Colloque de mathématiques de Montréal CRM - ISM

Calendrier des conférences / Conference Calendar

Date Heure/Time : 05/02/2014 - 16:00
Lieu/Venue : UQAM, Pav. Sherbrooke, 200, rue Sherbrooke O., salle SH-3420
Conférencier/Speaker : Eric Urban, Columbia University
Titre/Title : Eigenvarieties
Resume/Abstract :
After discussing some down-to-earth examples, I will explain what Eigenvarieties are for general reductive groups, present some important conjectures about them, and some basic number theory applications.

Date Heure/Time : 04/11/2014 - 16:00
Lieu/Venue : CRM, Université de Montréal, pavillon André-Aisenstadt, 2920 chemin de la Tour, salle 6214
Conférencier/Speaker : Alexey Kokotov, Concordia University
Titre/Title : Flat surfaces and determinants of Laplacians
Resume/Abstract :
In 2008 D. Korotkin and the author found an explicit formula for the determinant of the Friedrichs Laplacian on a compact 2d surface of genus g >1 provided with flat conical metric with trivial holonomy. This formula can be considered as a higher genus version of the classical Ray-Singer formula for the determinant of the Laplace operator on an elliptic curve provided with (smooth) flat conformal metric. We will discuss further generalizations of this result for 1) General polyhedral metrics on compact surfaces. 2) Other (i.e. non Friedrichs) self-adjoint extensions of conical Laplacians. 3) Noncompact flat surfaces with cylindrical and Euclidean ends. The talk is based on the joint works with L. Hillairet and V. Kalvin.

Date Heure/Time : 04/04/2014 - 16:00
Internal waves occur within a fluid that is density-stratified, most commonly by temperature or salinity variation. In the oceans, such disturbances in internal layers are often generated by tides. They appear as large amplitude, long wavelength nonlinear waves and can propagate over large distances. Photographs taken from orbital shuttle as well as local measurements show that their presence has a significant effect on the surface of the ocean. In some instances, the visible signature of internal waves on the surface of the ocean is a band of roughness which propagates at the same velocity as the internal wave, followed after its passage, by the mill pond effect, the complete calmness of the sea.

I will show an asymptotic analysis and a derivation of an effective system of PDEs modeling the coupling between the interface and the free surface of a two layers fluid in a scaling regime chosen to capture these observations.

This talk is based on joint work with Walter Craig and Philippe Guyenne.

**Resume/Abstract:**

It is believed that there should be infinitely many pairs of primes which differ by 2; this is the famous twin prime conjecture. More generally, it is believed that for every positive integer $m$, there should be infinitely many sets of $m$ primes, with each set contained in an interval of size roughly $m \log(m)$. Although proving these conjectures seems to be beyond our current techniques, recent progress has enabled us to obtain some partial results. We will introduce a refinement of the ‘GPY sieve method’ for studying these problems. This refinement will allow us to show (amongst other things) that $\liminf_n(p_{n+m}-p_n) \leq \infty$ for any integer $m$, and so there are infinitely many bounded length intervals containing $m$ primes.
When trying to understand extreme phenomena in mathematics, one of the natural things to study is whether the extremizer has any special structure. Indeed, the more information one has on the extremiser, the better one should be able to analyze the phenomenon under investigation. This approach has been proven very effective when studying the average behaviour of general multiplicative functions. These are complex-valued functions defined over the integers which respect the multiplicative structure of the integers, i.e. \( f(mn) = f(m)f(n) \) when \( m \) and \( n \) are coprime. They are of central importance to number theory as several important questions in number theory can be formulated in terms of the average behaviour of them. Perhaps the most prominent example is the Riemann Hypothesis, which is equivalent to proving that the partial sums of a certain multiplicative function exhibit square-root cancellation. During the recent years, Granville and Soundararajan pioneered a new theory whose goal is to unify and extend the theory of general multiplicative functions. The starting point is a theorem of Halasz which states that if a multiplicative function assumes values inside the unit circle then its partial sums can be large only if it “pretends to be” a very special multiplicative function, the function \( n^{it} \) with \( t \) fixed. So Halasz’s theorem gives a very elegant description of the extremizers for the problem of maximizing the partial sums of a function. This simple idea, of a one multiplicative function pretending to be another one, turns out to be very potent. Indeed, using it we now have new proofs of famous old theorems, such as the Prime Number Theorem and Linnik’s theorem, concerning the existence of primes in short arithmetic progression. More importantly, the theory of pretentious multiplicative functions has shed light to problems which were previously unattackable, most prominently concerning character sums and the Quantum Unique Ergodicity conjecture. My goal in this talk is to present this new and evolving theory, and some of my contributions to it.
ne convient plus car celle-ci est courbée alors que le tore est plat. A cause de cette
différence de courbure, on a longtemps pensé qu’il était impossible de représenter
isométriquement un tore plat comme une surface dans l’espace 3D. Cette croyance va
cesser au milieu des années 50 avec les travaux de J. Nash et N. Kuiper montrant l’existence
d’applications isométriques des tores plats dans l’espace euclidien 3D. En utilisant une
technique inventée par M. Gromov -- l’intégration convexe -- nous avons pu récemment
visualiser ces applications et comprendre en partie la géométrie paradoxale de leurs images.

