

Conference on
“Global Langlands, Shimura varieties, and shtukas”

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organized by
Frank Calegari (Chicago), Ana Caraiani (London), Laurent Fargues (Jussieu),
Peter Scholze (Bonn)

Abstracts

Samit Dasgupta (Duke University)

On the Brumer-Stark Conjecture and Refinements

Abstract: In this talk I will describe my recent work with Mahesh Kakde on the Brumer-Stark Conjecture and certain refinements. I will give a broad overview that motivates the conjecture and gives connections to explicit class field theory. I will conclude with a description of recent work (joint w/ Kakde, Jesse Silliman, and Jiuya Wang) in which we complete the proof of the conjecture. Moreover, we deduce a certain special case of the Equivariant Tamagawa Number Conjecture, which has important corollaries. The key aspect of the most recent results, which allows us to handle the prime $p=2$, is the proof of a version of Ribet’s Lemma in the case of characters that are congruent modulo p .

Matthew Emerton (University of Chicago)

Cohomology of Shimura varieties and the categorical Langlands program

Abstract: I will discuss a conjectural formula that describes the cohomology of Shimura varieties in terms of coherent sheaves on stacks of Galois representations arising from the categorical local Langlands correspondence. My emphasis will be on the background to and motivation for the conjecture, and some simple illustrative examples.
This is ongoing joint work with Toby Gee and Xinwen Zhu.

Dennis Gaitsgory (MPIM Bonn)

Geometric Langlands over F_q

Abstract: In the talk I’ll outline a strategy to deduce the geometric Langlands conjecture for ℓ -adic sheaves with nilpotent singular support on Bun_G over F_q from its de Rham counterpart over complex numbers.
This is a joint project with Sam Raskin.

Linus David Hamann (Princeton University)

Geometric Eisenstein Series and Torsion Vanishing

Abstract: We generalize the torsion vanishing results of Caraiani-Scholze and Koshikawa. Our results apply to the cohomology of general Shimura varieties (G,X) of PEL type A or C, localized at a suitably generic maximal ideal in the spherical Hecke algebra at primes p such that the local group at p is a group for which we know the Fargues-Scholze local Langlands correspondence is the semi-simplification of a suitably nice local Langlands correspondence. This is accomplished by combining Koshikawa's technique, the theory of geometric Eisenstein series over the Fargues-Fontaine curve, the work of Santos describing the structure of the fibers of the minimally and toroidally compactified Hodge-Tate period morphism for general PEL type Shimura varieties of type A or C, and ideas developed by Zhang on comparing Hecke correspondences on the moduli stack of G -bundles of the Fargues-Fontaine curve with the cohomology of Shimura varieties. In the process, we also establish a description of the generic part of the cohomology that bears resemblance to the work of Xiao-Zhu, but on the generic fiber. Moreover, we also construct a filtration on the compactly supported cohomology that differs from Manotovan's filtration in the case that the Shimura variety is non-compact. Our method showcases a very general paradigm; namely, that the behavior of the torsion cohomology localized at a semi-simple L -parameter under the action of the spectral Bernstein center constructed by Fargues and Scholze is related to the perversity of Hecke eigensheaves with Hecke eigenvalue given by that parameter. This allows us to formulate several new conjectures on the structure of the torsion cohomology, and, time permitting, we will discuss this.

This is joint work with Si-Ying Lee.

Srikanth Iyengar (University of Utah)

Congruence modules in higher codimensions

Abstract: Wiles, in his work on modularity lifting, discovered a numerical criterion for a map $R \rightarrow \mathbb{T}$ of Noetherian complete commutative local rings over a fixed discrete valuation ring \mathcal{O} and of relative dimension zero, to be an isomorphism of complete intersections. The criterion is in terms of the congruence module of \mathbb{T} attached to an augmentation $\mathbb{T} \rightarrow \mathcal{O}$ and the cotangent module of the composite map $R \rightarrow \mathcal{O}$. Diamond generalized this result (and also an extension by Lenstra) to a numerical criteria for a module over R to be free. The goal of my talk is to present aspects of joint work with Khare and Manning that extends these results to higher relative dimension. While the focus will be on the commutative algebra aspects of our work, I will present some applications including an unconditional (integral) $R = \mathbb{T}$ theorems at non-minimal level when \mathbb{T} is a Hecke algebra acting on the weight one cohomology of Shimura curves.

Vincent Lafforgue (CNRS and Universite Paris Cite)

Progress on local shtukas

Abstract: I will explain some recent progress on local shtukas in characteristic p , in joint works with Eteve and Genestier and with Eteve, Gaiitsgory and Genestier. I will also explain the compatibilities with global shtukas.

Si Ying Lee (Universität Bonn)

Unramifiedness of galois representations for Hilbert modular varieties

Abstract: The Serre weight conjectures, as extended by Edixhoven, imply a correspondence between unramified odd irreducible mod p Galois representations and weight 1 mod p modular forms. This correspondence has a natural generalization to Hilbert modular varieties, where we now consider the mod p coherent cohomology of Hilbert modular varieties. I will talk about showing one direction of this correspondence in the case where p is totally split, namely that the Galois representation associated to the (higher) mod p coherent cohomology of Hilbert modular varieties in partial weight 1 is unramified.

Chao Li (Columbia University)

Kudla-Rapoport conjecture for Krämer models

Abstract: The Kudla-Rapoport conjecture, proved jointly with Wei Zhang, is a precise identity relating arithmetic intersection numbers of special cycles on unitary Shimura varieties with good reduction and central derivatives of Siegel Eisenstein series. We discuss how to formulate and prove an analogous identity for certain unitary Shimura varieties with bad reduction (Krämer models at ramified places). We will motivate these conjectures, mention applications to L-functions and highlight interesting new phenomena in the presence of bad reduction.

