs, and various ties between these topics and symmetric functions and Schubert polynomials. A special mention should be made of the new combinatorial model for

Macdonald polynomials, proposed by Haglund, Haiman and Loehr, and their relationship with the Lascoux – Leclerc – Thibon polynomials.

Workshop
Real, Tropical, and Complex Enumerative Geometry

June 11 – 22, 2007, CRM

Organizers: Viatcheslav Kharlamov (Strasbourg 1) and Rahul Pandharipande (Princeton)
Speakers: Vladimir Berkovich (Weizmann Institute), Erwan Brugallé (Paris 6), Jim Bryan (UBC), Carel Faber (Johns Hopkins), Kenji Fukaya (Kyoto), Andreas Gathmann (TU Kaiserslautern), Ilia Itenberg (Strasbourg 1), Hannah Markwig (IMA, Minnesota), Davish Maulik (Princeton), Rahul Pandharipande (Princeton), Brett Parker (MIT), Sam Payne (Stanford), Sergey Shadrin (Zürich), Jake Solomon (IAS, Princeton), Frank Sottile (Texas A&M), Bernd Sturmfels (UC Berkeley), Johannes Walcher (IAS, Princeton), Jean-Yves Welschinger (ENS Lyon), Ilia Zharkov (Harvard), Aleksey Zinger (Stony Brook)
Number of participants: 45

The workshop was devoted to new developments in enumerative geometry, in particular, to developments related to the recent emergence of tropical geometry and a breakthrough in some enumerative problems over the reals; it also included recent ideas such as string/gauge dualities. All the topics discussed point to new directions in enumerative geometry. The aforementioned fields are developing very quickly, and one of the purposes of the workshop was to bring together the people working in these different, but closely related, directions. We expect that the workshop will stimulate progress in these areas. To familiarize the participants with the important developments of the field, five series of introductory lectures were organized in addition to the advanced talks. These lectures were given by Jim Bryan, Carel Faber, Andreas Gathmann, Rahul Pandharipande, and Jean-Yves Welschinger.

The main topic of the first week was the study of the tropical and real enumerative geometries. Four lectures on tropical geometry were given by A. Gathmann and four lectures on real (symplectic) enumerative geometry by J.-Y. Welschinger. Not only did both lecturers succeed in providing a thorough introduction to their respective subjects, but they also presented new techniques and results. Gathmann presented a new tropical intersection theory, and Welschinger a new method of computing and studying Welschinger invariants by means of symplectic field theory. Among the other talks of the first week let us mention Berkovich's talk on a bridge between tropical varieties and Berkovich non-Archimedian spaces; Itenberg's and Brugallé's talks on formulas of the Caporaso – Harris type for Welschinger invariants in the projective plane and the projective 3-space, respectively; Payne's talk on functoriality in tropical geometry; Markwig's talk on applications of tropical intersection theory to the proof of Kontsevich recursive formulas; and Parker's talk introducing a new enhanced tropical geometry. But the most sensational talks were those by J. Solomon, who discovered completely new recursive formulas combining Welschinger invariants with Gromov – Witten invariants. These formulas lead to a new kind of PDE, related to WDVV equations; the algebraic interpretation of these formulas is an intriguing and challenging question.

The main topic of the second week was the study of complex enumerative questions. The lectures were given by C. Faber, J. Bryan, and R. Pandharipande. Faber gave an exposition of his work with Aluffi on a more or less complete description of the degree of the orbit of a plane curve (in the projective space of plane curves). Faber and Aluffi used classical methods to achieve this. Bryan gave three lectures on modern questions. The first two lectures concerned Donaldson – Thomas theory and the crepant resolution conjecture for quotient stacks. From the work presented by Bryan came closed formulas for box counting in new geometries (extending the classical MacMahon function). The third lecture by Bryan concerned again the crepant resolution conjecture and Hurwitz – Hodge integrals. Pandharipande's lectures started with the algebraic foundations of the virtual cycle and then moved to threefold theories: the GW/DT correspondence and then a new theory of stable pairs for threefolds (developed with R. Thomas). Among other complex geometry lectures, let us mention those by Zinger, Maulik and Shadrin. Zinger spoke about computing virtual contributions by deforming sections, and Maulik spoke about the connections between GW theory and Noether – Lefschetz loci for K3 surfaces. Shadrin explained Givethals theory of semi-simple quantum cohomology, with new applications to r-spin curves. Finally, there were a few computational talks by Sturmfels and Sottile during the second week.

All of the participants agree that the workshop was very successful and instructive.

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.

2005 – 2006 Analysis in Number Theory
2004 – 2005 The Mathematics of Stochastic and Multiscale Modeling
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

Conference on 3-manifold Topology in Honour of Peter Shalen's 60th Birthday

June 12 – 15, 2006, CRM
Sponsored by CIRGET

Organizers: Steven Boyer (UQÀM), Richard Canary (Michigan), Marc Culler (Illinois at Chicago), Nathan Dunfield (Caltech), Benson Farb (Chicago)
Speakers: Ian Agol (Illinois at Chicago), Cameron Gordon (UT Austin), Alex Lubotzky (Hebrew University), Dan Margalit (Utah), Yair Minsky (Yale), Maryam Mirzakhani (Princeton), John Morgan (Columbia), Lenhard Ng (Stanford), Peter Ozsvath (Columbia), Jake Rasmussen (Princeton), Michah Sageev (Technion), Peter Storm (Stanford)
Number of participants: 70

A conference in honour of Peter Shalen, whose work has been a major force in bringing many different aspects of mathematics to bear on the study of 3-manifolds, and in expanding the influence of 3-manifold topology into other areas, was held at the CRM on July 12 – 15, 2006. The subject of 3-manifold topology has a long history of deep and interesting interactions with other parts of mathematics. The complexity of these connections has increased with time, as the subject developed, and has exploded in recent years. The coincidence of this explosion with the recent solution of several of the major outstanding problems in the area made this a good time for a reflection on its relationship to the rest of mathematics.

The conference brought together a varied group of leading researchers whose work demonstrates deep connections between 3-manifold topology and other areas of mathematics. The areas covered by the lectures included: geometrization of 3-manifolds; virtual properties of 3-manifolds; combinatorial group theory and coarse geometric properties of groups; properties of random 3-manifolds and asymptotic properties of hyperbolic surfaces; Floer homology, Khovanov – Rozansky homology; 3-manifold invariants arising from contact structures; character varieties; and Dehn surgery. The five lectures delivered by recent PhDs and the large number of students and young mathematicians who attended the workshop reflected the robust health of the subject.

Conference on Combinatorial Optimization in Honour of Vašek Chvátal's 60th Birthday

June 16 – 17, 2006, CRM
Sponsored by CRM and GERAD

Organizers: David Avis (McGill), Gena Hahn (Montréal), Bruce Reed (McGill)
Speakers: David Avis (McGill), Xiaomin Chen (Rutgers), Jarmila Chvátalová (Champlain College Saint-Lambert), Sanjeeb Dash (IBM Watson Research Center), Chinh Hoang (Wilfrid Laurier), Bahman Kalantari (Rutgers), Jean-François Maurras (Aix-Marseille 2), Ming Ouyang (University of Medicine and Dentistry of New Jersey), Hui-Yu Wang (Rutgers)
Number of participants: 21

Le colloque en l'honneur de Vašek Chvátal à l'occasion de ses 60 ans a réuni quelques-uns de ses proches collaborateurs, de ses anciens étudiants et de ses amis mathématiques. Vašek Chvátal est un des chercheurs les plus importants et les plus influents en optimisation combinatoire, et il a joué un rôle crucial dans l'organisation du semestre thématique en optimisation combinatoire tenu au CRM en 2006. Le présent colloque a été marqué entre autres par une conférence de Xiaomin Chen sur le théorème de Sylvester-Chvátal et des problèmes connexes, une conférence de Chinh Hoang sur les graphes parfaitement ordonnables et une conférence de David Avis sur une heuristique pour le problème du transversal.

Sanjeeb Dash a donné une conférence sur les plans de coupure pour les problèmes de programmation en nombres entiers mixte. Ming Ouyang et Hui-Yu Wang ont donné une conférence sur le jeu « Master Mind » et Bahman Kalantari une conférence sur la mise à l'échelle de matrices et un algorithme de Chvátal en programmation linéaire. Finalement, Jean-François Maurras a donné une conférence sur les preuves

que certaines inégalités définissent des facettes. Les participants ont eu assez de temps libre pour échanger des idées et travailler entre les sessions de conférences.

Mini-courses and Conference on Geometric Group Theory

July 3 – 14, 2006, CRM
Sponsored by CIRGET

Organizers: Mladen Bestvina (Utah), Steven Boyer (UQÀM), Tadeusz Januszkiewicz (Ohio State), Michah Sageev (Technion), Daniel T. Wise (McGill)
Mini-Course Lecturers: Mike Davis (Ohio State), Chris Hruska (Chicago), Graham Niblo (Southampton), Michah Sageev (Technion), Jacek Swiatkowski (Wroclaw), Kevin Whyte (Illinois at Chicago)
Speakers: Jason Behrstock (Utah), Marc Bourdon (Nancy 1), Noel Brady (Oklahoma), Inna Bumagin (Carleton), Ruth Charney (Brandeis), Matthew Clay (Utah), Yves de Cornulier (Penn State), Tullia Dymarz (Chicago), Mark Feighn (Rutgers), Soren Galatius (Stanford), Tim Hsu (San Jose State), Olga Kharlampovich (McGill), Bruce Kleiner (Yale), Ian Leary (Ohio State), Dan Margalit (Utah), Eduardo Martinez (Oklahoma), Jon McCammond (UC Santa Barbara), Alexei G. Miasnikov (McGill), Lee Mosher (Rutgers), Denis Osin (City College of New York, CUNY), Bertrand Remy (Lyon 1), Roman Sauer (Göttingen), Richard Scott (Santa Clara), Karen Vogtmann (Cornell), Bertold Wiest (Rennes 1)
Number of participants: 98

The first week of the conference was dedicated to five mini-courses that were pitched at an introductory level and aimed at students entering the field. Chris Hruska gave a mini-course on "Relative Hyperbolicity," which is a topic of continual interest having matured during the last couple of years. Graham Niblo and Michah Sageev jointly gave a mini-course on "CAT(0) Cube Complexes," a topic that is becoming increasingly central in geometric group theory and is rekindling in higher dimensions the monumental impact of group actions on trees introduced by Serre in the 1970s. Jacek Swiatkowski gave a mini-course on "Simplicial Nonpositive Curvature," which is an exciting emerging area; many of the student participants now embarking on a PhD are actually planning to work in this area. Kevin Whyte gave a mini-course on "Quasi-isometric Rigidity," which lies at the heart of geometric group theory and has featured many striking results (beginning with Gromov's virtually nilpotent classification of groups with polynomial growth). Finally, Mike Davis gave a mini-course on "L^2-Betti numbers," an older and more analytic topic whose presence is increasingly felt in the theory of infinite groups.

These courses were a great success. In addition to a substantial student presence, there were a fair number of seasoned mathematicians from neighboring fields who were interested in learning more about geometric group theory. Their numerous informed questions heightened the level of communication for all participants during the mini-courses.

During the second week, there were approximately thirty advanced research lectures on a wide variety of topics within geometric group theory. The organizers included a number of shorter contributed talks by additional participants; many of these talks built upon the mini-courses from the previous week. For instance, Bruce Kleiner spoke about the quasi-isometric rigidity of right-angled Artin groups, building upon both the quasi-isometric rigidity and the CAT(0) cube complexes mini-courses. Tim Hsu spoke about cubulating graphs of groups, building upon CAT(0) cube complexes and relative hyperbolicity. Roman Sauer spoke about measure theoretic methods in the study of L^2-Betti numbers, building upon the introduction to L^2-Betti numbers in group theory. There were exciting announcements of new results in the area, such as Osin's announcement of the construction of certain small-cancellation monsters (thus settling old questions from the Kovourka problem book). Mark Feighn announced a surprising characterization of constructible subsets of free groups. There were also many new research directions opened: Jon McCammond outlined a new approach to geometrize Artin groups to resolve notorious problems about their algebraic properties.

The participants were able to spend much time together in the evenings and during the breaks, to pursue ongoing collaborations. The conference was a resounding success and will have a major impact on the next generation of researchers in the area; it introduced them to several of the most important current topics, and allowed them to interact with seasoned researchers in the field.

Mini-workshop on Computational Aspects of Dynamical Systems

July 7, 2006, Concordia University
Sponsored by the Applied Mathematics Laboratory, CRM

Organizer: Eusebius J. Doedel (Concordia)

Speakers: Bernd Krauskopf (Bristol), Hinke Osinga (Bristol), Volodymyr Romanov (Concordia), Paul Tupper (McGill)
Number of participants: 12

This mini-workshop provided an opportunity for European and Canadian researchers in dynamical systems to meet and work together. The lectures were very well presented and covered an interesting range of topics. The topic of Hinke Osinga's talk was "Boundary Crisis: Mind the Gaps!"; that of Paul Tupper's talk, "A Non-Existence Result for Hamiltonian Integrators"; that of Bernd Krauskopf, "Global Bifurcations of the Lorenz Manifold"; and that of Volodymyr Romanov's talk, "Elemental Periodic Orbits Associated with the Libration Points of the Homogeneous Rotating Gravitating Triaxial Ellipsoid." The mini-workshop was held on the occasion of a 10-day visit to Montreal by Bernd Krauskopf and Hinke Osinga. During this visit, they worked with Eusebius Doedel on "Global Bifurcations of the Lorenz Model." They also met other Montreal researchers, including Paul Tupper and Volodymyr Romanov (Eusebius Doedel's PhD student). These encounters are very likely to lead to further scientific contact.

Workshop on Singularities in PDE and the Calculus of Variations

July 17 – 21, 2006, CRM
Financed by the CRM and the National Science Foundation

Organizers: Stan Alama (McMaster), Lia Bronsard (McMaster), Peter Sternberg (Indiana)
Speakers: Yaniv Almog (Louisana State), Leonid Berlyand (Penn State), Fabrice Béthuel (Paris 6), Rustum Choksi (Simon Fraser), Manuel Del Pino (Chile), Carlos J. Garcia-Cervera (UC Santa Barbara), Stephen Gustafson (UBC), Radu Ignat (Paris 6), Robert Jerrard (Toronto), Shuichi Jimbo (Hokkaido), Bernd Kawohl (Köln), David Kinderlehrer (Carnegie Mellon), Robert V. Kohn (Courant Institute, NYU), Chun Liu (Penn State), Andrea Malchiodi (SISSA, Trieste), Vincent Millot (Carnegie Mellon), Alberto Montero Zárate (Toronto), Yoshihisa Morita (Ryukoku), Pablo Padilla (UNAM), Daniel Phillips (Purdue), Xiaofeng Ren (Utah State), Maria G. Reznikoff (Georgia Tech), Sylvia Serfaty (Courant Institute, NYU), Daniel Spirn (Minnesota), Gabriella Tarantello (Tor Vergata), William P. Ziemer (Indiana), William K. Ziemer (California State University, Long Beach)
Number of participants: 57

In this workshop were presented results of a very high level in a remarkable range of subjects in the field. The atmosphere of the workshop was relaxed and of exceptional congeniality. Participants included researchers and students from several countries in North and South America, Europe, and Asia. The main theme of the meeting was the formation of geometrical singularities in PDE problems with a variational formulation. These equations typically arise in some applications (to physics, engineering, or biology, for example), and their resolution requires combining methods from functional and harmonic analysis, differential geometry, and geometric measure theory (for instance). Numerical simulations can also be helpful to visualize and predict the types of singularities expected in complex problems. The talks lasted 45 minutes each, which left ample time for discussions between participants, the fruits of which may be divulged in upcoming meetings!

The excellent opening talk of the conference, by David Kinderlehrer, set the high tone for the week. Throughout his distinguished career, D. Kinderlehrer has often pioneered methods and directions for research, and his influence (through former students and postdocs) is very significant. He spoke about the problem of transport in cells, a problem that combines modelling questions with optimization and diffusion and is a real challenge for researchers in PDE.

A recurrent theme in the meeting involved the Cahn – Hilliard model for phase transitions, which is ubiquitous in the description of domain walls (codimension-one singularities) in many contexts. Bob Kohn has played a major role in the development of this area, not only through his own groundbreaking research but through his many successful former students and postdocs (who were well represented at this meeting). His importance in the field of PDE is underlined by his selection as plenary speaker in this year's ICM. At the workshop he spoke on the dynamics of crystal facets as a steepest descent problem for a non-smooth energy functional.

There were many other fascinating results on Cahn – Hilliard-type systems. M. Del Pino spoke about the existence of multiple transition layers, a talk which generated much interest as the problem had been studied by many participants. M. Reznikoff presented a new approach to studying stochastic effects in switching between local minima for such problems. X. Ren gave new results on how modifications to Cahn – Hilliard (arising in other applications) can have

a stabilizing effect on the stationary problem. Radu Ignat spoke about a related problem from micromagnetism, in which nonlocal effects are introduced. R. Choksi presented striking results (obtained with P. Sternberg) on some new nonlocal isoperimetric problems arising from the Ohna – Kawasaki model for diblock copolymers.

A second major theme of the workshop was the family of Ginzburg – Landau models for superconductors, superfluids, and Bose – Einstein condensates. These models involve a complex-valued wave function, and the singularities are typically "vortices": quantized codimension-two defects in the complex phase. F. Béthuel beautifully presented some very impressive results on the dynamics and interactions of vortex solutions, including the difficult problem of "annihilation" and splitting in finite time, a fundamental problem that has been open for some time. Dynamical results on the difficult Schrödinger map problem (which is connected to models of micromagnetism) were described by S. Gustafson. L. Berlyand discussed the role of the capacity in minimizing the Ginzburg – Landau functional with prescribed degrees. A. Montero Zárate presented results (some of which were obtained with S. Alama and L. Bronsard) on local minimizers with vortices in a Bose – Einstein condensate.

In the setting of superconductivity there were many new and exciting results. S. Serfaty gave a sweeping overview of the vorticity of minimizers in increasing magnetic fields, tying the problem to the methods of div-curl systems introduced by DiPerna and Majda. S. Jimbo described a method producing solutions in narrow three-dimensional superconductors via a dimension-reduction procedure. This talk was nicely complemented by that of Y. Morita, who gave a complete bifurcation analysis of the reduced problem in a closed loop. Y. Almog analyzed the normal/superconducting transition in the presence of electric currents.

There were also some very interesting results on alternative models of Ginzburg – Landau type. D. Phillips presented a model for high-temperature superconductors with results on the unusual pattern of vortices observed. There were two talks on the Chern – Simons – Higgs functional from gauge-field theory: G. Tarantello discussed uniqueness problems in the self-dual regime, while D. Spirn showed gamma-convergence of the functional in the large-coupling limit. These functionals presented many new challenges and open problems for the participants.

Many fascinating talks fell outside of these broad categories, illustrating the breadth of the field. A. Malchiodi gave a very beautiful talk on singular perturbation problems with concentrations along curves or surfaces. These problems are related to pattern formation in biological systems. P. Padilla gave a very enlightening and entertaining closing talk on the wealth of variational problems in nature, where patterns may arise as optimal geometrical forms. B. Kawohl compared several variational models (such as Mumford – Shah) and geometrical models (such as Perona – Malik) used in image processing. C. Liu presented results on difficult problems of well-posedness in viscoelastic materials. C. Garcia-Cervera presented numerical and analytical results on density functional theory from quantum chemistry, an area which was new to most participants.

Several talks (including many of those mentioned above) also addressed the analytic foundations behind the models. R. Jerrard presented a new measure-theoretic approach to Monge – Ampère functions, which doesn't require convexity assumptions and is applied to the study of isoperimetric immersions and functionals of the Jacobian determinant. V. Millot discussed the lifting of $H^{1/2}$ maps with values in the circle, a problem related to Ginzburg – Landau functionals in higher dimensions. W. Ziemer spoke (with the collaboration of his son W.K. Ziemer) about a very weak form of the Gauss – Green theorem, which turns out to be related to methods described by S. Serfaty in her talk.

The workshop also included two poster sessions, in which seven posters were exhibited. The posters, made by graduate students or postdocs, were of very high quality and attracted the interest of many participants. The organizers were happy to give young mathematicians a chance to show their results to a larger audience, and to allow students and postdocs a chance to meet one another and exchange results. The participants were chosen so as to include a wide spectrum of interests in the field of PDE and singular perturbation theory. One measure of the organizers' success in this regard is that everyone attended the talks across the various "groups," although several participants had never met before in person. The organizers are grateful to the NSF for providing a generous grant ($15,000) to support young mathematicians coming from the United States.

MOPTA 06

The 6th Annual Conference on Modeling and Optimization: Theory and Applications

July 24 – 27, 2006, University of Waterloo
Sponsored by the University of Waterloo, the Fields Institute, MITACS, the CRM, the University of Waterloo Department of Combinatorics and Optimization and the Department of Management Sciences

Organizers: Tony Vanelli (Waterloo) and Henry Wolkowicz (Waterloo), Chairs of the program committee; Abdo Alfakih (Windsor), Antoine Deza (McMaster), Samir Elhedhli (Waterloo)
Plenary/Invited Speakers: Thomas F. Coleman (Waterloo), Michael Ferris (UW Madison), Charles Johnson (College of William and Mary), Sven Leyffer (Argonne National Laboratory), Zhi-Quan Luo (Minnesota), Michael Saunders (Stanford), Yinyu Ye (Stanford)
Number of participants: 140

This four-day conference brought together a diverse group of people from both discrete and continuous optimization, working on both theoretical and applied aspects. The aim of the conference was to bring together researchers from both the theoretical and applied communities, who would not usually have the chance to interact in the framework of a medium-scale event.

To encourage synergy, we hosted a combination of theoretical and applied one-hour talks by seven distinguished invited researchers. Michael Saunders opened the conference with his talk on matrix factorization and updating methods. Later that day, Charles Johnson presented the newly established results concerning positive, path-product, and inverse M-matrices. On the second day, Zhi-Quan (Tom) Luo described a probabilistic analysis of semidefinite relaxation for binary quadratic minimization with application to wireless communication, and Michael Ferris presented the latest techniques for solving hard optimization models in parallel. On the third day, Yinyu Ye introduced the semidefinite programming approach to tensegrity theory and realizability of graphs, and Sven Leyffer gave an overview of filter methods and discussed novel approaches. On the fourth day, Thomas Coleman spoke on his recent work on calibration and hedging of equity-linked insurance benefits under a jump model. The conference also featured about 80 contributed talks.

On the second day of the conference, a celebration was held to honour the recipients of the Lagrange Prize in Continuous Optimization, Roger Fletcher (Dundee), Sven Leyffer (Argonne National Laboratory) and Philippe Toint (Facultés Universitaires Notre-Dame de la Paix). This prize is awarded jointly by the Mathematical Programming Society (MPS) and the Society for Industrial and Applied Mathematics (SIAM).

Conference in honour of Pierre Leroux

September 8 – 9, 2006, Université du Québec à Montréal
Sponsored by LaCIM

Organizers: Srecko Brlek (UQÀM), Christophe Reutenauer (UQÀM), François Bergeron (UQÀM)
Speakers: Dominique Foata (Strasbourg), Adriano Garsia (UC San Diego), Alain Goupil (UQTR), Dominique Gouyou-Beauchamps (Paris 11), André Joyal (UQÀM), Gilbert Labelle (UQÀM), Cédric Lamathe (UQÀM), Volker Strehl (Erlangen-Nürnberg), Xavier Viennot (Bordeaux 1), Timothy Walsh (UQÀM)
Number of participants: 56

Le but de ces journées était d'honorer Pierre Leroux, qui fonda le LaCIM et est l'un des chercheurs québécois les plus actifs en combinatoire algébrique et énumérative. Les Journées Pierre Leroux, organisées quelques mois avant sa retraite, permirent de réunir d'anciens étudiants et des collaborateurs qui travaillent avec lui depuis longtemps.

Les conférences prononcées pendant ces journées couvrirent de nombreux domaines de la combinatoire. Xavier Viennot parla d'exclusion symétrique et de tableaux de Catalan et Adriano Garsia de produits de Kronecker et de la combinatoire de certaines équations diophantiennes. André Joyal donna un exposé sur les catégories de Möbius, la caractéristique d'Euler-Poincaré et l'interpolation de Newton. Cédric Lamathe parla d'énumération de graphes de k-arches étiquetés et Dominique Gouyou-Beauchamps d'énumération de tableaux de rubans. Pendant la deuxième journée, Dominique Foata donna un exposé sur les permutations signées, les points fixes et les points pixes, et Alain Goupil un exposé sur les polynômes de caractères et le produit de Kronecker. Volker Strehl donna une conférence intitulée « Combinatoire analytique – et nostalgique » et Timothy Walsh une conférence intitulée « Énumération des réseaux à deux pôles fortement planaires ». Pour conclure les journées, Gilbert Labelle parla de ses aventures mathématiques avec Pierre Leroux.

Gilles Fournier Memorial Conference on Classical and Computational Topological Methods

September 22 – 24, 2006, Université de Sherbrooke
Sponsored by the CRM, the Mathematical Analysis Laboratory, CRM, Bishop's University and the Faculty of Sciences of the Université de Sherbrooke

Organizers: Madjid Allili (Bishop's), Tomasz Kaczynski (Sherbrooke)
Speakers: Jean-Marc Belley (Sherbrooke), Hichem Ben-El-Mechaiekh (Brock), Octav Cornea (Montréal), David Corriveau (Sherbrooke), Jean-Noël Corvellec (Perpignan), Ketty de Rezende (Estadual de Campinas), Sara Derivière (Sherbrooke), Marlène Frigon (Montréal), Patrizio Frosini (Bologna), Massimo Furi (Firenze), Lech Gòrniewicz (Nicolaus Copernicus), Jan Jaworowski (Indiana), Robert Kotiuga (Boston), Jean-Philippe Lessard (Georgia Tech), Mario Martelli (Claremont McKenna College), Marian Mrozek (Jagellon University), Piotr Oprocha (AGH-UST), Andrzej Szymczak (Georgia Tech), Anik Trahan (Collège de Sherbrooke), Marcin Zelawski (Jagellon University), Natalia Zelazna (Jagellon University)
Number of participants: 34

This conference brought together many researchers working on topological methods in a variety of problems ranging from classical applications to nonlinear analysis and dynamics. These methods include Morse theory, the topological degree, the fixed point index, the Conley index, and the most recent applications of computational topology to computer science, namely, to image modelling and reconstruction. We also commemorated Professor Gilles Fournier by bringing up his numerous contributions to applications of topology. The conference took place at Bishop's University. Participants at all stages of their careers (MSc and PhD students, Emeritus Professors, etc.) came from Canada, the United States, Poland, France, Italy and Brazil. The conference unfolded in an atmosphere of friendship that promoted interaction and discussion. Among others, the collaboration between the research groups of Sherbrooke – Bishop's, Cracow and Bologna was reinforced by this meeting.

