

**Arithmetic Quantum Field Theory Conference**  
**March 25–29, 2024**



**Monday, March 25, 2024 – Women in Math and Physics**

8:30 – 9:00 am	<i>Breakfast</i>
9:00 – 10:00 am	<p><b>Melanie Matchett Wood (Harvard)</b></p> <p><b>Title:</b> <i>Statistics of Number fields, function fields, and 3-manifolds</i></p> <p><b>Abstract:</b> Motivated by conjectures of Cohen, Lenstra, and Martinet on the distribution of class groups of number fields, we describe the analogous questions of understanding distributions of class groups and fundamental groups of curves over finite fields, and the distribution of fundamental groups of 3-manifolds. We describe results on these distributions in the cases of curves over finite fields and 3-manifolds, joint with Liu, Zureick-Brown, and Sawin, and discuss how ideas have passed back and forth between the number field, curves over finite fields, and 3-manifold settings.</p>
10:00 – 10:20 am	<i>Coffee break</i>
10:20 – 11:20 am	<p><b>Charlotte Chan (U Michigan)</b></p> <p><b>Title:</b> <i>Generic character sheaves on parahoric subgroups</i></p> <p><b>Abstract:</b> Lusztig's theory of character sheaves for connected reductive groups is one of the most important developments in representation theory in the last few decades. I will give an overview of this theory and explain the need, from the perspective of the representation theory of p-adic groups, of a theory of character sheaves on jet schemes. Recently, R. Bezrukavnikov and I have developed the “generic” part of this desired theory. In the simplest nontrivial case, this resolves a conjecture of Lusztig and produces perverse sheaves on jet schemes compatible with parahoric Deligne–Lusztig induction. This talk is intended to describe in broad strokes what we know about these generic character sheaves, especially within the context of the Langlands program.</p>
11:30 – 12:30 pm	<p><b>Kim Klinger–Logan (Kansas State)</b></p> <p><b>Title:</b> <i>Connections between special values of L-functions and scattering amplitudes</i></p> <p><b>Abstract:</b> In this talk we will attempt make a connection between zeros and special values of L-functions and scattering amplitudes. The connection is best seen through solutions to differential equations of the form <math>(\Delta - \lambda)f = S</math> on <math>X = \mathrm{SL}(2, \mathbb{Z}) \backslash \mathrm{SL}(2, \mathbb{R}) / \mathrm{SO}(2, \mathbb{R})</math> for <math>\Delta = y^2(\partial_x^2 + \partial_y^2)</math> and <math>H^{\infty}(X) \cup M</math> where <math>M</math> is the space of moderate growth functions. Recently, Bombieri and Garrett (following work of Hass, Hejhal, and Colin de Verdiere) laid out the possibly</p>

	<p>connection with eigenvalue solutions to equations of this form with zeros of L-functions. On the other hand, physicists such as Green, Russo, Vanhove found that eigenfunction solutions to equations of this form give coefficients of the 4-graviton scattering amplitude. We will elaborate on these connections and discuss some recent work on finding solutions for such equations. This work is in collaboration with Ksenia Fedosova, Stephen D. Miller, Danylo Radchenko and Don Zagier.</p>
12:30 – 2:15 pm	<i>Lunch</i>
2:15 – 3:15 pm	<p><b>Fei Yan (Brookhaven National Lab)</b></p> <p><b>Title:</b> <i>Topological defects on the lattice</i></p> <p><b>Abstract:</b> Topological defects, endowed with a rich mathematical structure, play important roles in condensed matter physics, high energy theory and quantum information science. Realization of such defects on the lattice not only has interesting theoretical consequences, but also opens the pathway to quantum simulation of physical systems. In this talk, I will discuss lattice realizations of topological defects in simple (1+1)-d systems, taking the transverse field Ising model and the three-state Potts model as examples. Time permitting, I will also briefly comment on topological defects in non-equilibrium systems, such as periodically-driven Floquet systems.</p>
3:15 – 3:30 pm	<i>Coffee break</i>
3:30 – 4:30 pm	<p><b>Sarah Harrison (Northeastern)</b></p> <p><b>Title:</b> <i>Liouville Theory and Weil-Petersson Geometry</i></p> <p><b>Abstract:</b> Two-dimensional conformal field theory is a powerful tool to understand the geometry of surfaces. Liouville conformal field theory in the classical (large central charge) limit encodes the geometry of the moduli space of Riemann surfaces. I describe an efficient algorithm to compute the Weil-Petersson metric to arbitrary accuracy using Zamolodchikov's recursion relation for conformal blocks, focusing on examples of a sphere with four punctures and generalizations to other one-complex-dimensional moduli spaces. Comparison with analytic results for volumes and geodesic lengths finds excellent agreement. In the case of <math>M_{0,4}</math>, I discuss numerical results for eigenvalues of the Weil-Petersson Laplacian and connections with random matrix theory. Based on work with K. Coleville, A. Maloney, K. Namjou, and T. Numasawa.</p>

