Y-RANT VIII

Conference Booklet

2nd Sept- 4th Sept, 2026

Organisers

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Albert Lopez Bruch (King's College London)
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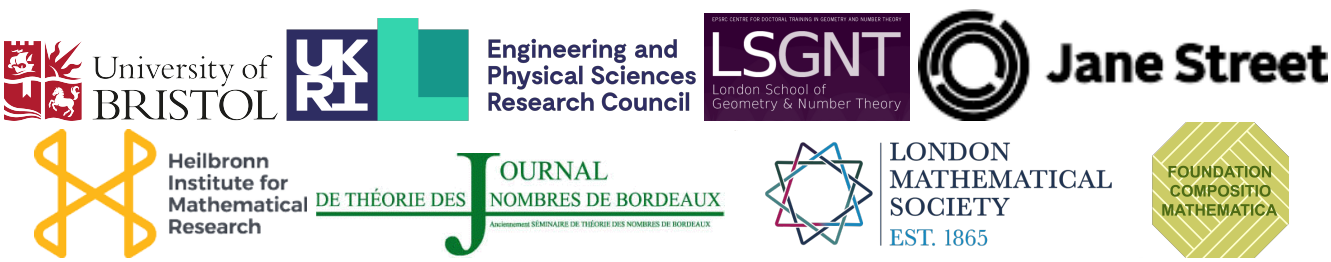

General Information

Venue and Location

The conference will be held on the ground floor of the **Fry Building, School of Mathematics, University of Bristol**, Bristol, UK.
All parallel sessions will take place in Rooms **G.09, Fry Bldg G.10 LT, G.13**. Plenary talks will be held in Room **G.10**.

Accommodation

Most participants will stay at the Travelodge Bristol Central, on 4A Anchor Road, Bristol, BS1 5TT, UK (url: https://maps.app.goo.gl/9QQvJjJcEGhkner76). It is 1km from the venue, approximately a 20-minute walk.

Registration

The registration desk opens at 09:00 AM on Wednesday, September 2nd. Please collect your badges upon arrival.

Wi-Fi Access

Participants should be able to connect to Wi-fi via eduroam. If you encounter any problems, you may instead use the guest Wi-Fi network. To do so, connect to the network `UoB Guest` and select "I am a guest of this University". You can then authenticate using Facebook, LinkedIn, or SMS.
Participants staying at the Travelodge will also have access to Wi-Fi. Please ask for connection instructions upon check-in.

Lunch and refreshments

Refreshments will be provided during the conference. Two coffee/tea breaks will take place each day in the Fry Building Atrium, at the allocated times, and lunch will be provided in the same place. Vegetarian, vegan, and allergen-friendly food will be available, according to the registration entries. A wine reception will be held on Wednesday at 16:30, right after the last talk.

Conference Dinner

The conference dinner will take place on Thursday, September 3rd, at 18:30 at the Lost and Found Restaurant.

Dinner recommendations

We will not cover dinner costs other than the conference dinner. There are good options near the hotel and near the venue. All of these offer vegetarian and vegan options. Here we list a few:

- Brisnoodles, 10A Park Row ($\leq$5 minute walk from the venue): Noodles and Chinese food.
- Yakinori, 78 Park St (5 minute walk from the venue): Japanese food.
- Pizza in the park, 31 Berkeley Square (5 minute walk from the venue): Neapolitan-style Stone-oven pizza.
- Black cumin, 50 Cotham Hill (10 minute walk from the venue): Indian food, with a dedicated vegan menu.