Québec – Maine Conference on Number Theory and Related Topics

September 30 - October 1, 2006, Université Laval
Sponsored by CICMA
Financed by the Number Theory Foundation, CICMA and the Department of mathematics and statistics of Université Laval

Organizers: Claude Levesque (Laval), Jean-Marie De Koninck (Laval)
Distinguished plenary speaker: Jean-Pierre Serre (Collège de France)
Plenary speakers: Chris Cummins (Concordia), Henri Darmon (McGill), Eyal Goren (McGill), Farshid Hajir (UMass Amherst), Hershy Kisilevsky (Concordia), Manfred Kolster (McMaster), John Labute (McGill), John McKay (Concordia), Carl Pomerance (Dartmouth College), Francisco Thaine (Concordia)
Invited speakers: Andreas Bender (KIAS), Elliot Benjamin (Maine), David Bradley (Maine), Hugo Chapdelaine (McGill), John Cullinan (Bard College), Mairead Greene (UMass Amherst), Kiran Kedlaya (MIT), Dominic Klyve (Dartmouth College), Andrew Knightly (Maine), Emmanuel Letellier (Concordia), Roger Oyono (Waterloo), Paul Pollack (Dartmouth College), Andrew Sills (Rutgers), Chip Snyder (Maine), Nicolas Thériault (Fields), Erik Tou (Dartmouth College)
Number of participants: 45

In 1998 number theorists at Université Laval and the University of Maine founded the Québec – Maine Conference on Number Theory and Related Topics. Since then it has been held annually on a weekend in early Fall (except in 2001). The organizers invite number theorists and mathematicians in related fields from New England, Eastern Canada, and beyond to speak about their research and discuss ideas for future work. Each year there is a change in venue: odd years at the University of Maine, even years at Université Laval. Thus the 2006 conference took place at Université Laval, and the highlight of the conference was the presence of Jean-Pierre Serre, who is a Fields medallist and one of the foremost mathematicians in the world. His lecture was entitled "Groupes finis: choix de théorèmes." There were 26 other lectures, including 5 by graduate students. The program of the conference may be found at the address `germain.umemat.maine.edu/msfiles/numbertheory/mainequebec.html`.

Xth International Workshop on Differential Equations, Number Theory, Data Analysis Methods and Geometry

February 19 – 23, 2007, Universidad de La Habana

Sponsored by the Faculty of Mathematics and Computation of the University of La Habana, the Department of Mathematics and Statistics of Concordia University, the Institute of Cybernetics, Mathematics and Physics of the Academy of Sciences of Cuba, and the CRM

Organizers: Syed Twareque Ali (Concordia), Reinaldo Rodriguez Ramos (La Habana), François Lalonde (Montréal)
Speakers: Jean-Pierre Antoine (Université catholique de Louvain), Natig Atakishiyev (UNAM Cuernavaca), Jorge Barrios Ginart (La Habana), Françoise Bastin (Liège), Stefan Berceanu (IFIN-HH), Alexander Bobenko (TU Berlin), Walter Carballosa (La Habana), Felix Carbonell (McGill), Sergei Chumakov (Guadalajara), Pierre Colmez (École Polytechnique, Palaiseau), Chantal David (Concordia), Didier Domínguez (ICIMAF), A. Fraguela Collar (Universidad Autónoma de Puebla), Nassif Ghoussoub (UBC), Joanka Hernández Cabañas (La Habana), Jarmo Hietarinta (Turku), Adrian Iovita (Concordia), Ángela León Mecías (La Habana), Trueman MacHenry (York, Toronto), Manuel Mañas (Complutense), José Marin-Antuna (La Habana), Rob Martin (Waterloo), Vladimir Matveev (Bourgogne, Dijon), Lester Melie-García (Centro de Neurosciencias de Cuba), Frank W. Nijhoff (Leeds), George W. Patrick (Saskatchewan), Nasser Saad (Prince Edward Island), Federico Sabina (UNAM), Yiannis Sakellaridis (Tel Aviv), Martin Schlichenmaier (Luxembourg), Peter Schneider (Münster), Dieter Schuch (Frankfurt), Yuri Suris (München), José R. Talavera Hurtado (La Habana), Nelson J. Trujillo-Barreto (Centro de Neurosciencias de Cuba), Pedro Valdés Sosa (Centro de Neurosciencias de Cuba), Ronald Van Luijk (Simon Fraser), Otmar Venjakob (Heidelberg), Alexander P. Veselov (Loughborough), Lilian Villarin Pildain (La Habana), John Willis (Cambridge), Kurt Bernardo Wolf (UNAM Cuernavaca)
Number of participants: 60

This was the 10th anniversary meeting of an annual series of activities that have been organized since 1998. These meetings have focused on the areas of differential equations, signal processing, quantization and composite systems. This year the scope of the meeting was broadened to include number theory and integrable systems. The main objective of the series is to provide Cuban researchers and students with an opportunity to interact with mathematicians and physicists from outside Cuba, in order to foster the development of collaborations and exchanges. Simultaneously these meetings have provided opportunities for research groups from Canada, Europe and Latin America to collaborate with Cuban mathematicians. This year's meeting was widely attended and brought together some of the leading experts in the domains represented.

Mini-course on GARCH Volatile Processes

March 12 and 14, 2007, Université de Montréal
Sponsored by GERAD and the Statistics Laboratory, CRM

Organizers: Roch Roy (Montréal), Pierre Duchesne (Montréal)
Speakers: Christian Francq (Lille 3), Jean-Michel Zakoïan (Lille 3)
Number of participants: 30

Ce mini-cours était une introduction aux modèles GARCH et à volatilité stochastique utilisés dans la modélisation des séries financières. Les modèles linéaires de séries temporelles se révèlent incapables de représenter certaines propriétés caractéristiques des séries financières (absence de corrélation entre les rendements, corrélation des carrés, regroupement des extrêmes, distributions leptokurtiques, effet de levier, etc.). Les modèles GARCH, introduits par Engle en 1982, sont particulièrement adaptés à la prise en compte de ces propriétés, ce qui explique leur fort impact dans les littératures économique, financière et économétrique. Ils reposent sur une spécification de la variance conditionnelle du rendement. Les points ci-dessous ont été abordés.

1. Conditions de stationnarité et propriétés probabilistes du modèle GARCH standard
2. Asymétries et autres spécifications de la variance conditionnelle
3. Estimation et tests, propriétés asymptotiques de la méthode du quasi-maximum de vraisemblance, méthodes alternatives
4. Modèles à volatilité stochastique et modèles ARCH à changement de régime markovien

Certains de ces points ont été illustrés à partir de données réelles, et certains résultats récents parus dans des articles scientifiques ont été mentionnés.

The 4th Montreal Scientific Computing Days

April 16 – 17, 2007, CRM
Sponsored by the Applied Mathematics Laboratory, CRM

Organizers: Emmanuel Lorin de la Grandmaison (Montréal), Robert G. Owens (Montréal), Thomas P. Wihler (McGill)

Lecturers: Don Estep (Colorado State), Christoph Schwab (ETH Zürich)
Number of participants: 86

By holding the Montreal Scientific Computing Days, the Applied Mathematics Laboratory seeks to nurture its young researchers and gather researchers interested in scientific computing. The 4th in the series of this very successful conference was held on April 16 and 17, and 86 students, postdocs and faculty members from Québec, Ontario, New York State and even such faraway countries as India, Haiti and France registered for the event. Travel support was offered to participants coming from outside Montréal. The participants were treated to excellent graduate-level lectures on adjoint-based error estimators and hierarchical wavelet methods for high-dimensional problems, given by Professors Don Estep and Christoph Schwab.

The lecture notes have been posted on the website of the conference. The organizing committee selected 11 out of the abstracts submitted by participants for oral presentation, and other contributions were made in the form of posters displayed during an evening reception on April 16. SIAM gift certificates were awarded for the best oral presentations and the best poster. Feedback from the participants at the end of the conference confirmed the success of the adopted format and encouraged the members of the Applied Mathematics Laboratory to make plans for similar events in the years to come.

Groups and Symmetries: From the Neolithic Scots to John McKay Conference Honouring the Contributions of John McKay

April 27 – 29, 2007, CRM
Sponsored by CRM, Concordia University, and the CICMA Laboratory, CRM

Organizers: John Harnad (Concordia), Pavel Winternitz (Montréal)
Speakers: Daniel Allcock (UT Austin), Philip Boalch (ÉNS, Paris), John Conway (Princeton), Henri Darmon (McGill), Jorge Andres Devoto (Instituto Tecnológico de Buenos Aires), Igor V. Dolgachev (Michigan), Chongying Dong (UC Santa Cruz), John Duncan (Harvard), Noam D. Elkies (Harvard), Nora Ganter (Illinois at Urbana-Champaign), Eyal Z. Goren (McGill), Valery Gritsenko (Lille 1), George Hart (Stony Brook), Nicholas M. Katz (Princeton), Yuri Manin (MPIM), Jack Morava (Johns Hopkins), M. Ram Murty (Queen's), Iku Nakamura (Hokkaido), Viacheslav V. Nikulin (Liverpool), Simon P. Norton (Cambridge)
Number of participants: 56

This conference honoured the contributions of John McKay, a world-renowned mathematician and one of the most influential Canadian mathematicians. Out of the 56 participants (who came from all parts of the globe), 46 were invitees and 18 gave one-hour talks. Yuri Manin gave two one-hour talks, and George Hart, sculptor and mathematician, gave a workshop session on polyhedral sculpture construction. The two main conference topics, "Monstrous Moonshine" and the "McKay Correspondence," are topics to which John McKay made pioneering contributions. The conference also included lectures on finite groups, Galois theory, modular groups and functions, algebraic computation, number theory, group representations, and algebraic geometry.

The titles, abstracts and videos of the conference talks may be found at the conference website (`crm.math.ca/McKay07/index_e.shtml`). A volume based upon the invited talks plus a number of additional refereed contributions will be published in the CRM Proceedings and Lecture Notes; it should be available in 2008.

Workshop on the Geometry of Holomorphic and Algebraic Curves in Complex Algebraic Varieties

April 30 – May 4, 2007, CRM

Organizers: Xi Chen (Alberta), James D. Lewis (Alberta), Steven Shin-Yi Lu (UQÀM), Peter Russell (McGill)
Speakers: Fedor Bogomolov (Courant Institute, NYU), Karen Chandler (Illinois at Urbana-Champaign), Jean-Pierre Demailly (Grenoble 1), Gerd-Eberhard Dethloff (Bretagne Occidentale, Brest), Hélène Esnault (Duisburg-Essen, Essen), Samuel Grushevsky (Princeton), Ryoichi Kobayashi (Nagoya), James D. Lewis (Alberta), Michael McQuillan (Glasgow), Reiko Miyaoka (Kyushu), Yoichi Miyaoka (Tokyo), Terrence Napier (Lehigh), Bruno de Oliveira (Miami), Gianluca Pacienza (Strasbourg), Mohan Ramachandran (Buffalo), Ziv Ran (UC Riverside), Erwan Rousseau (Strasbourg 1), Min Ru (Houston), Shuji Saito (Tokyo), Bernard Shiffman (Johns Hopkins), Jason Starr (Stony Brook), Andrey Todorov (UC Santa Cruz), Yuri Tschinkel (Courant Institute, NYU), Eckart Viehweg (Duisburg-Essen, Essen), Jörg Winkelmann (Bayreuth), Pit-Mann Wong (Notre Dame), Sai-Kee Yeung (Purdue), Qi Zhang (Missouri-Columbia), Scott Zrebiec (Johns Hopkins)
Doctoral students with financial support: John Baber (Johns Hopkins), Simone Diverio (La

Sapienza & Grenoble 1), Fabrizio Donzelli (Miami), Ning Hao (Stony Brook), Dano Kim (Princeton), Brian Macdonald (Johns Hopkins), Scott Zrebiec (Johns Hopkins)

Number of participants: 45

The past decades have seen several major breakthroughs in our understanding of the structure of algebraic varieties both from the algebraic geometric side and the complex analytic side. A major intersectRion of the two sides has to do with certain structural conjectures of Serge Lang that have catalyzed some of these advances. The conjectures are natural extensions of questions originating in hyperbolic geometry on the role of curvature in the distribution and behavior of curves and, by analogy, rational points, in algebraic varieties. This workshop brought together some international experts in this area; they presented the new ideas and introduced the rapid developments to a new generation of mathematicians. The workshop was intended as a small memorial to Serge Lang. Its talks rotated between algebraic geometry, complex geometry and related issues in arithmetic geometry.

On the algebraic side, the principal speakers were Viehweg, Bogomolov and Y. Miyaoka. Viehweg gave an overview of his results on the existence and hyperbolicity of the moduli stacks of Calabi – Yau (resp. canonically polarized) algebraic manifolds, including a sketch of the proof and some beautiful applications to the nonexistence of holomorphic (resp. Shimura) curves. He concluded with a list of open problems concerning curves and hyperbolicity of moduli spaces. Bogomolov spoke on his recent generalizations of his famous inequality of Chern numbers for the tangent bundle of a complex surface to the case of surfaces with nodal singularities. Miyaoka gave a new effective bound in terms of the genus and Chern numbers for curves in Bogomolov surfaces.

Other talks of interest were given by Starr, Ran and Zhang. Starr presented his generalization of the thesis of Serge Lang, who wrote the first and last work on the topic (before Starr's work). Starr's attempt is to connect rational simple connectedness (simple connectedness via chains of rational curves) to "weak approximation" by polynomials (algebraic interpolation). Examples and counterexamples were discussed, as well as the proof, and Starr concluded his talk by a slew of natural questions. Ran gave an overview of a general theory of deformation in the algebraic category that he is putting together; special cases of this theory, due to Ran, are now powerful tools in the study of algebraic curves on varieties, and have helped resolve the question of the nonexistence of curves of low genus in general hypersurfaces in projective space (a question in the spirit of Lang's conjectures). Qi Zhang gave an overview of the state of the art algebraic method in the analysis of varieties with nef anticanonical bundle, first introduced by Lu (2002). The important question in this regard is whether varieties with nef and big anticanonical bundle are rationally connected.

On the arithmetic side, the principal speakers were Esnault, Tschinkel and Saito. Esnault presented her new result, i.e., a successful interpretation of Grothendieck's section conjecture for the arithmetic fundamental group of hyperbolic curves, via an arithmetic analog of connections. Over a number field, her result shows that the said conjecture is in fact equivalent to the same conjecture over the projective line minus three points. Shuji Saito presented some state of the art techniques from Hodge theory for dealing with classical arithmetic questions, including questions on the distribution of rational points on algebraic varieties. Tschinkel pampered the audience with a beautiful PowerPoint presentation of the general conjecture concerning the distribution of rational points on algebraic varieties. He focused most of his talk on algebraic function fields and varieties that are rationally connected.

On the complex analytic side, the principal speakers were Demailly, Shiffman, Kobayashi and Winkelmann. Demailly presented his powerful tool of contact jet spaces, with which one expects to resolve Lang's holomorphic and algebraic conjectures in full. In dimension two, for example, this was used to give the best bound so far on the degree of generic hypersurfaces of a projective space that ensures hyperbolicity; this bound was obtained by Erwan Rousseau and well presented by him. In higher dimensions, a Riemann – Roch calculation gives the maximal growth of the alternating sum of the cohomological dimensions of the sheaf of jet differentials. The goal is to show that the 0th cohomology (i.e., the space of global jet differentials) has the same maximal growth. Although this goal has not been reached yet, Demailly shows how to use his powerful holomorphic Morse inequalities in order to bound the higher cohomologies. Demailly and his student Diverio (who was an invited participant) have used these inequalities to obtain exact formulas. It is hoped that their techniques will be successfully applied to give the desired maximal growth. This would imply a weakened form of Lang's conjecture for all varieties of general type.

Shiffman gave a presentation of recent results, mainly due to him, on the distribution of the zeros for Gaussian random holomorphic functions and on its connection to various aspects of physics and mathematics (the problem of sphere packing, for instance). His student, Scott Zrebiec, also gave a talk on this subject. Kobayashi gave a beautiful exposition of his results on the Gauss map of algebraic minimal surfaces, obtained through value distribution theory. This represents one of the most relevant applications of the value distribution of holomorphic curves, since the Gauss map of such a surface is a holomorphic curve in a projective space. These results are especially interesting in view of the fact that Serge Lang has paid a lot of attention to the ramification term in Nevanlinna theory. Winkelmann presented his thesis that entire Brody curves (that is, holomorphic curves with bounded derivatives) have less to do with the arithmetic geometry of the ambient variety than general holomorphic curves. His discussion was a tour de force of transcendental arithmetic geometry and was an attempt to bridge the gap between arithmetic geometry and holomorphic geometry.

Other talks of interest included that of Min Ru, who spoke on his solution to a conjecture of Shiffman and some generalizations by Dethloff and V.T. Tran; the talk of Dethloff on his characterization with Lu of hyperbolic surfaces with log irregularity 2; the talks of Ramachandran and Napier on an analytic Castelnuovo – DeFranchis lemma, a characterization of manifolds mapping to curves and its implications for the conjecture of Shafarevich concerning the universal cover of an algebraic manifold; and the talk of S.K. Yeung on his remarkable results, which gave an almost complete classification of fake projective planes via an arithmetic study of the automorphism group of the hyperbolic ball.

In conclusion, the workshop gathered some of the foremost experts on the various Lang conjectures on structures (hyperbolic or not) and curves in algebraic varieties. The comments and discussions were unusually fruitful and helped chart out future directions; they also fostered collaborations between researchers.

Analysis Day 2007

May 2, 2007, CRM
Organized by the Mathematical Analysis Laboratory, CRM

Organizer: Dmitry Jakobson (McGill)

Speakers: Francis Clarke (Lyon 1), François Germinet (Cergy-Pontoise), Igor Wigman (McGill)

Number of participants: 30

This activity is the third edition of the Analysis Day organized since 2004-2005 by the Mathematical Analysis Laboratory. This year, the Analysis Day Conference featured three speakers: Igor Wigman, Francis Clarke and François Germinet. Wigman spoke on "nodal lines for random eigenfunctions of the Laplacian on the torus," Clarke on the "regularity of solutions in the calculus of varations," and Germinet on "single energy multiscale analysis and Anderson localization."

CanaDAM 2007
The 1st Canadian Discrete and Algorithmic Mathematics Conference

May 28 – 31, 2007, Banff Conference Centre
Sponsored by the Department of Computing Science at the University of Alberta, the Fields Institute, CRM, PIMS, iCORE, and MITACS

Executive committee: Jason Brown (Dalhousie), Derek Corneil (Toronto), Chair, Pavol Hell (Simon Fraser), Ortrud Oellermann (Winnipeg), Daniel Panario (Carleton), Bruce Reed (McGill)

Local arrangements committee: Joe Culberson (Alberta), Ryan Hayward (Alberta), Chair, Guohui Lin (Alberta), Daniel Panario (Carleton), Mohammad R. Salavatipour (Alberta), Lorna Stewart (Alberta)

Plenary speakers: Valerie King (Victoria), Janos Pach (City College of New York), Bill Pulleyblank (IBM Global Services), David Sankoff (Ottawa), Bruce Shepherd (McGill), Vera Sós (Rényi Institute), Peter Winkler (Dartmouth College), Xuding Zhu (National Sun Yat-sen University)

Number of participants: 230

The field of discrete mathematics has grown tremendously in recent years, on the theoretical as well as the algorithmic side, and it has broad applications outside of mathematics as well as inside (i.e., to other fields of mathematics). The flagship international discrete mathematics conference, the SIAM Conference on Discrete Mathematics, is held each even year by SIAM (the Society for Industrial and Applied Mathematics). Since Canadian researchers in discrete mathematics have a strong international reputation, a group of researchers proposed a series of conferences, to be called CanaDAM conferences, in order to complement the SIAM Conference on

Discrete Mathematics. The first CanaDAM conference was held at the Banff Conference Center on May 28 – 31, 2007.

The program committee was chaired by Bojan Mohar (Simon Fraser) and all of its members are outstanding mathematicians. It also included Bill Cook (Georgia Tech), Pavol Hell (Simon Fraser), Joan Hutchinson (Macalester College), Nati Linial (Hebrew University), Christos Papadimitriou (UC Berkeley), Pavel Pevzner (UC San Diego), Doug Stinson (Waterloo), Éva Tardos (Cornell), Godfried Toussaint (McGill), Herb Wilf (Pennsylvania), and Nick Wormald (Waterloo). The plenary talks were of the highest calibre. Valerie King spoke on dynamic graph algorithms, Janos Pach on the "state of the intersection," David Sankoff on polyploidy and rearrangement phylogeny, Bruce Shepherd on single-source network flows with side constraints, Vera Sós on graph limits and the similarity of large graphs, and Xuding Zhu on the circular choosability of graphs. Bill Pulleyblank gave an entertaining lecture on the history of supercomputing and Peter Winkler an equally entertaining one on percolation, entitled "You can do physics. . . ."

To ensure critical mass in the areas covered by the plenary speakers, each plenary lecture was the focus of at least one invited minisymposium. Altogether, CanaDAM 2007 featured 19 minisymposia, covering a very broad range of topics in discrete mathematics: randomized algorithms; combinatorial geometry and graph drawing; linear and polyhedral optimization; combinatorial problems in genomics; graphs, matroids, colourings and flows; extremal combinatorics; problems at the interface of discrete mathematics and statistical physics; graph colouring; graph homomorphisms; spectral graph theory; discrete-time, deterministic graph processes and games; applications of association schemes to combinatorial problems; discrete dynamical systems over graphs; covering arrays and applications to software testing; applications of discrete mathematics to the analysis of algorithms; games on graphs; combinatorial designs; graph minors; and topological graph theory.

One of the primary goals of the conference was to encourage the participation of Canadian graduate students and PDFs. The three Canadian Mathematics Institutes (Fields, CRM and PIMS) provided $25,000 to support the graduate students and postdocs attending the conference. The graduate students were encouraged to contribute talks in order to receive financial support; furthermore, there was a problem session (followed by a reception) devoted to the presentation of research problems appropriate for graduate students. The list of these problems will appear in the *Discrete Mathematics* journal. The organizers were especially pleased that about 80 graduate students and postdocs attended the conference. Two other institutions, iCORE and MITACS, each provided $10,000 in support of the plenary speakers and graduate students.

The organizers of CanaDAM 2007 expected that 100 participants would attend the conference, but as the registrations started pouring in, they had to replace the 120-seat room initially booked as the main hall by a 250-seat lecture hall! The number of parallel sessions was increased to five, and in the end, 230 participants attended CanaDAM 2007, representing 36 Canadian universities, all 10 provinces and every continent except Antarctica. There were 51 invited minisymposia talks, 62 contributed minisymposia talks and 71 contributed talks. The strong Canadian and international attendance of CanaDAM 2007 suggests that the CanaDAM conference series is already established as one of the main international conferences on discrete and algorithmic mathematics.

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 the Fall 2006 semester, the colloquium coordinators were Marco Bertola (Concordia) and Vojkan Jakšić (McGill), and in the Winter 2007 semester, Jacques Hurtubise (McGill) and Alexander Shnirelman (Concordia).

September 8, 2006
Ken McLaughlin (UNC Chapel Hill) *Applications of an asymptotic expansion for the one-point function of random matrix theory: loop equations, partition function, large deviation principles*

September 22, 2006
Elliott Lieb (Princeton) *Quantum mechanics, the stability of matter, and quantum electrodynamics*

September 29, 2006
Joseph Kohn (Princeton) *Introduction to analysis on CR manifolds*

October 6, 2006
Michael Aizenman (Princeton) *Randomness, and its effects on spectra*

October 13, 2006
Jean-Pierre Bourguignon (IHÉS) *Comprendre la courbure*

October 20, 2006
Anatole Katok (Penn State) *Rigidity of orbit structure for actions of higher-rank abelian groups: kam-theory and algebraic k-theory*

November 3, 2006
David Ruelle (IHÉS & Rutgers) *Why is nonequilibrium statistical mechanics so hard to understand?*

November 10, 2006
Leszek F. Demkowicz (UT Austin) *hp-adaptive finite elements: a quest for exponential convergence*

November 17, 2006
Paul Tupper (McGill) *The trouble with molecular dynamics*

November 24, 2006
Jonathan Taylor (Montréal) *The integral geometry of random sets*

December 1, 2006
Richard Taylor (Harvard) *The Sato-Tate conjecture*

January 19, 2007
Dmitry Jakobson (McGill) *Eigenfunctions: limits, nodal sets and critical points*

January 26, 2007
Tadashi Tokieda (Cambridge) *Turn table, tippy tops, tapped turtles*

February 2, 2007
Yvan Saint-Aubin (Montréal) *Une courte histoire du modèle d'Ising*

February 9, 2007
Jack Edmonds (Waterloo) *Second Hamiltonian paths and Nash equilibria*

February 23, 2007
Philippe Di Francesco (CEA Saclay) *Integrable combinatorics*

March 2, 2007
Catherine Sulem (Toronto) *Water waves over a varying bottom*

March 9, 2007
Tomasz Mrowka (MIT) *What do we know about four-dimensional manifolds?*

March 16, 2007
Michael Brenner (Harvard) *Mathematical issues and opportunities in self assembly*

March 23, 2007
Ed Stredulinsky (UW Rock County) *Extreme heating of the sun's atmosphere and the topology of magnetic field lines*

March 30, 2007
Tamar Ziegler (Michigan) *Polynomial progressions in primes*

April 13, 2007
Stephen Kudla (Toronto) *Representation densities and arithmetic geometry*

April 20, 2007
Steven Kleiman (MIT) *Equisingularity, multiplicity, and dependence*

April 27, 2007
Yuri Manin (MPIM) *Counting rational points and rational curves: from Waring's problem to quantum cohomology*

May 4, 2007
Jean-Pierre Demailly (Grenoble 1) *New analytic techniques in algebraic geometry*

CRM – ISM – GERAD Statistics Colloquium

In 2006 – 2007, the coordinators of the CRM – ISM – GERAD Statistics Colloquium were Arusharka Sen (Concordia), Pierre Duchesne (Montréal), Christian Léger (Montréal), Brenda MacGibbon (UQÀM), and Russell Steele (McGill).

September 22, 2006
Siva Athreya (ISI Bangalore) *Some remarks on age dependent branching and super processes*

October 6, 2006
Erica Moodie (McGill) *Introduction to optimal dynamic treatment regimes*

October 13, 2006
Andrew Heunis (Waterloo) *A problem on multiple time-scales in perturbed stochastic differential equations*

October 20, 2006
Yali Amit (Chicago) *Statistical models for object recognition*

October 27, 2006
Jean-François Quessy (UQTR) *Comportement asymptotique local de tests pour l'indépendance*

November 3, 2006
Paul Gustafson (UBC) *On identifiability and prior information*

November 10, 2006
Marc Hallin (Université Libre de Bruxelles) *The general dynamic factor model: selecting the number of factors*

November 17, 2006
Sarat Dass (Michigan State) *Markov models for directional field and singularity extraction in fingerprint images*

November 24, 2006
Charmaine Dean (Simon Fraser) *Mixed nonhomogeneous Poisson process spline models for the analysis of recurrent event panel data*

December 1, 2006
Werner Stuetzle (Washington) *Estimating the cluster tree of a density*

January 12, 2007
Jeffrey S. Rosenthal (Toronto) *Les marches aléatoires et les algorithmes MCMC*

February 2, 2007
Jeffrey Morris (M.D. Anderson Cancer Research Center) *Bayesian wavelet-based mixed models for functional data*

February 9, 2007
Anthony Brockwell (Carnegie Mellon) *Brain-machine interfacing: direct mental control of a robotic arm*

February 16, 2007
Raphael Gottardo (UBC) *A flexible and powerful Bayesian hierarchical model for ChIP-chip data*

February 23, 2007
Hugh A. Chipman (Acadia) *Monitoring functional data mixed effects and high-dimensional clustering*

March 9, 2007
Christian Francq (Lille 3) *Estimating and testing GARCH processes when the parameter is on a boundary*

March 16, 2007
David O. Siegmund (Stanford) *Do complex statistical methods help in mapping and quantitative traits?*

March 23, 2007
Aurélie Labbe (Laval) *Latent class models for pedigree data*

March 30, 2007
Yong Zeng (Missouri-Kansas City) *Filtering with marked point process observations: applications to ultra-high frequency data*

April 13, 2007
Kjell Doksum (UW Madison & UC Berkeley) *Dimension reduction and tuning parameter selection in nonparametric regression*

April 20, 2007
Brad Carlin (Minnesota) *Bayesian areal wombling for geographical boundary analysis*

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 Program on Complex Data Structures (NPCDS). *The reports are presented in the language in which they were submitted.*

Activities of the Multidisciplinary and Industrial Program

XXIIIrd International Biometrics Conference

July 16-21, 2006, McGill University
Organized by the National Research Council of Canada

Organizer: James A. Hanley (McGill)
Number of participants: 750

The International Biometrics Conference is held every two years and brings together researchers who measure and analyze (through statistical means) biological, biomedical, environmental, agricultural and ecological information. The 2006 conference featured 14 invited sessions, 70 contributed sessions and 3 poster sessions. The CRM contributed to this conference by defraying some of the costs of Canadian mathematicians attending the conference.