Tuesday, March 26, 2024

9:00 – 9:30 am	<i>Breakfast</i>
9:30 – 10:30 am	<b>Roman Bezrukavnikov (MIT)</b> <b>Title:</b> <i>From affine Hecke category to invariant distributions</i> <b>Abstract:</b> By a result of Ben-Zvi, Nadler and Preygel the cocenter of the affine Hecke category can be identified with coherent sheaves on the appropriate stack of commuting pairs in the Langlands dual group. In a joint work (in progress) with Ciubotaru, Kazhdan and Varshavsky we recover the space of unipotent invariant distributions on the p-adic group from that category and develop applications to harmonic analysis, including endoscopic property of unipotent L-packets. Time permitting, I will explain how a part of this result can be recovered from a geometric realization of Lusztig's asymptotic affine Hecke algebra $J$ (joint with Karpov and Krylov), and present a conjecture generalizing the story to other depth zero representations; another special case of this generalization appears in a joint work with Varshavsky.
10:30 – 11:00 am	<i>Coffee break</i>
11:00 – 12:00 pm	<b>Sasha Braverman (Toronto/Perimeter)</b> <b>Title:</b> <i>Hecke operators for algebraic curves over local non-archimedean fields: a survey of some recent results</i> <b>Abstract:</b> The main goal of this talk is to discuss Hecke operators and Hecke eigen-functions for the moduli space of $G$ -bundles on a smooth projective algebraic curve $X$ defined over a local non-archimedean field $K$ (possibly with level structures at finitely many points). The plan is to discuss the following subjects: 1) Definition of Hecke operators and the space on which they act 2) Relation to “classical story” - i.e. eigen-functions of Hecke operators for curves over a finite field. 3) Detailed discussion of the examples when $X$ has genus zero and we consider bundles with trivialization at two points. In this case we'll discuss the relation to classical representation theory of p-adic groups and two representation theory of Cherednik algebras. Based on joint works with P. Etingof, D.Kazhdan, and A. Polishchuk.
12:00 – 12:15 pm	<i>Group photo. Meet on steps in front of 20 Garden Street.</i>
12:15 – 1:30 pm	<i>Lunch</i>
1:30 – 2:30 pm	<b>Peng Shan (Tsinghua)</b> <b>Title:</b> <i>Modularity for <math>W</math>-algebras, affine Springer fibres and associated variety</i> <b>Abstract:</b> I will explain a bijection between admissible representations of affine Kac-Moody algebras and fixed points in affine Springer fibres. I will also explain how to match the modular group action on the characters of representations with the one defined by Cherednik in terms of double affine Hecke algebras, and extensions of these relations to representations of $W$ -algebras. If time permits, I will discuss some extension of these results to non-admissible levels and some conjectures about their associated varieties. This is based on joint work with Dan Xie, Wenbin Yan, and Qixian Zhao.

2:30 – 3:00 pm	<i>Coffee break</i>
3:00 – 4:00 pm	<p><b>Bảo Châu Ngô (U Chicago)</b></p> <p><b>Title:</b> <i>On the nonabelian Fourier kernel and the Lafforgue transform</i></p> <p><b>Abstract:</b> In the case of SL<sub>2</sub>, we present an analytic formula for the nonabelian Fourier kernel responsible for the functional equation of automorphic L-functions. We use the Gelfand-Graev formula for Langlands' stable transfer factor and a linear map between the Bernstein center and the cocenter that we call the Lafforgue transform. This is a joint work with Zhilin Luo.</p>

