33rd Automorphic Forms Workshop
Duquesne University
March 6 - 10, 2019

ABSTRACTS FOR BOOT CAMP LECTURES (March 6)

Lola Thompson (Oberlin College) **lola.thompson@oberlin.edu**

What are modular forms?

ABSTRACT: In this lecture, we will discuss some of the basic objects that will show up repeatedly in AFW talks: congruence subgroups, modular forms, the valence formula, Eisenstein series, and Hecke operators (if time permits).

Robert Lemke Oliver (Tufts University) **Robert.Lemke_Oliver@tufts.edu**

Why do modular forms have L-functions?

ABSTRACT: In this lecture, we'll discuss why modular forms are the "right" objects to be associated with L-functions. We'll provide an overview of how this association works, in particular showing why modular transformation properties naturally give rise to functional equations of L-functions. Time permitting, we'll also loosely discuss so-called converse theorems that show that L-functions of a certain flavor have to be associated with modular forms, and we'll discuss other, often conjectural, sources of L-functions.

Ben Kane (The University of Hong Kong) **bkane@hku.hk**

What are mock modular forms? From E_2 to Zwegers

ABSTRACT: In this lecture, we will investigate mock modular forms. These are holomorphic functions which are "similar" to modular forms, but they aren't modular forms. Specifically, they can be "completed" to obtain modular objects, but while one gains modularity by adding a natural "missing" piece, one loses holomorphicity, yielding a special class of non-holomorphic modular forms. We will introduce a few examples of mock modular forms, starting with the mysterious mock theta functions first introduced by Ramanujan in his last letter to Hardy, from which the entire field stems. After that, we will see a simple example of a mock modular form given by the weight 2 Eisenstein series and see how it fits into this more general theory. If time permits, we will investigate some applications of the theory of mock modular forms to the theory of holomorphic modular forms.

Sudhir Kumar Pujahari (The University of Hong Kong) **sudhir@hku.hk**

Probabilistic methods and modular forms

ABSTRACT: Given a real number θ, let $\theta \pmod 1$ be the fractional part of θ. A sequence of real numbers $\{\theta \pmod 1\}$ is said to be equidistributed in $[0, 1]$ with respect to the Lebesgue measure if the probability of $\{\theta \pmod 1\}$ lying in any subinterval of $[0, 1]$ is same as the length of the subinterval. The story of equidistribution begins in 1842 when Dirichlet showed that 0 is a limit point of the sequence $\{n\theta \pmod 1\}$. In 1884, Kronecker went a little ahead and showed that the above sequence is in fact dense in the unit interval. Finally, in 1909 Bohl, 1910 Sierpinski and Weyl independently showed that this sequence is equidistributed in the unit interval. In the first part of the lecture, we will discuss the theory of equidistribution briefly. In the second part of the lecture, we will discuss the Sato-Tate conjecture (which is a theorem now due to Taylor, Harris, Shepherd-Barron, Geraghty, Clozel and Barnet-Lamb) and beyond. Moreover, we will see a stronger version of multiplicity one theorem for the space of cusp forms of weight k and level N as a consequence of the joint Sato-Tate conjecture.

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ABSTRACTS FOR CONFERENCE TALKS (March 7–10)

Fikreab Admasu (CUNY, The Graduate Center) **fadmasu@gradcenter.cuny.edu**

Subgroups growth zeta functions and Hecke algebras

ABSTRACT: The study of subgroup growth zeta functions is a relatively young research area. In my thesis, I consider nilpotent groups and I attempt to generalize the notion of the cotype zeta function of an integer lattice to finitely generated nilpotent groups. This helps in determining the distribution of subgroups of finite index and provides more refined invariants in the analytic number theory of nilpotent groups. Similar attempt on algebraic groups leads to a rederivation of zeta functions of classical algebraic groups using Hecke algebras. A connection with Cohen-Lenstra heuristics will also be discussed.

Keshav Aggarwal (Ohio State University, Columbus) **aggarwal78@buckeyemail.osu.edu**

Weyl bound for $GL(2)$ L-functions in t-aspect

ABSTRACT: A t-aspect Weyl bound for holomorphic cusp forms of level 1 was first proved by Good (1982), and for Maass forms of level 1 by Muerman (1987) and Jutila (1990). This was recently extended to holomorphic cusp forms of any level by Booker-Milinovich-Ng (2017). We give another proof of the Weyl bound by using a uniform partitioning of the circle. The simplicity of our approach allows us to extend the result to Hecke-Maass cusp forms of any level and nebentypus.