41st Actuarial Research Conference

August 10 – 12, 2006, CRM

Sponsors: Research and Education Committee of the Actuarial Foundation, American Academy of Actuaries, American Society of Pension Professionals & Actuaries, Canadian Institute of Actuaries, Casualty Actuarial Society, Colegio Nacional de Actuarios (Mexico), Conference of Consulting Actuaries, Society of Actuaries, Département de mathématiques et de statistique of the Université de Montréal and CRM
Organizing committee: Louis G. Doray (Montréal), Chair, Charles Dugas (Montréal), Manuel Morales (Montréal)
Scientific committee: Louis G. Doray (Montréal), José Garrido (Concordia)
Speakers: Doug Andrews (Waterloo), Jean-François Angers (Montréal), Alexandru Asimit (Western Ontario), Enrico Biffis (City University, London), Jose Blanchet (Harvard), Mathieu Boudreault (HÉC Montréal), Phelim P. Boyle (Wilfrid Laurier), James Bridgeman (Connecticut), Kai Chen (Waterloo), Corina Constantinescu (Oregon State), Steven Craighead (Towers Perrin), Victor De la Pena (Columbia), Alain Desgagné (UQÀM), Maikol Alejandra Diasparra Ramos (Carlos III de Madrid), Matthieu Dufour (UQÀM), Daniel Dufresne (Melbourne), Tom Edwalds (Munich American Reassurance Company), Karl-Theodor Eisele (Strasbourg 1), Carolina Espinosa (Heriot-Watt), Tingfing Fan (Waterloo), Runhuan Feng (Waterloo), Esteban Flores (Instituto Tecnológico Autónomo de México), Keith Freeland (Waterloo), Edward Furman (Haifa), Jinadasa Gamage (Illinois State), Denise Gómez Hernandez (City University, London), Vincent Goulet (Laval), Wenjing Guo (Waterloo), John B. Henry (Oregon State), Mary Hardy (Waterloo), Michel Jacques (Laval), Marwa Khalafallah (City University, London), Hyun Tae Kim (Waterloo), Ohoe Kim (Towson), Johnny Siu-Hang Li (Waterloo), Lily Yunsui Li (Waterloo), Zhongfei Li (Waterloo), Jed Linfield (Kaiser Permanente), Yang Liu (Waterloo), Yi Lu (Simon Fraser), Natalia Lysenko (Simon Fraser), Jean-Louis Massé (International Actuarial Association), Jorge Munoz Perez (ING Mexico), Claude Pichet (UQÀM), Ke Qiu (Waterloo), Sudath Ranasinghe (Connecticut), Mark Reesor (Western Ontario), Jiandong Ren (Western Ontario), Jean-François Renaud (Montréal), Gurbakhshash Singh (Simon Fraser), Jiafeng Sun (UW Madison), Ranee Thiagarajah (Illinois State), Matthew Till (Waterloo), Cary Chi-Liang Tsai (Simon Fraser), Barry Turner (McGill), Emiliano Valdez (New South Wales), Frank Xuyan Wang (Waterloo), Chengguo Weng (Waterloo), Jun Zhou (Concordia), Xiaowen Zhou (Concordia), Yanyun Judy Zhu (Illinois at Urbana-Champaign)
Number of participants: 126

The CRM hosted the 41st Actuarial Research Conference from August 10 to 12, 2006. This annual conference is sponsored by the Society of Actuaries and the Casualty Actuarial Society. This year, the ARC brought together, at the Université de Montréal, nearly 130 participants from 10 countries on 4 continents. Most of them were professors of actuarial mathematics from various universities, while the others came from industry or public institutions. Within 10 sessions spanning two and a half days, about 60 speakers presented the results of their research on risk models, health insurance, finance, life insurance, mortality, pensions, option pricing, and statistical models in insurance. The ARC 2006 conference was followed by a 2-hour workshop sponsored by the Canadian Institute of Actuaries, in

which the participants discussed a proposal for a new model of actuarial education in Canada.

The Conference led to the creation of the Montréal Seminar in Actuarial and Financial Mathematics. In 2006 – 2007, this new seminar featured 14 talks, held in one of the three Montréal universities offering an actuarial program (Université de Montréal, Concordia and UQÀM). The organizers of this seminar in 2006 – 2007 were Louis Doray and José Garrido.

4th RECOMB Comparative Genomics Satellite Workshop

September 24 – 26, 2006, Montréal
Sponsored by the CRM and the Centre Robert-Cedergren, Université de Montréal

Organizers: Guillaume Bourque (National University of Singapore), Nadia El-Mabrouk (Montréal)
Invited speakers: Lars Feuk (The Hospital for Sick Children, Toronto), Jennifer Gardy (UBC), Thomas J. Hudson (Montreal General Hospital), Tao Jiang (UC Riverside), Liqing Zhang (Virginia Tech)
Number of participants: 83

Le programme de cet atelier a comporté cinq présentations plénières de conférenciers invités renommés, ainsi que des présentations d'articles scientifiques. Les conférences plénières ont été prononcées par Lars Feuk, Jennifer Gardy, Thomas Hudson, Tao Jiang et Liqing Zhang. D'autre part, les articles scientifiques ont été sélectionnés par un comité de programme comprenant une vingtaine de chercheurs en biologie, mathématiques et informatique du monde entier. Cette année, le comité de programme a reçu 34 soumissions d'articles, parmi lesquels 17 ont été sélectionnés ; c'était la première fois qu'autant d'articles étaient soumis, et les présentations choisies furent particulièrement bonnes.

Comme pour les ateliers précédents, les comptes rendus de cet atelier ont été publiés dans la série *Lecture Notes in Bioinformatics*, sous-série de *Lecture Notes in Computer Science* (publiée par Springer). De plus, pour la première fois, les versions longues des articles sélectionnés ont été publiées dans un numéro spécial de la revue *Journal of Computational Biology*.

L'atelier a eu lieu à l'Hôtel de l'Institut de tourisme et d'hôtellerie du Québec. La salle était parfaitement adaptée à un public de 80 personnes. De plus, les repas du midi étaient servis sur place, ce qui permettait à tous les participants de rester ensemble pour échanger des idées. En effet, l'un des avantages majeurs d'un tel atelier spécialisé est le fait que les participants travaillent sur des sujets connexes. Par conséquent, même s'ils ne se connaissaient pas avant l'atelier, les échanges scientifiques sont très fructueux et aboutissent généralement à des collaborations.

Pour ce qui est du public, la participation des étudiants a été remarquable cette année. Les inscriptions des étudiants constituaient 60% des inscriptions. L'une des raisons en est la séance d'affiches, qui a attiré plusieurs étudiants montréalais et ontariens. De plus, les différentes universités montréalaises (Université de Montréal, UQÀM, McGill et Concordia) étaient bien représentées. Il est incontestable que l'organisation de cet atelier à Montréal a favorisé les collaborations entre les professeurs et étudiants de ces différentes universités. À titre d'exemple, Nadia El-Mabrouk a été invitée par le professeur Donal Hickey de l'Université Concordia à faire partie du comité de doctorat d'un de ses étudiants. Mathieu Blanchette, de l'Université McGill, a également accepté de co-diriger l'un des étudiants de doctorat de Nadia El-Mabrouk.

NBER/NSF Time Series Conference 2006

September 29 – 30, 2006, Montréal
Organized by the CRM and CIREQ (Centre interuniversitaire de recherche en économie quantitative)
Financed in part by the National Science Foundation (NSF) and the National Bureau of Economic Research (NBER)

Organizer: Roch Roy (Montréal)
Speakers: Donald Andrews (Yale), Christian Bontemps (Toulouse 1), Marine Carrasco (Montréal, CIREQ, CIRANO), Kung-Sik Chan (Iowa), Miguel A. Delgado (Carlos III de Madrid), David Dickey (North Carolina State), Francis X. Diebold (Pennsylvania & NBER), Rainer Dahlhaus (Heidelberg), Jean-Marie Dufour (Montréal, CIREQ and CIRANO), Robert Engle (New York), David Findley (U.S. Census Bureau), Nikolay Gospodinov (Concordia & CIREQ), Stéphane Grégoire (CREST-INSEE), Clifford Hurvich (New York), Ivana Komunjer (UC San Diego), Alexei Onatski (Columbia), Benedikt Pötscher (Wien), Suhasini Subba Rao (Bristol), Neil Shephard (Oxford), Mark Watson (Princeton)
Number of participants: 128

Cette série de congrès sur les séries chronologiques a commencé dans les années 1970 sous l'impulsion d'Arnold Zellner de l'Université de Chicago, un des chercheurs les plus éminents en économétrie. L'objectif premier de ces congrès était d'amener les statisticiens et les éco-

nomètres qui s'intéressent aux séries chronologiques à partager leurs expériences de recherche afin d'améliorer la compréhension et la prévision des phénomènes économiques. Le premier congrès ayant connu un grand succès, la série s'est poursuivie avec un congrès chaque année. Jusqu'au début des années 1990, George Tiao, également de l'Université de Chicago, fut le responsable principal de la composante statistique de ces congrès.

En 2006, le congrès eut lieu pour la première fois à Montréal ; c'était aussi la première fois qu'il avait lieu au Canada. Le fonctionnement de ce congrès est assez différent de celui de la plupart des congrès de mathématiques ou de statistique. Les conférenciers ne sont pas contactés directement, mais une invitation à soumettre une proposition est lancée aux chercheurs potentiellement intéressés et le comité du programme choisit les conférenciers invités en se basant sur les propositions soumises. En 2006, le comité du programme était composé de Russell Davidson (McGill), Richard Davis (Colorado State), Jean-Marie Dufour (Montréal), Nour Meddahi (Montréal), Roch Roy (Montréal), James Stock (Harvard & NBER) et Ruey Tsay (Chicago).

Cent quatre propositions de conférences (un nombre record !) ont été soumises. De ces 104 propositions, 20 ont été retenues pour des présentations orales et 20 pour des affiches. Comme le veut la tradition de ce congrès, le comité du programme s'est assuré d'une part que des chercheurs établis et des jeunes chercheurs figuraient au programme des présentations orales, et d'autre part que la répartition des présentations entre statisticiens et économètres était équilibrée. Les conférences invitées ont été réparties en six sessions, soit deux sessions le vendredi après-midi et quatre sessions le samedi. Les affiches ont été réparties en deux sessions, une session le vendredi après-midi et l'autre le samedi.

Parmi les conférenciers, Chan, Dahlhaus, Delgado, Dickey, Findley et Pötscher sont des statisticiens très connus dans le domaine des séries chronologiques. Subba Rao est une statisticienne junior. Andrews, Diebold, Dufour, Engle et Watson sont des sommités en économétrie. Engle a été le co-récipiendaire du prix Nobel d'économie en 2003 et Andrews a été de loin l'économètre le plus prolifique des années 1990 (le Peter Hall de l'économétrie !).

Au total, 128 personnes se sont inscrites à ce congrès : environ 60 venaient du Canada (dont près de 50 de la région de Montréal), environ 50 des États-Unis, et les autres de l'Allemagne, l'Autriche, l'Espagne, la France, la Grèce, Israël, le Nigéria et le Royaume-Uni. Étant donné la forte participation de la communauté montréalaise et le haut niveau des conférenciers invités, les organisateurs sont convaincus que ce congrès aura des retombées à moyen et à long terme.

Launch of the Transdisciplinary Institute for Quantum Information (INTRIQ)

November 9, 2006, CRM

Organizer: Gilles Brassard (Montréal)
Speakers: Charles H. Bennett (IBM Research), Chip Elliott (BBN Technologies), Michele Mosca (Waterloo), Barry Sanders (Calgary), John Watrous (Waterloo)
Number of participants: 30

The launch of the Transdisciplinary Institute for Quantum Information (INTRIQ) took place at the CRM on Thursday November 9, 2006. Quantum information is an emerging field of research, at the crossroads of mathematics, physics, computer science and chemistry. It could bring a fundamental revolution, not only in our way of processing information, but also in our way of understanding the world. Ever since the fundamental work of Claude Shannon and Alan Turing during the first half of the 20th century, information theory has been anchored in a classical conception of the physical world inherited from Newton and Einstein. This conception has prevented scientists from exploiting the full potential of the physical world for the processing of information, since actually the world is governed by the laws of quantum mechanics. These laws are quite different from those of classical physics. For instance, quantum mechanics teaches us that elementary particles do not behave like macroscopic objects such as planets and hockey pucks. What influence could this reality have on our way of processing information? Several laboratories have been established worldwide to investigate this avenue of research; the members of INTRIQ are among the pioneers of this extraordinary scientific adventure.

The launch started with welcoming remarks by Gilles Brassard, who holds a CRC in Quantum Information Processing in the Department of computer science and operations research of the Université de Montréal and is director of INTRIQ, and Francois Lalonde, director of the CRM. These remarks were followed by five talks on different aspects of quantum information: Barry Sanders lectured on *Implementing quantum information*, Michele Mosca on *Self-testing of quantum circuits*, Chip Elliott on *Architectures for quantum networks*, John Watrous on *Zero-*

knowledge against quantum attacks, and Charles H. Bennett on *Privacy, publicity, and permanence of information*. The day ended with the first plenary meeting of INTRIQ members, and a reception not to be forgotten soon!

Principles of magnetoencephalography, methods and tools for data analysis

November 22 – 23, 2006, CRM
Organized by the Centre de recherche en neuropsychologie et cognition (CERNEC) of the Université de Montréal

Organizers: Anne-Sophie Dubarry (Montréal), Stephan Grimault (Montréal)
Speakers: Anne-Sophie Dubarry (Montréal), Stephan Grimault (Montréal), Christophe Grova (Montréal), Kevin Sauvé (Montréal)
Number of participants: 36

Les neurosciences connaissent un développement considérable quant aux outils de mesure et de visualisation de l'activité cérébrale. La diversité de ces outils (IRM, EEG, MEG, NIRS) tient aux nombreux principes (magnétisme nucléaire, bioélectricité, magnétisme et diffusion optique) qui permettent ces mesures, directes ou indirectes, de l'activité neuronale. Parmi ces techniques, la magnétoencéphalographie (MEG) consiste à mesurer le champ magnétique externe créé par l'activité du cerveau. En se dotant du plus récent équipement de ce genre, le CERNEC (centre de recherche du Département de psychologie de l'Université de Montréal) offre aux chercheurs en neurosciences un appareil unique qui complète la panoplie des outils déjà disponibles dans les différents centres de recherche ou centres hospitaliers de Montréal.

Le CRM s'est associé au CERNEC pour offrir un atelier portant sur les aspects théoriques et pratiques de la MEG. Destiné principalement aux usagers des neurosciences, cet atelier a présenté les principes de base de la magnétoencéphalographie ainsi que les outils logiciels pour le traitement et l'analyse des signaux ainsi mesurés. La seconde partie de l'atelier, plus orientée vers les mathématiques appliquées, concernait l'analyse de la localisation des sources d'activité cérébrale grâce à une approche distribuée.

L'atelier était donc constitué de deux parties : une partie théorique qui dura une demi-journée et une partie pratique qui dura trois demi-journées. La partie théorique consista de quatre présentations d'une heure portant sur les principes de la magnétoencéphalographie et les méthodes d'analyse des données. Voici les titres et les auteurs de ces présentations.

1. *MEG, What is it, what can it see* (Kevin Sauvé)
2. *Acquisition MEG* (Anne-Sophie Dubarry)
3. *Basic data processings and time-frequency analysis* (Stephan Grimault)
4. *Introduction to EEG/MEG source localization* (Christophe Grova)

Pour la partie pratique, les organisateurs ont formé 3 groupes d'environ 10 participants chacun. Chaque participant disposait d'un ordinateur pour effectuer différents traitements sur un enregistrement MEG-EEG. Les outils de traitement de signal MEG-EEG avaient été installés au préalable, et un jeu de données avait été copié sur le serveur. Chaque utilisateur accédait aux outils et aux données grâce à un compte personnel dans un environnement Linux. Un document décrivant les différentes étapes à suivre pour le traitement avait été fourni aux participants et une version électronique était disponible sur le serveur. Durant cette session, les organisateurs ont d'abord présenté oralement la démarche à suivre, puis ont suivi pas à pas tous les participants durant la réalisation des différentes étapes.

Thoughts about integer programming DIRO – CRM – ncm_2 public lecture by Ralph Gomory

January 26, 2007, CRM
Sponsored by the Département d'informatique et de recherche opérationnelle (DIRO) of the Université de Montréal, the CRM and the ncm_2

Le vendredi 26 janvier 2007, M. Ralph E. Gomory a prononcé une grande conférence intitulée *Thoughts About Integer Programming*, dans laquelle il a parlé des méthodes de plans de coupes et de leurs relations avec les « corner polyhedra » et les fonctions sous-additives. En se servant de ce cadre théorique, il a montré comment construire une nouvelle famille de coupes utilisant l'information de plusieurs équations à la fois, contrairement aux coupes de Gomory classiques, qui sont basées sur une seule équation.

Cette grande conférence soulignait le semestre thématique en optimisation combinatoire, organisé par le Centre de recherches mathématiques (CRM) ; elle soulignait aussi le 40^{e} anniversaire du Département d'informatique et de recherche opérationnelle (DIRO). S'associait également à l'évènement le Réseau de calcul et de modélisation mathématique (rcm_2), auquel sont affiliés deux centres de réputation internationale en recherche opérationnelle, le Centre interuniversitaire de recherche sur les réseaux d'entreprise, la logistique et le transport (CIRRELT) et le Groupe d'études et de recherche

en analyse des décisions (GERAD). Immédiatement avant la conférence, le prix Harold Larnder 2006 de la Société canadienne de recherche opérationnelle (SCRO) a été attribué à M. Gomory. Ce prix est décerné annuellement par la SCRO à une personne qui s'est distinguée à l'échelle internationale par ses réalisations dans le domaine de la recherche opérationnelle. La conférence a été un franc succès et a attiré plus de 100 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 Aisenstadt Prize awarded to rising young Canadian stars, selected by the CRM's Scientific Advisory Committee. The CRM has invested enormously in time, effort and in its own resources, to propel leading Canadian scientists into the spotlight, giving them international recognition when they most need it.

CRM – Fields – PIMS Prize 2007 and CAP – CRM Prize 2007 awarded to Joel S. Feldman

The CRM – Fields – PIMS Prize for 2007 was awarded to Professor Joel S. Feldman (University of British Columbia) in recognition of his exceptional achievement and work in mathematical physics. Professor Feldman has risen to a position of international prominence in the world of mathematical physics, with a 30-year record of sustained output of the highest calibre. He has made important contributions to quantum field theory, many-body theory, Schrödinger operator theory, and the theory of infinite genus Riemann surfaces. Many of Professor Feldman's recent results on quantum many-body systems at positive densities and on Fermi liquids and superconductivity have been ranked as some of the best research in mathematical physics in the last decade.

Professor Feldman received his B.Sc. from the University of Toronto in 1970, and his A.M. and Ph.D. from Harvard University in 1971 and 1974, respectively. He worked as a Research Fellow at Harvard University from 1974 to 1975, and was a C.L.E. Moore Instructor at the Massachusetts Institute of Technology (MIT) from 1975 to 1977. Since 1977, he has taught at the University of British Columbia, where he is currently a full professor. Professor Feldman was an invited speaker at the International Congress of Mathematicians in Kyoto in 1990. He was a plenary speaker at the XIIth International Congress on Mathematical Physics in Brisbane in 1997, and an invited speaker at the XIVth International Congress on Mathematical Physics in Lisbon in 2003. He is a fellow of the Royal Society of Canada, and has been awarded the 1996 John L. Synge award and the CRM Aisenstadt Chair lectureship in 1999/2000, as well as the 2004 Jeffery-Williams Prize by the Canadian Mathematical Society for outstanding contributions to mathematical research.

A detailed description of the contributions of Professor Feldman to mathematics may be found in Le Bulletin du CRM (Spring 2007), at the address `crm.math.ca/rapports/bulletin/bulletin13-1.pdf`. Finally, Joel S. Feldman was also awarded the CAP – CRM Prize 2007 (see below for a description of this prize).

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), and Nicole Tomczak-Jaegermann (2006).

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 C. Myers (2005), and John Harnad (2006).

André-Aisenstadt Prize 2007 awarded jointly to Alexander E. Holroyd and Gregory G. Smith

Alexander E. Holroyd was educated at the University of Cambridge, where he obtained his Ph.D. in mathematics in 2000 under the supervision of Geoffrey Grimmett. Subsequently he became a Hedrick Assistant Professor at UCLA, then a Postdoctoral Fellow at the University of California at Berkeley. Since 2002 he has been at the University of British Columbia, where he is now Associate Professor. In 2004, he was awarded the Rollo Davidson Prize, an annual international prize for young probabilists.

Dr. Holroyd is an outstanding young probabilist, with broad research interests. His work is focused on discrete spatial models, including cellular automata, percolation, matching, traffic models, and sorting networks. Despite his youth he is already a major figure in this multi-disciplinary area. One of his most striking achievements is the determination of the exact threshold for bootstrap percolation, an important example of a cellular automata.

A detailed description of the contributions of Alexander E. Holroyd may be found in Le Bulletin du CRM (Spring 2007), at the address `crm.math.ca/rapports/bulletin/bulletin13-1.pdf`.

Gregory G. Smith was a mathematical physics undergraduate at Queen's University, obtaining an M.A. at Brandeis University, and receiving his Ph.D. in 2004 at Berkeley under the supervision of David Eisenbud. For the next three years he was a postdoctoral fellow at Barnard College of Columbia University, before returning to Canada to accept a tenure-track position at Queen's.

Dr. Smith has already made significant contributions in Algebraic Geometry and Commutative Algebra. His joint work with L. Chen and L.A. Borisov, in which toric Deligne–Mumford stacks are introduced and their orbifold cohomology calculated, has already been used to resolve a long-standing conjecture of Hibi on reflexive polytopes. Along with D. Maclaghan, Dr. Smith has proposed and explored the notion of Castelnuovo–Mumford regularity in the multigraded context. Their subtle approach generalizes and extends tentative approaches of others in specialized cases, and sets the stage for future advances.

Dr. Smith's clarity as a teacher and enthusiasm as an expositor have made him a regularly invited speaker at conferences and workshops around the world.

A detailed description of the contributions of Gregory G. Smith may be found in Le Bulletin du CRM (Fall 2007), at the address `crm.math.ca/rapports/bulletin/bulletin13-2.pdf`.

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 CRM's advisory committee. 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) and Tai-Peng Tsai (2006).

CRM – SSC Prize 2007 awarded to Dr. Richard Cook

Richard Cook, Professor in the Department of Statistics and Actuarial Science of the University of Waterloo, is the 2007 winner of the CRM-SSC prize. Dr. Cook's work in longitudinal and lifetime data analysis has had immense impact on biostatistics, medicine and public health. Within 15 years of his Ph.D., Richard Cook has made outstanding contributions to an impressive number of statistical research fields covering the design of clinical trials, hierarchical models, robust inference, and the analysis of survival, multi-state, and recurrent event data. He has made ingenious contributions to the analysis of multi-state models and the joint analysis of multiple events. His joint work with Jerry Lawless has helped set current frameworks used in the analysis of recurrent events, and their jointly authored book *The Statistical Analysis of Recurrent Events* has been published in 2007.

Richard Cook's work is solidly grounded in important problems in public health and clinical trials and he has substantially raised the level of statistical expertise in the Canadian and international medical community through his important methodological advances in these fields. He has made exceptional contributions to the medical community and is a leading expert in the application of statistics to rheumatology, cardiovascular disease, oncology, clinical trials and transfusion medicine. He has also provided great leadership through service on several medical advisory panels and medical research grant selection committees.

Professor Cook was a Scholar of the (former) Medical Research Council of Canada from 1996 to 2000. He also held an Investigator Award of the Canadian Institutes of Health Research from 2000 to 2005 and a Premier's Research Excellence Award from the Ontario Ministry of Energy, Science and Technology and GlaxoSmithKline from 1999 to 2004. That the medical community has awarded him several major awards to develop new theory in his areas of expertise is evidence of the great respect in which this community holds him. Richard Cook is gifted with great insight and a passion for closely knit collaborative work, one that truly embodies the sorts of interdisciplinary connections forming the cornerstone of rapid advances in medical and biostatistical research.

Richard Cook obtained his B.Sc. in Statistics from McMaster University and his M.Math., in 1989, and Ph.D., in 1993, from the University of Waterloo. He was appointed a Research Assistant Professor in Statistics in 1993 at the University of Waterloo. He currently holds adjunct appointments in the Department of Health Studies and Gerontology of the University of Waterloo and the Faculty of Health Sciences of McMaster University. In 1998, he became an Associate Professor and then, in 2003, a Full Professor. He was awarded a Tier I Canada Research Chair in Statistical Methods for Health Research at the University of Waterloo in 2005. Professor Cook has served as Associate editor of the *Canadian Journal of Statistics* and *Lifetime Data Analysis* and as President of the Biostatistics Section of the SSC. Professor Cook has also made important contributions to training by supervising four postdoctoral fellows, six doctoral students and thirteen Master's students.

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 Centre de recherches mathématiques (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.

Richard Cook is the ninth 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) and Jeffrey Rosenthal (2006).

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. Les *Grandes Conférences du CRM* are now well established and there were three lectures geared towards a general audience in 2006 – 2007. The first lecture was given by Bart de Smit and entitled *The mathematics of Escher's Print Gallery*; it was held in the Stewart Biology Building of McGill University on November 15, 2006.

During the winter term of 2007, the two lectures were held at the Université du Québec à Montréal. The first of these, entitled *Les limites logiques et mathématiques*, was given by Jean-Paul Delahaye on March 19, 2007. The program of the *Grandes Conférences* for 2006 – 2007 concluded on May 3 with a lecture by Francis Clarke entitled *Euler, la vie, l'univers, l'optimisation*, to celebrate the 300th anniversary of the birth of the great mathematician. Each of the lectures attracted between 150 and 200 people of all ages, and was followed by a "vin d'honneur" that enabled the participants to ask questions to the lecturers, reconnect with friends and colleagues, and meet people interested in mathematics and science in general.

