2014 – 2015

Colloque des sciences mathématiques du Québec

MONTRÉAL

Date Heure/Time : Le jeudi 9 avril 2015 - 16:00

Lieu/Venue : CRM, UdeM, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 6254

Conférencier/Speaker : Stephen S. Kudla, University of Toronto

Titre/Title : Modular generating series and arithmetic geometry

Resume/Abstract :
I will survey the development of the theory of theta series and describe some recent advances/work in progress on arithmetic theta series. The construction and modularity of theta series as counting functions for lattice points for positive definite quadratic forms is a beautiful piece of classical mathematics with its origins in the mid 19th century. Siegel initiated the study of the analogue for indefinite quadratic forms. Millson and I introduced a geometric variant in which the theta series give rise to modular generating series for the cohomology classes of "special" algebraic cycles on locally symmetric varieties. These results motivate the definition of analogous generating series for the classes of such special cycles in the Chow groups and for the classes in the arithmetic Chow groups of their integral extensions. The modularity of such series is a difficult problem. I will discuss various cases in which recent progress has been made and some of the difficulties involved.

Date Heure/Time : Le jeudi 2 avril 2015 - 16:00

Lieu/Venue : McGill University, Burnside Hall, 805 rue Sherbrooke O., Montréal, salle 920

Conférencier/Speaker : William Minicozzi, MIT

Titre/Title : Uniqueness of blowups and Lojasiewicz inequalities

Resume/Abstract :
The mean curvature flow (MCF) of any closed hypersurface becomes singular in finite time. Once one knows that singularities occur, one naturally wonders what the singularities are like. For minimal varieties the first answer, by Federer-Fleming in 1959, is that they weakly resemble cones. For MCF, by the combined work of Huisken, Ilmanen, and White, singularities weakly resemble shrinkers. Unfortunately, the simple proofs leave open the possibility that a minimal variety or a MCF looked at under a microscope will resemble one blowup, but under higher magnification, it might (as far as anyone knows) resemble a completely different blowup. Whether this ever happens is perhaps the most fundamental question about singularities. We will discuss the proof of this long standing open question for MCF at all generic singularities and for mean convex MCF at all singularities. This is joint work with Toby Colding.

**Date Heure/Time**: Le jeudi 26 mars 2015 - 16:00

**Lieu/Venue**: McGill University, Burnside Hall, 805 rue Sherbrooke 0., Montréal, salle 920

**Conférencier/Speaker**: Steve Boyer, UQAM

**Titre/Title**: Left-orderings of groups and the topology of 3-manifolds

**Resume/Abstract**: Many decades of work culminating in Perelman's proof of Thurston's geometrisation conjecture showed that a closed, connected, orientable, prime 3-dimensional manifold $W$ is essentially determined by its fundamental group $\pi_1(W)$. This group consists of classes of based loops in $W$ and its multiplication corresponds to their concatenation. An important problem is to describe the topological and geometric properties of $W$ in terms of $\pi_1(W)$. For instance, geometrisation implies that $W$ admits a hyperbolic structure if and only if $\pi_1(W)$ is infinite, freely indecomposable, and contains no $\mathbb{Z}$ or $\mathbb{Z} \oplus \mathbb{Z}$ subgroups. In this talk I will describe recent work which has determined a surprisingly strong correlation between the existence of a left-order on $\pi_1(W)$ (a total order invariant under left multiplication) and the following two measures of largeness for $W$: a) the existence of a co-oriented taut foliation on $W$ - a special type of partition of $W$ into surfaces which fit together locally like a deck of cards. b) the condition that $W$ not be an L-space - an analytically defined condition representing the non-triviality of its Heegaard-Floer homology. I will introduce each of these notions, describe the results which connect them, and state a number of open problems and conjectures concerning their precise relationship.
**Date Heure/Time**: Le jeudi 19 mars 2015 - 16:00

**Lieu/Venue**: McGill University, Burnside Hall, 805 rue Sherbrooke 0., Montréal, salle 920

**Conférencier/Speaker**: Alexei Borodin, MIT

**Titre/Title**: Integrable probability

**Resume/Abstract**:
The goal of the talk is to survey the emerging field of integrable probability, whose goal is to identify and analyze exactly solvable probabilistic models. The models and results are often easy to describe, yet difficult to find, and they carry essential information about broad universality classes of stochastic processes.

