Abstracts

Jayadev Athreya, University of Washington

Title: *Erdos-Szusz-Turan and homogeneous dynamics*

In joint work with Anish Ghosh, we show how to use homogeneous dynamics to solve a problem of Erdos-Szusz-Turan in probabilistic Diophantine approximation.

Tak-Wing Ching, The University of Hong Kong

Title: *Lagrange Equation with Almost-prime Variables*

Lagrange's Four-square Theorem states that every positive integer is the sum of four squares of integers. It is conjectured that every sufficiently large positive integer N of the form $24k+4$ is the sum of four squares of prime numbers. As an approximation, there are various known results of the solvability of the equation $N = x_1^2 + x_2^2 + x_3^2 + x_4^2$ with x_1, x_2, x_3 and x_4 being almost-prime variables.

Solomon Friedberg, Boston College

Title: *Langlands functoriality, the converse theorem, and the Rankin-Selberg method*

Langlands functoriality predicts maps between automorphic forms on different groups, dictated by a map of L-groups. One important class of such maps are endoscopic liftings, established by Arthur using the trace formula, work for which he received the 2017 Steele Prize for Lifetime Achievement. In this talk I describe an approach to endoscopic lifting that does not use the trace formula. Instead it relies on the converse theorem of Cogdell and Piatetski-Shapiro and on new Rankin-Selberg integral representations of L-functions of Cai, Friedberg, Ginzburg and Kaplan.

Title: *An introduction to the Langland Program*

The Langlands Program has shaped a great deal of research in number theory, representation theory and other areas over the past half century. Indeed, Langlands was awarded the 2018 Abel Prize for this program. In this talk, I will introduce the Langlands program, which connects arithmetic information to automorphic forms, and give an account of some recent progress.

Jeffrey Hoffstein, Brown University

Title : *The distribution of modular symbols and a conjecture of Mazur, Rubin and Stein*

Title : *An introduction to the theory of multiple Dirichlet series*

Min-Joo Jang, The University of Hong Kong

Title: *Quantum modular forms and singular combinatorial series*

Since Dyson defined the rank of a partition, a number of studies have been done on this statistic. For example, a celebrated result of Bringmann and Ono showed that the rank generating function is essentially a mock modular form. Andrews introduced k-marked Durfee symbols and more generally defined the ranks for them. In particular, when $k = 1$ one recovers Dyson's rank. In this talk, we establish the quantum modular properties of this combinatorial series, the rank generating function for k-marked Durfee symbols. This is joint work with Amanda Folsom, Susie Kimport, and Holly Swisher.

Ben Kane, The University of Hong Kong

Title: *Central L-values of elliptic curves, Tunnell's Theorem, and locally harmonic Maass forms*

In this talk, we will discuss a way to study the vanishing of central L-values of elliptic curves via locally harmonic Maass forms. In particular, we will discuss some combinatorial applications, such as an alternative formula for Tunnell's resolution of the congruent number problem (assuming BSD) and for representations of primes as the sum of two cubes. This talk is based on joint work with Stephan Ehlen, Pavel Guerzhoy, and Larry Rolen.

Yuk-Kam Lau, The University of Hong Kong

Title: *Hecke eigenvalues for $GL(n)$ Maass cusp forms*

We give an exposition on the eigenvalues of $GL(n)$ Hecke-Maass cusp forms under some Hecke operators. The (Hecke) eigenvalue is an interesting object, and one may hope to understand its statistical behaviour. This will be discussed in another talk by M.-H. Ng. Here we provide a basic background.

Min Lee, University of Bristol

Title: *A conjectural extension of Hecke's converse theorem*

During the workshop focused on Sarnaks Rigidity Conjecture in January 2017, we have formulated a precise conjecture that, if true, extends the converse theorem of Hecke without requiring hypotheses on twists by Dirichlet character or an Euler product. The main idea is to linearize the Euler product, replacing it with twists by Ramanujan sums. In this talk, I provide our motivation and evidence for the conjecture, including results of some special cases and under various additional hypotheses.
This is a joint work with S. Bettin, J. Bober, A. Booker, B. Conrey, G. Molteni, T. Oliver, D. Platt and R. Steiner.

Jingbo Liu, The University of Hong Kong

Title: *On a Waring's problem for integral quadratic and hermitian forms*

For each positive integer n, let $g_{\mathbb{Z}}(n)$ be the smallest integer such that if an integral quadratic form in n variables can be written as a sum of squares of integral linear forms, then it can be written as a sum of $g_{\mathbb{Z}}(n)$ squares of integral linear forms. We show that as n goes to infinity, the growth of $g_{\mathbb{Z}}(n)$ is at most an exponential of $\sqrt{n}$. Our result improves the best known upper bound on $g_{\mathbb{Z}}(n)$ which is in the order of an exponential of n. We also define an analogous number $g^*_{\mathcal{O}}(n)$ for writing hermitian forms over the ring of integers $\mathcal{O}$ of an imaginary quadratic field as sums of norms of integral linear forms, and when the class number of the imaginary quadratic field is 1, we show that the growth of $g^*_{\mathcal{O}}(n)$ is at most an exponential of $\sqrt{n}$. This is a joint work with Constantin N. Beli, Wai Kiu Chan, Maria Ines Icaza.