In 2006 – 2007, 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. The following description of the mathematical contents of the lectures is due to Christiane Rousseau.

The Mathematics of Escher's Print Gallery
Bart de Smit, Universiteit Leiden

Many among us are fascinated by Escher's work, and this fascination owes a lot to the mathematical aspects of his work, in spite of the fact that Escher did not have any mathematical training. One of Escher's engravings, *Print Gallery*, has intrigued mathematicians because the artist was unable to complete it. The children always have fun looking at the cover of *The Laughing Cow* cheese: on the cow's earring, one sees a cow with an earring, on which is pictured another cow, and so on. Escher's starting point is an etching of this type: a man looks at a painting in a gallery, which represents a man looking at a painting, etc. As in the case of *The Laughing Cow*, if one zooms correctly within this etching, one recognizes the same picture. In mathematical terms, if a point (x, y) within the picture is represented by the complex number $z = x + iy$, the picture is said to be invariant under the transformation $z \mapsto Cz$, where C is a constant.

In the case of Escher's original etching, the constant C is a positive real number smaller than 1. In the case of *The Laughing Cow*, the constant C has a nonzero argument defining the rotation needed to recognize the basic picture after the zoom. So far there is no surprise. Escher, however, applies a transformation to his original etching, so that in order to recover the basic picture, we tumble down an infinite spiral! Escher drew the beginning of the spiral but did not complete it. Two specialists of the theory of numbers, Hendrik Lenstra and Bart de Smit, showed how to complete the etching. The necessary transformations are analytic functions of a complex variable and are therefore angle-preserving. If we apply the transformation $z \mapsto Z = \ln z$ to the initial picture, which is invariant under $z \mapsto Cz$, then the transformed picture is invariant under the translation $Z \mapsto Z + \ln C$. Since $Z = \ln z$ is already a multi-form transformation of period $2\pi i$ the transformed picture yields a doubly periodic tiling of the plane.

One can wrap the plane into a cylinder whose circumference is the segment $[0, 2\pi i]$; the picture is then repeated infinitely often on small slices of the cylinder. But one can also wrap the plane with a slant so as to obtain pictures repeated infinitely often on spirals. This "wrapping" amounts to considering the transformation $Z \mapsto \alpha Z$, where the complex number α is chosen so that the picture be periodic of period $2\pi i$. One then uses the reciprocal of the complex logarithm function, and the problem is settled: the hole in Escher's engraving is no more! Although the ideas involved can be explained through mathematical formulas, they can be conveyed in a different manner to a general audience. In his lecture, Bart de Smit explained those ideas without using formulas, but the mathematicians present recognized the mathematical concepts underlying this remarkable lecture, which also included graphical animations of a very high calibre.

Les limites logiques et mathématiques
Jean-Paul Delahaye, Université Lille 1

Jean-Paul Delahaye is a French mathematician who publishes a monthly column in *Pour la Science*, the French equivalent of the *Scientific American*, and has published several books on mathematical topics, including the prime numbers, the number π and the mathematical foundations of computer science. Jean-Paul Delahaye is a master of popularization and a large audience went to UQÀM to hear him talk on the limits of logic and mathematics. Although Jean-Paul Delahaye is a professor of computer science at the Laboratoire d'Informatique Fondamentale de Lille, he considers himself to be a mathematician. In his lecture, he surveyed the important questions in mathematical logic, which held the mathematicians and computer scientists of the 20th century in thrall. After the paradoxes of logic were discovered at the beginning of the 20th century, the mathematicians felt that it was necessary to build solid foundations for mathematics and mathematical logic became a full-fledged branch of mathematics.

Researchers don't always find what they are looking for, however. Mathematicians were astounded when Kurt Gödel proved the famous theorem stating that Peano arithmetic is incomplete, which means that some true statements about integers cannot be proved within the confines of a formal system! One could say that Gödel himself was astounded… The 20th century also witnessed the birth of theoretical computer science, to which the mathematician Alan Turing made a fundamental contribution. Indeed, Turing gave a formal definition of the concept of "computable function": a function is said to be *computable* if and only if it can be computed by a relatively simple automaton known as a Turing machine. For mathematicians and computer scientists, Turing's definition still captures the notion of computability.

Jean-Paul Delahaye also surveyed some important problems of computer science whose solutions are a source of awe. One of these is Turing's *halting problem*: given a computer program, is it possible to predict whether it will halt eventually or be caught in an infinite loop? Naturally, to answer this question, it would be highly desirable to use a program able to determine whether any given program halts or not. Unfortunately, Turing proved that such a program could not exist; in the parlance of theoretical computer science, the halting problem is undecidable.

Euler, la vie, l'univers, l'optimisation
Francis Clarke, Université Lyon 1

Francis Clarke, a Montrealer by birth, was director of the CRM from 1984 until 1993. He transformed the CRM into a national institute financed by NSERC and FCAR (as the Québec granting agency was then called). He also founded the Institut des Sciences Mathématiques, a consortium of Québec universities that coordinates graduate studies in mathematics in the province. The organizers of the *Grandes Conférences* had asked Francis Clarke to give a lecture on Euler, to celebrate the 300th anniversary of the birth of the famous mathematician. Born on April 15, 1707, Leonhard Euler is one of the most prolific mathematicians of all times and the mathematical star of the 18th century. His contributions cover a very broad spectrum of mathematics, from number theory to differential equations, geometry, optics and astronomy. Euler was the first scientist to formulate one of the most profound scientific notions, the principle of least (or stationary) action, which enables us to describe natural phenomena in terms of optimization.

Francis Clarke rose to the challenge and gave a vivid portrait of Euler and his life. He also put Euler's contributions in a historical perspective by comparing them to the contributions of his contemporaries (Maupertuis, Lagrange, etc.). The lecturer explained the scientific and mathematical notions in simple language and his examples illustrated the genesis of the great ideas that have revolutionized science. Francis Clarke discussed the famous example of the Lagrange column: among all the columns of revolution of given height and volume, which one will offer the greatest resistance when crushed by a weight? For a long time, people believed (falsely) that it must be the cylindrical column. Indeed, people believed that the best column was smooth, but actually it contains angles. Nowadays mathematicians know that many optimization and control problems

have nonsmooth or even discontinuous solutions. Francis Clarke illustrated this fact in a modern setting by describing a fisheries model for which the best solution is a discontinous control.

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 with 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 were also involved in other initiatives, such as the CRM – Fields Prize awarded in recognition of outstanding accomplishments in the mathematical sciences in Canada. It was created in 1994 and in 2006 became the CRM – Fields – PIMS Prize. The administrative responsibility for this prize rotates between the three institutes.

International and National Collaborations

In 2006 – 2007, the CRM collaborated with or received financial assistance from the following institutions: INSERM, Paris; INRIA; the ALGANT program; the Banff International Research Station (BIRS); the Universidad de La Habana, Cuba; and the Groupe d'études et de recherche en analyse des décisions (GERAD).

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 and Lecture Notes Series. Two CRM series, in statistics and in mathematical physics, are published by Springer. The CRM has exchange agreements with the Fields Institute, PIMS, MSRI, the Institute for Mathematics and its Applications (IMA), École Normale Supérieure, the Isaac Newton Institute, the Institut des Hautes Études Scientifiques (IHÉS), 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 Scientific Advisory Committee. The CRM also supports 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 was conceived by the three Canadian mathematical sciences institutes. They envisioned a pan-Canadian network of projects each using sophisticated mathematical tools for modelling industrial problems in key sectors of the Canadian economy. 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. The network initiates and fosters linkages with industrial, governmental, and not-for-profit organizations that require mathematical technologies to deal with problems of strategic importance to Canada. MITACS is driving the recruiting, training, and

placement of a new generation of personnel with highly mathematical skills that is vital to Canada's future social and economic well-being.

MITACS creates links between academia, industry and the public sector to develop cutting edge mathematical tools vital to a knowledge-based economy. The only Network of Centres of Excellence (NCE) for the mathematical sciences, MITACS currently has 305 scientists, 611 students and 169 partner organizations working on 32 ongoing projects, involving 48 Canadian universities. To improve Canada's international competitiveness, MITACS research focuses on five key sectors of the economy:

- biomedical and health;
- environment and natural resources;
- information processing;
- risk and finance;
- communication, networks and security.

MITACS Inc. is a federally incorporated not-for-profit society formed to administer the MITACS Network of Centres of Excellence.

MITACS also gives financial support to some events organized by the CRM and other institutions. For instance, in 2006 – 2007, it gave support to three workshops or conferences partially sponsored by the CRM: the 6th Annual MOPTA Conference and CanaDAM 2007 (whose reports are included in the section on the CRM general program), and the Workshop on Data Mining and Mathematical Programming (whose report is included in the section on the CRM thematic program).

National Program on Complex Data Structures (NPCDS)

This initiative was developed in partnership with the three mathematical sciences institutes and the reallocations committee during the recently completed reallocations exercise at NSERC. The program was funded by NSERC for four years for a total of $687,000. An additional $200,000 has been committed to the program by the institutes. The NPCDS is a national network in the statistical sciences, conceived in partnership with the mathematics institutes. The broad goal of the proposal is to foster nationally coordinated projects with substantial interactions with the large community of scientists involved in the analysis of complex data sets, and to establish a framework for the national networking of research activities in the statistical community. The original proposal targeted the development and application of statistical methods for the analysis of data obtained from complex survey sample designs and longitudinal biological, epidemiological and medical studies. More specific objectives of the program include the development of collaborations between university and extra-university researchers, and the provision of training for graduate students in important scientific areas through these collaborations.

NPCDS Projects

STATISTICAL METHODS FOR COMPLEX SURVEY DATA
Project Leader: Changbao Wu (Waterloo)

CANADIAN CONSORTIUM ON STATISTICAL GENOMICS
Project Leader: Rafal Kustra (Toronto)

DATA MINING WITH COMPLEX DATA STRUCTURES
Project Leaders: Hugh Chipman (Acadia), Antonio Ciampi (McGill), Theodora Kourti (McMaster), Helmut Kröger (Laval)

DESIGN AND ANALYSIS OF COMPUTER EXPERIMENTS FOR COMPLEX SYSTEMS
Project Leader: Derek Bingham (Simon Fraser)

FORESTS, FIRES AND STOCHASTIC MODELING
Project Leaders: John Braun (Western Ontario), Charmaine Dean (Simon Fraser), Dave Martell (Toronto)

SPATIAL/TEMPORAL MODELING OF MARINE ECOLOGICAL SYSTEMS
Project Leaders: Michael Dowd (Dalhousie), Joanna Flemming (Dalhousie), Chris Field (Dalhousie), Rick Routledge (Simon Fraser)

NPCDS Workshops

SUMMER WORKSHOP ON MODERN APPLIED METHODS IN BIOSTATISTICS
August 14 – 17, 2006, University of Toronto
Director: Paul Corey (Toronto)

Atlantic Association for Research in the Mathematical Sciences (AARMS)

AARMS was founded in March 1997 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 Breton 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.

AARMS Scientific Activities

INTERNATIONAL CATEGORY THEORY CONFERENCE
June 25 – July 1, 2006, White Point Beach Resort, Nova Scotia
Organizers: Dorette Pronk (Dalhousie), Robert Dawson (Saint Mary's), Peter Selinger (Dalhousie)

BLUENOSE NUMERICAL ANALYSIS DAY 2006
June 23, 2006, St. Francis Xavier University
Organizers: Jeffrey McNally (St. Francis Xavier), Patrick Keast (Dalhousie), Richard Karsten (Acadia), Ronald Haynes (Acadia), Paul Muir (Saint Mary's)

GAMES-AT-DAL 4
August 21 – 25, 2006, Dalhousie University
Organizer: Richard Nowakowski (Dalhousie)

ATLANTIC OPTIMIZATION DAYS
October 5 – 6, 2006, University of New Brunswick
Organizers: David Bremner (New Brunswick), Hugh Thomas (New Brunswick)

APICS 2006: SPECIAL SESSION ON MATHEMATICAL MODELLING AND SIMULATION
October 14, 2006, Cape Breton University
Organizers: George Chen (Cape Breton), Ronald Haynes (Acadia)

APICS 2006: SPECIAL SESSION ON MULTIVARIATE STATISTICAL ANALYSIS
October 15, 2006, Cape Breton University
Organizer: Edmund Rudiuk (Cape Breton)

ATLANTIC COMMUNITY MATH NETWORK CONFERENCE
November 25, 2006, Acadia University
Organizer: Jeff Hooper (Acadia)

2ND AARMS/DALHOUSIE ATLANTIC ANALYSIS DAYS
March 30 – 31, 2007, Dalhousie University
Organizer: Karl Dilcher (Dalhousie)

EAST COAST COMBINATORIAL CONFERENCE 2007
April 18 – 19, 2007, Mount Allison University
Organizer: Catharine Baker (Mount Allison)

WORKSHOP ON MATHEMATICAL KNOWLEDGE MANAGEMENT
April 26, – 28, 2007, Dalhousie University
Organizer: Jonathan Borwein (Dalhousie)

BLACK HOLES VI
May 12 – 16, 2007, White Point Beach Resort
Organizer: Jack Gegenberg (New Brunswick)

12TH CANADIAN CONFERENCE ON GENERAL RELATIVITY AND RELATIVISTIC ASTROPHYSICS
May 17 – 20, 2007, University of New Brunswick
Organizer: Jack Gegenberg (New Brunswick)

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 with 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 nine 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. Please refer to the section "Research Laboratories" for reports describing 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 CRM scientific activities.

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.

Algebraic relativism: encoding the higher structure of morphisms
Kathryn Hess (EPFL), February 23, 2007

Eigenvalue problem and a new product in cohomology of flag varieties
Shrawan Kumar (UNC Chapel Hill), April 13, 2007

Network for Computing and Mathematical Modelling (ncm_2)

The CRM is one of the founding members of the Network for Computing and Mathematical Modelling (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 Centre for Interuniversity Research and Analysis of Organizations (CIRANO), the Centre for Research on Transportation (CRT), the Group for Research in Decision Analysis (GERAD), the Centre de Recherche Informatique de Montréal (CRIM), and the Institut National de la Recherche Scientifique-Énergie, Matériaux et Télécommunications (INRS-EMT).

Laboratoires universitaires Bell (LUB)

The CRM is an active participant in Laboratoires universitaires Bell, a joint project between the ncm_2 and Bell. The goal of the LUB is to make innovations in the field of multimedia research and applications (mainly interactive applications aimed at the general public, electronic commerce applications and new generations of networks), as well as to promote the training of a highly qualified, international calibre workforce in these areas.

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 in 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 Jussieu–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 reader will find below summaries of the meetings that took place in 2006 – 2007.

Annual Meeting of the Statistical Society of Canada

May 28 – 31, 2006, University of Western Ontario

Program Committee: Richard Lockhart (Simon Fraser), Chair; Michael Escobar (Toronto), Biostatistics Section; François Pageau (SNC Technologies), Business and Industrial Statistics Section; Patricia Whitridge (Elections Canada), Survey Methods Section; André Dabrowski (Ottawa), Probability Section

Chair of the Local Arrangements Committee: David Bellhouse (Western Ontario)

The thirty-fourth Annual Meeting of the Statistical Society of Canada has brought together researchers in statistics and probability and users from academia, government and industry. The meeting featured three workshops and seventy-two paper sessions (including a contributed poster session). SSC 2006 was sponsored by the CRM, the Fields Institute, PIMS, MITACS, the National Program on Complex

Data Structures (NPCDS), the Robarts Research Institute, the SAS Institute, and the Department of Statistical and Actuarial Sciences, the Faculty of Science and Research Western (University of Western Ontario).

The Presidential Invited Address was given by Ivars Pederson (Science News), the Gold Medal Address by David Andrews (Toronto) and the CRM–SSC Award Address by Jeffrey Rosenthal (Toronto). The Pierre-Robillard Award Address was given by Jean-François Quessy (UQTR) and the *Canadian Journal of Statistics* Award Address by Jennifer Asimit and W. John Braun (Western Ontario). The Special Invited Address of the Biostatistics Section was given by Donald Berry (M.D. Anderson Cancer Center), the Isobel Loutit Invited Address on Business and Industrial Statistics by Geoff Vining (Virginia Tech), and the Special Invited Address of the Survey Methods Section by Michael Larsen (Iowa State).

CMS Summer 2006 Meeting

June 3–5, 2006, University of Calgary

Meeting director: Claude Laflamme (Calgary)

The Summer 2006 Meeting of the Canadian Mathematical Society welcomed 271 participants. The public lecture was given by William R. Pulleyblank from IBM and was titled "From paper tape to the internet to BlueGene — forty years of computing history." The plenary speakers were Steve Awodey (Carnegie Mellon), John Conway (Princeton), Nicole El Karoui (École Polytechnique, Palaiseau), Nigel Kalton (Missouri), Alexander S. Kechris (Caltech), László Lovász (Microsoft) and Dave Marker (Illinois at Chicago).

The CMS was pleased to present lectures from its prize winners, namely, the Coxeter–James Lecture, given by Jim Geelen (Waterloo), the Krieger–Nelson Prize Lecture, given by Penny Haxell (Waterloo), and the CMS Excellence in Teaching Award Lecture, given by Frédéric Gourdeau (Laval). The meeting hosted 13 sessions, listed below.

CATEGORY THEORY
Organizer: Robin Cockett (Calgary)

DIFFERENTIAL EQUATIONS AND DYNAMICAL SYSTEMS
Organizers: Elena Braverman (Calgary), Michael Y. Li (Alberta)

DISCRETE AND CONVEX GEOMETRY
Organizers: Karoly Bezdek (Calgary), Jozsef Solymosi (UBC)

GAME THEORY/NUMBER THEORY
Organizers: Richard Nowakowski (Dalhousie), Bill Sands (Calgary), Hugh Williams (Calgary), Robert Woodrow (Calgary)

JOINT CMS/CMESG EDUCATION SESSION
Organizer: Peter Taylor (Queen's)

L-FUNCTIONS, AUTOMORPHIC FORMS AND REPRESENTATION THEORY
Organizers: Amir Akbary (Lethbridge), Clifton Cunningham (Calgary)

MATHEMATICAL FINANCE
Organizers: Len Bos (Calgary), Anatoliy Swishchuk (Calgary)

MODEL THEORY
Organizer: Patrick Speissegger (McMaster)

POSITIVITY IN FUNCTIONAL ANALYSIS AND APPLICATIONS
Organizers: Charalambos Aliprantis (Purdue), Vladimir Troitsky (Alberta)

RECENT WORK IN HISTORY OF MATHEMATICS
Organizer: Tom Archibald (Simon Fraser)

SET THEORY AND INFINITARY COMBINATORICS
Organizer: Stevo Todorcevic (Toronto)

SYMMETRY IN GEOMETRY
Organizers: Ted Bisztriczky (Calgary), Ferenc Fodor (Szeged & Calgary), Richard K. Guy (Calgary), Asia Weiss (York, Toronto)

CONTRIBUTED PAPERS SESSION
Organizer: Alexander Brudnyi (Calgary)

The meeting was sponsored by the University of Calgary, the CRM, the Fields Institute, MITACS, and PIMS.

CAIMS–MITACS 2006 Joint Annual Conference

June 16–20, 2006, York University

Event coordinator: Jo-Anne Rockwood (MITACS)

In 2006 MITACS and CAIMS (the Canadian Applied and Industrial Mathematics Society) held their first joint conference at York University. The conference attracted over 500 delegates who took part in 18 sessions, including the Canadian Symposium on Fluid Dynamics and the Summer School on Mathematical Modeling of Infectious Diseases. MITACS and CAIMS were pleased to host Plenary Speakers Dr. John Ockendon (Oxford), Dr. John Glasser (Emory) and Dr. Charles Williamson (Cornell), as well as the CAIMS Research Prize Winner, Dr. Michael Mackey (McGill). The conference was sponsored by York University (Vice-Principal Research, Vice-Principal Academic,

Faculty of Arts), Simon Fraser University (Faculty of Science, Faculty of Applied Science), Bombardier, Bell Canada, CRM, the Fields Institute and PIMS. Here is a list of the sessions.

7TH CANADIAN SYMPOSIUM ON FLUID DYNAMICS
Organizers: Nicholas Kevlahan (McMaster), Marek Stastna (Waterloo), Francis Poulin (Waterloo)

BIOINFORMATICS
Organizers: Anne Condon (UBC), Peter Swain (McGill), Shelley Bull (Mount Sinai Hospital), David Tritchler (Ontario Cancer Institute)

COMMUNICATION AND SECURITY IN AD HOC NETWORKS
Organizer: Evangelos Kranakis (Carleton)

DATA MINING (joint with the Statistical Society of Canada)
Organizer: Steven Wang (York, Toronto)

FINANCIAL MATHEMATICS
Organizers: Matt Davison (Western Ontario), John Walsh (UBC)

IMAGE PROCESSING/INVERSE PROBLEMS
Organizers: Hongmei Zhu (York, Toronto), Huaxiong Huang (York, Toronto)

STOCHASTIC MODELS IN INDUSTRIAL MATHEMATICS
Organizers: Rachel Kuske (UBC), Israel Ncube (Wilfrid Laurier)

NONLINEAR DYNAMICS IN THE HEALTH SCIENCES
Organizers: Sue Ann Campbell (Waterloo), Michael Mackey (McGill)

OPERATIONS RESEARCH AND OPTIMIZATION
Organizers: Tamas Terlaky (McMaster), Warren Hare (Simon Fraser)

SCIENTIFIC COMPUTING I
Organizer: Anne Bourlioux (Montréal)

SCIENTIFIC COMPUTING II
Organizer: Chen Greif (UBC)

APPLICATIONS AND RECENT DEVELOPMENTS IN SYMBOLIC COMPUTATION
Organizers: Rob Corless (Western Ontario), Dhavide Aruliah (Western Ontario)

VISUAL MATHEMATICS
Organizer: Karan Singh (Toronto)

MATHEMATICS AND SPACE EXPLORATION (conference by Canadian astronaut Chris Hadfield)
Organized by the MITACS Student Advisory Committee

CAREER PANEL
Organized by the MITACS Student Advisory Committee

MATHEMATICAL OUTBREAKS: EPIDEMICS AND INVASIONS
Organizers: James Watmough (New Brunswick), Huaiping Zhu (York)

RECENT ADVANCES IN ALGORITHMS AND SOFTWARE FOR THE NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS
Organizers: Paul Muir (Saint Mary's), Ray Spiteri (Saskatchewan)

USE OF UNSTRUCTURED GRID METHODS FOR OCEAN MODELING
Organizer: Paul Myers (Alberta)

First Joint CMS/SMM Meeting

September 21 – 23, 2006, Guanajuato, Mexico

Scientific Committee — CMS: Alejandro Adem (UBC), Chair, Andrew Granville (Montréal), Walter Craig (McMaster)
Scientific Committee — SMM: José C. Gómez Larrañaga (CIMAT), Chair, Lourdes Palacios (UAM Iztapalapa), Fernando Brambila (UNAM)

The Canadian Mathematical Society (CMS) and the Sociedad Matemática Mexicana (SMM) held their first joint meeting in 2006. This meeting was hosted by the Centro de Investigación en Matemáticas (CIMAT) and took place in Guanajuato from September 21 to 23. The Plenary Speakers were Francisco González Acuña (UNAM & CIMAT), David Brydges (UBC), Gonzalo Contreras (CIMAT), Pengfei Guan (McGill), Jorge Urrutia (UNAM) and Maciej Zworski (UC Berkeley). In addition, there were 11 sessions, listed below.

ALGEBRA
Organizers: Ragnar-Olaf Buchweitz (Toronto), José Antonio de la Peña (UNAM), Arturo Pianzola (Alberta)

DIFFERENTIAL GEOMETRY
Organizers: Pengfei Guan (McGill), L. Hernandez (CIMAT), McKenzie Wang (McMaster)

FUNCTIONAL ANALYSIS
Organizers: Hugo Arizmendi (UNAM), Anthony Lau (Alberta), Lourdes Palacios (UAM Iztapalapa)

GRAPH THEORY AND COMBINATORICS
Organizers: Isidoro Gitler (CINVESTAV), Luis Goddyn (Simon Fraser), Bruce Reed (McGill)

LOCALIZATION AND PARTIAL DIFFERENTIAL EQUATIONS
Organizers: Tim Minzoni (UNAM), Michael Ward (UBC)

LOW-DIMENSIONAL TOPOLOGY
Organizers: Victor Nuñez (CIMAT), Dale Rolfsen (UBC)

MATHEMATICAL PHYSICS
Organizers: David Brydges (UBC), Stephen Bruce Sontz (CIMAT), Carlos Villegas (UNAM Cuernavaca)

MATHEMATICS EDUCATION
Organizers: Carolyn Kieran (UQÀM) and M. Santillana (UPN)

PROBABILITY
Organizers: M.-E. Caballero (UNAM), Victor Pérez-Abreu (UAM Cuajimalpa), Tom Salisbury (York, Toronto)

TOPOLOGY
Organizers: Alejandro Adem (UBC), J. González (CINVESTAV), Ian Hambleton (McMaster), D. Juan (UNAM Morelia)

VARIATIONAL METHODS IN PARTIAL DIFFERENTIAL EQUATIONS
Organizers: Lia Bronsard (McMaster), P. Padilla (UNAM)

CMS Winter 2006 Meeting

December 9 – 11, 2006, University of Toronto

Meeting director: Ian Graham (Toronto)

The Winter 2006 Meeting of the Canadian Mathematical Society welcomed approximately 430 participants. The plenary speakers were Brent Davis (UBC), Dmitry Dolgopyat (Maryland), Dimitri Shlyakhtenko (UC Los Angeles), Karen Smith (Michigan), Susan Tolman (Illinois at Urbana-Champaign), and Shmuel Weinberger (Chicago). The Prize Lectures were given by Andrew Granville (Montréal), Jeffery-Williams Prize, Michael Newman (Waterloo), Doctoral Prize, and Peter Taylor (Queen's), CMS Adrien Pouliot Award. The public lecture was given by V. Kumar Murty from the University of Toronto and was titled *What is a Proof*? A list of the sessions and their organizers may be found below.