This is joint work with Qiao He, Yousheng Shi and Tonghai Yang.

Yifeng Liu (Zhejiang University)

Anticyclotomic p-adic L-functions for Rankin-Selberg motives

Abstract: In this talk, we will construct anticyclotomic p-adic L-functions for motives coming from conjugate-selfdual automorphic Rankin-Selberg products, for both root numbers. We will propose several conjectures concerning such p-adic L-functions and explain certain progress toward one of them, namely, one-side divisibility of a corresponding Iwasawa main conjecture.

James Newton (University of Oxford)

Symmetric power functoriality for Hilbert modular forms

Abstract: I will speak about joint work with Jack Thorne on symmetric power functoriality for Hilbert modular forms. I will also compare this with our earlier work in the elliptic modular case.

Lue Pan (Princeton University)

Some vanishing results for rational completed cohomology of Shimura varieties

Abstract: Let p be a prime number. Emerton introduced the p -adically completed cohomology, which admits a representation of some p -adic group and can be thought of as some spaces of p -adic automorphic forms. In this talk, I want to explain that for Shimura varieties, sufficiently regular infinitesimal characters of the p -adic group can only show up in the middle degree of the completed cohomology. The proof is based on a very recent result of Bhatt on Kodaira vanishing in mixed characteristic and an old idea of using translation functors.

This is joint work in progress with Kai-Wen Lan.

Vincent Pilloni (Université Paris Saclay)

p-adic Eichler-Shimura theory and an arithmetic application

Abstract: Following work of Pan and Rodriguez, we study the p-adic Eichler-Shimura decomposition of completed cohomology in terms of higher Coleman theory. We then give an application to modularity. This is joint work in progress with G. Boxer, F. Calegari and T. Gee.

Alice Pozzi (Imperial College London)

Generalised eigenvalues via Flach classes

Abstract: The action of Hecke algebras on the space of mod p modular forms need not be semisimple. In this talk, we present a formula relating “generalised eigenvalues” for mod p cusp forms of weight 2 to certain Galois cohomology classes constructed geometrically by Matthias Flach. This is joint work in progress with Henri Darmon.

Sam Raskin (University of Texas at Austin)

AGKRRV with ramification (conjectures)

Abstract: In joint work with Arinkin, Gaitsgory, Kazhdan, Rozenblyum, and Varshavsky, we formulated a version of the unramified geometric Langlands conjecture for l-adic sheaves and explained how its trace of Frobenius yields a spectral description of unramified, compactly supported automorphic functions.

In this talk, we will formulate a conjectural extension of this work to the ramified setting. One key player is a purely local, higher categorical analogue (conjecturally) of the AGKRRV story. This work is joint with Kazhdan, Gaitsgory, and Varshavsky.

Pol van Hoften (Stanford University)

On exotic Hecke correspondences

Abstract: The goal of this talk is to discuss joint work in progress with Jack Sempliner on the construction of exotic Hecke correspondences between the mod p fibers of different Shimura varieties of Hodge type. This generalizes forthcoming results of Xiao–Zhu; our results cover the new situation where the groups underlying the two different Shimura varieties are allowed to be non-isomorphic at p. As a consequence of our main results, we obtain exotic isomorphisms of Igusa varieties in the style of Caraiani–Tamiozzo."

Cong Xue (Institut de mathématiques de Jussieu – Paris Rive Gauche)

Cohomology sheaves of stacks of shtukas

Abstract: I will recall the cohomology sheaves of stacks of shtukas and talk about the smoothness outside the level. I will also talk about what happens at the level.

Sarah Zerbes (ETH Zürich)

Iwasawa theory for the symmetric square of an elliptic curve

Abstract: The arithmetic of the adjoint, or symmetric square, of an elliptic curve over \mathbb{Q} (or, more generally, of a modular form) is a particularly interesting case from the viewpoint of Iwasawa theory, not least because of its close connection with modularity-lifting problems and hence with Fermat's last theorem. In this talk I will describe ongoing work with David Loeffler in which we prove the cyclotomic Iwasawa main conjecture in this setting, using Euler systems for Hilbert modular surfaces.

Rong Zhou (University of Cambridge)

Strongly compatible systems associated to abelian varieties

Abstract: Let A be an abelian variety over a number field E and r_ℓ the representation of the absolute Galois group of E on its ℓ -adic Tate module. Then a classical result of Weil, Deligne and Raynaud implies that $(r_\ell)_{\ell \text{ prime}}$ forms a strongly compatible system. Explicitly, this means that the Weil-Deligne representation associated to the restriction of r_ℓ to the decomposition group at each finite place satisfies an ℓ -independence property.

In this talk I will discuss recent and ongoing work with Kisin towards proving a motivic refinement of this result, namely that upon replacing E by a finite extension, the r_ℓ can be refined to a strongly compatible system of G -valued representations, where G is the Mumford-Tate group of A .

Xinwen Zhu (Stanford University)

Correspondences between mod \mathfrak{p} fibers of Shimura varieties

Abstract: A few years ago, Liang Xiao and I proposed a general strategy to construct cohomological correspondences between mod \mathfrak{p} fibers of certain Shimura varieties. There are two main ingredients in such construction. The first, as well understood nowadays, is the Frobenius categorical trace of the geometric Satake (or more generally categorical local Langlands). The second is the construction of physical correspondences between mod \mathfrak{p} fibers of different Shimura varieties. I will discuss the second ingredient for Shimura varieties of Hodge type with hyperspecial level at \mathfrak{p} . As we shall see, in the case of tori, this leads to a generalization of the theory of complex multiplication.

This is a joint work with Liang Xiao.