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**Date Heure/Time**: Le jeudi 12 mars 2015 - 16:00

**Lieu/Venue**: CRM, UdeM, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 1360

**Conférencier/Speaker**: Pierre Colmez, CNRS & Paris VI Jussieu

**Titre/Title**: The upper half-planes

**Resume/Abstract**:
The upper half-planes (complex and p-adic) are very elementary objects, but they have a surprisingly rich structure that I will explore in the talk.

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**Date Heure/Time**: Le jeudi 5 mars 2015 - 16:00

**Lieu/Venue**: McGill University, Burnside Hall, 805 rue Sherbrooke 0., Montréal, salle 920

**Conférencier/Speaker**: Alvaro Pelayo, UC San Diego

**Titre/Title**: ANNULÉ - CANCELLED

**Resume/Abstract**:
Integrable systems appear naturally in many branches of mathematics and physics. I will present recent progress in the subject, emphasizing the interplay between spectral
Our study involves symplectic geometry.

**Date Heure/Time**: Le jeudi 5 mars 2015 - 16:00

**Lieu/Venue**: McGill University, Burnside Hall, 805 rue Sherbrooke 0., Montréal, salle 920

**Conférencier/Speaker**: Sophie Morel, Princeton University

**Titre/Title**: Periods

**Resume/Abstract**: We will discuss periods, in particular the periods conjecture of Kontsevich and Zagier and the relationship between formal periods and Nori motives.

**Date Heure/Time**: Le jeudi 26 février 2015 - 16:00

**Lieu/Venue**: McGill University, Burnside Hall, 805 rue Sherbrooke 0., Montréal, salle 920

**Conférencier/Speaker**: Alistair Savage, University of Ottawa

**Titre/Title**: Categorification in representation theory

**Resume/Abstract**: This will be an expository talk concerning the idea of categorification and its role in representation theory. We will begin with some very simple yet beautiful observations about how various ideas from basic algebra (monoids, groups, rings, representations etc.) can be reformulated in the language of category theory. We will then explain how this viewpoint leads to new ideas such as the "categorification" of the above-mentioned algebraic objects. We will conclude with a brief synopsis of some current active areas of research involving the categorification of quantum groups. One of the goals of this idea is to produce four-dimensional topological quantum field theories. Very little background knowledge will be assumed.

**Date Heure/Time**: Le jeudi 19 février 2015 - 16:00

**Lieu/Venue**: CRM, UdeM, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 6214

**Conférencier/Speaker**: Francis Brown, IHES, Bures-sur-Yvette
**Titre/Title**: Irrationality proofs, moduli spaces and dinner parties

**Resume/Abstract**:
After introducing an elementary criterion for a real number to be irrational, I will discuss Apery’s famous result proving the irrationality of zeta(3). Then I will give an overview of subsequent results in this field, and finally propose a simple geometric interpretation based on a classical dinner party game.

**Date Heure/Time**: Le jeudi 12 février 2015 - 16:00

**Lieu/Venue**: McGill University, Burnside Hall, 805 rue Sherbrooke 0., Montréal, salle 920

**Conférencier/Speaker**: Laure Saint-Raymond, École normale supérieure, Paris

**Titre/Title**: Influence des côtes sur les courants marins / The role of boundary layers in the global ocean circulation

**Resume/Abstract**:
Comprendre les mécanismes qui régissent la circulation océanique est un défi pour les géophysiciens, mais aussi pour les mathématiciens qui doivent développer de nouveaux outils d'analyse pour ces modèles complexes (qui font intervenir en particulier de très nombreuses échelles de temps et d'espace). Un mécanisme particulièrement important pour la circulation à l'échelle planétaire est le phénomène de couche limite qui explique une partie des échanges énergétiques. On montrera ici au travers d'un modèle très simplifié qu'il permet d'expliquer notamment l'intensification des courants de bord Ouest. On évoquera ensuite les difficultés mathématiques liées à la prise en compte de la géométrie. Note : l'exposé sera en anglais avec des transparents en français.