ALGEBRAIC COMBINATORICS
Organizers: Nantel Bergeron (York, Toronto), Christophe Hohlweg (Fields), Michael Zabrocki (York, Toronto)

CALABI – YAU VARIETIES AND MIRROR SYMMETRY (with a feature lecture by Shing-Tung Yau)
Organizers: James Lewis (Alberta), Noriko Yui (Queen's)

CLUSTER ALGEBRAS
Organized jointly by the sessions on Algebraic Combinatorics and on Representations of Algebras

COMMUTATIVE ALGEBRA AND ALGEBRAIC GEOMETRY
Organizers: Ragnar-Olaf Buchweitz (Toronto), Graham Leuschke (Syracuse), Greg Smith (Queen's)

COMPLEXITY AND COMPUTABILITY IN ANALYSIS, GEOMETRY, AND DYNAMICS
Organizers: Alex Nabutovsky and Michael Yampolsky (Toronto)

DIFFERENTIABLE DYNAMICS AND SMOOTH ERGODIC THEORY
Organizers: Giovanni Forni (Toronto), Konstantin Khanin (Toronto)

FUNCTIONAL ANALYSIS
Organizers: Robb Fry (Thompson Rivers), S. Swaminathan (Dalhousie)

HARMONIC ANALYSIS
Organizers: Izabella Laba (UBC), Malabika Pramanik (Caltech & UBC)

HISTORY OF MATHEMATICS
Organizer: Tom Archibald (Simon Fraser)

KNOT HOMOLOGIES
Organizer: Dror Bar-Natan (Toronto)

MATHEMATICAL ASPECTS OF CONTINUUM PHYSICS: ANALYSIS, COMPUTATION, AND MODELING
Organizers: Rustum Choksi (Simon Fraser), Mary Pugh (Toronto)

MATHEMATICAL BIOLOGY
Organizer: Gail Wolkowicz (McMaster)

MATHEMATICS EDUCATION
Organizer: Walter Whiteley (York, Toronto)

NONLINEAR SCHRÖDINGER EQUATIONS
Organizers: James Colliander (Toronto), Robert Jerrard (Toronto)

POISSON GEOMETRY AND MATHEMATICAL PHYSICS
Organizer: Eckhard Meinrenken (Toronto)

PROBABILISTIC METHODS IN ANALYSIS AND ALGEBRA
Organizers: Matthias Neufang (Carleton), Balint Virag (Toronto)

REPRESENTATIONS OF ALGEBRAS
Organizers: Ibrahim Assem (Sherbrooke), Thomas Brüstle (Sherbrooke), Shiping Liu (Sherbrooke)

CONTRIBUTED PAPERS SESSION
Organizer: Bill Weiss (Toronto)

The following institutions sponsored the CMS Winter 2006 Meeting: CRM, Fields Institute, MITACS, PIMS, the University of Toronto (Department of Mathematics, Department of Mathematical and Computational Sciences at UTM, Department of Computer and Mathematical Sciences at UTSC, Faculty of Arts and Science, Office of the Vice-President, Research, Office of the Vice-Principal, Research, UTM)

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).

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 University, Université Laval, McGill University, Université de Montréal, UQÀM, 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 centers 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 harmonisation 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.

2006 – 2007 Postdoctoral Fellows

Félix Carbonell (Ph.D. 2006, La Habana) is working with Keith Worsley (McGill) in medical imaging.

Stefan Friedl (Ph.D. 2003, Brandeis) is working with Olivier Collin and Steven Boyer (UQÀM) on the topology of 3-dimensional and 4-dimensional manifolds. His research article "Symplectic $S^1 \times N^3$, surface subgroup separability, and totally degenerate Thurston norm" (in collaboration with Stefano Vidussi) will be published in the prestigious *Journal of the American Mathematical Society*. Friedl has accepted a position at the University of Warwick starting in June 2008.

Başak Gürel (Ph.D. 2003, UC Santa Cruz) is working in symplectic topology and Hamiltonian dynamical systems with Octav Cornea and François Lalonde. She is one of the organizers of the weekly seminar in symplectic topology.

Emmanuel Lorin de la Grandmaison (Ph.D. 2001, ENS Cachan) works in quantum chemistry and numerical analysis for hyperbolic systems. Lorin has published four research articles in collaboration with André Bandrauk (Sherbrooke).

Dan Mangoubi (Ph.D. 2006, Technion) works in geometry and differential analysis with Dmitry Jakobson (McGill) and Iosif Polterovich (Université de Montréal). Mangoubi has written the article "Tubular neighborhoods of nodal sets and Diophantine approximation" in collaboration with Jakobson. He was awarded the prestigious scholarship of the European Postdoctoral Institute for Mathematical Sciences and is now a postdoctoral fellow at the Institut des Hautes Études Scientifiques à Paris.

Andrew McIntyre (Ph.D. 2002, Stony Brook) studies the spectral geometry of 2-dimensional and 3-dimensional hyperbolic manifolds in collaboration with Dmitry Korotkin (Concordia). He is currently visiting the Max Planck Institut für Mathematik in Bonn (Germany).

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.

Marc Desgroseilliers
Topic: Calculer explicitement des sommes exponentielles en petite caractéristique
Duration: 2 months (July – August)
Supervisor: Emmanuel Letellier
The CICMA laboratory financed half of this scholarship.

Julia Evans
Topic: Rational points on elliptic curves
Duration: 4 months
Supervisor: Christian Wuthrich
Professor Henri Darmon financed half of this scholarship.

Gabriel Gauthier-Shalom
Topic: Number theory and elliptic curves
Duration: 3 months (May – July)
Supervisor: Christian Wuthrich
Professor Henri Darmon financed half of this scholarship.

Rachel Kidd
Topic: Study of nodal sets and nodal domains of eigenfunctions of elliptic operators
Duration: 2 months
Supervisor: Igor Wigman
Professor Dmitry Jakobson financed half of this scholarship.

Alexandre Lang
Topic: Complex networks
Duration: 3 months (May – July)
Supervisor: Navin Goyal
Professor Pascal Tesson financed half of this scholarship.

Vincent Quenneville-Bélair
Topic: Arithmetic on elliptic curves
Duration: 4 months
Supervisor: Christian Wuthrich
Professor Henri Darmon financed half of this scholarship.

Philippe Sosoe
Topic: Number of zeroes of random trigonometric polynomials
Duration: 2 months
Supervisor: Igor Wigman
Professor Dmitry Jakobson financed half of this scholarship.

ISM Graduate Student Conference

The ninth ISM Graduate Student Conference (Colloque panquébécois annuel des étudiants), which took place at Concordia University on May 11 – 13, 2007, was attended by 76 students from seven Québec universities and Queen's University (Kingston, Ontario). For students, the Conference afforded a great opportunity to meet one another, present their research work and exchange ideas with their peers. Valérie Hudon, Ahmad Lavasani, Alexandra Lemus, Rami Tabri, Maiko Ishii and Jeremy Porter were the members of the organizing committee. The

conference was supported by the CRM, Concordia University, the Graduate Student Association of Concordia University, the Concordia University Alumni Association and Meloche Monnex.

The plenary speakers, all of which were ISM professors, presented five of the most active fields of research in mathematics. François Bergeron (UQÀM) gave a lecture entitled "À questions symétriques, réponses symétriques." Steven Boyer (UQÀM) spoke on the topology of 3-dimensional manifolds, and Gilles Brassard (Université de Montréal) spoke on pseudo-telepathy. Andrew Granville (Université de Montréal) gave a lecture on patterns in the primes and Wei Sun (Concordia) a lecture on stochastic filtering and its applications.

The following students gave talks at the Conference: Antonio Reiser, Jérôme Grand'Maison, Ian Marquette, Liam Watson, Andreea Pruncut, Tamara Diaz Chang, Ferenc Balogh, John Chapman, François Charrette, Clément Hyvrier, Tuan Xing, Frédérick Tremblay, Hong Yue, Émilie Dufresne, Maiko Ishii, Baptiste Chantraine, Klara Kelecsenyi, Daniel Simeone, Alexandre Girouard, Shiva Gol Tabaghi, Zanin Kavazovic, Valérie Hudon, Christopher Brav, Quentin Rajon, Patrice Rivard, Ahmad Lavasani, Eugene Kritchevski, Steven Rayan, Érik Pronovost, Yafang Wang.

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 is available free of charge in all the high schools and cegeps of Québec. Three issues of Accromαth have been published so far; five thousand copies of each issue have been printed and distributed. 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.

In 2007, the quality of Accromαth was highlighted in two ways. First, Jean-Paul Delahaye, who has published several articles in the French magazine *Pour la science*, has agreed to collaborate with Accromαth on a regular basis by contributing a column on paradoxes (*Rubrique des paradoxes*), starting in the Summer-Fall issue of 2007. Second, the design of Accromαth won a bronze medal in the "image brochure" category at the "Summit Creative Awards" international contest, which features thousands of submissions from 23 countries.

André Ross, instructor of mathematics at the Cégep de Lévis-Lauzon, is the editor-in-chief of Accromαth. The members of its editorial board are France Caron (Université de Montréal), Louis Charbonneau (UQÀM), Jocelyn Dagenais (Commission scolaire Marie-Victorin), Jean-Marie De Koninck (Université Laval), André Deschênes (Petit Séminaire de Québec), Christian Genest (Université Laval), Frédéric Gourdeau (Université Laval), Bernard R. Hodgson (Université Laval), and Christiane Rousseau (Université de Montréal). Alexandra Haedrich (ISM) is responsible for the magazine production and its iconography, and Pierre Lavallée (Neograf design) is responsible for its graphical design. The linguistic revision is under the responsibility of Jean-Claude Girard (Cégep Saint-Jean-sur-Richelieu) and Jacques Sormany (Cégep de Chicoutimi).

Other joint initiatives

CMS Math Camps 2006

The CMS Math Camp Program (initially called the ESSO/CMS Math Camp Program) started in 1999 with three camps, and the program has now grown to include at least one camp in every province. The support received from the sponsors enables the Canadian Mathematical Society to make these camps accessible to students from across Canada who demonstrate an interest and excellence in mathematics. In 2006, there were thirteen regional math camps in ten provinces, as well as a national camp.

Organized by Daniel Gatien and Matthieu Dufour, the national camp was held at the John Abbott cegep from July 2 to 8, 2006. The National Camp is designed primarily for younger Canadian students with at least two years remaining in high school and with the potential to compete at the Mathematical Olympiad level. The selection of invited students is based upon

their results in various mathematics competitions. Presentations on specific topics and the various problem solving sessions are run by local area teachers and faculty members as well as former IMO team members.

The Regional Camps are intended to provide some mathematics enrichment in a fun and rewarding environment. Each camp invites between 20 and 30 students (from grade 9 to 11) on the basis of national or regional mathematics competitions as well as recommendations from teachers. The 2006 regional camps took place at Sir Wilfred Grenfell College, the University of Prince Edward Island, the University of New Brunswick, the Université du Québec à Rimouski, Simon Fraser University (Burnaby and Surrey campuses), the University of Ottawa, Dalhousie University, Brock University, the University of Western Ontario, the University of Alberta, the University of Manitoba, and the University of Regina.

Finally, the Summer 2006 IMO Training Seminar, designed to prepare a team of Canadian students for the International Mathematical Olympiad (IMO), took place from June 24 to July 2, 2006, and was organized by Dalhousie University. The Winter 2007 IMO Training Seminar took place on January 2-7, 2007, and was organized by York University.

The sponsors of the Math Camp Program in 2006-2007 were the Canadian Mathematical Society, the CRM, the Fields Institute, the Pacific Institute for the Mathematical Sciences, the Association mathématique du Québec, the host universities, and the governments of New Brunswick, Alberta, the Northwest Territories, Newfoundland and Labrador, Nova Scotia, Québec, Ontario, and Saskatchewan.

2006 AMQ Mathematics Camp

June 2 – 13, 2006, Bishop's University

Organizers: François Huard (Bishop's), Pierre-Yves Leduc (Sherbrooke)

The AMQ Mathematics Camp allows approximately thirty cegep students, mostly laureates of the Concours mathématique du Québec, to participate in a series of workshops coordinated by Québec mathematicians.

Sciences et mathématiques en action

The CRM also contributed 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 in high schools and the general public. Within the framework of this program, mathematics shows were presented to the students of many high schools and other institutions during the year 2007.

Research Laboratories

In 2006 – 2007 the CRM was encompassing nine research laboratories at the heart of the Québec mathematical community, including the new INTRIQ laboratory (*Institut transdisciplinaire d'informatique quantique*), devoted to quantum computing. 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 applied mathematics laboratory is a flourishing research-based network of 17 members or associate members drawn from 6 different universities and spanning departments of computer science, chemistry, atmospheric and ocean sciences and, of course, mathematics and statistics. Members are very actively engaged in cutting edge research in areas as diverse as numerical simulation, applied dynamical systems, quantum chemistry, turbulence, combustion, biomechanics, numerical methods in fluid mechanics and electromagnetism, finite element methods, molecular dynamics, control, optimization, preconditioners and large-scale eigenvalue problems. As testimony to the excellence of the research pursued in the laboratory and the international reputation enjoyed by its members, we detail below some distinctions awarded to and invited talks and courses given by its members.

The objectives of the laboratory are principally to foster and encourage collaboration and scientific interchange between its own members, with other researchers in Montréal and with the numerous visitors and conference and seminar speakers invited to Montréal by members of the laboratory. Lab members have always been active in interdisciplinary research. André Bandrauk and Nilima Nigam, for example, are members of RQMP (Regroupement québécois sur les matériaux de pointe). Nilima Nigam is an associate member of the CRM mathematical analysis laboratory. Sebius Doedel and Jacques Bélair are members of the Centre for Nonlinear Dynamics in Physiology and Medicine at McGill. Michel Delfour is a member of GIREF (*Groupe Interdisciplinaire de Recherche en Éléments Finis*) at Université Laval and Anne Bourlioux and Jacques Bélair are members of MITACS sponsored industrial project teams. Indeed, the diversity of the members' research expertise is regarded by the laboratory as positive and enriching and leads to stimulating common seminars and workshops, where ideas are exchanged and links forged between different people and subject areas. Details of some of the numerous conferences, workshops and seminars organized by lab members are supplied below.

The Laboratory organizes the Montreal Scientific Computing Days each February, as well as other workshops. It has two regular seminars running during the academic year, a weekly applied mathematics seminar and a biweekly computational science and engineering seminar. It also supports postdoctoral fellows and summer students as well as Canadian and international visitors.

News and highlights

André Bandrauk has been nominated Fellow by the Humboldt Foundation, Berlin. He will make three visits, each of four months, to the Free University of Berlin and to the Max Born Institute in 2007, 2008 and 2009, respectively. Jacques Bélair will be President of the Canadian Applied and Industrial Mathematics Society (CAIMS) from 2008 – 2009. Nilima Nigam obtained a grant from the Discovery Accelerator Supplements Program, which amounts to 40,000 dollars per year for three years.

Laboratory members received a very large number of invitations to speak at conferences and seminars during this past year. Regrettably, these are too numerous to enumerate here, but we mention a short course of invited lectures delivered by Eusebius Doedel on the theme of "Numerical methods for bifurcation problems" at the National Center of Theoretical Sciences, National Tsing-Hua University (Taiwan), in May 2007, and at the Research Institute of Mathematical Sciences of Kyoto University in July 2006. Paul Tupper was one of the two applied mathematicians (the other being Michael Brenner, from Harvard) to give a talk in the CRM mathematics colloquium series in 2006 – 2007. He was also an invited panelist for a panel discussion on the ambitious theme "The next 50 years" at the conference "Stanford 50: The state of the art and future directions of computational mathematics and numerical computing," held at Stanford University on March 31, 2007. Tucker Carrington, an associate member of the applied maths lab, was a visiting professor at the ETH Zürich during July 2006 and gave a number of invited talks in Germany and Switzerland at that time. Robert Owens was invited to be a plenary speaker at the

International Conference on Spectral and High Order Methods in Beijing in June 2007, but declined the invitation.

Michel Delfour was a member of the board of the International Congress on Industrial and Applied Mathematics (ICIAM) held in Zürich in July 2007; he represented the Canadian Mathematical Society. M. Delfour was also a member of the ICIAM 2007 International Scientific Committee and the organizer of two mini-symposia that took place during this meeting. Thomas Wihler was one of the organizers of a mini-symposium on "Advances in Discontinuous Galerkin Methods" at ICIAM 2007. Michel Delfour was a member of the planning committee for the meeting in memory of Maurice L'Abbé (September 10, 2007). Michel Delfour and Jean-Paul Zolésio were organizers of a session entitled "Static and Moving Geometries as Modeling and/or Control Variables" at the 23rd IFIP TC 7 Conference on System Modelling. This conference took place on July 23 – 27, 2007, in Krakow (Poland).

Members of the laboratory have been involved in the organization of events promoting industrial applied mathematics recently. Nilima Nigam was on the organizing committee of the Fields – MITACS Industrial Problem-Solving Workshop held in Toronto on August 14 – 18, 2006, and Anne Bourlioux was one of the organizers of the first Montréal Industrial Problem Solving Workshop (held in August 2007). The annual meeting of CAIMS in Banff on May 20 – 24, 2007, brought together applied mathematicians from across Canada for four days of sessions, mini-symposia, and invited and contributed talks. In 2007, Anne Bourlioux (as a CAIMS board member) organized a session on numerical PDEs, and Paul Tupper and Robert Owens were responsible, together with Peter Swain (McGill) and Ian Frigaard (British Columbia), for mini-symposia on stochastic spatial models of biochemical systems and the mathematical modelling and numerical simulation of complex fluids, respectively.

Part of the summer and all of the autumn term 2007 at the CRM were devoted to Applied Dynamical Systems, and the applied maths laboratory earmarked 5000 dollars to support the event. This thematic program was a major undertaking for the organizing committee, which included four members of the applied maths laboratory: Tony Humphries, Paul Tupper, Eusebius Doedel and Jacques Bélair. Altogether there will be six main workshops with five taking place at the CRM and one to be held in Halifax (Nova Scotia). Two of the Montréal workshops will be preceded by mini-courses for graduates (Eusebius Doedel being one of the lecturers); two semester-long advanced courses will also be offered. In addition to being on the scientific committee of the thematic semester, Eusebius Doedel was a member of the advisory board for the International Workshop on Topics in Nonlinear Dynamics and Complexity, held in Puebla, Mexico, in February 2007, and a member of the scientific committee for the Workshop on Applied Dynamical Systems held at the University of Ghent (Belgium) in June 2006.

Looking further into the future, Michel Delfour is one of the organizers of the first CRM – INRIA congress to be held in early May 2008. In June 2008, the second Canada – France Congress will take place in Montréal, and Paul Arminjon is preparing, together with Emmanuel Lorin (CRM) and Marc Laforest (Polytechnique Montréal), a session on hyperbolic problems entitled "Numerical Analysis for Hyperbolic Systems of Conservation Laws." Anne Bourlioux is involved in the same congress as a session organizer on the theme of scientific computing. Peter Bartello will be one of the organizers of the program entitled "The Nature of High-Reynolds Number Turbulence," to be held in the autumn of 2008 at the Isaac Newton Institute (University of Cambridge). He has also agreed to organize a workshop on Cloud Turbulence to be hosted by the Institute for Mathematical Sciences of Imperial College (London) in March 2009.

Finally, in 2006 – 2007, the Lab contributed to the signing of a letter of intention between the CRM and the Tata Institute of Fundamental Research of Bangalore (India), thus laying the foundations for exchange visits for students and faculty members of the two institutions. This was achieved through the involvement of Michel Delfour in the provincial government's "Québec Trade and Innovation" mission, which spent eight days in India earlier this year.

Students, postdoctoral fellows, and visitors

In 2006 – 2007 the laboratory allocated a larger part of its budget than before to the employment and support of postgraduate students and postdoctoral researchers. The laboratory has approximately 40 graduate students and 10 postdoctoral researchers, supervised and directed by the lab's 17 members or associate members. The applied maths lab now partially finances (to a level of at least 9000 dollars per year) three of the postdocs (Miguel Moyers-Gonzalez, Jason Cooper and Abderrazak Ramadane), and some

money is available for their travel expenses, so that they make research visits and attend conferences. The quality of the research environment provided by the laboratory is in part measured by the success of postdocs in getting good academic positions; we are pleased to mention that Emmanuel Lorin de la Grandmaison has been offered a tenure track assistant professorship at the University of Ontario Institute of Technology, and Miguel Moyers-Gonzalez has been offered a lectureship at Durham University (United Kingdom). A travel bursary scheme, whereby an amount of 400 dollars was made available to each lab member or associate member to refund travel expenses by one or more of their research students, was initiated in 2006–2007.

Altogether, in 2006–2007, one undergraduate student, 21 master's students, 30 Ph.D. students and 13 postdoctoral fellows were supervised or cosupervised by regular or associate members of the laboratory. Visitors hosted by lab members in 2006–2007 included Bob Skeel (Purdue), Bob Batterman (Western Ontario), Marek Stastna (Waterloo), Marc Thiriet (INRIA and Paris 6), Christoph Schwab (ETH Zürich), Dominik Schoetzau (UBC) and Adimurthi (TIFR Bangalore).

Seminars

The main regular event in the applied mathematics laboratory is the weekly seminar. The organizers for 2006–2007 were Nilima Nigam and Eusebius Doedel, and twenty-five seminars on a wide range of topics of interest to members of the lab were delivered over the two semesters. One of these (a seminar by Professor Harold W. Kuhn of Princeton on September 1, 2006) was sponsored jointly with the ncm_2; this "Grande conférence rcm_2" was organized by Michel Delfour. The idea of the seminars is not only to stimulate and inform those who attend the talks, but to forge or strengthen research collaborations with the speakers. A number of applied maths talks were given in a two-semester series organized by Nilima Nigam at McGill. In 2006–2007, Thomas Wihler and Peter Bartello were the organizers of the Computational Sciences and Engineering Seminar, held on alternate Fridays during the two semesters.

Workshops, special sessions, and others

In 2006–2007 the following workshops were sponsored by the Applied Mathematics Laboratory. Reports on these workshops may be found in the section on the CRM General Program.

• MINI-WORKSHOP ON COMPUTATIONAL ASPECTS OF DYNAMICAL SYSTEMS
July 7, 2006, Concordia
Organizer: Eusebius J. Doedel (Concordia)

• THE 4TH MONTREAL SCIENTIFIC COMPUTING DAYS
April 16–17, 2007, CRM
Organizers: Emmanuel Lorin de la Grandmaison (Montréal), Robert G. Owens (Montréal), Thomas P. Wihler (McGill)

One of the main goals of the Montreal Scientific Computing Days is to nurture the young researchers of the Applied Mathematics Laboratory. Michel Delfour will be the organizer of the 5th Montréal Scientific Computing Days, to be held in April 2008.

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)
Modeling, numerical simulation in turbulent combustion

MICHEL C. DELFOUR (Montréal)
Control, optimization, design, shells, calculus, biomechanics

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

ANTONY R. HUMPHRIES (McGill)
Numerical analysis, differential equations

SHERWIN A. MASLOWE (McGill)
Asymptotic methods, fluid mechanics

PAUL F. TUPPER (McGill)
Numerical analysis, stochastic processes, statistical mechanics

THOMAS P. WIHLER (McGill)
Numerical analysis, computational methods for PDEs

JIAN-JUN XU (McGill)
Asymptotics and numerical analysis, nonlinear PDEs, materials science

Associate members

TUCKER CARRINGTON (Montréal)
Chemical dynamics

MARTIN J. GANDER (Genève)
Domain decomposition, preconditioning

NILIMA NIGAM (McGill)
Applied analysis, numerical methods in electromagnetism

JEAN-PAUL ZOLÉSIO (INRIA Sophia-Antipolis)
Control, optimization

CICMA

Description

This centre comprises researchers working in number theory, group theory and algebraic geometry. Contemporary number theory follows two major courses. On the 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 Centre, with Darmon, Iovita, and Kisilevsky. CICMA also acquired an expertise in many aspects of analytic number theory when Andrew Granville, one of the leaders in the field, became a member of CICMA. On the group theory side, Kharlampovich and Miasnikov are world-renowned specialists on group varieties and McKay is one of the originators of the moonshine program.

The problems to be studied by the group in the coming years include the construction of rational points on elliptic curves both from the algorithmic and theoretical viewpoints; zeta functions of varieties over finite fields and the algorithmic approach; canonical lifting of elliptic curves and Abelian varieties; cryptography, Abelian varieties, and many aspects of analytic number theory, for instance averages of special values of L-functions, distribution of prime numbers and prime divisors, and problems in additive number theory.

News and highlights

Andrew Granville was awarded the prestigious Chauvenet Prize (2008) of the Mathematical Association of America (MAA), and the Lester R. Ford Award (2007) of the MAA. He was elected member of the Royal Society of Canada in 2006, and in the same year, was awarded the Jeffery-Williams Prize of the Canadian Mathematical Society. He was the first Canadian to give the prestigious Erdős memorial lecture of the American Mathematical Society; he gave this lecture in Davidson (North Carolina) in 2007.

Henri Darmon gave a 45-minute lecture in the Number Theory Section of the International Congress of Mathematicians, held in Madrid in August 2006. In July 2006, he organized in Göttingen a Summer School on Arithmetic Geometry sponsored by the Clay Mathematics Institute (CMI); several other members of CICMA (Pierre Charollois, Hugo Chapdelaine, Matthew Greenberg, and John Voight) were involved in this school. In March 2007, at Les Diablerets, he also gave a mini-course to Swiss doctoral students with a CICMA postdoctoral fellow, Christian Wuthrich. In April 2007, he gave the "Koweit Foundation Lecture" at the University of Cambridge.

Students, postdoctoral fellows, and visitors

Many CICMA postdoctoral fellows were offered tenure-track positions recently. Guillaume Ricotta was offered a position at the Université Bordeaux 1, Nathan Ng at the University of Ottawa, Pierre Charollois at the Université Paris 6, Mak Trifkovic at the University of Victoria, Adriano Marmora at the Université Strasbourg 1, Payman Kassei and Ambrus Pàl at King's College (University of London), Matteo Longo at the Università degli Studi di Milano, Gonzalo Tornaria at the Universidad de la República (Uruguay), Alex Ghitza at Colby College (Maine), Peter Clark at the University of Georgia (Athens), and Ye Tian at the Academy of Sciences (Beijing).

CICMA hired four new postdoctoral fellows in 2007: Bryden Cais (Michigan), Riad Masri (UT Austin), Jeehoon Park (Boston), and Arnaud Chadozeau (Bordeaux 1). Altogether, in 2006 – 2007, 27 master's students, 33 Ph.D. students and 23 postdoctoral fellows were supervised or cosupervised by laboratory members.

Seminars

The Québec – Vermont Number Theory Seminar is the main scientific activity of CICMA,

is held every second Thursday for a full day and is attended by about 30 regular participants from Montréal, Vermont, Québec and Ottawa. In 2006 – 2007, Eyal Goren and Henri Darmon were the organizers of the seminar and the latter consisted of 40 lectures. In the fall of 2006, the seminar was devoted (albeit not exclusively) to the recent proof of the Sato – Tate conjecture. We also mention an activity related to the seminar, a mini-course on cohomological invariants given by Jean-Pierre Serre from September 6 to October 6. The complete program of the Québec – Vermont Number Theory Seminar may be found at the address `www.math.mcgill.ca/darmon/qvnts/qvnts.html`.

Workshops, special sessions, and others

In 2006 – 2007 CICMA sponsored two conferences. Jean-Pierre Serre, from the Collège de France, was the distinguished plenary speaker of the Québec – Maine Conference on Number Theory and Related Topics. The second conference honoured the contributions of John McKay, a member of CICMA who is one of the most influential Canadian mathematicians. Reports on these two conferences may be found in the section on the CRM general program.