Allen Moy, Hong Kong University of Science and Technology

Title: *Morita equivalence of Peter-Weyl Iwahori algebras*

The Peter-Weyl idempotent of a parahoric subgroup is the sum of the idempotents of irreducible representations which have a nonzero Iwahori fixed vector. The associated convolution algebra is called a Peter-Weyl Iwahori algebra. We show any Peter-Weyl Iwahori algebra is Morita equivalent to the Iwahori-Hecke algebra. Both the Iwahori-Hecke algebra and a Peter-Weyl Iwahori algebra have a natural C^*-algebra structure, and the Morita equivalence preserves irreducible hermitian and unitary modules. Both algebras have another anti-involution denoted as, and the Morita equivalence preserves irreducible and unitary modules for the involution. This work is joint with Dan Barbasch.

Ming-Ho Ng, The University of Hong Kong

Title: *Distribution laws of Hecke eigenvalues*

The Erdős-Kac central limit theorem asserts that the numbers of prime factors of large integers (suitably normalised) tend to follow the Gaussian distribution. Central limit behaviour is also observed in certain family of automorphic forms. In $GL(2)$, the central limit theorem for Hecke eigenvalues of holomorphic primitive cusp forms was obtained by Nagoshi while in case of Maass cusp forms it was given by Wang and Xiao. In this talk, we will discuss some extensions in $GL(N)$ where $N \geq 3$. This is a joint work with Y.-K. Lau and Y. Wang.

Ken Ono, Emory University

Title: *Polya's Program for the Riemann Hypothesis and Related Problems*

In 1927 Polya proved that the Riemann Hypothesis is equivalent to the hyperbolicity of Jensen polynomials for Riemann's Xi-function. This hyperbolicity has only been proved for degrees $d = 1, 2, 3$. We prove the hyperbolicity of almost every Jensen polynomials of every degree. We obtain a general theorem which models such polynomials by Hermite polynomials. This theorem also allows us to prove a conjecture of Chen, Jia, and Wang on the partition function. This is joint work with Michael Griffin, Larry Rolen, and Don Zagier.

Title: *Can't you just feel the Moonshine?*

Richard Borcherds won the Fields medal in 1998 for his proof of the Monstrous Moonshine Conjecture. Loosely speaking, the conjecture asserts that the representation theory of the Monster, the largest sporadic finite simple group, is dictated by the Fourier expansions of a distinguished set of modular functions. This conjecture arose from astonishing coincidences noticed by finite group theorists and arithmetic geometers in the 1970s. Recently, mathematical physicists have revisited moonshine, and they discovered evidence of undiscovered moonshine which some believe will have applications to string theory and 3d quantum gravity. The speaker and his collaborators have been developing the mathematical facets of this theory, and have proved the conjectures which have been formulated. These results include a proof of the Umbral Moonshine Conjecture, and Moonshine for the first sporadic finite simple group which does not occur as a subgroup or subquotient of the Monster. The most recent Moonshine (announced here) yields unexpected applications to the arithmetic elliptic curves thanks to theorems related to the Birch and Swinnerton-Dyer Conjecture and the Main Conjectures of Iwasawa theory for modular forms. This is joint work with John Duncan, Michael Griffin and Michael Mertens.

Sudhir Pujahari , The University of Hong Kong

Title: *Zeros of Dirichlet series attached to half-integral weight cusp forms*

In this talk, firstly, we will find an explicit vertical strip on the complex plane where all the non-trivial zeros of the L-function attached to a cusp form of half-integral weight lie. Secondly, we prove that the L-function attached to certain cusp forms of half-integral weight have infinitely many zeros of odd order on the critical line. This is a joint work with J. Meher and K.D. Shankadhar.

Ping Xi, Xi'an Jiaotong University

Title: *Katz's problem on modular structures of Kloosterman sums*

Around 40 years ago, Katz proposed a problem on modular structures of Kloosterman sums that $\pm S(1, 1; p)/\sqrt{p}$ with prime moduli p might coincide with the p-th Fourier coeffcient of certain Hecke–Maass cusp form for GL_2. In this talk, we will show how to combine a weighted Selberg sieve, ℓ-adic cohomology and spectral theory of automorphic forms to provide a partial "negative" answer to this problem in the sense of almost prime moduli.

Dongxi Ye, Sun Yat-Sen University

Title: *The Monster Denominator Formula, the Gross–Zagier CM Value Formula, and Their Extensions*

In this talk, we first briefly review the celebrated monster denominator formula and Gross–Zagier CM value formula. Then we will talk about their extensions to genus zero Hecke subgroups.

Xin Zhang, The University of Illinois

Title: *Linear Forms on Fuchsian Groups*

Let $\Gamma < SL(2,\mathbb{Z})$ be a finitely generated group or semigroup. Let l be a linear form on the entries of matrices of Γ (say, let $l(\gamma)$ be the 2-2 entry of γ for $\gamma \in \Gamma$). What integers can appear in the set $\{l(\gamma) : \gamma \in \Gamma\}$? A theorem of Bourgain-Kontorovich says that for some linear forms l, if Γ is parabolic free and has critical exponent sufficiently close to 1, then the set $\{l(\gamma) : \gamma \in \Gamma\}$ satisfies an asymptotic local-global principle. This theorem has important application to pseudo-random numbers generation. Later, I proved that a similar theorem also holds for Γ with parabolics. I will explain how the Hardy-Littlewood circle method and several counting results for Γ can lead to these theorems.