Schedule

Wednesday, 2nd September			
9:00 - 10:00	Registration (Reception)		
10:00 - 11:00	Plenary Talk **(G.10)**: *Alice Pozzi* Ribet's method and beyond		
11:00 - 11:30	Coffee break **(Atrium)**		
	Session 1 ***(G.10)***	*Session 2* ***(G.09)***	*Session 3* ***(G.13)***
11:30 - 12:00	*Júlia Martínez-Marín* Reduction types of curves and tame base change	*Mateo Crabit Nicolau* Computing Darmon–Dasgupta units via generating series	*Sara Varljen* Computing a presentation for Bianchi groups
12:00 - 12:30	*Lewis Matthews* Mordell-Weil Groups as Galois Modules	*Michael Daas* Refined singular moduli through p-adic Galois deformations	*Paolo Bordignon* A p-adic cohomological approach to congruences of meromorphic modular forms
12:30 - 14:00	Lunch **(Atrium)**		
14:00 - 14:30	*Ludovic Felder* Descent properties for an abelian variety with extended Galois representation	*Mark Chambers* Mod p aspects of L-values, and Fourier Coefficients of theta lifts	*Izaak Fairclough* Breuil–Mézard and Serre Weights
14:30 - 15:00	*Daniel Lang* Probabilistic Recognition of $\mathrm{Gal}(f) = S_n$	*Joseph Cohen* A Zilber–Pink type question in Dynamical Systems	*Charlotte Clare-Hunt* Eigenvarieties and p-adic rigidity for GSp_4
15:00 - 15:30	Coffee/tea break **(Atrium)**		
15:30 - 16:00	*Jakab Schrettner* Plane curve singularities and reduction types of curves	*Xiangmiao Yin* Formalising the modular j-function in Lean	*Jorge Gómez Chouza* On automorphic Galois representations for GSp_4
16:00 - 16:30	*Asuka Shiga* On the Abundance and Rarity of BSD Twins of Elliptic Curves	*William Coram* Formalising aspects of p-adic modular forms	*Suvir Rathore* Phenomenon of ℓ-independence
16:30 -	Wine reception **(Atrium)**		

Schedule

Thursday, 3rd September			
10:00 - 11:00	Plenary Talk **(G.10)**: *Adam Morgan* The distribution of 2-Selmer groups in quadratic twist families		
11:00 - 11:15	Conference Photo **(Atrium)**		
11:15 - 11:30	Coffee break **(Atrium)**		
	Session 1 ***(G.10)***	*Session 2* ***(G.09)***	*Session 3* ***(G.13)***
11:30 - 12:00	*Katerina Santicola* The stack BG, and why you should join the dark side	*Kenza Memlouk* The motivic Galois group for a double zeta value	*Saverio Caleca* The topology of G-bundles over Scholze's twistor
12:00 - 12:30	*Xiang Li* Polylogarithmic Chabauty–Kim Loci over Number Fields	*Leonardo Carofiglio* Generalized Thakur identities among Multiple Polylogarithms over Function Fields	*Lucie Gatzmaga* Obstructions to Minimality in Serre's Conjecture via Derived Galois Deformation Rings
12:30 - 14:00	Lunch **(Atrium)**		
14:00 - 14:30	*Thais Gomes Ribeiro* A geometric model for the Appell hypergeometric function F_2	*Carpintero Pérez Valentin* Exponential Periods	*Julian Huber* The Geometry of Shimura Varieties
14:30 - 15:00	*Ruth Raistrick* Integral Norms via Selmer Groups	*Ben Snodgrass* Periods of E-operators	*Lucas Valle Thiele* Integral Models of Modular Curves
15:00 - 15:30	Coffee/tea break **(Atrium)**		
15:30 - 16:00	*Edison Au-Yeung* The finiteness of integral points on elliptic curves	*Saheb Mohapatra* Cryptographic Applications of Polylogarithmic Groups	*Dwipanjana S.* Explicit valuation criterion for the surjectivity of (T)-adic Galois representations of Drinfeld A-modules of rank 3
16:00 - 16:30	*Jed Thorpe* Sufficiency of the Brauer-Manin Obstruction over Global Function Fields	*Paul Lezeau* Machine learning over the p-adics	*Maximilien Mackie* Weights and characters for affine Hecke algebras

Schedule

Friday, 4th September			
10:00 - 11:00	Plenary Talk **(G.10)**: *Beth Romano* Graded Lie algebras and families of algebraic curves		
11:00 - 11:30	Coffee break **(Atrium)**		
	Session 1 ***(G.10)***	*Session 2* ***(G.09)***	*Session 3* ***(G.13)***
11:30 - 12:00	*Isabel Rendell* Modular forms in quadratic Chabauty for modular curves	*Alberto Angurel* Ultra Euler systems	*Haoran Liang* p-adic families of automorphic forms
12:00 - 12:30	*Mia Lam* Brauer Twists & Moduli Spaces in Algebraic Geometry	*David Heras* TBC	*Yicheng Yang* Local global compatibility of weight one modular forms
12:30 - 14:00	Lunch **(Atrium)**		
14:00 - 14:30	*Alistair Severn* The number of soluble fibres in a conic bundle, via the LSD method	*Philipp Wiedemann* p-adic L-functions and Iwasawa Theory	*Gurpreet Kour* Direct problem for dilated sumset of type $m \cdot A + k \cdot B$
14:30 - 15:00	*Gergely Jakovac* Key polynomials for discrete valuations on function fields	*Ikrame daqaq* On the Stability of the 2-Iwasawa Module Rank in Families of Real Biquadratic Fields.	*Joseph Harrison* Sum-product phenomena in algebraic groups
15:00 - 15:30	Coffee/tea break **(Atrium)**		
15:30 - 16:00		*Antau Yang* Continued Fractions in the Field of p-adic Numbers	*Madhav Sharma* A Note On Restricted H-Fold Signed Sumsets