Michael Allen (Oregon State University) **allenm3@oregonstate.edu**

Existence of eta-quotients of squarefree levels

ABSTRACT: In this talk, we consider which spaces of modular forms can contain eta-quotients for squarefree levels N coprime to 6. For such N, we begin with a necessary and sufficient condition for the existence of weakly holomorphic eta-quotients of even weights for $\Gamma_1(N)$. A bound originally obtained by Bhattacharya allows us to then determine when this existence can be strengthened to spaces of fully holomorphic modular forms when N is either prime or a product of two distinct primes. Finally, we discuss how far these methods can be generalized for arbitrary squarefree levels.

Allison Arnold-Roksandich (Oregon State University) **arnoldra@oregonstate.edu**

Establishing Several Infinite Families of Mock Modular Forms

ABSTRACT: In 2013, Lemke Oliver created a list of all eta-quotients which are theta functions. Then in 2016, Folsom, Garthwaite, Kang, Swisher, and Treneer utilized this list of “eta-theta” functions along with Zwegers's construction of mock theta functions to create a set of mock modular forms which are also quantum modular forms. Later in 2016, Diaz, Ellefsen, and Swisher generalized a subset of these quantum modular forms to a single general form of quantum modular forms which included the every element of this subset. This talk will discuss the work done to extend this generalization to a larger general form which encompasses all functions made by Folsom et al. as well as showing that all of the generalized functions are mock modular forms.

Henrik Bachmann (Nagoya University) **henrik.bachmann@math.nagoya-u.ac.jp**

Modular forms and multiple zeta values

ABSTRACT: In this talk, we will give an overview of recent results on the connections of modular forms and multiple zeta values. The first of such connections was observed by Zagier in the early '90s due to numerical experiments. In 2006 it was then proven by Gangl, Kaneko, and Zagier, that cusp forms for the full modular group, or more precisely their period polynomials, give rise to linear relations among double zeta values. In recent months these types of relations have been generalized and modified in various different ways. After giving an introduction to the theory of multiple zeta values, we will summarize these results and discuss some open questions.

Alex Beckwith (The Ohio State University) **beckwith.67@buckeyemail.osu.edu**

The nonvanishing of Rankin-Selberg L-functions at the special point in shortened spectral intervals

ABSTRACT: Let u be a Hecke-Maass cusp form for $SL(2, \mathbb{R})$ with Laplace eigenvalue $\frac{1}{4} + {t_u}^2$ and f a fixed holomorphic newform with prime level and trivial nebentypus. The conductor of the Rankin-Selberg L-function $L(s, u \otimes f)$ "drops" at the so-called "special point" $s_u = \frac{1}{2} + it_u$, causing it to behave like a $GL(2)$ L-function rather than a $GL(2) \times GL(2)$ L-function. Wenzhi Luo studied the moments of these L-functions at the special point, and was able to obtain a lower bound on the number of $L(s_u, u \otimes f)$ that are nonvanishing, a result which has important applications in Phillips-Sarnak's deformation theory of discrete groups. We consider the nonvanishing of the same L-functions in shortened spectral intervals, and obtain asymptotic expansions for the first and second moments of $L(s_u, u \otimes f)$ in such intervals. We will also discuss recent work on extending this study to $GL(3) \times GL(2)$ L-functions.

Lea Beneish (Emory University) **lea.beneish@emory.edu**

Weierstrass mock modular forms and a dimension formula

ABSTRACT: In joint work with Michael Mertens, we show that for N square-free corresponding to $X_0(N)$ with genus one, the space of weight zero mock modular forms on $\Gamma_0(N)$ is generated by Weierstrass mock modular forms and their images under Atkin-Lehner involutions and Hecke operators. We use this fact to re-derive a dimension formula of Van Ekeren, Möller, and Scheithauer for the weight one space of a holomorphic vertex operator algebra. The constant terms of the Weierstrass mock modular forms allow us to relate the dimension of the weight one space of the vertex operator algebra to periods of elliptic curves.

John Bergdall (Bryn Mawr College) **jbergdall@brynmawr.edu**

Upper bounds for constant slope p-adic families of modular forms

ABSTRACT: This talk is concerned with the radius of convergence of p-adic families of modular forms — q-series over a p-adic disc whose specialization to certain integer points is the q-expansion of a classical Hecke eigenform of level p. Numerical experiments by Gouvêa and Mazur in the nineties predicted the general existence of such families but also suggested, in spirit, the radius of convergence in terms of an initial member. Buzzard and Calegari showed, ten years later, that the Gouvêa–Mazur prediction was false. It has since remained open question how to salvage it. Here we will present some recent theoretical results towards such a salvage, backed up by numerical data.