**Date Heure/Time**: Le jeudi 5 février 2015 - 16:00

**Lieu/Venue**: McGill University, Burnside Hall, 805 rue Sherbrooke 0., Montréal, salle 920

**Conférencier/Speaker**: Octav Cornea, Université de Montréal

**Titre/Title**: Cobordism and Lagrangian topology
Resume/Abstract:
This talk aims to discuss how two different basic organizing principles in topology come together in the study of Lagrangian submanifolds. The first principle is cobordism and it emerged in topology in the 1950’s, mainly starting with the work of Thom. It was introduced in Lagrangian topology by Arnold in the 1970’s. The second principle is to reconstruct a subspace of a given space from a family of “slices”, each one obtained by intersecting the subspace with a member of a preferred class of special “test” subspaces. For instance, a subspace of 3d euclidean space can be described as the union of all its intersections with horizontal planes. The key issue from this point of view is, of course, how to assemble all the slices together. The perspective that is central for my talk originates in the work of Gromov and Floer in the 1980’s: if the ambient space is a symplectic manifold M, and if the subspace to be described is a Lagrangian submanifold, then, surprisingly, the “glue” that puts the slices together in an efficient algebraic fashion is a reflection of the combinatorial properties of J-holomorphic curves in M. This point of view has been pursued actively since then by many researchers such as Hofer, Fukaya, Seidel leading to a structure called the Fukaya category. Through recent work of Paul Biran and myself, cobordism and the Fukaya category turn out to be intimately related and at the end of the talk I intend to give an idea about this relation.

**Date Heure/Time**: Le jeudi 29 janvier 2015 - 16:00

**Lieu/Venue**: McGill University, Burnside Hall, 805 rue Sherbrooke 0., Montréal, salle 920

**Conférencier/Speaker**: Thomas Ransford, Université Laval

**Titre/Title**: Spectres et pseudospectres / Spectra and pseudospectra

**Resume/Abstract**: Les valeurs propres sont parmi les notions les plus utiles en mathématiques: elles permettent la diagonalisation des matrices, elles décrivent l'asymptotique et la stabilité, elles donnent de la personnalité à une matrice. Cependant, lorsque la matrice en question n'est pas normale, l'analyse par des valeurs propres ne donne qu'une information très partielle, et peut même nous induire en erreur. Cet exposé se veut une introduction à la théorie des pseudospectres, un raffinement de la théorie spectrale standard qui s'est avéré utile dans des applications concernant des matrices non normales. Je vais m'intéresser surtout à la question suivante: À quel point les pseudospectres d'une matrice déterminent-ils le comportement de la matrice?
personality. However, when the matrix in question is not normal, standard eigenvalue
analysis is only partially applicable and can even be misleading. This talk will be an
introduction to the theory of pseudospectra, a refinement of standard spectral theory
which has proved successful in applications concerning non-normal matrices. In
particular I shall focus on the question: do pseudospectra determine matrix behavior?
Ce colloque sera présenté en anglais.

**Date Heure/Time**: Le jeudi 22 janvier 2015 - 16:00

**Lieu/Venue**: McGill University, Burnside Hall, 805 rue Sherbrooke 0., Montréal,
salle 920

**Conférencier/Speaker**: Hansjoerg Albrecher, HEC, Lausanne

**Titre/Title**: On the usefulness of mathematics for insurance risk theory - and vice
versa

**Resume/Abstract**: This talk is on applications of various branches of mathematics in the field of risk
theory, a branch of actuarial mathematics dealing with the analysis of the surplus
process of a portfolio of insurance contracts over time. At the same time such practical
problems frequently trigger mathematical research questions, in some cases leading to
remarkable identities and connections. Next to the close interactions with probability
and statistics, examples will include the branches of real and complex analysis,
algebra, symbolic computation, number theory and discrete mathematics.