Date Heure/Time : 02/07/2014 - 16:00
Lieu/Venue : UQAM, Pav. Sherbrooke, 200, rue Sherbrooke O., salle SH-3420
Conférencier/Speaker : Charles Epstein, University of Pennsylvania
Titre/Title : Degenerate diffusions arising in population genetics
Resume/Abstract :
I will speak on recent work, joint with Rafe Mazzeo and Camelia Pop, on the analysis of
solutions to a class of degenerate diffusion equations that arise as limits of Markov chain
models used in population genetics and mathematical finance. These equations are
naturally defined on spaces with rather singular boundaries, like simplices and orthants. In
addition to basic existence, uniqueness and regularity results, I will discuss Harnack
inequalities and heat kernel estimates.

Date Heure/Time : 01/17/2014 - 16:00
Lieu/Venue : UQAM, Pav. Sherbrooke, 200, rue Sherbrooke O., salle SH-3420
Conférencier/Speaker : Boris Khesin, University of Toronto
Titre/Title : Nondegenerate curves and pentagram maps
Resume/Abstract :
A plane curve is called nondegenerate if it has no inflection points. How many classes of
closed nondegenerate curves exist on a sphere? We are going to see how this geometric
problem, solved in 1970, reappeared along with its generalizations in the context of the
Korteweg-de Vries and Boussinesq equations. Its discrete version is related to the 2D
pentagram map defined by R.Schwartz in 1992. We will also describe its generalizations,
pentagram maps on polygons in any dimension and discuss their integrability properties.
This is a joint work with Fedor Soloviev.

Date Heure/Time : 12/13/2013 - 16:00
Lieu/Venue : Université de Montréal, Pav. André-Aisenstadt, 2920, chemin de la Tour,
SALLE 6214
Conférencier/Speaker : Yuji Kodama, Ohio State University
Resume/Abstract : 
Let $\text{Gr}(N,M)$ be the real Grassmann manifold defined by the set of all $N$-dimensional subspaces of $\mathbb{R}^M$. Each point on $\text{Gr}(N,M)$ can be represented by an $N$ times $M$ matrix $A$ of rank $N$. If all the $N$ times $N$ minors of $A$ are nonnegative, the set of all points associated with those matrices forms the totally nonnegative part of the Grassmannian, denoted by $\text{Gr}(N,M)_{\geq 0}$. In this talk, I start to give a realization of $\text{Gr}(N,M)_{\geq 0}$ in terms of the (regular) soliton solutions of the KP (Kadomtsev-Petviashvili) equation which is a two-dimensional extension of the KdV equation. The KP equation describes small amplitude and long waves on a surface of shallow water. I then construct a cellular decomposition of $\text{Gr}(N,M)_{\geq 0}$ with the asymptotic form of the soliton solutions. This leads to a classification theorem of all solitons solutions of the KP equation, showing that each soliton solution is uniquely parametrized by a derangement of the symmetric group $S_M$. Each derangement defines a combinatorial object called the Le-diagram (a Young diagram with zeros in particular boxes). Then I show that the Le-diagram provides a complete classification of the "entire" spatial patterns of the soliton solutions coming from the $\text{Gr}(N,M)_{\geq 0}$ for asymptotic values of the time. I will also present some movies of real experiments of shallow water waves which represent some of those solutions obtained in the classification problem. Finally I will discuss an application of those results to analyze the Tohoku-tsunami on March 2011. The talk is elementary, and shows interesting connections among combinatorics, geometry and integrable systems.

Date Heure/Time : 11/29/2013 - 16:00 
Lieu/Venue : Université de Montréal, Pav. André-Aisenstadt, 2920, chemin de la Tour, SALLE 6214 
Conférencier/Speaker : Michael Gekhtman, University of Notre-Dame 
Titre/Title : Higher Pentagram Maps via Cluster Mutations and Networks on Surfaces 
Resume/Abstract : 
The pentagram map that associates to a projective polygon a new one formed by intersections of short diagonals was introduced by R. Schwartz and was shown to be integrable by V. Ovsienko, R. Schwartz and S. Tabachnikov. M. Glick demonstrated that the pentagram map can be put into the framework of the theory of cluster algebras, a new and rapidly developing area with many exciting connections to diverse fields of mathematics. In this talk I will explain that one possible family of higher-dimensional generalizations of the pentagram map is a family of discrete integrable systems intrinsic to a certain class of cluster algebras that are related to weighted directed networks on a torus and a cylinder. After presenting necessary background information on Poisson geometry of cluster algebras, I will show how all ingredients necessary for integrability - Poisson brackets, integrals of motion - can be recovered from combinatorics of a network. The talk is based on a joint project with M. Shapiro, S. Tabachnikov and A. Vainshtein.
Date Heure/Time: 11/22/2013 - 16:00