Walter Bridges (Louisiana State University) **wbridg6@lsu.edu**

Kadell-type Partition Inequalities and Applications to Sum-Product Conjectures of Kanade-Russell

ABSTRACT: The Rogers-Ramanujan Identities state that

$$\sum_{n\geq 0}\frac{q^{n^2}}{(q;q)_n}=\frac{1}{(q,q^4;q^5)_\infty}\qquad\text{and}\qquad\sum_{n\geq 0}\frac{q^{n^2+n}}{(q;q)_n}=\frac{1}{(q^2,q^3;q^5)_\infty}.$$

The difference in the left and right sums clearly has nonnegative coefficients, but without reference to the Rogers-Ramanujan Identities it is not obvious that the same is true for the difference in product sides. In 1998, Kadell provided a combinatorial proof, and since then many other differences of products have been considered. We give combinatorial proofs and extensions of partition inequalities due to Berkovich-Garvan and McLaughlin. These may be applied to recently conjectured sum-product identities of Kanade-Russell. We show nonnegativity of differences of corresponding product sides, which provides some evidence as to the truth of these conjectures.

Luca Candelori (Wayne State University) **candelori@wayne.edu**

Integrality Properties of the Weil Representation of a finite quadratic module

ABSTRACT: The Weil representation of a finite quadratic module is an essential tool in studying the transformation laws of theta functions, and vector-valued modular forms in general. This complex, finite-dimensional representation factors through a finite quotient of the metaplectic cover of the modular group and it has a canonical basis of delta functions. With respect to this basis, the matrix entries of the Weil representation lie in a cyclotomic field extension. In this talk we prove that after a suitable change of basis the matrix entries can be taken to lie in the ring of integers of the cyclotomic extension. For cyclic quadratic modules of prime order, we exhibit a canonical choice for such an integral basis. This is joint work with Richard Ng and Yilong Wang at Lousiana State University.

Liubomir Chiriac (University of Massachusetts Amherst) **chiriac@math.umass.edu**

On the equality case of the Ramanujan Conjecture for Hilbert modular forms

ABSTRACT: Given a cuspidal unitary automorphic representations π on GL(2), the Ramanujan Conjecture asserts that each local component π_v is tempered. This is equivalent to the statement that $|a_v(\pi)|\leq 2$, where $a_v(\pi)$ is the trace of the Langlands conjugacy class in $\mathrm{GL}(2,\mathbb{C})$ associated to π_v. In the context of Hilbert modular forms of parallel weight two we show that this inequality is strict when π is of CM-type and v has degree one. We also present examples when the equality case does occur for certain places v of degree two.

Dylon Chow (University of Illinois at Chicago) **dchow4@uic.edu**

Integral Points by Height on the Wonderful Compactification

ABSTRACT: A conjecture of Batyrev and Manin predicts the distribution of rational points of bounded height on a wide class of projective varieties. An analogous conjecture predicts the distribution of integral points. The case of the wonderful compactification was proven in two ways, one using harmonic analysis on adele groups, and the other using techniques from dynamics. In this talk I will give an overview of these conjectures and discuss the input from the theory of automorphic forms to prove special cases.

Bin Guan (CUNY Graduate Center) **bguan@gradcenter.cuny.edu**

Exact averages of central values of triple product L-functions via the relative trace formula

ABSTRACT: Feigon and Whitehouse studied central values of triple product L-functions averaged over newforms of weight 2 and prime level. They proved some exact formulas applying the results of Gross and Kudla which link central values of L-functions to classical "periods". In this talk, I will use the relative trace formula and a period formula proved by Ichino to generalize their result to modular forms of weight 2 and square-free levels.

Jonathan Hales (Brigham Young University) **jonathanrhales@gmail.com**

Modular Parameterizations of Elliptic Curves

ABSTRACT: The modularity theorem gives that for every elliptic curve $E/\mathbb{Q}$, there exists a rational map from the modular curve $X_0(N)$ to E, where N is the conductor of E. This map may be expressed in terms of two modular functions $X(\tau)$ and $Y(\tau)$ (derived from the Weierstrass $\wp$-function and its derivative) where $X(\tau)$ and $Y(\tau)$ satisfy the equation for E, as well as a certain differential equation. Using these two relations, a recursive algorithm can be constructed to calculate the q-expansions of these parameterizations at any cusp. These functions are algebraic over $\mathbb{Q}(j(\tau))$ and satisfying modular polynomials where each of the coefficient functions are rational functions in $j(\tau)$. Using these functions, we determine the divisor of the parameterization and the preimage of rational points on E.

