

**Motives and Automorphic Forms**  
**September 28 – October 2, 2015**

**Abstracts of Talks**

**Massimo Bertolini** (Universität Duisberg-Essen)

Title: Generalised Kato classes and arithmetic applications

Abstract: Generalised Kato classes are associated to triples of modular forms on  $GL_2$  (either cusp forms or Eisenstein series), and live in the Galois cohomology of the associated tensor Galois representations. I will report on some past and ongoing work with Darmon and Rotger, studying the relations between these classes and the arithmetic of elliptic curves.

**George Boxer** (Harvard University)

Title: Construction of torsion Galois representations

Abstract: Recently, Scholze has constructed Galois representations associated to torsion classes in the cohomology of certain arithmetic locally symmetric spaces. I will explain a different construction of some of these Galois representations. The ingredients are a construction of boundary cohomology inspired by the earlier work of Harris-Lan-Taylor-Thorne and a construction of congruences using the theory of "generalized Hasse invariants".

**Ana Caraiani** (Princeton University)

Title: On vanishing of torsion in the cohomology of Shimura varieties

Abstract: I will discuss joint work in progress with Peter Scholze showing that the cohomology (with torsion coefficients) of many compact unitary Shimura varieties is concentrated in the middle degree, after localizing at a maximal ideal of the Hecke algebra satisfying a genericity assumption on the corresponding Galois representation.

**Laurent Fargues** (Jussieu)

Title: G-torsors in p-adic Hodge theory

Abstract: For any reductive group  $G$  over the p-adic numbers, I will explain the classification of G-torsors over the curve defined in my joint work with Fontaine. This has applications to the computation of the étale cohomology of this curve in relation with local class field theory. In particular one can prove that the fundamental class of the curve is the fundamental class of local class field theory.

**Michael Harris** (Jussieu), **Jack Thorne** (University of Cambridge)

Title: Modularity theorems in the function field setting

Abstract: Let  $G$  be a reductive group over a global field of positive characteristic. In a major breakthrough, Vincent Lafforgue has recently shown how to assign a Langlands parameter to a cuspidal automorphic representation of  $G$ . The parameter is a homomorphism of the global Galois group into the Langlands L-group  ${}^L G$  of  $G$ . In a two-part talk, we (MH and JT) will report on

our joint work in progress with Gebhard Böckle and Chandrashekar Khare whose goal is to develop the Taylor-Wiles-Kisin method in the setting of Lafforgue's correspondence. New (representation-theoretic and Galois-theoretic) issues arise when we seek to extend the earlier work of Böckle and Khare on the case of  $GL(n)$  to general reductive groups. We will describe hypotheses on the Langlands parameter that allow us to apply modularity arguments unconditionally.

**Mark Kisin** (Harvard University)

Title: Honda-Tate theory for Shimura varieties

Abstract: Honda-Tate theory asserts that an abelian variety over a finite field is isogenous to one which has a CM lifting. We will explain a result which says that, under some mild conditions, the analogous statement holds for isogeny classes on a Shimura variety of Hodge type. This is joint work with Keerthi Madapusi and Sug-Woo Shin.

**George Pappas** (Michigan State University)

Title: On some Rapoport-Zink spaces

Abstract: We will describe a construction of Rapoport-Zink type formal schemes that uniformize the completions of Hodge type Shimura varieties along certain loci of their fibers modulo primes. We will then concentrate on the example coming from a spinor similitude group and the supersingular locus. In this case, we will also give an explicit description of the underlying reduced schemes in terms of (finite) Deligne-Lusztig varieties for orthogonal groups. This is joint work with B. Howard.

**Vytautas Paskunas** (Universität Duisberg-Essen)

Title: On the Cohen-Macaulayness of crystabelline deformation rings

Abstract: We will prove that certain crystabelline Galois deformation rings of two dimensional residual representations of the absolute Galois group of  $\mathbb{Q}_p$  are Cohen-Macaulay. This is joint work with Yongquan Hu.