Ribet's method and beyond

Alice Pozzi

The theory of modular forms is often used to establish connections between special values of L-functions and the arithmetic of number fields. A striking example is the Herbrand–Ribet theorem, which relates the mod p divisibility of Bernoulli numbers to the structure of the class group of the p-th cyclotomic field. In this talk, I will focus on Ribet's proof of the converse to Herbrand's theorem, which leverages congruences between modular forms, a technique now known as Ribet's method. I will then discuss more recent developments of this circle of ideas, in which precise control of such congruences is used to detect finer arithmetic invariants; for example, the vanishing of certain cup products in Galois cohomology.

The distribution of 2-Selmer groups in quadratic twist families

Adam Morgan

I will review various results (and conjectures) concerning the distribution of ranks and Selmer groups in quadratic twist families of abelian varieties. In particular, I will discuss recent work with Bartel that determines the distribution of 2-Selmer groups for some families of abelian varieties with large endomorphism rings.

Graded Lie algebras and families of algebraic curves

Beth Romano

In recent work with Jef Laga, we adapt a construction of Slodowy to build families of algebraic curves in graded Lie algebras. Our motivation comes from proofs in arithmetic statistics in which orbits in certain representations are used to parametrize rational points on curves. This generalizes earlier work of Jack Thorne. In the talk, I won't assume prior knowledge of graded Lie algebras or arithmetic statistics. I'll give an introduction to these areas via examples.

Ultra Euler systems

Alberto Angurel

Euler systems are a powerful tool in Iwasawa theory, relating the behaviour of certain arithmetic objects to special values of L-functions. Among other results, this technique has led to a proof of the Birch and Swinnerton-Dyer conjecture in the case of analytic rank at most one. The underlying argument rests on the existence of a norm-compatible collection of elements along a $\mathbb{Z}_p$-extension.

In this talk, I will discuss an analogue of this argument in a non-standard model of the rational numbers, which is constructed via ultrafilters. This formalism allows us to exploit the existence of infinitely many $\mathbb{Z}_p$-extensions. The resulting construction, which we call ultra Euler systems, enables the computation of the structure of Selmer groups in new cases.

The finiteness of integral points on elliptic curves

Edison Au-Yeung

A famous theorem of Siegel states that there are only finitely many integral points on any elliptic curve E/K. This result can be geometrically interpreted as 'integral points repel each other'. In this talk, I will illustrate this interpretation through two results: Helfgott-Venkatesh's bound on the number of integral points (2006), and Ingram's bound on the size of n among the multiples $[n]P$ of any non-torsion integral point P (2009).

A p-adic cohomological approach to congruences of meromorphic modular forms

Paolo Bordignon

In this talk, I will present several congruences relating the Fourier expansion of meromorphic modular forms to the Frobenius action on the elliptic curves corresponding to their poles. I will explain how this phenomenon hides deeper structures arising from the geometry and cohomology of modular curves in the p-adic setting. There exists a sequence of filtered φ-modules relating the cohomology of the punctured modular curve to the fibers at the poles, where Frobenius acts through the corresponding elliptic curves. In particular, using the theory of overconvergent modular forms defined by Katz, we can relate this Frobenius action to the Hecke operator U_p giving us genuine congruences on Fourier coefficients.

The topology of G-bundles over Scholze's twistor

Saverio Caleca

Let G be a reductive group over $\mathbb{Q}_p$. The stack of G-bundles over the Fargues-Fontaine curve is one of the key players in Fargues and Scholze's work on the geometrization of the local Langlands correspondence for non-archimedean fields. In particular, its category of ℓ-adic sheaves encodes the automorphic representations of G.

It is therefore natural to ask: can we describe the topological space underlying this stack? Fargues and Scholze conjectured, and Viehmann subsequently proved, that it is homeomorphic to Kottwitz's set $B(G)$, endowed with its natural topology. More recently, Scholze defined an analogue of this stack over the twistor, which is the archimedean counterpart of the Fargues-Fontaine curve. This naturally leads to the question: what can we say about its underlying topological space?