### Wednesday, March 27, 2024

9:00 – 9:30 am	<i>Breakfast</i>
9:30 – 10:30 am	<p><b>YoungJu Choie (POSTECH)</b></p> <p><b>Title:</b> <i>Schubert Eisenstein series and Poisson summation for Schubert varieties</i></p> <p><b>Abstract:</b> Schubert Eisenstein series by restricting the summation in a degenerate Eisenstein series to a particular Schubert variety has been studied. In the case of GL<sub>3</sub> over Q it was proved that these Schubert Eisenstein series have meromorphic continuations in all parameters and conjectured the same is true in general. We revisit the conjecture and relate it to the program of Braverman, Kazhdan, Lafforgue, Ngô, and Sakellaridis aimed at establishing generalizations of the Poisson summation formula. This is a joint work with Jayce Getz.</p>
10:30 – 11:00 am	<i>Coffee break</i>
11:00 – 12:00 pm	<p><b>Axel Kleinschmidt (MPI)</b></p> <p><b>Title:</b> <i>Automorphic representations in string amplitudes</i></p> <p><b>Abstract:</b> I will review how automorphic representations arise in the low-energy expansion of string scattering amplitudes, highlighting the connection found by Green/Miller/Vanhove between wavefront sets and BPS conditions. To study the wavefront sets I will present reduction principles for the calculation of Fourier coefficients. String theory also predicts new types of automorphic objects that are characterised by lacking finiteness under the center of the universal enveloping algebra.</p>
12:00 – 1:30 pm	<i>Lunch</i>
1:30 – 2:30 pm	<p><b>Pavel Etingof (MIT)</b></p> <p><b>Title:</b> <i>Analytic Langlands correspondence over C and R</i></p> <p><b>Abstract:</b> I will review the analytic component of the geometric Langlands correspondence, developed recently in my joint work with E. Frenkel and D. Kazhdan (based on previous works by other authors), with a special focus on archimedean local fields, especially R. This is based on our work with E. Frenkel and D. Kazhdan and insights shared by D. Gaiotto and E. Witten.</p>
2:30 – 3:00 pm	<i>Coffee break</i>

3:00 – 4:00 pm	<p><b>Davide Gaiotto (Perimeter)</b></p> <p><b>Title:</b> <i>Unexpected Unitarity</i></p> <p><b>Abstract:</b> Much of the mathematical content of Supersymmetric Quantum Field Theories can be extracted through “twisted theories”: simplified QFTs which are topological (or holomorphic) in a derived sense and often amenable of a rigorous mathematical treatment. The twisting procedure destroys or obfuscates certain properties of the underlying SQFTs, including unitarity. I will discuss a variety of situations where some form of unitarity can be restored, endowing the twisted theories with unexpected structures. This includes the recently developed Analytic Langlands program, an analytic version of Symplectic Duality, an A-model description of quantization (as opposed to deformation quantization) and other constructions of Hodge-theoretic or twistorial flavour.</p>
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**Thursday, March 28, 2024**

8:30 – 9:00 am	<i>Breakfast</i>
9:00 – 10:00 am	<p><b>Spencer Leslie (Boston College)</b></p> <p><b>Title:</b> <i>Relative Langlands and endoscopy</i></p> <p><b>Abstract:</b> Spherical varieties play an important role in the study of periods of automorphic forms. But very closely related varieties can lead to very distinct arithmetic problems. Motivated by applications to relative trace formulas, we discuss the natural question of distinguishing different forms of a given spherical variety in arithmetic settings, giving a solution for symmetric varieties. It turns out that the answer is intimately connected with the construction of the dual Hamiltonian variety associated with the symmetric variety by Ben-Zvi, Sakellaridis, and Venkatesh. I will explain the source of these questions in the theory of endoscopy for symmetric varieties, with application to the (pre)-stabilization of relative trace formulas.</p>
10:00 – 10:30 am	<i>Coffee break</i>
10:30 – 11:30 am	<p><b>Anne-Marie Aubert (IMJ-PRG)</b></p> <p><b>Title:</b> <i>The Local Langlands correspondence: from extended quotients to affine Hecke algebras</i></p> <p><b>Abstract:</b> We will introduce the notion of extended quotient, illustrate it on examples, and show how it can be used to construct the local Langlands correspondence in the nonarchimedean case. Next, we will connect extended quotients, that are attached to the Bernstein decomposition of the category of smooth representations of p-adic groups, and their Langlands duals, to representations of affine Hecke algebras in order to get a description of the LLC as a correspondence between the categories of modules of two collections of such algebras.</p>