**Vincent Pilloni** (ENS Lyon)

Title: Integral properties of overconvergent modular forms

Abstract: Coleman constructed finite slope families of overconvergent modular forms. This was an extension of Hida's construction of ordinary families. One striking difference was that while Hida's theory was completely integral and worked over formal schemes, Coleman's theory was  $\mathbb{Q}_p$ -rigid analytic. Nevertheless Coleman observed that the characteristic series of the  $U_p$ -operator had coefficients in the Iwasawa algebra and conjectured that there should exist an integral or positive characteristic theory of overconvergent modular forms. We will describe this theory and give some applications. This is joint work with Andreatta and Iovita.

**Dinakar Ramakrishnan** (California Institute of Technology)

Title: Hilbert modular forms and trace inequalities

Abstract: Hilbert modular forms (over totally real fields  $F$ ) are well studied objects, with associated Galois representations (in fact motives). Given a subfield  $k$  of  $F$  with  $F/k$  Galois, we will discuss the

part of the geometric side of the trace formula over  $F$  (for strongly positive functions) which is in a sense inherited from  $k$  via an inequality. Certain subtle questions arise concerning class numbers which we will show how to circumvent. This is an ongoing program, with some partial success, to understand the Langlands philosophy in a concrete example using a non-standard approach.

**Sug Woo Shin** (University of California, Berkeley)

Title: Galois representations for general symplectic groups

Abstract: We prove the existence of  $G\text{Spin}$ -valued Galois representations corresponding to regular algebraic cuspidal automorphic representations of general symplectic groups under simplifying local hypotheses. This is joint work with Arno Kret.

**Bertrand Toën** (Université Toulouse)

Title: Motivic realizations of categories.

Abstract: This is a report on a work in progress with Robalo and Vezzosi. I will present the construction of a motivic realization of (dg-)categories over base of arbitrary characteristics, based on some previous work by A. Blanc. This will be used in order to define various realizations of categories,  $l$ -adic, de Rham, Betti etc, recovering the usual realizations when applied to the derived category of an algebraic variety. As a consequence I will present an extension of  $p$ -adic Hodge theory to the non-commutative setting, as well as a new relations between vanishing cycles and categories of matrix factorizations in positive and mixed characteristics.

**Eric Urban** (Columbia University)

Title: Euler systems, Eisenstein congruences and Iwasawa theory

Abstract: I will discuss a strategy to construct Euler systems using Eisenstein congruences that is potentially applicable to a large number of situations for which no  $K$ -theoretic or geometric constructions are yet available. It also gives a way to provide Euler system of higher ranks.

**Eva Viehmann** (TU München)

Title: Affine Deligne-Lusztig varieties and the building of  $J$

Abstract: I report on joint work with M. Chen defining new stratification of the reduced subschemes of Rapoport-Zink spaces and of affine Deligne-Lusztig varieties that highlights the relation between the geometry of these spaces and the action of the automorphism group of the  $p$ -divisible group determining the moduli space. This provides a joint group-theoretic interpretation of several well-known stratifications which only exist for special cases.

**Jared Weinstein** (Boston University)

Title: The cohomology of local Shimura varieties

Abstract: Local Shimura varieties are  $p$ -adic analogues of Shimura varieties. According to conjectures of Rapoport-Viehmann, one has a tower of local Shimura varieties associated to each reductive group  $G$  over the  $p$ -adic numbers (together with some ancillary data), and the cohomology of this tower is expected to realize the local Langlands correspondence (the Kottwitz conjecture). Following techniques of Strauch and Mieda, we prove a piece of the Kottwitz conjecture (ignoring

the action of the Weil group), assuming the endoscopic character relations among the inner forms of  $G$ . This is joint work in progress with Tasho Kaletha.

**Sarah Zerbès** (University College London)

Title: Euler systems for Rankin-Selberg convolutions and generalisations

Abstract: I will briefly summarize my joint work with Kings, Lei and Loeffler on the construction of an Euler system for Rankin-Selberg convolutions of modular forms. I will then explain generalisations of these techniques to other Shimura varieties.