Trajan Hammonds (CMU), **Steven J. Miller** (CMU and Williams) **thammond@andrew.cmu.edu, sjm1@williams.edu**

Rank and Bias in Families of Curves via Nagaos Conjecture

ABSTRACT: Let $\mathcal{X} : y^2 = x^{2g+1} + A_{2g}(T)x^{2g} + \cdots + A_0(T)$ be a nontrivial one-parameter family of hyperelliptic curves of genus g over $\mathbb{Q}(T)$ with $A_i(T) \in \mathbb{Z}[T]$. Denote by $\mathcal{X}_t$ the specialization of $\mathcal{X}$ to an integer t, $a_t(p)$ its trace of Frobenius, and $A_{r,\mathcal{X}}(p) = \sum_{t(p)} a_t(p)^r$ its r-th moment. The first moment is related to the rank of the Jacobian by the generalized Nagao conjecture. Generalizing a result of Arms, Lozano-Robledo, and Miller, we compute first moments for various families resulting in infinitely many hyperelliptic curves over $\mathbb{Q}(T)$ with Jacobian of moderately large rank; by the specialization theorem, this yields hyperelliptic curves over $\mathbb{Q}$ with large rank Jacobian. When $\mathcal{X}$ is an elliptic curve, Michel proved $A_{2,\mathcal{X}} = p^2 + O\left(p^{3/2}\right)$. For the families studied, we observe the same second moment expansion. Furthermore, we observe the largest lower order term that does not average to zero is on average negative, a bias first noted by Miller in the elliptic curve case. We prove this bias for a number of families. This is joint work with Scott Arms, Seoyoung Kim, Ben Logsdon, and Alvaro Lozano-Robledo.

Jordan Hardy (University of Idaho) **jghardy@uidaho.edu**

Special Values of Genus Two Modular Forms with Interesting Divisors

ABSTRACT: Siegel constructed units in the Hilbert class field of a quadratic imaginary field using the special values of quotients of the cusp form Δ. In a 1997 paper, Goren and De Shalit modified this construction to generate class invariants in the Hilbert class field of a quartic CM field K by replacing the function Δ with a multiple of the Siegel modular cusp form χ_{10}. However, these invariants fail to be units. Their analysis of these values in large part depends on the fact that χ_{10} has a well-understood divisor. We will investigate what can be learned about the special values of other genus two modular forms with known divisors.

Adrian Hauffe-Waschbüsch (RWTH Aachen) **adrian.hauffe@matha.rwth-aachen.de**

Cuspidality and Fourier coefficients of Hermitian modular forms

ABSTRACT: In my talk I transfer a result of Böcherer and Kohnen on Siegel modular forms to Hermitian modular forms. The main result is that for large weights all modular forms, which satisfy a certain growth condition on the Fourier coefficients, are cusp forms. For example we will see that satisfying the Hecke bound is equivalent to being a cusp form for large weights.

Peter Humphries (University College London) **pclhumphries@gmail.com**

Archimedean newform theory

ABSTRACT: We discuss the interrelation between the notions of newforms, conductors, and test vectors for Rankin-Selberg integrals, in both the classical and adèlic settings. We propose a new theory of these notions in the archimedean setting that mimics the well-studied nonarchimedean theory.

Brian Hwang (Cornell University) **bwh59@cornell.edu**

Orthogonal and symplectic families of algebraic automorphic forms

ABSTRACT: Self-dual automorphic representations on $GL(n)$ come in two forms: those that come from orthogonal groups and those that come from symplectic groups; this can be detected via zeros of L-functions. But if we insist that the representation be algebraic (e.g. if there is an associated Galois representation), a number of interesting phenomena occur. For example, if n is even, it turns out that the Langlands functorial transfer from SO(n) to GL(n) does not preserve algebraicity. One way to understand such phenomena arise is through harmonic families of automorphic forms. As an illustration, we will show how we can solve a local-to-global problem in number theory using harmonic families, essentially reducing an existence problem in arithmetic problem to the vanishing or non-vanishing of an explicit integral; this leads to a purely local characterization of orthogonality for such representations.

Marie Jameson (University of Tennessee) **mjameso2@utk.edu**

Congruences for modular forms and generalized Frobenius partitions

ABSTRACT: The partition function is known to exhibit beautiful congruences that are often proved using the theory of modular forms. Here, we discuss the extent to which these congruence results apply to the generalized Frobenius partitions defined by Andrews. In particular, we prove that there are infinitely many congruences for $c\phi_k(n)$ modulo ℓ, where $\gcd(\ell, 6k) = 1$, and we also prove results on the parity of $c\phi_k(n)$. Along the way, we prove results regarding the parity of coefficients of weakly holomorphic modular forms which generalize work of Ono.

Subhajit Jana (ETH Zurich) **subhajit.jana@math.ethz.ch**

Analytic Newvector Theory and Applications

ABSTRACT: We will describe, after a brief introduction to the classical non-archimedean newvector theory by Jacquet–Piatetski-Shapiro–Shalika, an approximate archimedean analogue of this newvector theory. If time permits we will talk about some applications of these newvectors in some analytic questions of automorphic forms, e.g. counting automorphic forms, estimating moments of automorphic L-functions. This is an ongoing joint work with Paul D. Nelson.