11:45 – 12:45 pm	<p><b>Kobi Kremnitzer (Oxford)</b></p> <p><b>Title:</b> <i>Functional analysis over the integers, L-functions and global Hodge theory</i></p> <p><b>Abstract:</b> In this talk I will explain how using bornological methods one can develop functional analysis over the integers unifying Archimedean and non-Archimedean analysis. I will give examples of algebras of functions and distributions defined over the integers which base change to the usual algebras over the reals and p-adics. Using these it is possible to write some version of L-functions over the integers. I will then introduce an analytic stack over the integers for which the category of quasi-coherent sheaves gives global Hodge structures. I will relate the integral L-functions to trivialisations of line bundles on this stack. I will also explain how to define a cohomology theory for schemes valued in global Hodge structures (possibly related to q-deRham) and speculate on the relation between the determinant of cohomology and L-functions. This is work in progress joint with Federico Bambozzi and Jack Kelly.</p>
12:45 – 2:00 pm	<i>Lunch</i>
2:00 – 3:00 pm	<p><b>David Nadler (Berkeley)</b></p> <p><b>Title:</b> <i>Going to the boundary</i></p> <p><b>Abstract:</b> I'll describe several situations where degenerating a marked smooth curve to a marked nodal curve leads to interesting structures on automorphic moduli spaces. In particular, I'll discuss its implications for the cocenter of the affine Hecke category, real-symmetric duality in relative Langlands, and some other conjectural situations. The talk will borrow from joint work with various authors including D. Ben-Zvi, T.-H. Chen, P. Li, and Z. Yun.</p>
3:00 – 3:30 pm	<i>Coffee break</i>

### Friday, March 29, 2024

9:00 – 9:30 am	<i>Breakfast</i>
9:30 – 10:30 am	<p><b>George Pappas (Michigan State)</b></p> <p><b>Title:</b> <i>Finite and p-adic Chern-Simons type invariants</i></p> <p><b>Abstract:</b> We will define arithmetic invariants of Galois covers and of 'etale local systems which are inspired by the classical constructions of Dijkgraaf-Witten and Chern-Simons. We will discuss various conjectures and recent results about these invariants.</p>
10:30 – 11:00 am	<i>Coffee break</i>
11:00 – 12:00 pm	<p><b>Sam Raskin (Yale)</b></p> <p><b>Title:</b> <i>The geometric Langlands conjecture</i></p> <p><b>Abstract:</b> I will describe the main ideas that go into the proof of the (unramified, global) geometric Langlands conjecture. All of this work is joint with Gaitsgory and some parts are joint with Arinkin, Beraldo, Chen, Faergeman, Lin, and Rozenblyum.</p>

12:00 – 1:30 pm	<i>Lunch</i>
1:30 – 2:30 pm	<p><b>Alejandra Castro (Cambridge)</b></p> <p><b>Title:</b> <i>The light we can see: Extracting black holes from weak Jacobi forms</i></p> <p><b>Abstract:</b> Modular forms play a pivotal role in the counting of black hole microstates. The underlying modular symmetry of counting formulae was key in the precise match between the Bekenstein-Hawking entropy of supersymmetric black holes and Cardy's formula for the asymptotic growth of states. The goal of this talk is to revisit the connection between modular forms and black hole entropy, and tie it with other consistency conditions of AdS/CFT. We will focus our attention on weak Jacobi forms.</p> <p>I will quantify how constraints on polar states affect the asymptotic growth of non-polar states in weak Jacobi forms. The constraints I'll consider are sparseness conditions on the Fourier coefficients of these forms, which are necessary to interpret them as gravitational path integrals. In short, the constraints will leave an imprint on the subleading corrections to the asymptotic growth of heavy states. With this we will revisit the UV/IR connection that relates black hole microstate counting to modular forms. In particular, I'll provide a microscopic interpretation of the logarithmic corrections to the entropy of supersymmetric black holes and tie it to consistency conditions in AdS<sub>3</sub>/CFT<sub>2</sub>.</p>
2:30 – 3:00 pm	<i>Coffee break</i>
3:00 – 4:00 pm	<p><b>Zhiwei Yun (MIT)</b></p> <p><b>Title:</b> <i>Theta correspondence and relative Langlands</i></p> <p><b>Abstract:</b> A reductive dual pair (such as a symplectic group and an orthogonal group) acting on the tensor product of their standard representations is an example of hyperspherical varieties, and is the geometric avatar for theta correspondence. I will explain two geometric results/constructions motivated by the theta correspondence over finite fields. The first one describes how principal series representations behave under theta correspondence using Springer correspondence (joint with Jiajun Ma, Congling Qiu and Jialiang Zou). The second one is a definition of character sheaves in the setup of theta correspondence (joint with Shamgar Gurevich). I will speculate how the first result fits into relative Langlands duality.</p>