• QUÉBEC – MAINE CONFERENCE ON NUMBER THEORY AND RELATED TOPICS
September 30 – October 1, 2006, Université Laval
Financed by the Number Theory Foundation, CICMA and the Department of mathematics and statistics of Université Laval
Organizers: Claude Levesque (Laval), Jean-Marie De Koninck (Laval)

• "GROUPS AND SYMMETRIES: FROM THE NEOLITHIC SCOTS TO JOHN MCKAY"
CONFERENCE HONOURING THE CONTRIBUTIONS OF JOHN MCKAY
April 27 – 29, 2007, CRM
Sponsored by CRM, Concordia University and the CICMA
Organizers: John Harnad (Concordia), Pavel Winternitz (Montréal)

Regular members of the laboratory

HENRI DARMON (McGill), *Director*
Algebraic number theory, geometry, arithmetic, *L*-functions, diophantine equations, elliptic curves

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

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

ADRIAN IOVITA (Concordia)
Number theory, *p*-adic cohomology

OLGA KHARLAMPOVICH (McGill)
Combinatorial theory of groups 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

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

ALEXEI G. MIASNIKOV (McGill)
Group theory

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 have been evident throughout human history and reflect their deep link to our experience of the universe. They are a focal point of modern mathematics and in effect several domains of mathematics have recently shown a strong trend towards a geometrization of ideas and methods: two cases in point are mathematical physics and number theory. During the last twenty-five years, several researchers of international calibre in geometry and topology have been hired by Québec universities. The research centre, based at UQÀM, now comprises eighteen professors together with a large number of postdoctoral fellows and graduate students. 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; and Hamiltonian dynamical systems.

News and highlights

Many of our postdoctoral fellows have left for new positions, and we are particularly pleased to note that they have been offered positions at prestigious institutions around the world, such as Caltech, Duke, École Polytechnique, Stanford and Warwick. Likewise, several of our Ph.D. students have finished last summer, and then left for various postdoctoral positions around the world. We would like in particular to highlight the contributions of Baptiste Chantraine, founder and organizer of the CIRGET Junior Seminar and a very promising young mathematician. Throughout his stay, he worked to create the dynamic student life that has become one of the great assets of CIRGET.

Students, postdoctoral fellows, and visitors

Here is a list of the CIRGET postdoctoral fellows for 2006 – 2007, including their research interests.

Ceyhan, Özgür (Ph.D. 2006, Strasbourg 1)
Real algebraic geometry and enumerative problems

Charbonneau, Benoit (Ph.D. 2004, MIT)
Gauge theory
Charbonneau has accepted a visiting professor position at Duke University.

Chuai, Jianjun (Ph.D. 2003, Queen's)
Invariant theory

Duchemin, David (Ph.D. 2004, Strasbourg 1)
Low-dimensional quaternionic geometry
David Duchemin left in February 2007 for a postdoctoral position at the École Polytechnique in Palaiseau, France.

Friedl, Stefan (Ph.D. 2003, Brandeis)
Low-dimensional topology and knot theory
Stefan Friedl has been offered an Assistant Professor position at the University of Warwick, starting in 2008.

Gambino, Nicola (Ph.D. 2002, Manchester)
Combinatorics, homotopy algebra
Gambino will be continuing as a postdoctoral fellow at the Centre de Recerca Matemàtica in Barcelona, Spain.

Ghiggini, Paolo (Ph.D. 2004, Pisa)
Low-dimensional contact topology
Paolo Ghiggini has accepted a postdoctoral position at Caltech.

Gürel, Başak (Ph.D. 2003, UC Santa Cruz)
Hamiltonian dynamical systems, symplectic topology and geometry

Hu, Shengda (Ph.D. 2003, Wisconsin – Madison)
Algebraic geometry of toric varieties, Gromov – Witten invariants and orbifolds

Lisi, Samuel (Ph.D. 2005, Courant Institute, NYU)
Symplectic and contact geometry
Samuel Lisi has started a postdoctoral position at Stanford University in September 2007.

Mohammadalikhani, Ramin (Ph.D. 2003, Toronto)
Equivariant cohomology, moduli spaces of fiber bundles, quantum homology

Walsh, Genevieve (Ph.D. 2003, UC Davis)
Virtual properties of three-dimensional manifolds
Genevieve Walsh is now an Assistant Professor at Tufts University.

Altogether, in 2006 – 2007, 12 undergraduate students, 34 master's students, 20 Ph.D. students and 27 postdoctoral fellows were supervised or cosupervised by regular or associate members of the laboratory.

Seminars

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 Seminar, organized by Olivier Collin, is a general seminar series attended by all CIRGET members. Of the 24 talks given this year, 18 were given by invited speakers who stayed at the centre for short research visits. To complement this general seminar, CIRGET organized two more specialized seminars and one working group, so that three poles of research were developed: the Geometric Group Theory Seminar with 20 talks given (organizer: Dani Wise), the Symplectic Topology Seminar with 25 talks given (organizers: Başak Gürel and Samuel Lisi), and the Working Group on Heegaard Floer Homology (organizer: Paolo Ghiggini).

CIRGET graduate students from UQÀM, Université de Montréal and McGill continued to participate in the CIRGET Junior Seminar, organized by Baptiste Chantraine, a doctoral student. This seminar gives graduate students a forum to present their research to their peers and to practice giving talks in a relaxed setting. It has also created a natural meeting place for the students, who now form a cohesive interuniversity student body. This year a total of 20 talks were given.

Workshops, special sessions, and others

In 2006 – 2007, the members of CIRGET organized three conferences at the CRM. The first two of these were actually sponsored by CIRGET. Reports on these conferences may be found in the section on the CRM general program.

• CONFERENCE ON 3-MANIFOLD TOPOLOGY IN HONOUR OF PETER SHALEN'S 60TH BIRTHDAY
June 12 – 15, 2006, CRM
Organizers: Steven Boyer (UQÀM), Richard Canary (Michigan), Marc Culler (Illinois at Chicago), Nathan Dunfield (Caltech), Benson Farb (Chicago)

• MINI-COURSES AND CONFERENCE ON GEOMETRIC GROUP THEORY
July 3 – 14, 2006, CRM
Organizers: Mladen Bestvina (Utah), Steven Boyer (UQÀM), Tadeusz Januszkiewicz (Ohio), Michah Sageev (Technion), Daniel T. Wise (McGill)

• WORKSHOP ON THE GEOMETRY OF HOLOMORPHIC AND ALGEBRAIC CURVES IN COMPLEX ALGEBRAIC VARIETIES
April 30 – May 4, 2007, CRM
Organizers: Xi Chen (Alberta), James D. Lewis (Alberta), Steven Shin-Yi Lu (UQÀM), Peter Russell (McGill)

Members of the laboratory

Regular members

STEVEN BOYER (UQÀM), *Director*
Topology of manifolds, low-dimensional geometry and topology

VESTISLAV APOSTOLOV (UQÀM)
Complex geometry, Kähler geometry

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 (UQÀM)
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 (UQÀM)
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 (UQÀM)
Chern number inequalities, semi-stability 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)
Spectral theory, semi-classical analysis, microlocal analysis, Hamiltonian mechanics

LaCIM

Description

LaCIM (French acronym meaning "Combinatorics and Mathematical Informatics Laboratory") is home to mathematics and theoretical computer science researchers whose interests comprise discrete mathematics and the mathematical aspects of computer science. LaCIM was founded in 1989 and is associated with the Department of Mathematics, the Department of Computer Science, and the Canada Research Chair in Algebra, Combinatorics and Mathematical Informatics of the Université du Québec à Montréal. LaCIM includes 13 regular members (of whom 8 are UQÀM professors), 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, undergraduate students who do research work during the summer, and some cégep 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

Gilbert Labelle retired in September 2006 but is still a very active member of LaCIM. He was made an Emeritus Professor by UQÀM. On October 18, 2006, during a convocation ceremony, UQÀM awarded an honorary doctorate to Maurice Nivat, Emeritus Professor at the Université Paris 6 and collaborator of Srecko Brlek and Christophe Reutenauer. LaCIM is becoming ever more international, and in 2007 the following distinguished researchers joined LaCIM: Jean Berstel (Marne-la-Vallée), Michel Mendès France (Bordeaux 1), Mark Haiman (UC Berkeley) and Laurent Vuillon (Chambéry). These four mathematicians have been visiting LaCIM regularly over the years and have collaborated extensively with its regular members. A new UQÀM professor, Christophe Hohlweg, is a collaborating member of LaCIM and will become a regular member as soon as he is awarded an NSERC grant.

Students, postdoctoral fellows, and visitors

In 2006–2007 five postdoctoral fellows were working at LaCIM (the names of the supervisors are within parentheses): Nicola Gambino (André Joyal), Amy Glen (Srecko Brlek and Christophe Reutenauer), Aaron Lauve (François Bergeron and Christophe Reutenauer), Sarah Mason (François Bergeron) and Franco Saliola (François Bergeron). Sarah Mason is now Assistant Professor at Davidson College (North Carolina) and Aaron Lauve Visiting Assistant Professor in the Department of Mathematics of Texas A&M University. Nicola Gambino is currently a postdoctoral fellow at the Centre de Recerca Matemàtica in Barcelona (Spain).

Christophe Paul, of LIRMM (Montpellier), spent a sabbatical year at LaCIM working with Srecko Brlek and Cédric Chauve. Laurent Vuillon, of LAMA (Chambéry), visited LaCIM from February to April 2007 and collaborated with Srecko Brlek and Christophe Reutenauer. Kia Dalili visited LaCIM to work with Aaron Lauve. In 2006–2007, the following mathematicians visited François Bergeron: Christian Kassel (Strasbourg 1), Jim Haglund (Pennsylvania), Mark Haiman (UC Berkeley), Richard Stanley (MIT), Ernst Dieterich (Uppsala), Stéphanie van Willigenburg (UBC), and Adriano Garsia (UC San Diego). As part of a CNRS project ("Projet International de Coopération Scientifique") between LaBRI (Bordeaux 1) and LaCIM, Srecko Brlek supervised the students Abdelaziz Hibaoui from July 5 to August 5, 2006, and Omer-Landry Nguena-Timo from June 26 to August 16, 2006. As part of Cédric Chauve's cooperation project, Sylvie Hamel supervised the following students: Sébastien Angibaud (Ph.D. student, LINA, Nantes), from November 27 to De-

cember 16, 2006, Emric Gioan (CNRS, LIRMM, Montpellier), from November 22 to December 2, 2006, and Annelyse Thevenin (Ph.D. student, LRI, Paris-Sud), from November 6 to December 16, 2006.

Altogether, in 2006–2007, 5 undergraduate students, 31 master's students, 30 Ph.D. students and 7 postdoctoral fellows were supervised by Laboratory members.

Seminars

The LaCIM Combinatorics and Theoretical Informatics Seminar, held weekly on Friday mornings, is attended regularly by LaCIM members, graduate students and postdoctoral fellows. The lectures are sometimes given by members of other CRM laboratories (for instance Andrew Granville and Alexei Miasnikov), but most of them are given by visitors. Let us mention Jeff Remmel (San Diego), Luigi Santocanale (LIF/CMI, Marseille), Angèle Hamel (Wilfrid Laurier), Damien Roy (Ottawa), Christian Kassel (Strasbourg), Christophe Hohlweg (Fields, Toronto), Kia Dalili (Dalhousie), Pierre Cartier (IHÉS), Denis Serbin (McGill), Mark Haiman (Berkeley) and George Lusztig (MIT). There were no lectures during the Winter 2007 term, because at that time the focus of LaCIM members was the Thematic Semester on Recent Advances in Combinatorics (see below).

Workshops, special sessions, and others

In September 2006, François Bergeron, Srecko Brlek and Christophe Reutenauer organized a Conference in honour of Pierre Leroux. The goal of the conference was to highlight his contributions to the development of combinatorics at UQÀM and elsewhere, and especially to the founding of LaCIM. Although Pierre Leroux is now retired, he is actively involved in research and remains one of the driving forces of LaCIM. A detailed report on this conference may be found in the section on the CRM General Program.

• CONFERENCE IN HONOUR OF PIERRE LEROUX
September 8–9, 2006, Université du Québec à Montréal
Organizers: Srecko Brlek (UQÀM), Christophe Reutenauer (UQÀM), François Bergeron (UQÀM)

On the other hand, the Thematic Semester on Recent Advances in Combinatorics was a resounding success; a detailed report on this semester may be found in the section on the CRM Thematic Program. The semester was organized by several members of LaCIM, including François Bergeron, Srecko Brlek, Pierre Leroux and Christophe Reutenauer, and consisted of schools and workshops on varied topics. Students from all parts of the world took part in those events, which were of a very high calibre.

Members of the laboratory

Regular members

SRECKO BRLEK (UQÀM), *Director*
Combinatorics of words, algorithmics

ROBERT BÉDARD (UQÀM)
Representations of finite groups, Lie theory

FRANÇOIS BERGERON (UQÀM)
Combinatorics, algebra, representations of finite groups

CEDRIC CHAUVE (Simon Fraser and UQÀM)
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

GILBERT LABELLE (UQÀM)
Enumerative combinatorics, analysis

PIERRE LEROUX (UQÀM)
Enumerative and algebraic combinatorics

VLADIMIR MAKARENKOV (UQÀM)
Computational biology, mathematical classification

JOHN MULLINS (Polytechnique Montréal)
Analysis of cryptographic protocols and e-commerce protocols, formal semantics, secure mobile code specification, operational concurrency models

CHRISTOPHE REUTENAUER (UQÀM)
Algebraic combinatorics, noncommutative algebra, automata theory, coding theory, free algebras

DENIS THÉRIEN (McGill)
Complexity theory, logic, combinatorics, probability theory

TIMOTHY R.S. WALSH (UQÀM)
Algorithmics, enumerative combinatorics, graph theory

Associate members

PIERRE LALONDE (Cégep 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 (UQÀM)
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 (UQÀM and CRM)
Combinatorial optimization, integer programming, graph theory

DOMINIC ROCHON (UQTR)
Complex analysis, hypercomplex numbers

Collaborating members

MARCELLO AGUIAR (Texas A&M)
Algebraic combinatorics, non-commutative algebra, Hopf algebras and quantum groups, category theory

LUC BÉLAIR (UQÀM)
Mathematical logic, model theory

NANTEL BERGERON (York)
Applied algebra

PIERRE BOUCHARD (UQÀM)
Commutative algebra, algebraic geometry and combinatorics

MICHEL BOUSQUET (Cégep du Vieux-Montréal)
Enumeration of combinatorial structures, planar maps and cacti, theory of species, Lagrange inversion formulas

YVES CHIRICOTA (UQÀC)
Computer graphics, mathematical methods in computer graphics, combinatorics, computational geometry, symbolic computation

SYLVIE CORTEEL (LRI, Paris-Sud)
Enumerative and bijective combinatorics, partitions of integers and q-series

ADRIANO GARSIA (UC San Diego)
Algebraic combinatorics, symmetric functions, harmonic and co-invariant spaces, quasiharmonic and quasi-invariant functions

ANDRÉ JOYAL (UQÀM)
Algebraic topology, category theory

JACQUES LABELLE (UQÀM)
Combinatorics, topology

LOUISE LAFOREST (UQÀM)
Data structures, combinatorics, asymptotic analysis, quaternary trees

DANIEL LEMIRE (TELUQ)
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. Currently the Laboratory has 32 regular and 6 associate members working at eight different universities in Québec, the United States 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

Eugene Kritchevski, a Ph.D. student in Analysis at McGill, won the Carl Herz Prize. Congratulations! The Carl Herz Prize, awarded annually, recognizes a research contribution to mathematics or statistics made by a doctoral student registered at one of the ISM member universities (see the section on Mathematical Education).

Alina Stancu (Concordia) has become a regular member of the laboratory in 2006 – 2007 and Alexey Kokotov (Concordia) an associate member in 2007 – 2008. Welcome!

Students, postdoctoral fellows, and visitors

In 2006 – 2007, the following postdoctoral fellows were working with members of the Mathematical Analysis Laboratory (the names of the supervisors are within parentheses): Constantin Costara (Thomas Ransford), Sara Derivière (Tomasz Kaczynski), Dan Mangoubi (Dmitry Jakobson and Iosif Polterovich), Andrew McIntyre (D. Korotkin), Julie Rowlett (Dmitry Jakobson, John Toth and Iosif Polterovich), Igor Wigman (Dmitry Jakobson, John Toth, Andrew Granville, Iosif Polterovich and Alexander Shnirelman), and Chang Zhong Zhu (Paul Gauthier). Altogether, in 2006 – 2007, 9 undergraduate students, 40 master's students, 39 Ph.D. students and 15 postdoctoral fellows were supervised or cosupervised by regular or associate members of the laboratory.

The Mathematical Analysis Laboratory also welcomed the following researchers: M. Aizenman (Princeton), P. Bachurin (Toronto), A. Blanco (Queen's University Belfast), A. Bourhim (Moncton), D. Chang (Georgetown), D. G. de Figueiredo (Campinas, Brazil), D. Dryanov, E. Fricain (Lyon), F. Germinet (Cergy-Pontoise), A. Koldobsky (Missouri), J.-P. Lessard (Georgia Tech), M. Levitin (Heriot-Watt), V. Matsaev (Tel Aviv), M. Monastyrski (Moscow), A. Moudafi (Université des Antilles et de la Guyane), Y. Pautrat (Orsay), R. Pereira (Saskatchewan), M. Pramanik (UBC), R. Roussarie (Dijon), D. Ruelle (IHÉS), Y. Safarov (King's College London), D. Schenker (Princeton), R. Schubert (Bristol), R. Shvydkoi (Chicago), L. Stolovitch (Toulouse), E. Stredulinsky (Wisconsin), A. Strohmaier (Bonn), S. Warzel (Princeton), M. White (Newcastle), and S. Zelditch (Johns Hopkins).

Seminars

The members of the Mathematical Analysis Laboratory organize several seminars at four main locations. Laval University hosts an Analysis Seminar, which featured 20 talks in 2006 – 2007, and an Analysis Workshop, which featured 21 talks. Alex Shnirelman (Concordia) and Dmitry Jakobson (McGill) organize jointly the McGill/Concordia Analysis Seminar, which featured 31 talks in 2006 – 2007. At the Université de Montréal, Christiane Rousseau organizes a Seminar in Nonlinear Analysis and Dynamical Systems that featured 9 talks in 2006 – 2007. At the Université de Sherbrooke, Madjid Allili, Virginie Charette, François Dubeau and Tomasz Kaczynski organize a Seminar in Computational Geometry and Topology that featured 10 talks in 2006 – 2007. At the Université de Montréal, Paul Gauthier organized a Séminaire d'analyse featuring 7 talks and Iosif Polterovich a Working Seminar in Spectral Geometry that featured 12 talks. Finally, Eugene Kritchevski and Ivo Panayotov organized a Student Seminar in Analysis and Probability (Concordia/McGill/Montréal) that featured 11 talks.

Workshops, special sessions, and others

In 2006 – 2007 the following conferences were organized by members of the Mathematical Analysis Laboratory. Detailed reports on these conferences may be found in the section on the CRM General Program.

• GILLES FOURNIER MEMORIAL CONFERENCE ON CLASSICAL AND COMPUTATIONAL TOPOLOGICAL METHODS
September 22 – 24, 2006, Université de Sherbrooke
Sponsored by the CRM, the Mathematical Analysis Laboratory (CRM), Bishop's University and the Faculty of Sciences of the Université de Sherbrooke
Organizers: Madjid Allili (Bishop's), Tomasz Kaczynski (Sherbrooke)

• ANALYSIS DAY 2007
May 2, 2007, CRM
Organizer: Dmitry Jakobson (McGill)

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, several complex variables

DONALD A. DAWSON (Carleton)
Probability, stochastic processes

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

RICHARD DUNCAN (Montréal)
Ergodic theory, martingale theory, probability theory in Banach spaces

RICHARD FOURNIER (Dawson College)
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

KOHUR GOWRISANKARAN (McGill)
Potential theory

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

YIANNIS N. PETRIDIS (Lehman College, CUNY)
Automorphic forms and their spectral theory, analytic number theory, spectral and scattering theory of manifolds

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

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, non-smooth analysis, stability, optimal order

JOHN A. TOTH (McGill)
Spectral theory, semi-classical analysis, microlocal analysis, Hamiltonian mechanics

SAMUEL ZAIDMAN (Montréal)
Functional analysis and differential equations in abstract spaces, pseudo-differential operators

Associate members

OCTAVIAN CORNEA (Montréal)
Algebraic topology, dynamical systems

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 (McGill)
Applied analysis, numerical methods in electromagnetism

Mathematical Physics

Description

The mathematical physics group is one of the oldest and most active at the CRM. It consists of fourteen regular members, all full-time faculty at five Quebec Universities, and fourteen associate members. The Laboratory also includes eight research associates and postdoctoral fellows, and lab members supervise or cosupervise the thesis work of approximately fifty students. The group hosts many visiting researchers and 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; asymptotics of eigenstates; foundational questions in quantization; coherent states; wavelets; supersymmetry; the symmetry analysis of PDE's and difference equations; representation theory of Lie groups and quantum groups; and the mathematical structure of classical and quantum field theories.

News and highlights

After a major reorganization in the previous year (2005–2006), the PhysMath Lab membership, consisting of fourteen regular members and fourteen associate members, remained invariant during the 2006–2007 academic year. Five of the Associate members are "external" members, three from France, one from Italy and one from the U.S., all close collaborators of regular members of the Lab and frequent visitors at the CRM.

John Harnad was recipient of the 2006 CAP–CRM Prize in Theoretical and Mathematical Physics, which was conferred at the annual Congress of the Canadian Association of Physicists (CAP) at Brock University, in June 2006. This award is given annually jointly by the CAP and the CRM, "in recognition of exceptional achievements in theoretical and mathematical physics." He gave a plenary talk at the CAP congress entitled "Shadows on the Wall: Plato's Parable of the Cave as a metaphor for Integrable Dynamics and Spectral Statistics." Harnad was the third recipient of the award amongst the members of the CRM PhysMath Lab — the previous winners being Pavel Winternitz (2002) and Jiří Patera (2004). He was also the recipient, in October 2006, of the first Concordia University FAS Dean's Award for Distinguished Scholarship.

John Harnad was an invited organizer, jointly with Jinho Baik (University of Michigan), of the session on Random Matrices at the August 2006 International Congress of Mathematical Physics (ICMP), which was held in Rio de Janeiro. The ICMP takes place every three years. In October 2006, Pavel Winternitz was awarded a Doctorate Honoris Causa by the Czech Technical University (Prague). The PhysMath Lab bestowed its "best student" awards for 2006–2007 to two doctoral students completing their thesis research under the supervision of Lab members. The recipients were: 1) Ferenc Balogh (Concordia), whose doctoral research, under the supervision of John Harnad, is on equilibrium measures of log Coulomb gases, spectral distributions of random normal matrices, orthogonal polynomials in the plane and Laplacian growth; and: 2) Benoit Huard (Université de Montréal), whose doctoral research, under the supervision of Michel Grundland, is on conditional symmetries and Riemann invariants for hyperbolic systems of PDEs.

The preparatory work for the 2008–2009 CRM Thematic Program on Probabilistic Methods in Mathematical Physics began in May 2006. This involved choosing, first of all, two further coordinators, Pavel Bleher (IUPUI) and Steve Zelditch (Johns Hopkins), who, together with Lab Director John Harnad, were responsible for selecting the Scientific Committee and guiding the program into existence. The Scientific Committee consists of four Canadians: David Brydges (UBC), John Harnad (Concordia), Yvan Saint-Aubin (Montréal), and Pavel Winternitz (Montréal); four Americans: Pavel Bleher (IUPUI), Charles Newman (Courant Institute), Craig Tracy (UC Davis), and Steve Zelditch (Johns Hopkins); and three Europeans: Alice Guionnet (ENS, Lyon), Herbert Spohn (TU München), and Jean-Bernard Zuber (LPTHE, Paris 6).

The program was decided upon by the coordinators, in consultation with the Scientific Committee and partly in consultation with a committee based at PIMS (which is planning a joint PIMS–CRM 2009 Program on New Trends in Probability Theory). It will consist mainly of: eleven research workshops, each lasting one week, nine of which will take place

in Montréal, one in the Laurentian Mountains and one at the Banff International Research Station; three Aisenstadt Chairs: Wendelin Werner (2006 Fields Medallist), Craig Tracy (2002 SIAM Pólya Prize and 2007 SIAM Wiener Prize winner), and Andrei Okounkov (2006 Fields Medallist); twenty-four long-term visitors who will be at the CRM for periods of three to four weeks, plus one, Pavel Bleher, who will be staying for a five-month period; five postdoctoral fellows working under the supervision of Lab members on subjects lying within the scope of the Thematic Year; and several preparatory courses on related topics, given by lab members and long-term visitors. This CRM Thematic Program will take place between June 2, 2008 and June 14, 2009. More details may be found on the CRM web site.

Two further events organized by Lab members will take place in June 2008: the NATO Advanced Study Institute (June 9 – 21, 2008), and the international workshop SIDE 8 (June 22 – 28, 2008). Both events are on the same general theme (Symmetries and Integrability of Discrete Equations). The main organizer for these events is Pavel Winternitz, helped by Decio Levi (Roma 3) and Peter Olver (Minnesota). Other lab members on the organizing committee are John Harnad, Véronique Hussin and Luc Vinet. More details may be found on the site `crm.math.ca/SIDE8/contact_e.shtml`.

Students, postdoctoral fellows, and visitors

The following postdoctoral fellows and research associates worked in 2006 – 2007 under the supervision of one or more of the regular members of the PhysMath Lab (the names of the supervisors are listed within parentheses): Iana Anguelova (M. Bertola, J. Harnad, C. Cummins), Armen Atoyan (research associate, J. Patera), Mhenni Benghorbal (R. Hall), Mickaël Germain (J. Patera), Andrew McIntyre (D. Korotkin, M. Bertola), Man Yue Mo (J. Hurtubise, M. Bertola), Maryna Nesterenko (collaborator, J. Patera), Béla Gábor Pusztai (M. Bertola, J. Harnad, D. Korotkin), David Ridout (P. Mathieu), Ismet Yurdusen (collaborator, Michel Grundland, Véronique Hussin, Pavel Winternitz).

Amongst our recent postdoctoral fellows and students, Man Yue Mo completed a year on a postdoctoral research position at the University of Bristol, where he is continuing in 2007 – 2008, and Igor Loutsenko spent the two years 2005 – 2007 as Marie Curie Research Fellow at the Oxford Centre for Industrial and Applied Mathematics (OCIAM). Former doctoral student Oksana Yermolayeva was continuing as Marie Curie Research Fellow at the International School for Advanced Studies (SISSA) in Trieste, and former student Vasilisa Schramchenko divided her time over the past two years (2005 – 2007) between the Max Planck Institut in Bonn (where she held an Alexander von Humboldt Fellowship) and the Mathematical Institute at the University of Oxford (where she held an EPSRC postdoctoral research fellowship and was a Junior Fellow of Worcester College).

Altogether, in 2006 – 2007, 6 undergraduate students, 37 master's students, 21 Ph.D. students and 17 postdoctoral fellows were supervised or cosupervised by regular or associate members of the laboratory. The following is a list of the researchers who visited the Lab in the period July 2006 – June 2007, as guests of one or more of the Lab members. Many of these are collaborators and/or external Associate Members. Their affiliations and the names of their hosts are indicated within parentheses.