**Date Heure/Time**: Le jeudi 15 janvier 2015 - 16:00

**Lieu/Venue**: CRM, UdeM, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 1360

**Conférencier/Speaker**: Fang Yao, Univ. of Toronto - Lauréat du Prix CRM-SSC
2014

**Titre/Title**: Functional data analysis and related topics

**Resume/Abstract**: Functional data analysis (FDA) has received substantial attention, with applications
arising from various disciplines, such as engineering, public health, finance etc. In
general, the FDA approaches focus on nonparametric underlying models that assume
the data are observed from realizations of stochastic processes satisfying some
regularity conditions, e.g., smoothness constraints. The estimation and inference procedures usually do not depend on merely a finite number of parameters, which contrasts with parametric models, and exploit techniques, such as smoothing methods and dimension reduction, that allow data to speak for themselves. In this talk, I will give an overview of FDA methods and related topics developed in recent years.

**Date Heure/Time**: Le jeudi 4 décembre 2014 - 16:00

**Lieu/Venue**: CRM, UdeM, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 5340

**Conférencier/Speaker**: François Bergeron, UQAM

**Titre/Title**: Algebraic combinatorics and finite reflection groups

**Resume/Abstract**: The lecture will be delivered in French, with English slides, so that anyone may enjoy it. ------ La conférence sera présentée en français, avec des transparents en anglais, pour que tous puissent suivre. Les dernières années ont vu une explosion d’activités à la frontière entre la combinatoire algébrique, la théorie de la représentation et la géométrie algébrique, avec des liens captivants avec la théorie des nœuds et la physique mathématique. En gardant un large auditoire en tête, nous esquisserons en quoi cette interaction a été très fructueuse et a soulevé de nouvelles questions intrigantes dans les divers domaines concernés. Nous essaierons de donner la saveur des résultats obtenus, des techniques utilisées, du grand nombre de questions ouvertes, et du pourquoi de leur intérêt. Ce fascinant échange entre combinatoire et algèbre fait d’une part intervenir des généralisations au contexte des rectangles des « chemins de Dyck ». Il est bien connu, depuis Euler, que ces chemins sont comptés par les nombres de Catalan, dans le cas d’un carré. De plus, les fonctions de stationnement (parking functions) sont intimement reliées à ces chemins. D’autre part, du côté algébrique, apparaissent des $S_n$-module bigradué de polynômes harmoniques diagonaux du groupe symétrique $S_n$. Il a été conjecturé qu’une énumération adéquate des fonctions de stationnement, associées à certaines familles de chemins de Dyck, fournit une formule combinatoire explicite du caractère bigradué de ces modules. Cette conjecture, connue sous le nom de conjecture « shuffle », a récemment été grandement étendue pour couvrir tous les cas rectangulaires. Interviennent dans tout ceci, des opérateurs sur les polynômes de Macdonald, l’algèbre de Hall elliptique, les algèbres de Hecke affines doubles (DAHA), le schéma de Hilbert de points dans le plan, etc.

**Date Heure/Time**: Le jeudi 20 novembre 2014 - 16:00
**Titre/Title :** High-dimensional phenomena in mathematical statistics and convex analysis

**Resume/Abstract :**
Statistical models in which the ambient dimension is of the same order or larger than the sample size arise frequently in different areas of science and engineering. Although high-dimensional models of this type date back to the work of Kolmogorov, they have been the subject of intensive study over the past decade, and have interesting connections to many branches of mathematics (including concentration of measure, random matrix theory, convex geometry, and information theory). In this talk, we provide a broad overview of the general area, including vignettes on phase transitions in high-dimensional graph recovery, and randomized approximations of convex programs.