Ryan Keck (Brigham Young University) **ryank@mathematics.byu.edu**

Congruences for Coefficients of Modular Forms in Levels $3, 5,$ and 7 with Poles at 0

ABSTRACT: Let $M_k^\flat(N)$ be the space of weakly holomorphic modular forms that are holomorphic away from the cusp at 0. We prove congruences modulo powers of $3, 5,$ and 7 for the Fourier coefficients of weight 0 forms in the spaces where $N = 3, 5, 7$ respectively. We conjecture that these congruences can be improved to a congruence involving counting the number of times certain digits appear in the base N expansion of the modular form's order of vanishing at infinity.

Rizwanur Khan (The University of Mississippi) **rrkhan@olemiss.edu**

Distribution of mass of automorphic forms

ABSTRACT: I will discuss recent work on the 4-norm of automorphic forms.

Krzysztof Klosin (City University of New York) **krzysztof.klosin@yahoo.com**

Modularity of mod p Galois extensions

ABSTRACT: Serre's Conjecture (now a theorem of Khare and Wintenberger) predicts that every odd continuous and irreducible representation ρ of the absolute Galois group $G_{\mathbf{Q}}$ of the rationals into $GL_2(\overline{\mathbf{F}}_p)$ arises from a modular form. However, if ρ is reducible, but not a sum of two characters, the problem is more complex. In this talk we will discuss such extensions ρ and the connection between their modularity and the structure of a certain Eisenstein ideal. This is joint work with T. Berger.

Robert Lemke Oliver (Tufts University) **Robert.Lemke_Oliver@tufts.edu**

Number fields and class groups

ABSTRACT: Number fields tautologically come in two flavors: those that contain nontrivial subfields and those that don't. For example, degree n fields whose Galois closure has Galois group S_n or A_n do not admit interesting subfields, while for example D_4-quartic extensions do (and for this reason, they arise with positive density among all quartic fields!). Much work has been focused on problems related to counting families of fields not admitting subfields, but in this talk we instead focus on fields that do admit subfields. In particular, we present a philosophy that makes clear how to think about such problems, with a particular emphasis on how this philosophy may be used to understand questions related to determining average sizes of class groups.

Benjamin Linowitz (Oberlin College) **benjamin.linowitz@oberlin.edu**

Constructing non-compact isospectral non-isometric hyperbolic 3-manifolds

ABSTRACT: Garoufalidis and Reid have recently constructed examples of 1-cusped isospectral non-isometric hyperbolic 3-manifolds. In this talk we will extend their construction and provide examples of n-cusped isospectral non-isometric hyperbolic 3-manifolds with $n > 1$. Moreover, we will show that our examples have the same Eisenstein series.

Shenhui Liu (University of Toronto) **sliu@math.toronto.edu**

Spectral analog of Selberg's result on $S(T)$

ABSTRACT: In 1940's, Selberg studied the average behavior of $S(T) = \frac{1}{\pi}\arg\zeta(\frac{1}{2}+iT)$. And later Selberg as the analogous case of $S(t,\chi)$ for Dirichlet L-functions for primitive characters of modulus prime q. Later, Hejhal and Luo studied the spectral analog of $S(T)$ in the context of L-functions for Hecke–Maass cusp forms for $SL(2,\mathbb{Z})$. In this talk, we will discuss the average behavior of $S(t,F) = \frac{1}{\pi}\arg L(\frac{1}{2}+it)$ for Hecke–Maass forms F for $SL(3,\mathbb{Z})$. This is joint work with Sheng-Chi Liu.

Kimball Martin (University of Oklahoma) **kimball.martin@ou.edu**

Ranks, root numbers and bias for small $a(p)$'s

ABSTRACT: The Birch and Swinnerton-Dyer conjecture predicts that elliptic curves with more global points tend to have more local points, i.e., the $a(p)$'s are negatively biased for p large. We will report on joint work with Thomas Pharis about (i) computational investigations of this bias for p small, and (ii) related results for modular forms.

Grant Molnar (Dartmouth College) **Grant.S.Molnar.GR@dartmouth.edu**

The Arithmetic of Modular Grids

ABSTRACT: Zagier duality between sequences of modular forms has been discovered and proven in various contexts. In this talk, we review this history of Zagier duality and demonstrate how it arises from the Bruinier-Funke pairing. This perspective allows us to prove Zagier duality holds for certain canonical bases of quite general spaces.

Jiakun Pan (Texas A & M University) **jpan@math.tamu.edu**

Quantum unique equidistribution for Eisenstein series in the level aspect

ABSTRACT: We study Eisenstein series on growing levels with general central characters, and find an asymptotic formula for their mass distribution. An interesting feature is that the main term depends on the values of the logarithmic derivative of Dirichlet L-functions on the 1-line. The estimation for the error terms uses the subconvexity bound of twisted L-functions by Blomer, Harcos and Michel. As a variation of the QUE conjecture raised by Rudnick and Sarnak, our research extends previous work of Kowalski, Michel, and Vanderkam, Holowinsky and Soundararajan, Nelson, Pitale, and Saha, and Koyama, among many other authors. Joint with Matthew P. Young.