- J. M. Antuna (La Habana), May 1 – August 28, 2006 (T. Ali and R. Hall)
- L. Lapointe (Talca), June 10 – 15, 2006 (P. Mathieu)
- B. Doyon (Oxford), August 6 – 10, 2006 (P. Mathieu)
- O. Sanchez (La Habana), September 1 – 30, 2006 (T. Ali)
- P. Desrosiers (Melbourne), September – December, 2006 (P. Mathieu)
- V. Enolskii (Kiev), September – December, 2006 (J. Harnad)
- L. Snobl (Czech Technical University), September 9 – 30, 2006 (P. Winternitz)
- M. Englis (Czech Academy of Sciences, Prague), September 5 – 17, 2006 (T. Ali)
- W. Lucha (Austrian Academy of Sciences), October 2006 (R. Hall)
- A. Orlov (Oceanology Institute, Moscow), October 2 – 30, 2006, and January 8 – February 8, 2007 (J. Harnad)
- Z. Thomova (SUNY, IT Utica), October 26 – 31, 2006, and January 8 – 14, 2007 (P. Winternitz)
- D. Levi (Roma 3), October 28 – November 28, 2006 (P. Winternitz)
- Maia Angelova (Newcastle, Northumbria), November 2006 (V. Hussin)
- Jean-Pierre Gazeau (Paris 6), November 4 – 11, 2006 (T. Ali, J. Patera and M. Grundland)
- Robert Conte (CEA, Saclay), November 4 – 11, 2006 (M. Grundland)
- Jørgen Rasmussen (Melbourne), November 6 – 10, 2006 (Y. Saint-Aubin)

• Mark Bodner, November 29 – 30, 2006 (J. Patera)
• Erhard Neher (Ottawa), December 5 – 6, 2006 (J. Patera)
• Patrick Jacob, Durham, December 19 – 21, 2006 (P. Mathieu)
• John Van de Leur (Utrecht), January 20 – 30, 2007 (J. Harnad)
• Pavel Bleher (IUPUI), January 25 – 27, 2007 (J. Harnad)
• Vyacheslav Furtony (São Paulo), January 30 – February 2, 2007 (J. Patera)
• Iryna Kashuba (São Paulo), December 8, 2006 – February 28, 2007 (J. Patera)
• B. Eynard (CEA Saclay, France), March 18 – 30, 2007 (J. Harnad)
• Slava Yukalov (Dubna, Russia), March 2007 (R. Hall)
• Alexander Its (IUPUI), March 12 – 17, 2007 (J. Harnad)
• Michael Gekhtman (Notre Dame), April 9 – 13, 2007 (M. Bertola)
• Jacek Szmilgielski (Saskatchewan), April 9 – 13, 2007 (M. Bertola)
• Philip Boalch (ENS, Paris), April 23 – 30, 2007 (J. Harnad and J. Hurtubise)
• Anatoliy Klimyk (Kiev, Ukraine), April 23 – May 31, 2007 (J. Patera)
• Willy Hereman (Colorado School of Mines), May 12 – 31, 2007 (M. Grundland)
• Robert Conte (CEA, Saclay), April 9 – 24, 2007 (M. Grundland)
• P.-G. Tempesta (SISSA, Trieste), Spring 2007 (P. Winternitz)
• G. Pogosyan (Yerevan, Dubna), Spring 2007 (P. Winternitz)

Seminars

The usual weekly Seminar Series in Mathematical Physics took place at the CRM every Tuesday afternoon throughout both terms, with active participation by members, visitors, postdoctoral fellows and students. Michel Grundland (UQTR) and S. Twareque Ali (Concordia) were the organizers for the 2006 – 2007 academic year. Approximately half the talks were given by visiting invited speakers, the rest by regular and associate lab members, postdoctoral fellows and visitors.

In addition, the Working Seminar on Integrable Systems, Random Matrices, Random Processes continued, taking place every Thursday afternoon at Concordia, with the active participation of many lab members, students, postdoctoral fellows and visitors. In 2006 – 2007 Marco Bertola (Concordia) and Iana Anguelova (postdoctoral fellow) were the organizers of this seminar.

Workshops, special sessions, and others

S.T. Ali and members of the Department of Physics of the University of Havana, with active input from further members of the PhysMath Lab (J. Harnad) and members of CICMA (H. Kisilevsky), organized again an International Workshop on Differential Equations, Number Theory, Data Analysis Methods and Geometry. This workshop was on a much larger scale than the previous ones, and took place at the beautifully located and historic Hotel Nacional in central Havana. The PhysMath Lab provided some resources (web site, poster), as well as some modest financial support. A detailed report on this event may be found in the section on the CRM general program.

• XTH INTERNATIONAL WORKSHOP ON DIFFERENTIAL EQUATIONS, NUMBER THEORY, DATA ANALYSIS METHODS AND GEOMETRY
February 19 – 23, 2007, Universidad de La Habana
Sponsored by the Faculty of Mathematics and Computation of the University of Havana, the Department of Mathematics and Statistics of Concordia University, the Institute of Cybernetics, Mathematics and Physics of the Academy of Sciences of Cuba, and the CRM
Organizers: Syed Twareque Ali (Concordia), Reinaldo Rodriguez Ramos (La Habana), François Lalonde (Montréal)

John Harnad was one of the organizers of a conference honouring John McKay. A detailed report on this conference may be found in the section on the CRM general program.

• "GROUPS AND SYMMETRIES: FROM THE NEOLITHIC SCOTS TO JOHN MCKAY"
CONFERENCE HONOURING THE CONTRIBUTIONS OF JOHN MCKAY
April 27 – 29, 2007, CRM
Sponsored by CRM, Concordia University, and CICMA
Organizers: John Harnad (Concordia), Pavel Winternitz (Montréal)

From May 12 to July 28, 2006, Yvan Saint-Aubin held a workshop on the renormalizaton group (*Atelier d'étude sur le groupe de renormalisation*). This was a weekly workshop geared towards graduate students; 8 participants attended the workshop.

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

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

JEAN LETOURNEUX (Montréal)
Symmetry properties of systems, special functions

PIERRE MATHIEU (Laval)
Conformal field theory, classical and quantum integrable systems, affine Lie algebras

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

LUC VINET (Montréal)
Symmetry properties of systems, special functions

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 (Cégep 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 7)
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, infinite dimensional transformation groups

DECIO LEVI (Roma 3)
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 (Miami)
Non-equilibrium statistical mechanics, fluctuations and stochastic processes, quantum transport in condensed matter, electronic behavior in submicron quantum devices

PhysNum

Description

PhysNum is a laboratory dedicated to the study and solution of mathematical problems arising in medicine and pharmacology. We first describe the work of the PhysNum – MIC group, where MIC stands for "Mathématiques de l'Imagerie Cérébrale" (Mathematics of Brain Imaging).

The members of the PhysNum – MIC group specialize in brain imaging methodology and functional neuroimaging, in particular the modelling of cerebral activity, the analysis methodology for optical and bioelectrical signals, the solution of inverse problems that include multimodal data, time-frequency analyses, and the synchrony and specter of singularities of intracranial electroencephalography signals. On the other hand, Frédéric Lesage is developing new imaging modalities for small animals, especially photo-acoustic imaging and intrinsic optical imaging; in his work, he uses recent results from approximation theory ("compressed sensing") to develop ground-breaking innovations in methodology.

Habib Benali works on the modelling of physiological brain processes and has developed models of interaction between the neuron populations whose activity is detected through functional magnetic resonance imaging (fMRI) or electroencephalography (EEG). His goal is to obtain a better interpretation of the signals produced by these two modalities and, broadly speaking, to understand better the functional connectivity of the brain. Habib Benali's research thus sheds light on the learning and adaptive processes of the brain, on the postoperative recuperation processes, and on the BOLD signal of spinal chord imaging.

All members of the PhysNum – MIC group belong to a research team financed by FQRNT, the Québec government granting agency. The goal of this team is to develop methods of analysis for signals produced by different methodologies (optical imaging, EEG, MEG, and fMRI). The team members use variational calculus techniques and entropy-based methods to solve inverse problems arising in the detection of neuronal activity through several imaging modalities (including optical imaging). Jean-Marc Lina uses techniques based on analytic wavelets to study bioelectrical signals in the brain. The two goals of the team are to study the synchronies and "skeletons" in the time/frequency plane of the signals (optical signals, EEG signals, intracranial signals in the context of epilepsy), and to study the specters of singularities in the preictal phase (i.e., the phase just before a fit of epilepsy). The work of the team relies on the use of "wavelet leaders" within the framework of Daubechies complex wavelets.

The research interests of Fahima Nekka, a professor at the Faculty of Pharmacy of the Université de Montréal, are in pharmacokinetic models and the application of fractal analysis to porous media. One of her projects consists of studying the pharmacokinetic variability induced by drug intake behaviour in animal collective therapy. The non-uniform access to medicated feed, influenced by swine individual feeding behaviour, is a determinant of antibiotic exposure. F. Nekka and her team used reported animal behaviour to propose a feeding behaviour pharmacokinetic model of in-feed chlortetracycline; they were able to delineate the impact of different feeding behaviour components and characterize the induced model variability. This work enabled them to offer a practical tool, incorporated into medical practice, for choosing a dosing regimen based on dose and age.

In a second project, F. Nekka and her team are using a random time series approach to formalize the drug intake behaviour of patients and make it an integral part of a general pharmacokinetic model. They showed that the random features of drug intake behaviour, previously treated as "noise," are in fact an inherent component of the mechanistic model. Thus the variability in compliance adds an additional variation to the regular oscillation curves of the main drug administration routes. F. Nekka and her team have properly characterized this variation; their work will allow an objective medical intervention and can be adapted to different compliance patterns in various pathologies.

Fahima Nekka and her research group are also working on the processing of complex data and the application of complexity analysis to polymers and porous media (which are widely used as vehicles for drug delivery). The design of synthetic polymers has been revolutionized by the recent achievements in high-resolution, broad-mass-range spectrometry. Wave propagation and scattering through porous media and highly ramified materials give rise to (spatial) signals that can be considered as defined on fractal systems. The autocorrelating process is a classical mathematical method widely used in engineering and the applied sciences to reorganize

intrinsic similarities hidden in a structure. On the other hand, fractal methods enable one to quantify efficiently complex information based on existing similarities. The inadequacy of traditional methods and the known limitations of popular fractal methods led F. Nekka to combine both approaches in order to create more powerful and less degenerate methods.

Students

In 2006 – 2007, Frédéric Lesage supervised the Ph.D. students Sarah Chapuisat (in collaboration with H. Benali) and Mathieu Dehaes, and the master's students Nicolas Brieu, Michèle Desjardins, Louis Gagnon, Carl-Matteau Pelletier (in collaboration with J.-M. Lina), Jean Provost and Ronan Quelever. Jean-Marc Lina supervised the Ph.D. student Aude Donfack (in collaboration with R. Noumeir) and the master's students Aude Guidini, François Laurent (in collaboration with J. Gotman), Hicham Mahkoum and Yann Potiez. Fahima Nekka supervised the following students: Frédérique Fenneteau, Liah Fereydoonzad, Guillaume Gallois, Denis Gohore Bi, Fabien Montiel, Caroline Emmanuelle Petit-Jetté, and Alexandre Trudel.

Altogether, in 2006 – 2007, 4 undergraduate students, 14 master's students, 10 Ph.D. students and 1 postdoctoral fellow were supervised or co-supervised by regular or associate members of PhysNum.

Publications of the PhysNum – MIC group (journals)

1. J. Provost, F. Lesage, *The application of compressed sensing for limited angle photo-acoustic tomography*, IEEE Medical Imaging, 2007 (submitted).
2. J.-M. Lina, M. Dehaes, C. Matteau-Pelletier, F. Lesage, *Complex wavelets applied to diffuse optical spectroscopy for brain activity detection*, Optics Express, 2007 (submitted).
3. A. Gallagher, M. Lassonde, D. Bastien, P. Vannasing, F. Lesage, C. Grova, A. Bouthillier, L. Carmant, F. Lepore, R. Béland, D. Khoa Nguyen, *A non-invasive pre-surgical investigation in a 10-year-old epileptic boy using simultaneous NIRS-EEG: comparison with SPECT, PET, fMRI-EEG, MEG-EEG and post surgical neuroanatomical assessments*, Brief Communication, Epilepsia, 2007 (submitted).
4. K. Kahlaoui, F. Lesage, N. Senhadji, H. Benali, Y. Joanette, *Hemispheric specialization for the semantic processing of words: a Near-Infrared Spectroscopy (NIRS) study*, Brain and Language, 2007 (in press).
5. J. Cohen-Adad, S. Chapuisat, J. Doyon, S. Rossignol, J.-M. Lina, H. Benali, F. Lesage, *Activation detection in diffuse optical imaging by means of the general linear model*, Medical Image Analysis, 2007 (in press).
6. J. Daunizeau, C. Grova, G. Marrelec, J. Mattout, S. Jbabdi, M. Pélégrini-Issac, J.-M. Lina, H. Benali, *Symmetrical event-related EEG/fMRI information fusion in a variational Bayesian framework*, Neuroimage, 2007, 36(1):69 – 87.
7. S. Jbabdi, P. Bellec, R. Toro, J. Daunizeau, M. Pélégrini-Issac, H. Benali, *Accurate anisotropic fast marching for diffusion-based geodesic tractography*, International Journal of Biomedical Imaging, 2007 (in press).
8. E. Mandonnet, S. Jbabdi, L. Taillandier, D. Galanaud, H. Benali, L. Capelle, H. Duffau, *Preoperative estimation of residual volume for WHO II glioma operated with intraoperative functional mapping*, Neurooncology, 2007, 9(1):63 – 69.
9. G. Marrelec, H. Benali, *Independence between two Gaussian variables given any conditioning subset implies block diagonal covariance matrix*, Statistics & Probability Letters, 2007 (in press).
10. G. Marrelec, B. Horwitz, J. Kim, M. Pélégrini-Issac, H. Benali, J. Doyon, *Using partial correlation to enhance structural equation modelling of functional MRI data*, Magnetic Resonance Imaging, 2007 (in press).
11. V. Perlbarg, P. Bellec, J. L. Anton, M. Pélégrini-Issac, J. Doyon, H. Benali, *CORSICA: Correction of structured noise in fMRI by automatic identification of ICA components*, Magnetic Resonance Imaging, 2007, 25(1):35 – 46.
12. L. Thivard, P. F. Pradat, S. Lehéricy, L. Lacomblez, D. Dormont, J. Chiras, H. Benali, V. Meininger, *Diffusion tensor imaging and voxel based morphometry study in amyotrophic lateral sclerosis: relationships with motor disability*, Journal of Neurology, Neurosurgery, and Psychiatry, 2007, 78:889 – 892.
13. J. Cohen-Adad, H. Benali, S. Rossignol, *Methodology for MR diffusion tensor imaging of the cat spinal cord*, Proceedings of the 29th Annual International Conference of the IEEE EMBS, 2007, pp. 323 – 326.
14. A. Lemay, R. Noumeir, J.-M. Lina, *Pseudonymisation of radiology data for research purposes*, Journal of Digital Imaging, 2007 (in press).
15. S. Chartier, G. Giguère, P. Renaud, J.-M. Lina, R. Proulx, *FEBAM: A feature-extracting*

Bidirectional Associative Memory, International Joint Conference on Neural Networks, 2007.
16. C. Grova, J.-M. Lina, J. Daunizeau, A.-S. Dubarry, J. Gotman, P. Jolicoeur, *MEG sources localization of single trial versus average data: an evaluation using realistic simulations*, NeuroImage, 2007, 36 (Suppl. 1) (abstract).
17. C. Grova, E. Kobayashi, L. Tyvaert, J.-M. Lina, F. Dubeau, P. Jolicoeur, J. Gotman, *Magnetoencephalogram of interictal spike activity: correlation with BOLD responses in EEG–fMRI studies*, Proceedings of the American Epilepsy Society Conference, Philadelphia, 2007 (abstract).
18. C. Grova, J. Daunizeau, E. Kobayashi, A. P. Bagshaw, J.-M. Lina, F. Dubeau, J. Gotman, *Assessing the concordance between EEG source localization and simultaneous EEG–fMRI studies of epileptic spikes*, NeuroImage, 2007 (in press).

Representative publications of Fahima Nekka

1. J. Li, F. Nekka, *A pharmacokinetic formalism explicitly integrating the patient drug compliance*, Journal of Pharmacokinetics and Pharmacodynamics, 2007, 34(1):115 – 139.
2. J. Li, F. Nekka, *Is the classical autocorrelation function appropriate for spatial signals defined on fractal supports*? *The necessity of the generalized autocorrelation function*, Physica A. 2007, 376:147 – 157.
3. F. Nekka, J. Li, *Mathematical tools updated for a variety of complexities and purposes*: *development and adaptation*, Modern Mathematical Models, Methods and Algorithms for Real World Problems (A.H. Siddiqi, L. S. Duff, O. Christensen, eds.), 2007, pp. 125 – 139.
4. A. Khalil, G. Joncas, F. Nekka, P. Kestener, A. Arnéodo, *Morphological analysis of H.* I *Features.* II. *Wavelet-based multifractal formalism*, The Astrophysical Journal Supplement Series, 2006, 165:512 – 596.

Members of the laboratory

Regular members

JEAN-MARC LINA (ÉTS), *Director*
Wavelets, statistical modelling and brain imaging, machine learning

ALAIN ARNÉODO (ENS Lyon)
Fractals and wavelets

HABIB BENALI (Paris 6)
Quantitative analysis in brain imaging, medical imaging and multimodal systems

LINE GARNERO (Paris 6)
Magnetoencephalography

BERNARD GOULARD (Montréal)
Brain imaging

FRÉDÉRIC LESAGE (Polytechnique Montréal)
Conformal theory, integrable systems, inverse problems, optical imaging

FAHIMA NEKKA (Montréal)
Fractal analysis, porous systems, wavelets

Associate member

KEITH J. WORSLEY (McGill)
Statistics of brain mapping, geometry of random images in medicine and astrophysics

Statistics

Description

Statistics is central to many endeavours in society. Whether it be 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 for large data sets. Data mining is one of the tools used.

One of the aims of the Laboratory is to structure the Québec statistical community so that it take part in this revolution at a time when an important renewal of the academic personnel is taking place. This structure allows the Québec community to benefit from a recently created Pan-Canadian program for complex data structures (NPCDS), organized by the three Canadian mathematics institutes. The Laboratory consists 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.

News and highlights

In 2006 – 2007, six new professors became members of the Laboratory: Jonathan Taylor (Université de Montréal, Canada Research Chair in Statistical Imaging), Aurélie Labbe (Université Laval), Fabrice Larribe (UQÀM), Éric Marchand (Université de Sherbrooke), Alejandro Murua (Université de Montréal) and David Stephens (McGill University). Their expertise in statistical genetics, Bayesian statistics, statistical learning, Gaussian processes, and statistical imaging complements the expertise of the other laboratory members.

Several prestigious lectures were delivered by Laboratory members in 2006 – 2007. Jim Ramsay had the great honour of being invited to read one of his papers, "Parameter estimation for differential equations: A generalized smoothing approach" (co-authored with G. Hooker, J. Cao and D. Campbell), at the Royal Statistical Society in England. His article generated the submission of 29 discussion papers and was published in 2007. Keith Worsley gave an invited lecture at the IPAM conference in Shanghai and another one at the IPAM conference in Rio de Janeiro; he was also elected Chair of the Program Committee of the Organization for Humain Brain Mapping at the OHBM Conference that took place in Chicago in June 2007.

Christian Genest was an invited speaker at conferences in Estonia and Brazil. While on sabbatical leave, he delivered series of lectures in Spanish, Swiss, German, Belgian, French, and Italian universities. Jonathan Taylor was an invited speaker in Rio de Janeiro, at the IPAM conference, and at workshops organized by SAMSI and MSRI. Bruno Rémillard was an invited speaker at the first joint meeting of the Canadian Mathematical Society (CMS) and the Sociedad Matemática Mexicana (SMM), held at Guanajuato, Mexico.

Laboratory members are actively taking part in the work of Canadian statistical associations. In 2006 – 2007, Christian Genest was president of the Association des statisticiennes et statisticiens du Québec, and President-Elect of the Statistical Society of Canada (SSC). Bruno Rémillard is co-chair of the Scientific Program Committee of the joint meeting of the Statistical Society of Canada and the Société française de statistique, which will take place in Ottawa in June 2008. As Program Secretary of the SSC, Christian Léger is playing an important role in the scientific planning and organization of this meeting. In 2006 – 2007, he continued his work as Chairman of the Board of the National Program on Complex Data Structures (NPCDS), at a time when the NPCDS was preparing the application for the first renewal of its grant. Christian Léger was appointed to the Statistical Methods Advisory Committee of Statistics Canada for a second term. Belkacem Abdous is still a member of the Grant Selection Committee of NSERC for Statistical Sciences.

Students, postdoctoral fellows and visitors

Laboratory members are very much involved in the training of HQP. Indeed, within their respective departments, statisticians are usually among those who train the largest number of students. Altogether, in 2006 – 2007, 3 undergraduate students, 80 master's students, 59 Ph.D. students and 14 postdoctoral fellows were supervised by regular or associate Laboratory members.

Seminars

On a weekly basis, the scientific life of the laboratory revolves around the CRM – ISM – GERAD Statistics Colloquium in Montréal, the Statistics Seminar at Université Laval in Québec City, and the Statistics Seminar at the Université de Sherbrooke in Sherbrooke. In 2006 – 2007, the Statistics Seminar at Université Laval featured 17 lectures and the Statistics Seminar at the Université de Sherbrooke featured 16 lectures. The list of lectures of the CRM – ISM – GERAD Statistics Colloquium may be found at the end of the section on the CRM general program. A special note must be made of the lectures given by David Siegmund (Stanford) and Kjell Doksum (Berkeley).

Workshops, special sessions, and others

The first "Journée de statistique Montréal-Québec" took place on June 1st, 2007, at Université Laval; statisticians from all regions of Québec participated in this Statistics Day, which was organized by Christian Léger, Alejandro Murua and Aurélie Labbe. The main talks were given by Martin Bilodeau (Montréal) and Bruno Rémillard (HEC Montréal). Also four students and postdoctoral fellows presented their research work to an audience of around forty participants.

Regular members of the laboratory

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, changepoint 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)
Extreme values, robustness

SORANA FRODA (UQÀM)
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 (UQÀM)
Statistical genetics and biostatistics

CHRISTIAN LÉGER (Montréal)
Resampling methods, adaptive estimation, model selection, robustness, applications in data mining

BRENDA MACGIBBON (UQÀM)
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)
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

JONATHAN E. TAYLOR (Montréal)
Gaussian processes, multiple comparisons, neuroimaging, HIV protein sequence analysis

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

DAVID B. WOLFSON (McGill)
Changepoint problems, survival analysis, Bayesian statistics, optimal design, applications in medicine

KEITH J. WORSLEY (McGill)
Statistics of brain mapping, geometry of random images in medicine and astrophysics

INTRIQ

Quantum information is an emerging field of research, at the crossroads of mathematics, physics, computer science and chemistry. It could potentially bring about a fundamental revolution, not only in our way of processing information, but also in our way of understanding the world. INTRIQ is a French acronym meaning "Transdisciplinary Institute for Quantum Information"; it refers to a CRM laboratory in which computer scientists and physicists study this new paradigm of information processing. INTRIQ was launched recently and organized two main activities in 2006-2007, a conference to mark the laboratory lauch and a mini-course on quantum error correction given by David Poulin (Caltech) from January 15 to 26, 2007. A detailed description of the lauch may be found in the section on the CRM multidisciplinary and industrial program.

LAUNCH OF THE TRANSDISCIPLINARY INSTITUTE FOR QUANTUM INFORMATION (INTRIQ)
November 9, 2006, CRM
Organizer: Gilles Brassard (Montréal)

The members of INTRIQ are David Avis (Computer Science, McGill), Alexandre Blais (Physics, Sherbrooke), Michel Boyer (Computer Science, Montréal), Gilles Brassard (Computer Science, Montréal), Aashish Clerk (Physics, McGill), Claude Crépeau (Computer Science, McGill), José Manuel Fernandez (Computer Engineering, Polytechnique), Patrick Fournier (Physics, Sherbrooke), Guillaume Gervais (Physics, McGill), Nicolas Godbout (Engineering Physics, Polytechnique), Peter Grütter (Physics, McGill), Patrick Hayden (Computer Science, McGill), Michael Hilke (Physics, McGill), Richard MacKenzie (Physics, Montréal), Prakash Panangaden (Computer Science, McGill), Alain Tapp (Computer Science, Montréal), and André-Marie Tremblay (Physics, Sherbrooke).

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 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* and the Subseries of the *Springer Lecture Notes in Statistics*. An asterisk preceding an author indicates that this is a monograph from an Aisenstadt Chairholder.

Recent Titles

The following list of recent titles contains books that appeared in 2006 – 2007 or that will be published soon.

American Mathematical Society
CRM Monograph Series

Olga Kharlampovich & Alexei Myasnikov, *Algebraic Geometry for a Free Group* (to appear).

American Mathematical Society
CRM Proceedings & Lecture Notes

Jean-Marie De Koninck, Andrew Granville & Florian Luca (eds.), *Anatomy of Integers* (to appear).

Panos M. Pardalos & Pierre Hansen (eds.), *Data Mining and Mathematical Programming* (to appear).

Stanley Alama, Lia Bronsard & Peter Sternberg (eds.), *Singularities in PDE and the Calculus of Variations* (to appear).

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 Sciences and Engineering*, vol. 41, 2007.

Springer
CRM Series in Mathematical Physics

Marc Thiriet, *Biology and Mechanics of Blood Flows* (to appear).

Les Publications CRM

Laurent Guieu & Claude Roger, *L'Algèbre et le Groupe de Virasoro*, 2007.

Previous Titles

American Mathematical Society
CRM Monograph Series

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*, 2e édition, vol. 10, 1999 (with an appendix by 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

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

David Sénéchal, André-Marie Tremblay & Claude Bourbonnais, *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
CRM Subseries of the Lecture Notes in Statistics

Marc Moore (ed.), *Spatial Statistics*: *Methodological Aspects and Applications*, 2001.

S. Ejaz Ahmed & Nancy Reid (eds.), *Empirical Bayes and Likelihood Inference*, 2001.

CRM Publications

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*, Montréal, 1997.

Faqir Khanna & Luc Vinet (eds.), *Field Theory, Integrable Systems and Symmetries*, Montréal, 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*, Les Publications CRM, 1988.

Lucien Le Cam, *Notes on Asymptotic Methods in Statistical Decision Theory*, 1974.

Les Presses de l'Université de Montréal Aisenstadt Chair Collection

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 Gauthiers-Villars).

Videos

Efim Zelmanov, *Abstract Algebra in the* 20*th 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.

CRM Preprints

[CRM-3219] Kengne, E., Vaillancourt, R., "Stabilized soliton in attractive Bose-Einstein condensate in hyperbolic potential," in Boundary Field Problems and Computer Simulation, volume 48, Scientific Proceedings of the Riga Technical University — Computer Science, volume 29, Riga, Riga Technical University, 2006.

[CRM-3220] Nguyen-Ba, T., Yagoub, H., Li, Y., Vaillancourt, R., "Variable-step variable-order 3-stage Hermite – Birkhoff ODE solver of order 5 to 15," The Canadian Applied Mathematics Quarterly, 14:1 (2006), 43–69.

[CRM-3221] Hajji, M. A., Vaillancourt, R., "Matrix derivation of Gaussian quadratures," in Boundary Field Problems and Computer Simulation, volume 48, Scientific Proceedings of the Riga Technical University — Computer Science, volume 29, Riga, Riga Technical University, 2006.

[CRM-3222] Labbé, S., Lorin de la Grandmaison, E., "On the reservoir technique convergence. Part I," September 2006.

