Colloque des sciences mathématiques du Québec

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David Stephens (Université McGill)
Hugh Thomas (UQAM)
Yi Yang (Université McGill)

**2017 - 2018**
**Calendrier / Calendar**

**MONTREAL**

**Date Heure/Time** : Le vendredi 4 mai 2018 - 16:00
**Lieu/Venue** : UQAM, pavillon Président-Kennedy, 201, av. du Président-Kennedy, salle P-5115
**Conférencier/Speaker** : Emmanuel Hebey, Université de Cergy-Pontoise

**Titre/Title** : Klein-Gordon-Maxwell-Proca systems in the Riemannian setting

**Resume/Abstract** : We intend to give a general talk about Klein-Gordon-Maxwell-Proca systems which we aim to be accessible to a broad audience. We will insist on the Proca contribution and then discuss the kind of results one can prove in the electromagnetic static case of the equations.

**Date Heure/Time** : Le vendredi 13 avril 2018 - 16:00
**Lieu/Venue** : UQAM, pavillon Président-Kennedy, 201, av. du Président-Kennedy, salle PK-5115
**Conférencier/Speaker** : Eva Bayer, École Polytechnique Fédérale de Lausanne

**Titre/Title** : Local-global principles in number theory

**Resume/Abstract** : One of the classical tools of number theory is the so-called local-global principle, or Hasse principle, going back to Hasse’s work in the 1920’s. His first results concern quadratic forms, and norms of number fields. Over the years, many positive and negative results were proved, and there is now a huge number of results in this topic. This talk will present some old and new results, in particular in the continuation of Hasse’s cyclic norm theorem. These have been obtained jointly with Parimala and Tingyu Lee.

**Date Heure/Time** : Le vendredi 23 février 2018 - 16:00
**Lieu/Venue** : UQAM, Pavillon Président-Kennedy, 201, ave du Président-Kennedy, salle PK-5115
**Conférencier/Speaker** : Sabin Cautis, University of British Columbia

**Titre/Title** : Cluster theory of the coherent Satake category

**Resume/Abstract** : The affine Grassmannian, though a somewhat esoteric looking object at first sight, is a fundamental algebro-geometric construction lying at the heart of a series of ideas connecting number theory (and the Langlands program) to geometric representation theory, low dimensional topology and mathematical physics. Historically it is popular to study the category of constructible perverse sheaves on the affine Grassmannian. This leads to the “constructible” Satake category and the celebrated (geometric) Satake equivalence. More recently it has become apparent that it makes sense to also study the category of perverse “coherent” sheaves (with a Satake category). Motivated by certain ideas in mathematical physics this category is conjecturally governed by a cluster algebra structure. We will illustrate the geometry of the affine Grassmannian in an elementary way, discuss what we mean by a cluster algebra structure and then describe a solution to this conjecture in the case of general linear groups.

**Date Heure/Time** : Le vendredi 16 février 2018 - 15:30
**Lieu/Venue** : McGill University, OTTO MAASS 217
**Conférencier/Speaker** : Xiao-Li Meng, Harvard University,

**Titre/Title** : The Law of Large Populations: The return of the long-ignored N and how it can affect our 2020 vision

**Resume/Abstract** : For over a century now, statisticians have successfully convinced ourselves and almost everyone else, that in statistical inference the size of the population N can be ignored, especially when it is large. Instead, we focused on the size of the sample, n, the key driving force for both the Law of Large Numbers and the Central Limit Theorem. We were thus taught that the statistical error (standard error) goes down with n typically at the rate of 1/√n. However, all these rely on the presumption that our data have perfect quality, in the sense of being equivalent to a probabilistic sample. A largely overlooked statistical identity, a potential counterpart to the Euler identity in mathematics, reveals a Law of Large Populations (LLP), a law that we should be all afraid of. That is, once we lose control over data quality, the systematic error (bias) in the usual estimators, relative to the benchmarking standard error from simple random sampling, goes up with N at the rate of N. The coefficient in front of -N can be viewed as a data defect index, which is the simple Pearson correlation between the reporting/recording indicator and the value reported/recorded. Because of the multiplier-N, a seemingly tiny correlation, say, 0.005, can have detrimental effect on the quality of inference. Without understanding of this LLP, “big data” can do more harm than good because of the drastically inflated precision assessment hence a gross overconfidence, setting us up to be caught by surprise when the reality unfolds, as we all experienced during the 2016 US presidential election. Data from Cooperative Congressional Election Study (CCES, conducted by Stephen Ansolabehere, Douglas Rivers and others, and analyzed by Shiro Kuriki), we used to estimate the data defect index for the 2016 US election, with the aim to gain a clearer vision for the 2020 election and beyond.