Shashika Petta Mestrige (Louisiana State University) **pchama1@lsu.edu**

Congruences for the partition function $p_[1^c, 11^d](n)$

ABSTRACT: The partition function $p_{[1^c\ell^d]}(n)$ has been extensively studied in recent years. In this talk we prove infinite families of congruences for the partition function $p_{[1^c 11^d]}(n)$ modulo powers of 11 for any integers c and d. We use Hecke operators, explicit basis of the vector space of modular functions of the congruence subgroup $\Gamma_0(11)$ and work of Atkin and Gordon on proving congruences for the partition functions $p(n)$ and $p_{-k}(n)$.

Kyle Pratt (University of Illinois at Urbana-Champaign) **kpratt4@illinois.edu**

Breaking the $\frac{1}{2}$-barrier for the twisted second moment of Dirichlet L-functions

ABSTRACT: I will discuss recent work on the second moment of Dirichlet L-functions to a large prime modulus q twisted by the square of an arbitrary Dirichlet polynomial. We break the 1/2-barrier in this problem, and obtain an asymptotic formula when the Dirichlet polynomial has length up to $q^{51/101}$. This is joint work with H. M. Bui, Nicolas Robles, and Alexandru Zaharescu.

Sudhir Kumar Pujahari (The University of Hong Kong) **sudhir@hku.hk**

Zeros of Dirichlet series attached to half-integral weight cusp forms and generalised Davenport-Heilbronn function.

ABSTRACT: In this talk, firstly, we will find an explicit vertical strip on the complex plane where all the non-trivial zeros of the Dirichlet series attached to a cusp form of half-integral weight lie. Secondly, we will prove that the Dirichlet series 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. Finally, we will see an analogue of Selberg's result for generalised Davenport-Heilbronn function. The last part is a joint work with M.K Das.

Wissam Raji (American University of Beirut) **wissam.raji@gmail.com**

Non-Vanishing of L-functions of Hilbert Modular Forms in the Critical Strip

ABSTRACT: We show that, on average, the L-functions of cuspidal Hilbert modular forms with sufficiently large weight k do not vanish on the line segments $\Im(s) = t_0, \Re(s) \in (\frac{k-1}{2}, \frac{k}{2} - \epsilon) \cup (\frac{k}{2} + \epsilon, \frac{k+1}{2})$. (joint work with Alia Hamieh)

Ramakrishnan Balakrishnan (Harish-Chandra Research Institute) **b.ramki61@gmail.com**

On Shimura and Shintani lifts for certain subspaces of modular forms

ABSTRACT: In this talk, we consider the problem of constructing Shimura and Shintani liftings for some subspaces of modular forms. The subspaces are characterized by the Atkin-Lehner W-operators and this work is a generalization of a result of Choi and Kim.

Thomas Rüd (University of British Columbia) **thomas@math.ubc.ca**

Computing Tamagawa numbers of algebraic tori arising as centralisers of regular semisimple elements.

ABSTRACT: Tamagawa numbers were introduced nearly 60 years ago to associate some canonical number-theoretic measure to an algebraic group defined over a global field. Ono found shortly after that in the case of algebraic tori over a number field, this analytically-defined invariant surprisingly turned out to be a ratio of two purely algebraic invariants. This lead to a similar formula for connected algebraic groups and the problem was considered solved. However in practice the formulas just link a hard invariant to other hard invariants. The Tamagawa numbers resurfaced with the work of Gaitsgory and Lurie treating the case over function fields, and also in a motivic setting. In a more elementary way, the Tamagawa numbers of algebraic tori showed up in formulas counting the isogeny class of principally polarized abelian varieties over finite fields, and to the surprise of many those numbers stayed as black boxes and were not computed. We will present some early results in the computation of those numbers and in-depth description of their tori and character lattices, plus we implemented new structures in SAGE that lets us build and manipulate algebraic tori and compute their cohomology. This lead to computing examples we are not able to do theoretically, and make some useful conjectures. Since the talk will only tackle the case of algbraic tori, it should be a rather basic talk, understandable by any with little Galois cohomology background.

Andrew Salch (Wayne State University) **dy8211@wayne.edu**

Why we hope "topological Maass forms" exist

ABSTRACT: In this talk I'll survey some relationships between homotopy theory, modular forms, and L-functions, particularly:

1. formulas expressing orders of certain stable homotopy groups of finite CW-complexes in terms of special values of L-functions,
2. Lichtenbaum's conjecture (now a theorem), relating special values of Dedekind zeta-functions of totally real number fields to orders of algebraic K-groups, and
3. the portion of the stable homotopy groups of spheres which is detected by the generalized cohomology theory tmf ("topological modular forms").