Generalized Thakur identities among Multiple Polylogarithms over Function Fields

Leonardo Carofiglio

The Carlitz module and its tensor powers $C^{\otimes n}$ are the moral analogue of the Tate twists $\mathbb{Z}(n)$ over function fields of positive characteristic. In this context identities among Multizeta Values and Multiple Polylogarithms are of great interest, with the ultimate goal of describing all the relations among them. In this talk I will introduce the subject of arithmetic in positive characteristic and I will explain the results of an upcoming joint work with N. Green (University of California) and F. Pellarin (Sapienza University of Rome) in which we use iterated extensions of higher Carlitz modules to deduce a non-commutative factorization of the corresponding Euler–Carlitz operator, and ultimately derive a new class of identities among Multiple Polylogarithms that generalize Thakur's foundational one, as well as some consequences of underlying $K[\tau]$-structures. One important introduction is that of a new characteristic zero formalism that allows for the lifting of the quantities relating to the Carlitz module and allows a deeper interpretation of these new identities.

Exponential Periods

Valentin Carpintero Pérez

Exponential periods are complex numbers defined by integrating algebraic differential forms multiplied by the exponential of an algebraic function over an algebraic domain. They form a broader class than classical periods, including constants such as e, Euler's constant γ and special values of the Gamma and Bessel functions. We will see how exponential periods arise as values of the integration pairing between Betti and de Rham cohomology associated with a pair (X, f) of a variety X with a potential f. We will briefly mention the motivic viewpoint and its role in the study of exponential periods, exponential sums over finite fields, E-functions, special values of L-functions and much more!

Mod p aspects of L-values, and Fourier Coefficients of theta lifts.

Mark Chambers

In the Langlands program, many things (e.g. L-values, Fourier coefficients, multiplicity one) are studied over the complex numbers. However, if we want to study these algebraically, or integrally, it makes sense to look at these mod p. In this talk, we give what appropriate definitions of these (L-values, multiplicity one, theta lifts) could be mod p, look at some results on their compatibility, and give some applications.

Eigenvarieties and p-adic rigidity for GSp_4

Charlotte Clare-Hunt

There has been substantial progress in the construction of eigenvarieties and p-adic families of automorphic forms, and their relationship with Selmer groups and (p-adic) L-functions. In this talk I will introduce some of these constructions, starting with modular forms, and the concept of complete p-adic rigidity: the non-existence of nontrivial p-adic deformations. I will explain some of the techniques used to study the geometry of eigenvarieties, and how these specialise to show that certain noncuspidal 'Saito—Kurokawa' points are completely p-adically rigid. If time permits, I will also briefly outline how similar strategies may be used to construct p-adic families through cuspidal, nonholomorphic Saito—Kurokawa points and to produce nontrivial Selmer classes predicted by the Bloch—Kato conjecture.

A Zilber—Pink type question in Dynamical Systems

Joseph Cohen

Questions about special points on curves have a long and rich history. They have evolved from Mordell's theorem and conjecture to the Manin—Mumford Conjecture and Mordell—Lang framework and finally the Unlikely Intersections philosophy and Zilber—Pink Conjecture.

There exist dynamical analogues to both Manin—Mumford and Zilber—Pink. I will introduce some of these frameworks and a specific question I have been working on and give an idea of the proof methods involved.

Formalising aspects of p-adic modular forms

William Coram

In the study of p-adic modular forms, one can use newton polygons to get information on eigenvalues of compact Hecke operators and my recent work has been on formalising results on this in Lean. This talk will provide an introduction to how newton polygons are used in this field and highlight the subtleties in formalising the classical construction of newton polygons.

Refined singular moduli through p-adic Galois deformations

Michael Daas

In the 1980s, Gross and Zagier studied the norms of the differences between singular moduli. Analogous questions on Shimura curves allow for purely p-adic investigations through their p-adic uniformisations. We explain how the theory of p-adic Galois deformations can be used to obtain results beyond the norm, supporting purely p-adic methods to prove the algebraicity of conjecturally algebraic p-adic quantities. This is joint work with Yingkun Li.

On the Stability of the 2-Iwasawa Module Rank in Families of Real Biquadratic Fields.

Ikrame Daqaq

We investigates the stability of the 2-rank along the cyclotomic $\mathbb{Z}_2$-extension of real biquadratic number fields. We determine several families of real biquadratic fields F for which the ranks of the 2-class group $A(F)$ and the associated 2-Iwasawa module $A_\infty(F)$ coincide.