**Date Heure/Time** : Le vendredi 16 février 2018 - 16:00
**Lieu/Venue** : CRM, Université de Montréal, Pavillon André-Aisenstadt, salle 6254
**Conférencier/Speaker** : Alexander Turchin, UNAM,

**Titre/Title** : Quantum n-body problem: generalized Euler coordinates (from J-L Lagrange to Figure Eight by Moore and Ter-Martirosyan, then and today)

**Resume/Abstract** : The potential of the n-body problem, both classical and quantum, depends only on the relative (mutual) distances between bodies. By generalized Euler coordinates we mean relative distances and angles. Their advantage over Jacobi coordinates is emphasized. The NEW IDEA is to study trajectories in both classical, and eigenstates in quantum systems which depends on relative distances ALONE. We show how this study is equivalent to the study of (i) the motion of a particle (quantum or classical) in curved space of dimension $n(n-1)/2$ or the study of (ii) the Euler-Arnold (quantum or classical) - $\mathfrak{so}(n-1)/2, R^3$ algebra top. The curved space of (i) has a number of remarkable properties. In the 3-body case the (ii) de-Quantization of quantum Hamiltonian leads to a classical Hamiltonian which solves a $\sim 250$-years old problem posed by Lagrange on 3-body planar motion.
Date Hour/Time: Le vendredi 9 février 2018 - 16:00
Lieu/Venue : UQAM, Pavillon Président-Kennedy, 201, ave du Président-Kennedy, salle PK-5115
Conférencier/Speaker : Egor Shelukhin, Université de Montréal
Titre/Title : Persistence modules in symplectic topology
Resume/Abstract : In order to resolve Vladimir Arnol'd's famous conjecture from the 1960's, giving lower bounds on the number of fixed points of Hamiltonian diffeomorphisms of a symplectic manifold, Andreas Floer has associated in the late 1980's a homology theory to the Hamiltonian action functional on the loop space of the manifold. It was known for a long time that this homology theory can be filtered by the values of the action functional, yielding information about metric invariants in symplectic topology (Hofer's metric, for example). We discuss a recent marriage between the filtered version of Floer theory and persistent homology, a new field of mathematics that has its origins in data analysis, providing examples of new ensuing results.

Date Hour/Time: Le vendredi 12 janvier 2018 - 16:00
Lieu/Venue : CRM, Université de Montréal, Pavillon André-Aisenstadt, salle 6254
Conférencier/Speaker : Semjon Dyatlov, UC Berkeley / MIT
Titre/Title : What is quantum chaos
Resume/Abstract : Where do eigenfunctions of the Laplacian concentrate as eigenvalues go to infinity? Do they equidistribute or do they concentrate in an uneven way? It turns out that the answer depends on the nature of the geodesic flow. I will discuss various results in the case when the flow is chaotic: the Quantum Ergodicity theorem of Shnirelman, Colin de Verdière, and Zelditch, the Quantum Unique Ergodicity conjecture of Rudnick-Sarnak, the progress on it by Lindenstrauss and Soudanaranjan, and the entropy bounds of Anantharaman-Nomennacher. I will conclude with a recent lower bound on the mass of eigenfunctions obtained with Jin. It relies on a new tool called "fractal uncertainty principle" developed in the works by Bourgain and Zahl.

Date Hour/Time: Le vendredi 8 décembre 2017 - 16:00
Lieu/Venue : UQAM, Pavillon Président-Kennedy, 201, ave du Président-Kennedy, salle PK-5115
Conférencier/Speaker : James Maynard, University of Oxford
Titre/Title : Primes with missing digits
Resume/Abstract : Many famous open questions about primes can be interpreted as questions about the digits of primes in a given base. We will talk about recent work showing there are infinitely many primes with no 7 in their decimal expansion. (And similarly with 7 replaced by any other digit.) This shows the existence of primes in a 'thin' set of numbers (sets which contain at most $X^{1-c}$ elements less than X) which is typically very difficult. The proof relies on a fun mixture of tools including Fourier analysis, Markov chains, Diophantine approximation, combinatorial geometry as well as tools from analytic number theory.

Date Hour/Time: Le vendredi 24 novembre 2017 - 15:30
Lieu/Venue : Université McGill, Leacock Building, salle LEA 232
Conférencier/Speaker : David R. Belfhouse, Western University, London, Ontario
Titre/Title : 150 years (and more) of data analysis in Canada
Resume/Abstract : As Canada celebrates its 150th anniversary, it may be good to reflect on the past and future of data analysis and statistics in this country. In this talk, I will review the Victorian Statistics Movement and its effect in Canada, data analysis by a Montreal physician in the 1850s, a controversy over data analysis in the 1850s and 60s centred in Montreal, John A. MacDonald's use of statistics, the Canadian insurance industry and the use of statistics, the beginning of mathematical statistics in Canada, the Fisherian revolution, the influence of Fisher, Neyman and Pearson, the computer revolution, and the emergence of data science.