As of 2019, there is no clear relationship between item 3 and the first two items on this list. The goal of this talk will be to explain why it's natural to expect that a suitable generalized cohomology theory of "topological Maass forms of eigenvalue 1/4" ought to link these three items in a satisfying way. Most of the talk will be expository, but I will report on a few new results as part of item 1.

Felix Schaps (RWTH Aachen University) **felix.schaps@matha.rwth-aachen.de**

Fourier coefficients of Eisenstein series for orthogonal groups

ABSTRACT: We consider Eisenstein series of weight k for the orthogonal modular group $O(2, n)$. The aim is to derive its Fourier expansion. By methods of Siegel and Braun, we obtain that the Fourier coefficients are given by a L-series evaluated at $s = k$. Under additional assumptions for the lattice, the Fourier-Jacobi expansion of index 1 is equal to Jacobi-Eisenstein series whose Fourier coefficients can be computed and are rational.

Daniel Shankman (Purdue University) **dshankma@purdue.edu**

Local Langlands correspondence for Asai L and epsilon factors

ABSTRACT: Let E/F be a quadratic extension of p-adic fields. The local Langlands correspondence establishes a bijection between n-dimensional Frobenius semisimple representations of the Weil-Deligne group of E and smooth, irreducible representations of $GL(n, E)$. We reinterpret this bijection in the setting of the Weil restriction of scalars $Res(GL(n), E/F)$, and show that the Asai L-function and epsilon factor on the analytic side match up with the expected Artin L-function and epsilon factor on the Galois side.

Shingo Sugiyama (Nihon University) **s-sugiyama@math.cst.nihon-u.ac.jp**

A cuspidal analogue of trace formula and nonvanishing central L-values for $\mathrm{GL}(2) \times \mathrm{GL}(3)$

ABSTRACT: By integrating a kernel function and a fixed even Hecke-Maass cusp form ϕ of level 1, we give an exact formula of the first moment of triple products of modular forms ϕ, f and $\bar{f}$ over cuspidal Hecke eigenforms f of weight $k \geq 4$ and level 1. As an application, we give a quantitative version of Luo-Sarnak's result on an infinitude of f such that $L(1/2, \phi \times \mathrm{Sym}^2(f)) \neq 0$. This is a joint work with Masao Tsuzuki (Sophia University).

Lola Thompson (Oberlin College) **lola.thompson@oberlin.edu**

The Fourier coefficients of Eisenstein series newforms

ABSTRACT: In this talk, we discuss several recent extensions of the authors' previous work on the Fourier coefficients of Eisenstein series newforms. For example, we obtain a sharp refinement of the strong multiplicity-one theorem by showing that the density of primes p for which the p^{th} Hecke eigenvalues of two distinct Eisenstein series newforms differ is of the form $1/n$ for some $n \geq 2$. Additionally, we show that if f is an Eisenstein series newform whose Fourier coefficients $a_f(n)$ are real then there is a constant $\delta > 0$ such that the sequence $(a_f(n))_{n \leq x}$ has at least δx sign changes. This talk is based on a joint paper with Benjamin Linowitz.

Jesse Thorner (Stanford University) **jthorner@stanford.edu**

Mass equidistribution on average

ABSTRACT: Let f traverse the self-dual Hecke-Maass forms of squarefree level N and Laplace eigenvalue λ as $N\lambda \to \infty$. We prove that for 100% of such forms f, the push-forward of the L^2 mass of f to the level 1 modular surface equidistributes with respect to the uniform hyperbolic measure at a power-saving rate of convergence in the hybrid λ and N aspects. This builds on the works of Soundararajan and Nelson on the quantum unique ergodicity conjecture. The key new input is a zero-density estimate for Rankin-Selberg L-functions that extends prior work of Kowalski and Michel. Joint work with Farrell Brumley and Asif Zaman.

Jan-Willem van Ittersum (Utrecht University) **j.w.m.vanittersum@uu.nl**

A supersymmetric Bloch–Okounkov theorem

ABSTRACT: Partitions of integers are related to modular forms in many ways. We discuss the question when the normalized generating series of a function on partitions is quasimodular. This is the case when the function is shifted symmetric and this result is called the Bloch–Okounkov theorem. We comment on this result and show that if the function is supersymmetric this generating series is quasimodular as well.

Jan-Willem van Ittersum (Utrecht University) **j.w.m.vanittersum@uu.nl**

An equivariant version of Lehmer's conjecture (3 minute talk)

ABSTRACT: The Mahler measure of a monic polynomial equals to absolute value of the product of all of its roots outside the unit circle. For cyclotomic polynomials this number equals one. For other polynomials it is a long standing conjecture that the Mahler measure equals at least the Mahler measure of the special polynomial $z^{10} + z^9 - z^7 - z^6 - z^5 - z^4 - z^3 + z + 1$. The action of a finite group of Möbius transformations gives rise to an equivariant Mahler measure. If this group does not stabalize the unit circle, an appropriate analogue of this conjecture for the equivariant Mahler measure holds.