**Date Heure/Time :** Le jeudi 13 novembre 2014 - 16:00

**Lieu/Venue :** CRM, UdeM, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 1360

**Conférencier/Speaker :** Martin Wainwright, University of California, Berkeley

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**Titre/Title :** Recent advances in the arithmetic of elliptic curves

**Resume/Abstract :**
In the past few years there have been several spectacular advances in understanding the arithmetic of elliptic curves including results about ranks on average and on the conjecture of Birch and Swinnerton-Dyer. I will give an introduction to the main problems of interest and survey some of these developments. This talk will be addressed to a general mathematical audience.

**Date Heure/Time :** Le jeudi 6 novembre 2014 - 16:00

**Lieu/Venue :** CRM, UdeM, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 6214

**Conférencier/Speaker :** Kartik Prasanna, University of Michigan, Ann Arbor

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**Titre/Title :** The Cubical Route to Understanding Groups

**Date Heure/Time :** Le jeudi 6 novembre 2014 - 16:00

**Lieu/Venue :** CRM, UdeM, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 6214

**Conférencier/Speaker :** Dani Wise, McGill University

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Resume/Abstract:
Cube complexes have come to play an increasingly central role within geometric group theory, as their connection to right-angled Artin groups provides a powerful combinatorial bridge between geometry and algebra. This talk will primarily aim to introduce nonpositively curved cube complexes, and then describe some of the developments that have recently culminated in the resolution of the virtual Haken conjecture for 3-manifolds, and simultaneously dramatically extended our understanding of many infinite groups.

Date Heure/Time : Le jeudi 30 octobre 2014 - 16:00

Lieu/Venue : CRM, UdeM, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 6214

Conférencier/Speaker : Georgia Benkart, University of Wisconsin-Madison

Titre/Title : A Pedestrian Approach to Group Representations

Resume/Abstract:
Determining the number of walks of n steps from vertex A to vertex B on a graph often involves clever combinatorics or tedious treading. But if the graph is the representation graph of a group, representation theory can facilitate the counting and provide much insight. This talk will focus on connections between Schur-Weyl duality and walking on representation graphs. Examples of special interest are the simply-laced affine Dynkin diagrams, which are the representation graphs of the finite subgroups of the special unitary group SU(2) by the McKay correspondence. The duality between the SU(2) subgroups and certain algebras enables us to count walks and solve other combinatorial problems, and to obtain connections with the Temperley-Lieb algebras of statistical mechanics, with partitions, with Stirling numbers, and much more.

Date Heure/Time : Le jeudi 9 octobre 2014 - 16:00

Lieu/Venue : CRM, Université de Montréal, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 1140

Conférencier/ Speaker : Alex Kontorovich, Rutgers University

Titre/Title : Applications of additive combinatorics to homogeneous dynamics
2014 – 2015

Colloque des sciences mathématiques du Québec

QUÉBEC

Date Heure/Time : Le vendredi 1 mai 2015 - 14:00

Lieu/Venue : Université Laval, Pavillon Alexandre Vachon, salle 3820

Conférencier/Speaker : Éric Moulines, Télécom ParisTech

Titre/Title : Gradient proximal stochastique et applications pour l'inférence de modèles à effets mixtes en grande dimension

Resume/Abstract :
We study a perturbed version of the proximal gradient algorithm for which the gradient is not known in closed form and should be approximated. We address the convergence and derive a non-asymptotic bound on the convergence rate for the perturbed proximal gradient, a perturbed averaged version of the proximal gradient algorithm and a perturbed version of the fast iterative shrinkage-thresholding (FISTA) of Beck and Teboulle (2009). When the approximation is achieved by using Monte Carlo methods, we derive conditions involving the Monte Carlo batch-size and the step-size of the algorithm under which convergence is guaranteed. In particular, we show that the Monte Carlo approximations of some averaged proximal gradient algorithms and a Monte Carlo approximation of FISTA achieve the same convergence rates as their deterministic counterparts. To illustrate, we apply the algorithms to high-dimensional generalized linear mixed models using $\ell_1$-penalization.