[CRM-3224] Lorin de la Grandmaison, E., Ben Haj Ali, A., Soulaimani, A., "An accurate positivity preserving scheme for the Spalart-Allmaras turbulence model ," September 2006.

[CRM-3227] Nguyen-Ba, T., Yagoub, H., Desjardins, S. J., Vaillancourt, R., "Variable-step variable-order 4-stage Hermite-Birkhoff-Obrechkoff ODE solver of order 5 to 14," in Boundary Field Problems and Computer Simulation, volume 48, Scientific Proceedings of the Riga Technical University — Computer Science, volume 29, Riga, Riga Technical University, 2006.

[CRM-3229] Dryanov, D., Fournier, R., "Equality cases for two polynomial inequalities," Annuaire de l'Université de Sofia "St Kliment Ohridski," Faculté de Mathématiques et Informatique, 99, accepted.

[CRM-3230] Fournier, R., Serban, M., "An extension of Jack's lemma to polynomials of fixed degree ," Computational Methods and Function Theory, 7:2 (September 2007), 371 – 378.

[CRM-3231] Vaillancourt, R., Zakharov, V. G., "Biorthogonal wavelet bases for solving time-dependent PDEs," in Boundary Field Problems and Computer Simulation, volume 48, Scientific Proceedings of the Riga Technical University — Computer Science, volume 29, Riga, Riga Technical University, 2006.

[CRM-3232] Nguyen-Ba, T., Yagoub, H., Zhang, Y., Vaillancourt, R., "Variable-step variable-order 3-stage Hermite – Birkhoff – Obrechkoff ODE solver of order 4 to 14," The Canadian Applied Mathematics Quarterly, 14:4 (2006), 413–437.

[CRM-3233] Lamontagne, Y., Coutu, C., Rousseau, C., "Bifurcation analysis of a predator-prey system with generalised Holling type III functional response," Journal of Dynamics and Differential Equations, submitted.

[CRM-3236] Christopher, C., Schlomiuk, D., "Center conditions for a class of polynomial differential systems," November 2006.

[CRM-3237] Schlomiuk, D., Vulpe, N., "Integrals and phase portraits of planar quadratic differential systems with invariant lines of total multiplicity four," November 2006.

[CRM-3225] Murua, A., Stanberry, L., Stuetzle, W., "On Potts model clustering, kernel K-means and density estimation," Journal of Computational and Graphical Statistics, submitted.

[CRM-3238] Fournier, R., "Asymptotics of the Bohr radius for polynomials of fixed degree," Journal of Mathematical Analysis and Applications, accepted.

[CRM-3239] Bertola, M., Gekhtman, M., "Effective inverse spectral problem for rational Lax matrices and applications," International Mathematical Research Notices, accepted.

[CRM-3254] Kengne, E., Vaillancourt, R., "Exact solutions of the Gross – Pitaevskii equation in periodic potential in the presence of external source," Journal of Mathematical Physics, 48 (July 2007), 073520, 13 pages.

Scientific Personnel

CRM Members in 2006 – 2007

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: Université de Montréal, Concordia University, McGill University, Université du Québec à Montréal (UQÀM), Université Laval, Université de Sherbrooke and the University of Ottawa. Other members are researchers affiliated with the CRM in 2006 – 2007 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 have even contributed 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

Ali, Syed Twareque, Concordia University
Angers, Jean-François, Université de Montréal
Apostolov, Vestislav, Université du Québec à Montréal
Arminjon, Paul, Université de Montréal
Bandrauk, André D., Université de Sherbrooke
Baribeau, Line, Université Laval
Bartello, Peter, McGill University
Bédard, Robert, Université du Québec à Montréal
Bélair, Jacques, Université de Montréal
Benali, Habib, CHU Pitié Salpêtrière
Bengio, Yoshua, Université de Montréal
Bergeron, François, Université du Québec à Montréal
Bertola, Marco, Concordia University
Bourgault, Yves, University of Ottawa
Bourlioux, Anne, Université de Montréal
Boyer, Steven, Université du Québec à Montréal
Brassard, Gilles, Université de Montréal
Brlek, Srecko, Université du Québec à Montréal
Broer, Abraham, Université de Montréal
Brunet, Robert C., Université de Montréal
Bryant, David, McGill University
Chauve, Cédric, Simon Fraser University
Chvátal, Vašek, Concordia University
Clarke, Francis H., Université de Lyon 1
Collin, Olivier, Université du Québec à Montréal
Cornea, Octavian, Université de Montréal
Csűrös, Miklós, Université de Montréal
Cummins, Chris, Concordia University
Dafni, Galia, Concordia University
Darmon, Henri, McGill University
David, Chantal, Concordia University
De Koninck, Jean-Marie, Université Laval
Delfour, Michel C., Université de Montréal
Doedel, Eusebius J., Concordia University
Dssouli, Rachida, Concordia University
Duchesne, Pierre, Université de Montréal
Duchesne, Thierry, Université Laval
El-Mabrouk, Nadia, Université de Montréal
Fortin, André, Université Laval
Fournier, Richard, Dawson College
Frigon, Marlène, Université de Montréal
Garon, André, École Polytechnique de Montréal
Gauthier, Paul M., Université de Montréal
Genest, Christian, Université Laval
Goren, Eyal Z., McGill University
Goulard, Bernard, Université de Montréal
Granville, Andrew, Université de Montréal
Grundland, Alfred Michel, Université du Québec à Trois-Rivières
Guan, Pengfei, McGill University
Hahn, Gena, Université de Montréal
Hall, Richard L., Concordia University
Hamel, Sylvie, Université de Montréal
Harnad, John, Concordia University
Humphries, Tony R., McGill University
Hurtubise, Jacques, McGill University
Hussin, Véronique, Université de Montréal
Iovita, Adrian, Concordia University
Jakobson, Dmitry, McGill University
Jakšić, Vojkan, McGill University

Joyal, André, Université du Québec à Montréal
Kaczynski, Tomasz, Université de Sherbrooke
Kamran, Niky, McGill University
Kharlampovich, Olga, McGill University
Kisilevsky, Hershy, Concordia University
Koosis, Paul, McGill University
Korotkin, Dmitry, Concordia University
Labelle, Gilbert, Université du Québec à Montréal
Labute, John, McGill University
Lalonde, François, Université de Montréal
Léger, Christian, Université de Montréal
Leroux, Pierre, Université du Québec à Montréal
Lesage, Frédéric, École Polytechnique de Montréal
Lessard, Sabin, Université de Montréal
LeTourneux, Jean, Université de Montréal
Levesque, Claude, Université Laval
Lina, Jean-Marc, École de Technologie Supérieure
Lu, Steven, Université du Québec à Montréal
MacGibbon, Brenda, Université du Québec à Montréal
Mackey, Michael C., McGill University
Makarenkov, Vladimir, Université du Québec à Montréal
Makkai, Michael, McGill University
Mashreghi, Javad, Université Laval
Maslowe, Sherwin A., McGill University
Mathieu, Pierre, Université Laval
McKay, John, Concordia University
Miasnikov, Alexei G., McGill University
Murty, M. Ram, Queen's University
Nekka, Fahima, Université de Montréal
Nigam, Nilima, McGill University
Owens, Robert G., Université de Montréal
Patera, Jiří, Université de Montréal
Perron, François, Université de Montréal
Polterovich, Iosif, Université de Montréal
Ramsay, James O., McGill University
Ransford, Thomas J., Université Laval
Rémillard, Bruno, HEC Montréal
Reutenauer, Christophe, Université du Québec à Montréal
Rivest, Louis-Paul, Université Laval
Rosenberg, Ivo G., Université de Montréal
Rousseau, Christiane, Université de Montréal
Roy, Damien, University of Ottawa
Roy, Roch, Université de Montréal
Russell, Peter, McGill University
Saint-Aubin, Yvan, Université de Montréal
Sankoff, David, Université de Montréal
Schlomiuk, Dana, Université de Montréal
Shnirelman, Alexander, Concordia University
Stern, Ron J., Concordia University
Thaine, Francisco, Concordia University
Toth, John A., McGill University
Tupper, Paul F., McGill University
Vinet, Luc, Université de Montréal
Walsh, Timothy R.S., Université du Québec à Montréal
Wihler, Thomas P., McGill University
Winternitz, Pavel, Université de Montréal
Wise, Daniel T., McGill University
Worsley, Keith J., McGill University

Associate Members

Beaulieu, Liliane, Collège du Vieux-Montréal
Bergeron, Nantel, York University
Conte, Robert, CEA Saclay
Durand, Stéphane, Collège Édouard-Montpetit
Gander, Martin J., Université de Genève
Garnero, Line, CHU Pitié Salpêtrière
Levi, Decio, Università di Roma Tre
Li, Jun, Université de Montréal
Petridis, Yiannis N., Lehman College (CUNY)
Shahbazian, Elisa, Lockheed Martin Canada
Thiriet, Marc, INRIA Rocquencourt
Valin, Pierre, DRDC Valcartier
Van Vliet, Carolyne M., University of Miami
Zolésio, Jean-Paul, INRIA Sophia-Antipolis

Invited Members

Bilodeau, Martin, Université de Montréal
Doray, Louis G., Université de Montréal
Dugas, Charles, Université de Montréal
Gowrisankaran, Kohur, McGill University
Haiman, Mark, University of California, Berkeley

Larose, Benoît, Champlain College Saint-Lambert
Morales, Manuel, Université de Montréal
Murua, Alejandro, Université de Montréal

Postdoctoral Fellows

Each year the CRM plays host to a great number of postdoctoral fellows. Their funding is provided by the NSERC and FQRNT 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.

Anguelova, Iana, University of Illinois at Urbana-Champaign
Bourhim, Abdellatif, Université Mohammed V, Rabat
Carbonell, Felix, Universidad de La Habana
Ceyhan, Özgür, Université Strasbourg 1
Charollois, Pierre, Université Bordeaux 1
Chen, Chuan Zhong, Central South University, Changsha
Cooper, Jason, University of Calgary
Derivière, Sara, Université de Rouen
Desrosiers, Patrick, Université Laval
Dujmovic, Vida, McGill University
Friedl, Stefan, Brandeis University
Germain, Mickaël, Université de Sherbrooke
Glen, Amy, University of Adelaide
Gürel, Başak, University of California, Santa Cruz
Hu, Shengda, University of Wisconsin-Madison
Jones, Nathan Conrad, University of California, Los Angeles
Letellier, Emmanuel, Université Paris 6
Lisi, Samuel, Courant Institute, New York University
Lorin de la Grandmaison, Emmanuel, École Normale Supérieure de Cachan
Lucier, Jason Bryan, University of Waterloo
Maher, Joseph, University of California, Santa Barbara
Mangoubi, Dan, Technion
Marmora, Adriano, Université Paris 13
Mason, Sarah K., University of Pennsylvania
Masri, Riad, University of Texas at Austin
McIntyre, Andrew, Stony Brook University
Mo, Man Yue, University of Oxford
Mohammadalikhani, Ramin, University of Toronto
Moyers-Gonzalez, Miguel Angel, University of British Columbia
Ndiaye, Ismaila, École Polytechnique Fédérale de Lausanne
Nesterenko, Maryna, National Academy of Sciences, Ukraine
Pierre, Charles, Université de Nantes
Pusztai, Bélà Gabor, University of Szeged
Ridout, David, University of Adelaide
Rowlett, Julie, Stanford University
Tian, Ye, Columbia University
Tore, Jensen Bernt, McMaster University
Urquiza, José Manuel, Université Paris 6
Villani, Éric, Université Paris 6
Wigman, Igor, Tel Aviv University
Yurdusen, Ismet, Middle East Technical University, Ankara

Long-term 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 the year 2006 – 2007, 1010 such participants registered in the thematic program workshops, 640 in activities of the general program and 320 in those of the industrial and multidisciplinary program. The CRM also contributed financially to around fifteen other scientific events. The following list only includes visitors who were in residence for at least four weeks.

Adimurthi, Adi, Tata Institute, Bangalore
Asatryan, Davit, National Academy of Sciences of Armenia
Benali, Habib, CHU Pitié-Salpêtrière
Boyko, Vyacheslav, National Academy of Sciences of Ukraine

Clarke, Francis H., Université Lyon 1
Croot, Ernest S., Georgia Institute of Technology
Donato, Paul, Université Aix-Marseille 1
El Gradechi, Amine, Université d'Artois
Enolskii, Victor, National Academy of Sciences of Ukraine
Fleischer, Isidore, Montréal
Fricain, Emmanuel, Université Lyon 1
Gao, Peng, University of Michigan
Haglund, Jim, University of Pennsylvania
Kashuba, Iryna, Universidade de Sao Paulo
Khan, Rizwan, Institute for Advanced Study
Klimyk, Anatoliy, Bogolyubov Institute for Theoretical Physics
Levi, Decio, Università di Roma Tre
Luca, Florian, Universidad Autónoma de Mexico
Monastyrsky, Michael, Institute for Theoretical and Experimental Physics, Moscow
Mukhopadhyay, Anirban, Institute of Mathematical Science, Chennai
Nang, Philibert, Gabon
Ng, Nathan, University of Ottawa
Nobakhtian, Soghra, University of Isfahan
Orlov, Aleksander Yu., Shirshov Institute for Oceanology
Pouryayevali, Mohamad Reza, University of Isfahan
Prasanna, Kartik, University of California, Los Angeles
Safarov, Yuri, King's College London
Soundararajan, K., University of Michigan
Stoll, Manfred, University of South Carolina
Sun, Chengjun, Shanghai Jiao Tong University
Tanimoto, Ryuji, Osaka University
Tardif, Camille, École Normale Supérieure de Cachan-Bretagne
Thiriet, Marc, INRIA Rocquencourt
Thomas, Hugh, University of New Brunswick
van Willigenburg, Stephanie, University of British Columbia
Vinuesa, Carlos, Universidad Autónoma de Madrid
Vulpe, Nicolae, Academy of Sciences of Moldova
Willems, Matthieu, Université de Cergy-Pontoise
Wooley, Trevor, University of Michigan
Zhang, Yuanli, Montréal
Zhedanov, Alexei, Donetsk Institute for Physics and Technology
Zograf, Peter, Steklov Mathematical Institute

Short-term Visitors

The following visitors were in residence for less than four weeks.

Adler, Robert, Technion
Alon, Noga, Tel Aviv University
Angelova, Maia, University of Northumbria
Anjos, Silvia, Instituto Superior Technico, Lisbon
Banyaga, Augustin, Pennsylvania State University
Bleher, Pavel, Indiana University-Purdue University, Indianapolis
Boalch, Philip, École Normale Supérieure, Paris
Bodner, Mark, MIND Institute
Borodzik, Maciej, University of Warsaw
Conte, Robert, CEA Saclay
de Smit, Bart, Universiteit Leiden
Eynard, Bertrand, CEA Saclay
Faridi, Sara, Dalhousie University
Feigon, Brooke, Institute for Advanced Study
Frid, Anna, Sobolev Institute of Mathematics
Futorny, Vyacheslav, Universidade de São Paulo
Gazeau, Jean-Pierre, Université Paris 7
Gekhtman, Michael, University of Notre Dame
Ginzburg, Victor, University of California, Santa Cruz
Goemans, Michel, Massachusetts Institute of Technology
Grigoryan, Arthur, National Academy of Sciences of Armenia
Hereman, Willy, Colorado School of Mines
Its, Alexander, Indiana University-Purdue University, Indianapolis
Moody, Robert V., University of Alberta
Neher, Erhard, University of Ottawa
Pacelli, Allison, Williams College
Pinsonnault, Martin, Fields Institute
Pogossian, Edward, National Academy of Sciences of Armenia

Rosenthal, Jeffrey S., University of Toronto
Roussarie, Robert, Université de Bourgogne
Seymour, Paul, Princeton University
Snobl, Libor, Czech Technical University
Stanley, Richard, Massachusetts Institute of Technology
Stolovitch, Laurent, Université Toulouse 3
Szmigielski, Jacek, University of Saskatchewan
Thomova, Zora, State University of New York Institute of Technology, Utica
Tolar, Jiří, Czech Technical University
Tomczak-Jaegermann, Nicole, University of Alberta
Turbiner, Alexander, Universidad Autónoma de Mexico
Tyran-Kaminska, Marta, Silesian University, Katowice
Ujino, Hideaki, Gunma College of Technology
Vakil, Ravi, Stanford University
van de Leur, Johan, University of Utrecht
Wilson, R. Eddie, University of Bristol
Zakoïan, Jean-Michel, Université Lille 3

Governance and Scientific Guidance

Bureau de direction

The Bureau adopts the policies of the Centre, recommends the nomination and the promotion of researchers and the appointment of regular and associate members, advises the Director on the preparation of the budget and the Selection Committee on the choice of the Director.

Syed Twareque Ali
Concordia University
Yoshua Bengio
Université de Montréal
Michel Delfour
Université de Montréal
Joseph Hubert, Dean
Faculty of Arts and Sciences, Université de Montréal
Véronique Hussin
Université de Montréal
Niky Kamran
McGill University
François Lalonde
Université de Montréal
Javad Mashreghi
Université Laval
Christiane Rousseau
Université de Montréal
Jacques Turgeon, Vice-Principal (Research)
Université de Montréal

Chantal David (Concordia University), **Andrew Granville** (Université de Montréal), **Jean LeTourneux** (Université de Montréal), and **Odile Marcotte** (Université du Québec à Montréal), all Deputy Directors of the CRM, were invited members.

Scientific Advisory Committee

The 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.

Jerry Bona is a Professor at the Department of Mathematics, Statistics and Computer Science at The University of Illinois at Chicago. He received a B.Sc. degree from Washington University in St. Louis (1966) and a Ph.D. from Harvard University (1971). His research experience is vast. His research interests include fluid mechanics, partial differential equations, computational mathematics and the associated numerical analysis, oceanography, coastal engineering, and mathematical economics. He is an Elected Fellow of the American Association for the Advancement of Science and a member of the editorial boards of twenty-five scientific journals and of several academic committees and panels. Jerry Bona is a co-organizer of the Mathematicians and Educational Reform Network.

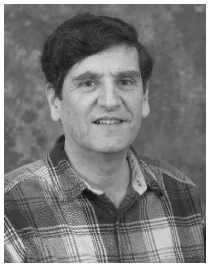
Jean-Pierre Bourguignon received an engineering degree from the École Polytechnique and a Ph.D. in mathematics. A differential geometer by training, he has also worked on the mathematical aspects of physical theories: Dirac operators and spins, general relativity. His areas of specialty are the geometrical estimation of eigenvalues of Laplace–Beltrami operators, Kählerian geometry and, more recently, Finslerian geometry. Jean-Pierre Bourguignon is a research leader at the highest echelon of the Centre national de la recherche scientifique (CNRS). He is currently the Director of the Institut des Hautes Études Scientifiques (IHÉS) at Bures-sur-Yvette and Professor of Mathematics at the École Polytechnique. From 1990 to 1992, he served as President of the Société Mathématique de France, and from 1995 to 1998, as President of the European Mathematical Society. He is a member of several scientific advisory committees in Europe. He has been a member of Academia Europaea since 1996 and a foreign associate of the Spanish Royal Academy since 2002.

Jean-Louis Colliot-Thélène is "directeur de recherche" at the Centre national de la recherche scientifique (CNRS) at the UMR 8628 (Université de Paris-Sud, Orsay). He specializes in algebraic geometry

and its links to arithmetic. He obtained a Doctorat d'État (1978) from Paris-Orsay. He is a member of the editorial board of the *Annales scientifiques de l'École Normale Supérieure* (of which he was editor-in-chief until recently), as well as the boards of the *Journal of Number Theory* and the *Journal of K-Theory*. Jean-Louis Colliot-Thélène was one of the main organizers of the 2005 – 2006 Thematic Program at MSRI (Berkeley).

A mathematician and physicist by training, **François Lalonde** holds a Doctorat d'État (1985) from the Université de Paris-Sud Orsay in the field of differential topology. His fields of interests include symplectic topology, Hamiltonian dynamics and the study of infinite-dimensional transformation groups. He has been a member of the Royal Society of Canada since 1997 and held a Killam Research Fellowship in 2000 – 2002. He holds the Canada Research Chair in Symplectic Geometry and Topology at the Department of Mathematics and Statistics of the Université de Montréal. He was Plenary Speaker at the First Canada – China congress in 1997, and part of his collaborative work with Dusa McDuff was presented in her plenary address at the ICM 1998 in Berlin. Professor Lalonde was an invited speaker at the ICM 2006 in Madrid.

Richard Lockhart is a Professor at the Department of Statistics and Actuarial Science of Simon Fraser University. He received a B.Sc. in Mathematics from the University of British Columbia (1975) and degrees in Statistics from the University of California, Berkeley (M.A., 1976, and Ph.D., 1979). A former Editor of the *Canadian Journal of Statistics*, he has also served on the Advisory Committee on Statistical Methods of Statistics Canada. He was President of the Statistical Society of Canada in 1996 – 1997. Much of his work is in the area of model assessment, generally in the form of goodness-of-fit.



Carl Pomerance is a Professor at the Department of Mathematics of Dartmouth College. From 1999 to 2003, he was a member of the technical staff of Bell Labs-Lucent Technologies. He holds degrees from Brown University (B.A., 1966) and from Harvard University (M.A., 1970, Ph.D., 1972). A number theory specialist, he has received numerous prizes and awards including the Levi L. Conant Prize of the American Mathematical Society. He is one of the editors-in-chief of *Integers*: *The Electronic Journal of Combinatorial Number Theory* and a member of the editorial board of the *Journal of Supercomputing* and the AMS Undergraduate Book Series.

Thomas Salisbury is President of the Canadian Mathematical Society and a Professor at the Department of Mathematics and Statistics of York University. He was Deputy Director of the Fields Institute until May 2006. He holds degrees from McGill University (B.Sc.) and the University of British Columbia (Ph.D.). His research is in probability theory and its connections to both finance and mathematical analysis. He was Editor-in-Chief of the *Canadian Mathematical Bulletin*, Associate Editor of the *Canadian Journal of Statistics*, and is presently on the editorial board of *Potential Analysis*.

Peter Shalen is a Professor at the Department of Mathematics, Statistics and Computer Science at The University of Illinois at Chicago. He received his B.A. from Harvard College (1966) and his Ph.D. from Harvard University (1972). He also spent a year as an undergraduate at the École Normale Supérieure in Paris. His main research interests are 3-dimensional topology, hyperbolic geometry, and geometric and combinatorial group theory. He is associate editor of the *Journal of Knot Theory and its Ramifications* and was the geometric topology editor of the *Transactions of the American Mathematical Society* from 1992 to 2000.

Catherine Sulem is a Professor in the Department of Mathematics of the University of Toronto. She received a Doctorat d'État from the Université de Paris-Nord in 1983. She was Keynote Speaker at IMACS2003 (International Association for Mathematics and Computers in Simulation) and an invited speaker at a meeting of the American Mathematical Society in 1999. In 1998, she was awarded the Krieger – Nelson Prize by the Canadian Mathematical Society. Her research interests are in nonlinear partial differential equations arising in physics: nonlinear partial differential equations, nonlinear

Schrödinger equations and related systems, the water wave problem, the Boltzmann equation, and computational fluid mechanics. Since 2000, she has been an Associate Editor of the *SIAM Journal of Mathematical Analysis*. From 1999 to 2005, she was an Associate Editor of the *Canadian Journal of Mathematics*.

Mary F. Wheeler holds the Ernest and Virginia Cockrell Chair in Engineering at the University of Texas at Austin where she is also Professor at the Department of Mathematics. In addition, she is Director of the Center for Subsurface Modeling of the Texas Institute for Computational and Applied Mathematics (TICAM) at the same university. She obtained her Ph.D. from Rice University. She is currently an editor of six journals and is Managing Editor of *Computational Geosciences*. In 1998, she was elected to the National Academy of Engineering. Her research interests include parallel computation and numerical solution of partial differential systems with applications to the modelling of subsurface and surface flows.

Jean-Christophe Yoccoz is Professor at the Collège de France where he holds a Chair in Mathematics (Differential Equations and Dynamical Systems). He obtained a Doctorat d'État in 1985. He was awarded the Fields medal in 1994 and is a member of the Académie des sciences (France), a Chevalier de la Légion d'Honneur (1995) and an Officer of the Ordre du Mérite (2000). His research work concerns the theory of dynamical systems and the Julia and Mandelbrot sets.

Steven Zelditch is a Professor of Mathematics at Johns Hopkins University. He received his Ph.D. from the University of California, Berkeley, in 1981. A past member of the editorial board of the *Annales Scientifiques de l'École Normale Supérieure*, he is presently on the editorial board of the *American Journal of Mathematics*. His research centers around applications of microlocal analysis to problems in the following areas: asymptotics of eigenfunctions/eigenvalues on Riemannian manifolds, statistical algebraic geometry, mathematical physics (quantum chaos, 2D Yang – Mills, string/M-theory).

Jacques Turgeon, Vice-Principal (Research), Université de Montréal, is an ex-officio member of the Advisory Committee. **Chantal David** (Concordia University), **Andrew Granville** (Université de Montréal), **Jean LeTourneux** (Université de Montréal), and **Odile Marcotte** (Université du Québec à Montréal), all Deputy Directors of the CRM, were invited members of the Committee.

CRM Administrative and Support Staff

The Director's Office

François Lalonde
Director

Chantal David
Deputy Director, Bulletin du CRM

Andrew Granville
Deputy Director, CRM Prizes

Jean LeTourneux
Deputy Director, Publications

Odile Marcotte
Deputy Director, Annual Report and Coordination with Related Fields

Administration

Vincent Masciotra
Head of Administration

Muriel Pasqualetti
Administrative Assistant

Guillermo Martinez-Zalce
Research Laboratories Administrative Coordinator

Diane Brulé-De Filippis
Secretary

Scientific Activities

Louis Pelletier
Coordinator

Josée Laferrière
Assistant

Sakina Benhima
Project Manager (starting in September 2006)

Josée Simard
Project Manager (until August 2006) and Assistant (starting in September 2006)

Louise Letendre
Assistant

Computer Services

Daniel Ouimet
Systems Administrator

André Montpetit
Office Systems Manager (half time)

François Cassistat
Technical Assistant

Publications

André Montpetit
TeX Expert (half time)

Louise Letendre
Technician

Communications

Suzette Paradis
Communications Officer and Webmaster

Mandate of the CRM

The Centre de recherches mathématiques (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 Université de Montréal, as well as McGill University, Université du Québec à Montréal, Concordia University, University of Ottawa, Université Laval 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 scientic 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 Aisenstadt Prize given for outstanding work done 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 about ten 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 in place last year, funded in partnership with other organizations and researchers,
- it informs the community of its activities through its newsletter, Bulletin du CRM, and its web site at `crm.math.ca`,
- it participates, with the other two Canadian institutes, in groundbreaking national initiatives. One example is the MITACS (Mathematics of Information Technology and Complex Systems) network. 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 Program on 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 nine 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 ISM (Institut des sciences mathématiques) 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-EMT, and INSERM) led to the creation of industrial networks. The most recent ones involved, in 2004 – 2005, Bombardier Aerospace and the Brain Imaging Unit CRM – IUGM – INSERM.

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. It is recognized worldwide as one of the major institutes in the mathematical sciences. The director of the CRM is assisted by two managerial structures: the Bureau de direction and the 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 Aisenstadt Prize and suggest new scientific ventures to explore.