PERFECTION IN IWASAWA THEORY : TITLES AND ABSTRACTS

- Marco Artusa

Title: Towards a geometrisation of Deligne cohomology

Abstract: Deligne cohomology of a complex manifold Y is a hybrid object: it mixes Betti cohomology with the Hodge filtration on de Rham cohomology, producing a complex of locally compact abelian groups. Despite its central role in regulators and special-value conjectures, it lacks a geometric framework that treats the archimedean structure of de Rham cohomology and the discrete structure of Betti cohomology at the same time.

In this talk, we construct an analytic stack $\mathcal{X}$ (in the sense of Clausen-Scholze) that serves as a universal base for such objects. Quasi-coherent sheaves on $\mathcal{X}$ combine archimedean (liquid) modules and non-archimedean (solid) modules. In particular, Deligne cohomology groups appear as quasi-coherent sheaves on $\mathcal{X}$.

If time permits, we present a strategy to associate, to any complex analytic manifold Y, an analytic stack Y^{Del} over $\mathcal{X}$, whose relative cohomology should recover Deligne cohomology. This is a work in progress.

- Pierre Colmez

Title: On the cohomology of (φ, Γ)-modules

Abstract: In this talk, we will discuss about the cohomology and duality of (φ, Γ)-modules.

- Xenia Dimitrakopoulou

Title: p-adic L-functions for $U(n) \times U(n)$

Abstract: I will report on joint work in progress with Raphaël Beuzart-Plessis on constructions of p-adic L-functions for the pair of definite unitary groups $U(n) \times U(n)$. By using the resolution of the Ichino-Ikeda conjecture for Fourier–Jacobi periods, we can construct a p-adic L-function for ordinary automorphic representations. Time allowing, I will explain how to extend this result to families.

- Lennart Gehrmann

Title: Cohomology of p-arithmetic groups and p-adic L-functions

Abstract: I will present a general machinery for constructing p-adic L-functions that blends Loeffler's approach via spherical varieties with the use of the cohomology of p-arithmetic groups, as pioneered by Darmon.

- Andrew Graham

Title: Explicit reciprocity laws for twisted unitary Friedberg–Jacquet cycles

Abstract: Unitary Friedberg–Jacquet (UFJ) periods generalise the toric periods appearing in Waldspurger's formula, and are closely related to central L-values of symplectic-type cuspidal automorphic representations over CM fields. For certain choices of signatures, the unitary groups which appear in these periods give rise to special cycles on unitary Shimura varieties, generalising the construction of Heegner points.

In this talk, I will discuss an explicit reciprocity law relating values of a p-adic L-function (interpolating UFJ periods) to the p-adic regulator of these special cycles. This generalises the formula of Bertolini–Darmon–Prasanna.

- Chi-Yun Hsu

  Title: p-adic companion forms for Yoshida lifts

  Abstract: Coleman showed that the $(k-1)$st power of the theta operator $q\frac{d}{dq}$ defines a map from overconvergent modular forms of weight $2-k$ and slope 0 to weight k and slope $k-1$. Moreover, the critical p-stabilization of a classical CM form is the image of a p-adic CM form, strengthening the fact that its Galois representation splits locally at p. In the GSp_4 setting, the Galois representation of a Yoshida lift splits locally into two 2-by-2 blocks at p. We prove an analogous strengthening in the joint work in progress with Bharathwaj Palvannan. The relevant theta operator arises from the last differential of the dual BGG complex. We computed its explicit effect on q-expansions. Using the explicit Fourier coefficients of Yoshida lifts by Hsieh–Namikawa, we show that Yoshida lifts lie in the image of this theta operator, with a certain choice of p-stabilization.

- Yifeng Liu

  Title: Iwasawa theory for ordinary families

  Abstract: In this talk, we will introduce a version of Iwasawa theory over the ordinary eigenvariety of Rankin-Selberg product of unitary groups. We will formulate the corresponding main conjecture and explain what we know for the moment.

- Zheng Liu

  Title: Yoshida lifts and congruences

  Abstract: A Yoshida lift is the theta lift of two modular forms to GSp(4). Its congruence with stable forms on GSp(4) can be used to produce a lower bound on the Selmer group of the Rankin-Selberg product of the two modular forms. We study this congruence by using Rallis inner product formula, Bessel periods and Furusawa's pullback formula, together with p-adic interpolation.

- David Loeffler

  Title: Euler systems and Selmer group bounds at non-ordinary primes

  Abstract: A key theme in Iwasawa theory is to study the sizes of Selmer groups attached to global Galois representations over the p-cyclotomic tower; this plays a key role in studying major open problems such as the Birch–Swinnerton-Dyer conjecture for elliptic curves. The theory of Euler systems has played a major role in this theory, serving to give upper bounds for Selmer groups.

  However, when the Galois representation does not satisfy some kind of "ordinarity" condition at p, even defining these Selmer groups becomes substantially more difficult. About 10 years ago, Pottharst introduced a beautiful new formalism for defining Selmer groups using ideas from p-adic Hodge theory, which works uniformly for ordinary and non-ordinary primes; but so far it has seemed difficult to use Euler systems to study Pottharst's Selmer groups. I will report on a new breakthrough using the notion of "ultraprimes" introduced by Scholze and Sweeting, which has made it possible to relate Euler systems to Pottharst's theory, and explain applications to the Iwasawa main conjecture for Rankin-Selberg convolutions and for GSp(4) at non-ordinary primes.