Breuil–Mézard and Serre Weights

Izaak Fairclough

The Breuil–Mézard conjecture describes (using the representation theory of GL_n) which mod p local Galois representations have lifts to characteristic zero with specified p-adic Hodge theoretic properties. It has applications to modularity.

The weight part of Serre's conjecture describes the weights in which a *global* mod p Galois representation is modular. One can state a neat version in terms of the Breuil–Mézard conjecture.

My goal is to give a soft introduction to 'geometric' Breuil–Mézard (its modern incarnation) and further state a version of the weight part of Serre's conjecture. I'll also try and briefly discuss some 'irregular/geometric weight' phenomena.

Descent properties for an abelian variety with extended Galois representation

Ludovic Felder

Let A be an abelian variety defined over a number field L, and let K be a subfield of L. In 1956, André Weil gave the conditions that A needs to satisfy in order to be actually defined over K. In this case, we say that A descends to K.

If A descends to K, then every associated ℓ-adic representation of the absolute Galois group of L can be extended to a representation of the absolute Galois group of K. In this talk, we will show that the converse is true for some abelian varieties. Surprisingly, in some specific cases, having an extended Galois action for a single prime ℓ is a sufficient condition to have a descent of the base field.

Obstructions to Minimality in Serre's Conjecture via Derived Galois Deformation Rings

Lucie Gatzmaga

Serre's original modularity conjecture predicted that every irreducible odd mod p Galois representation is modular of minimal weight, level and nebentypus. However, this strong form of the conjecture turned out to be too optimistic: for certain 'badly dihedral' Galois representations, the minimal nebentypus part of the conjecture fails. Curiously, the corresponding minimal Galois deformation rings mirror this degeneracy. In this talk, we will introduce the necessary ideas from Galois deformation theory, then study the geometry of these badly dihedral deformation rings and make the obstruction to modularity with minimal nebentypus explicit. To achieve this, we prove a derived version of a minimal R=T theorem.

On automorphic Galois representations for GSp_4

Jorge Gómez Chouza

An important question in the Langlands programme is, given an automorphic representation of a general reductive group, to construct its associated Galois representation. A general strategy for realising this for cuspidal automorphic representations is to find it in the cohomology of the associated Shimura variety. In this talk we will explain some of the ideas behind this construction and the particularities that arise in the case of GSp_4 with respect to the classical case of GL_2.

Sum-product phenomena in algebraic groups

Joseph Harrison

The cardinality of sumsets and product sets can be regarded as quantitative indicators of additive or multiplicative structure. Erdős and Szemerédi proved that a set of integers cannot have both a small sumset and a small product set. In other words, a set of integers cannot be both additively and multiplicatively structured. Bourgain and Chang proved that cardinality of the k-fold sumset or k-fold product set of A exceeds any power of $|A|$, as k grows. Mudgal proved that the same is true with the k-fold sumset of A replaced by the sumset of polynomial images $\phi_1(A) + \cdots + \phi_k(A)$.

I will report on joint work with Akshat Mudgal and Harry Schmidt, which generalises these three results, replacing the multiplicative group and the additive group with arbitrary commutative algebraic groups of dimension 1, in characteristic zero. The open immersion $\mathbb{G}_m \to \mathbb{G}_a$, implicit in the work of Erdős–Szemerédi and Bourgain–Chang, and the polynomial morphism $\mathbb{G}_m^k \to \mathbb{G}_a^k$ in the work of Mudgal, is replaced by an arbitrary algebraic correspondence. The proofs employ the work of David and Philippon on the uniform Mordell–Lang conjecture in products of elliptic curves, the work of Evertse, Schlickewei and Schmidt on the S-unit equation, and the recent work of Gowers, Green, Manners and Tao on the polynomial Freiman–Rusza conjecture.

TBC

David Heras

TBC

The Geometry of Shimura Varieties

Julian Huber

In this talk, I will give an introduction to Shimura varieties, focusing in particular on PEL-type Shimura varieties, and discuss some examples. The talk is based on a first-year LSGNT mini-project.

Key polynomials for discrete valuations on function fields

Gergely Jakovac

We give a generalization of MacLane's theory of key polynomials to function fields of varieties over a non-Archimedean field. Discrete valuations of geometric interest (those which come from irreducible components of the special fibre of a model) correspond precisely to the discrete valuations given by finitely many key polynomials.