Date Hour/Time: Le vendredi 24 novembre 2017 - 16:00
Lieu/Venue : CRM, Université de Montréal, Pavillon André-Aisenstadt, salle 6254
Conférencier/Speaker : Stanislav Smirnov, , University of Geneva and Skolkovo Institute of Science and Technology
Titre/Title : Complex analysis and 2D statistical physics
Resume/Abstract : Over the last decades, there was much progress in understanding 2D lattice models of critical phenomena. It started with several theories, developed by physicists. Most notably, Conformal Field Theory led to spectacular predictions for 2D lattice models: e.g., critical percolation cluster a.s. has Hausdorff dimension $91/48$, while the number of self-avoiding length $N$ SAWs on the hexagonal lattice grows like $|\sqrt{2+\sqrt{2}}|^N N^{11/32}$. While the algebraic framework of CFT is rather solid, rigorous arguments relating it to lattice models were lacking. More recently, mathematical approaches were developed, allowing not only for rigorous proofs of many such results, but also for new physical intuition. We will discuss some of the applications of complex analysis to the study of 2D lattice models.

Date Hour/Time: Le vendredi 17 novembre 2017 - 16:00
Lieu/Venue : UQAM, Pavillon Président-Kennedy, 201, ave du Président-Kennedy, salle PK-5115
Conférencier/Speaker : Jun-Cheng Wei, UBC
Titre/Title : Recent progress on De Giorgi Conjecture
Resume/Abstract : Classifying solutions to nonlinear partial differential equations are fundamental research in PDEs. In this talk, I will report recent progress made in classifying some elementary PDEs, starting with the De Giorgi Conjecture (1978). I will discuss the classification of global minimizers and finite Morse index solutions, relation with minimal surfaces and Toda integrable systems, as well as recent exciting developments in fractional De Giorgi Conjecture.

Date Hour/Time: Le vendredi 27 octobre 2017 - 16:00
Lieu/Venue : UdM, Pavillon André-Aisenstadt, salle 6254
Conférencier/Speaker : Justin Solomon, MIT
Titre/Title : Beneath the Surface: Geometry Processing at the Intrinsic/Extrinsic Interface
Resume/Abstract:
Algorithms for analyzing 3D surfaces find application in diverse fields from computer animation to medical imaging, manufacturing, and robotics. Reflecting a bias dating back to the early development of differential geometry, a disproportionate fraction of these algorithms focuses on discovering intrinsic shape properties, or those measurable along a surface without considering the surrounding space. This talk will summarize techniques to overcome this bias by developing a geometry processing pipeline that treats intrinsic and extrinsic geometry democratically. We describe theoretically justified, stable algorithms that can characterize extrinsic shape from surface representations. In particular, we will show two strategies for computational extrinsic geometry. In our first approach, we will show how the discrete Laplace-Beltrami operator of a triangulated surface accompanied with the same operator for its offset determines the surface embedding up to rigid motion. In the second, we will treat a surface as the boundary of a volume rather than as a thin shell, using the Steklov (Dirichlet-to-Neumann) eigenproblem as the basis for developing volumetric spectral shape analysis algorithms without discretizing the interior.

Date/Heure/Time: Le vendredi 13 octobre 2017 - 16:00
Lieu/Venue: UdeM, Pavillon André-Aisenstadt, salle 6254
Conférencier/Speaker: Avi Soffer, Rutgers University

Resume/Abstract:
I will review the problem of Global existence for dispersive equations, in particular, supercritical equations. These equations who play a fundamental role in science, have been, and remain a major challenge in the field of Partial Differential Equations. They come in various forms, derived from Geometry, General Relativity, Fluid Dynamics, Field Theory. I present a new approach to classify the asymptotic behavior of wave equations, supercritical and others, and construct global solutions with large initial data. I will then describe current extensions to Nonlinear Schrödinger Equations.

Date/Heure/Time: Le vendredi 29 septembre 2017 - 16:00
Lieu/Venue: UdeM, Pavillon André-Aisenstadt, salle 1140
Conférencier/Speaker: John H. Conway, Princeton University

Resume/Abstract:
The “first field” is obtained by making the entries in its addition and multiplication tables be the smallest possibilities. It is really an interesting field that contains the integers, but with new addition and multiplication tables. For example, 2 x 2 = 3, 5 x 7 = 13, ... It extends to the infinite ordinals and the first infinite ordinal is the cube root of 2!

Date/Heure/Time: Le vendredi 15 septembre 2017 - 16:00
Lieu/Venue: UQAM, Pavillon Président-Kennedy, 201, ave du Président-Kennedy, salle PK-5115
Conférencier/Speaker: Silyuan Lu, Rutgers University, Lauréat 2017 du Prix Carl Herz / 2017 Carl Herz Prize Winner

Resume/Abstract:
In this talk, we will first review the classic Weyl's embedding problem and its application in quasi-local mass. We will then discuss some recent progress on Weyl's embedding problem in general Riemannian manifold. Assuming isometric embedding into Schwarzschild manifold, we will further establish a quasi-local type inequality. This talk is based on works joint with Pengfei Guan and Pengzi Miao.