Lieu/Venue : Université de Montréal, Pav. André-Aisenstadt, 2920, chemin de la Tour, SALLE 6214

Conférencier/ Speaker : Jeremy Quastel, University of Toronto

Titre/Title: Exact formulas in random growth

Resume/Abstract:

In the past few years a number of exact solutions have been discovered for the distribution of fluctuations in discrete and continuous models in the KPZ (Kardar-Parisi-Zhang) universality class. We will review some of the history of the equations, solutions, and some of the new developments.

Date Heure/Time: 11/15/2013 - 16:00

Lieu/Venue : UQAM, Pav. Sherbrooke, 200, rue Sherbrooke O., salle SH-3420

Conférencier/ Speaker : Henri Gillet, University of Illinois at Chicago

Titre/Title: Singular (arithmetic) Riemann Roch Revisited

Resume/Abstract:

I shall discuss an alternative approach to proving the "classical" Baum-Fulton-MacPherson singular Riemann-Roch theorem, and how this allows one to prove an arithmetic Riemann-Roch Theorem. I will also give an overview of arithmetic Remann-Roch.

Date Heure/Time: 10/25/2013 - 16:00

Lieu/Venue : Université de Montréal, Pav. André-Aisenstadt, 2920, chemin de la Tour, SALLE 6214

Conférencier/ Speaker : François Lalonde, Université de Montréal

Titre/Title: Un survol élémentaire de la topologie symplectique sans homologie de Floer et sans théorie de jauge.

Resume/Abstract:

La topologie symplectique peut être pensée comme le versant mathématique de la théorie des cordes: elles sont nées toutes les deux, indépendamment, dans les années 80, la seconde comme entreprise fantastique d’unification des physiques à grande et à petite échelle, et la
première pour résoudre les problèmes dynamiques classiques sur les orbites périodiques des systèmes physiques, notamment les conjectures d'Arnold. Dans les années 80, le travail révolutionnaire de Gromov a permis de présenter la topologie symplectique comme géométrie presque Kähler (un concept qu'il a défini) en construisant une théorie qui est covariante, alors que la géométrie algébrique est contravariante. Quelques années plus tard, on a compris que les aspects dynamiques et kahlériens de la topologie symplectique sont intimement reliés : c'est ce que Lalonde-McDuff ont montré en établissant l'équivalence entre le Non Squeezing theorem et l'inégalité capacité-énergie. De nos jours, la topologie symplectique est l'un des sujets les plus actifs, et il n'y a peut-être pas d'autre discipline qui produise tant de nouveaux espaces de modules à un tel rythme ! Des résultats plus récents seront aussi présentés. ______________________ Nous profiterons de l'occasion pour remercier François suite au travail remarquable qu'il a accompli au cours de ses années à la direction du CRM. Une réception en son honneur suivra sa présentation.

Date Heure/Time : 10/18/2013 - 16:00
Lieu/Venue : Université de Montréal, Pav. André-Aisenstadt, 2920, chemin de la Tour, SALLE 1360
Conférencier/Speaker : Ram Murty, Queen's University
Titre/Title : The Sato-Tate conjecture
Resume/Abstract :
In the 1960's, Michio Sato and John Tate (independently) conjectured an equidistribution theorem related to elliptic curves. This conjecture propelled the rapid development of both number theory and representation theory in the context of the Langlands program. Expanding on the methods used by Wiles in his solution of Fermat's last theorem, Taylor, Harris, Geraghty and Lamb settled the Sato-Tate conjecture recently. We will explain in simple language what the conjecture is and highlight how the proof was assembled (without getting into too much technical detail).

Date Heure/Time : 09/20/2013 - 16:00
Lieu/Venue : UQAM, Pav. Sherbrooke, 200, rue Sherbrooke O., salle SH-3420
Conférencier/Speaker : Svetlana Jitomirskaya, University of California, Irvine
Titre/Title : Quasiperiodic Schrödinger operators
Resume/Abstract :
We will give an overview and briefly present some recent developments in the spectral theory of discrete one-dimensional quasiperiodic operators, focusing on several
phomena that distinguish this class from both random and periodic models: metal-insulator transitions, Cantor spectra, statistics of eigenvalues.