Nahid Walji (The American University of Paris) **nahidwalji@gmail.com**

A conjectural refinement of strong multiplicity one

ABSTRACT: Given two distinct unitary cuspidal automorphic representations for $GL(n)/\mathbb{Q}$, denote S to be the set of primes at which the associated Hecke eigenvalues differ. Under the assumption that the adjoint lifts are automorphic and furthermore cuspidal, we obtain a lower bound on the lower Dirichlet density of S.

Liyang Yang (Caltech) **lyyang@caltech.edu**

Arithmetic Distribution of Tempered Components of Cuspidal Representations of $GL(3)$

ABSTRACT: Let π be a unitary cuspidal representation for $GL(3)$ over a number field F. The general Ramanujan conjecture predicts that π is tempered at all local places. When $F = \mathbb{Q}$, Ramakrishnan proved that there are infinitely many finite places at which π is tempered. However, for general base field, it was not even known if there exists one such finite place where π is tempered. In this talk, we generalize Ramakrishnan's result to show that there are infinitely many such finite places in any given trivial ray class; moreover, the traces of local Hecke operators at these places lie inside the unit disk.

Rongqing Ye (The Ohio State University) **ye.352@buckeyemail.osu.edu**

Epsilon factors over finite field

ABSTRACT: For irreducible cuspidate representations of $GL_n(F)$ where F is a finite field, we define epsilon factors associated to them via Macdonald's correspondence. We will show in the talk that such epsilon factors are closely related to finite factors coming from integral representations. Moreover, we will show that these finite factors process multiplicativity properties and they are equal to products of Gauss sums. This is joint work with Elad Zelingher.

Shaoyun Yi (University of Oklahoma) **yishaoyun926@gmail.com**

Klingen p^2 vectors for $GSp(4)$

ABSTRACT: In 2007, Roberts and Schmidt had a satisfactory local new- and oldform theory for $GSp(4)$ with trivial central character, in which they considered the vectors fixed by the paramodular groups $K(p^n)$. In this talk, we consider the vectors fixed by the Klingen subgroup of level p^2. We determine the dimensions of the spaces of these invariant vectors for all irreducible, admissible representations of $GSp(4)$ over a p-adic field.

Sadiah Zahoor (University of Sheffield) **szahoor1@sheffield.ac.uk**

What's interesting about Modular Forms of Half Integral Weight?

ABSTRACT: Modular forms of half integral weight have been less pleasing than modular forms of integral weight as unlike the integral case, they have a more complicated spectral theory and don't connect to number fields via galois representations. However, more light has been shed in this area since Shimura published his paper in Annals of Mathematics in 1973 lifting half integral modular forms to even integral modular forms via *Shimura correspomdence*. I shall briefly introduce half integral modular forms which will be followed with a quick overview of some interesting connections that are known for them.

Shaul Zemel (Hebrew University of Jerusalem) **zemels@math.huji.ac.il**

Shintani Lifts of Nearly Holomorphic Modular Forms

ABSTRACT: The classical Shintani lift is known to take cusp forms of weight $2k$ to cusp forms of weight $k + 1/2$, and it can be realized as an integral against an appropriate theta kernel. Extensions of this lift to several larger spaces have been investigated, and we present the lifting of nearly holomorphic modular forms (involving negative powers of the imaginary part of the variable). The main result is that the Shintani lift of a nearly holomorphic modular form of depth d is nearly holomorphic of depth $d/2$ (also in some regularized settings).

Zhuohui Zhang (Zhuohui Zhang) **zhuohui.zhang@weizmann.ac.il**

Bernstein-Zelevinsky Derivatives and Their Analogues

ABSTRACT: In a series of papers circa 1980, Bernstein and Zelevinsky have developed a functorial method known as the derivatives to classify irreducible smooth representations of GLn over p-adic fields. I will give a survey talk on their method as well as an analogue developed by Aizenbud, Gourevitch and Sahi over the smooth representations for GLn over the real and complex fields. I will also discuss similar analogues of derivatives for automorphic forms.

Sonja Žunar (University of Zagreb) **sonja.zunar@gmail.com**

Integral non-vanishing criteria for Poincaré series

ABSTRACT: In 2009, Goran Muić proved an integral criterion for the non-vanishing of Poincaré series on locally compact Hausdorff groups. We present a strengthening of this criterion and apply it to various families of cuspidal automorphic forms on (the metaplectic cover of) $\mathrm{SL}_2(\mathbb{R})$. As a corollary, we prove some results on the non-vanishing of L-functions associated to cusp forms of (half-)integral weight.