Date Heure/Time : Le jeudi 27 novembre 2014 - 15:30

Lieu/Venue : Université Laval, Pavillon Alexandre Vachon, salle 2830

Conférencier/Speaker : Nilima Nigam, Simon Fraser University

Titre/Title : On the well-posedness of the 2D stochastic Allen-Cahn equation

Resume/Abstract :
Non-linear parabolic PDE arise in many physical and biological settings; we often need to incorporate the effects of additive white noise. The resultant stochastic partial differential equations are well-understood in 1D. In higher spatial dimensions, there is an interesting dichotomy: such models are popular in application, while mathematicians assume these models to be ill-posed. We investigate the specific case of the two dimensional Allen-Cahn equation driven by additive white noise. Without noise, the Allen-Cahn equation is 'pattern-forming'. Does the presence of noise affect this behaviour? The precise notion of a weak solution to this equation is unclear. Instead, we regularize the noise and introduce a family of approximations. We discuss the continuum limit of these approximations and show that it exhibits divergent behavior. Our results show that a series of published numerical studies are somewhat problematic: shrinking the mesh size in these simulations does not lead to the recovery of a physically meaningful limit. This is joint work with Marc Ryser and Paul Tupper.
Colloque des sciences mathématiques du Québec

SHERBROOKÉ

Date Heure/Time : Le jeudi 7 mai 2015 - 16:30

Lieu/Venue : Université de Sherbrooke

Conférencier/Speaker : Robert Lund, Clemson University

Titre/Title : A Statistical View of some Recent Climate Controversies

Resume/Abstract :
This talk looks at some recent climate controversies from a statistical standpoint. The issues are motivated via changepoints and their detection. Changepoints are ubiquitous features in climatic time series, occurring whenever stations relocate or gauges are changed. Ignoring changepoints can produce spurious trend conclusions. Changepoint tests involving cumulative sums, likelihood ratio, and maximums of F statistics are introduced; the asymptotic distributions of these statistics are quantified under the changepoint-free null hypothesis. The case of multiple changepoints is considered. The methods are used to study several controversies, including extreme temperature trends in the United States and Atlantic Basin tropical cyclone counts and strengths.

Date Heure/Time : Le jeudi 2 avril 2015 - 16:30

Lieu/Venue : 2500, boul. de l'Université, Sherbrooke (Québec), salle/room D3-2041

Conférencier/Speaker : Konstantin Mischaikow, Rutgers University

Titre/Title : A combinatorial approach to dynamics applied to switching networks

Resume/Abstract :
Models of multiscale systems, such as those encountered in systems biology, are often characterized by heuristic nonlinearities and poorly defined parameters. Furthermore, it is typically not possible to obtain precise experimental data for these systems.
Nevertheless, verification of the models requires the ability to obtain meaningful dynamical structures that can be compared quantitatively with the experimental data. With this in mind we present a purely combinatorial approach to modeling dynamics. We will discuss this approach in the context of switching networks.
Resume/Abstract:
We will discuss the role played by additive combinatorics in attacks on various problems in dynamics related to finer equidistribution questions beyond Duke's Theorem, particularly those posed by McMullen and Einsiedler-Lindenstrauss-Michel-Venkatesh. This work is joint with Jean Bourgain.

Date Heure/Time: Le jeudi 2 octobre 2014 - 16:00

Lieu/Venue: CRM, Université de Montréal, Pav. André-Aisenstadt, 2920, ch. de la Tour, salle 6214

Conférencier/Speaker: Paul Bourgade, New York University

Titre/Title: Universality in random matrix theory

Resume/Abstract:
Wigner stated the general hypothesis that the distribution of eigenvalue spacings of large complicated quantum systems is universal, in the sense that it depends only on the symmetry class of the physical system but not on other detailed structures. The simplest case for this hypothesis concerns large but finite dimensional matrices. I will explain some historical aspects random matrix theory, as well as recent techniques developed to prove eigenvalues and eigenvectors universality, for matrices with independent entries from all symmetry classes. The methods are both probabilist (random walks and coupling) and analytic (homogenization for parabolic PDEs).