- Luca Marannino

Title: On recent applications of diagonal classes to anticyclotomic twists of modular forms

Abstract: In the 2010s, pioneering works by Darmon–Rotger and Bertolini–Seveso–Venerucci introduced diagonal classes, a generalization of Gross–Kudla–Schoen diagonal cycles on a triple product of modular curves. The study of diagonal classes led to important arithmetic applications. More recently, via a careful manipulation of such classes, Castella and Do obtained a full anticyclotomic Euler system for twists of modular forms by anticyclotomic Hecke characters of quadratic imaginary fields, both in the so-called definite and indefinite setting. In this talk, I plan to explain this construction and to survey some recent applications in intriguing arithmetic situations, in which either the fixed prime p is inert in the relevant quadratic imaginary field or the given modular form is non-ordinary at p. Some of the results are joint work (in progress) with Raúl Alonso and Kâzım Büyükboduk.

- David Marcil

Title: p-adic L-functions for P-ordinary Hida families on unitary groups.

Abstract: First, I will discuss P-ordinary Hida theory on unitary groups, where P is some parabolic subgroup at p. This aims to adapt the work of Pilloni from the symplectic setting to the unitary setting. I will emphasize some of the differences between the two settings, particularly the introduction of finite-dimensional types to this theory which generalizes the role of nebentype.

Then, given a P-ordinary family C, I will detail the construction of a compatible p-adic family of Eisenstein series (an Eisenstein measure) by calculating mod p congruences of Fourier coefficients. This exposes congruences between special L-values for members of C. More precisely, using an algebraic version of the doubling method, I will identify this Eisenstein measure with a p-adic L-function for C. These results generalize the ones obtained by Eischen-Harris-Li-Skinner in the ordinary setting, where P is maximal.

- Gautier Ponsinet

Title: Exponential maps and Iwasawa theory

Abstract: Perrin-Riou's exponential map associated with a de Rham Galois representation is a key construction in cyclotomic Iwasawa theory, it is notably part of a framework to define and study p-adic L-functions of motives. Its main property, Perrin-Riou's explicit reciprocity law, is the interpolation of Bloch-Kato's exponential maps and dual exponential maps associated with cyclotomic twists of the representation.

In a work in progress with Joaquín Rodrigues Jacinto, we recover Perrin-Riou's exponential map and the explicit reciprocity law geometrically via the Fargues-Fontaine curve and the theory of solid locally analytic representations. Moreover, this geometric construction generalises to other settings.

- Gal Porat

Title: Solid Locally Analytic Representations in Mixed Characteristic

Abstract: The theory of locally analytic representations of p-adic Lie groups with $\mathbb{Q}_p$ coefficients play an important role in p-adic Hodge theory and in the p-adic Langlands program. A few years ago, Rodrigues Jacinto and Rodriguez Camargo developed a "solid" version of this theory using the language of condensed mathematics, which provides more robust homological tools for studying these representations.

This talk will present work that extends this solid theory to a much broader class of mixed characteristic coefficients such as $\mathbb{F}_p((X))$ or $\mathbb{Z}_p[[X]]\langle p/x\rangle$. I'll try to explain how these ideas relate to boundary phenomena in locally analytic Langlands, and describe expected results in this direction.

- Johannes Sprang

Title: p-adic L-functions for totally imaginary fields

Abstract: The p-adic L-function of Kubota and Leopoldt p-adically interpolates the values of the classical Riemann zeta function at negative integers. More generally, for other L-functions one may ask for a p-adic L-function, which is typically characterized by the interpolation of certain critical L-values up to explicit periods. In the case of Hecke L-functions, it is known that critical values can exist only when the underlying number field is either totally real or totally imaginary. For totally real number fields, p-adic L-functions are well understood. The totally imaginary case is substantially more difficult. In particular, for non-ordinary primes, such p-adic L-functions for totally imaginary number fields beyond the quadratic case have so far been unknown. In this talk, I will explain joint work with Guido Kings about the construction of such p-adic L-functions for totally imaginary fields.

- Vinayak Vatsal

Title: Cyclotomic μ-invariants via $(\phi - \Gamma)$-modules.

Abstract: A famous conjecture of Iwasawa from the 1960s states that the μ-invariant vanishes for abelian number fields. This conjecture was proven by Ferrero and Washington in 1979, via properties of Kubota-Leopoldt p-adic L-functions and a miraculous explicit formula due to Iwasawa for these objects, involving the p-adic digits of the $p-1$-st roots of unity.

A second proof was given in 1984 by Sinnott, using a different method, which — although sharing many formal similarities – seems to rely on a completely different ingredient, namely, that the Kubota-Leopoldt p-adic L-functions are given by Γ-transforms of rational functions.

In this talk, we will give a proof that the μ-invariant vanishes for Kubota-Leopoldt L-functions by using properties of the corresponding (ϕ, Γ)-modules (which are 1-dimensional in the case at hand). Our main result is that there is a "universal" criterion for vanishing of the μ-invariant, cast in terms of the p-adic digits of the $p-1$-st roots of unity, and certain other quantities arising from Fontaine's theory. Our criterion makes sense in any étale (ϕ, Γ)-module, and shows that the appearance of p-adic digits of the $p-1$-st roots of unity in Iwasawa's formula is a special case of a general phenomenon.

If time permits, we will explain how our criterion applies to the case of the p-adic L-functions of modular forms associated to rational elliptic curves with ordinary reduction.

- Robin Zhang

Title: The Stark conjectures for cyclotomic extensions of complex cubic fields

Abstract: In a series of four papers from 1971 to 1980, Stark proposed conjectures relating algebraic units to the leading coefficients of Artin L-functions. This talk will recall the well-established theory for abelian extensions of the field of rational numbers and imaginary quadratic fields before turning towards cyclotomic extensions of complex cubic fields. Our constructions will be framed in classical language, but they provide explicit arithmetic data – namely Stark units – that may be crucial for the development of Euler systems and the broader Iwasawa theory of complex cubic fields.