Direct problem for dilated sumset of type $m \cdot A + k \cdot B$

Gurpreet Kour

Let A and B be two non-empty finite subsets of integers and $m, k \in \mathbb{Z}^+$. The sum of dilates of A and B can be defined, $m \cdot A + k \cdot B = \{na + kb : a \in A, b \in B\}$. Major problems in these types of sumsets is direct problem estimate or determine the minimum cardinality of $m \cdot A + k \cdot B$ for given sets A and B. Under certain conditions, in 2017, Mistri proved that $|A + k \cdot B| \geq 4|A| - 4$, where A and B are non-empty subsets of integers and $|k| \geq 3$. In this article, we consider $|p \cdot A + k \cdot B|$, with $k(> p) \in \mathbb{Z}^+$, where p is an odd prime and $(p, k) = 1$, and proved that $|p \cdot A + k \cdot B| \geq 4|A| - 4$, where A and B be the non-empty finite subsets of integers satisfying some properties.

Brauer Twists & Moduli Spaces in Algebraic Geometry

Mia Lam

In this talk, we discuss different ways of thinking about Brauer groups, as groups of Azumaya algebras, Brauer-Severi varieties, $\mathbb{G}_m$-gerbes and twisted sheaves. In particular, we look at how Brauer twists arise naturally from the moduli problem of stable sheaves.

Probabilistic Recognition of Gal$(f) = S_n$

Daniel Lang

Galois groups of polynomials $f \in \mathbb{Z}[x]$ over $\mathbb{Q}$ are difficult to compute; however, in the generic case the Galois group is the full symmetric group. Verifying whether $\mathrm{Gal}(f) = S_n$ (where $n = \deg(f)$) can be done deterministically in polynomial time, but for large n this becomes infeasible. We will present a Monte Carlo algorithm for checking whether $\mathrm{Gal}(f) = S_n$, explain how results of Eberhard, Ford and Green can be used to bound the expected run time above, and motivate the study of Chebotarev invariants of finite groups. This talk is based on my master's dissertation, which I completed under the supervision of the group theorist Dr. Gareth Tracey.

Machine learning Over the p-adics

Paul Lezau

In this talk, I'll give a very brief introduction to the topic of Machine learning, and then say how we can adapt some of its core concepts to the p-adic setting, using some ideas from non-Archimedean geometry. If time permits, I'll explain how this gives a new perspective on the ancient art of (approximately) solving systems of polynomial equations.

Polylogarithmic Chabauty–Kim Loci over Number Fields

Xiang Li

I will discuss explicit computations in the polylogarithmic Chabauty-Kim method for the thrice-punctured line over number fields. I will describe the number field framework, including Selmer schemes, Galois actions, and localisation formulas, and explain applications to quadratic and cyclotomic fields. A main consequence is a proof of the S-Selmer Section Conjecture for imaginary quadratic fields when S is empty or consists of one Galois-unstable prime. I will also present new verifications of Kim's Conjecture, including the case $K = \mathbb{Q}(\zeta_8)$, $S = (1 - \zeta_8)$, and discuss exceptional Chabauty-Kim loci arising from roots of unity.

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p-adic families of automorphic forms

Haoran Liang

A central theme in modern number theory is to understand how automorphic forms vary in p-adic families. In the 1990s, Coleman developed a geometric theory of finite slope overconvergent modular forms and proved his celebrated classicality theorem. A natural question is how to generalize this theory beyond modular curves to higher-dimensional Shimura varieties. In this direction, Andreatta–Iovita–Pilloni (2015) developed a theory of p-adic families of Siegel eigenforms using the geometry of Siegel modular varieties and canonical subgroups. In this mini talk, I will explain some of the basic ideas behind the AIP construction and, if time permits, briefly discuss its resulting eigenvariety.

Weights and characters for affine Hecke algebras

Maximilien Mackie

Weights play an essential role in the classification of simple modules for affine Hecke algebras. I will present recent work showing the extent to which weights determine simple modules, and as an application present an algorithm for determining the composition series of finite length modules for certain affine Hecke algebras.

Reduction types of curves and tame base change

Júlia Martínez Marín

The reduction type of a curve C/K is a discrete invariant that encodes arithmetic information of C. For elliptic curves, this is known as the Kodaira type. This invariant depends on K, and it is not preserved under base change. In this talk, assuming L/K is tame, I will discuss how much the reduction type of the base change C_L is controlled by that of C.

Mordell-Weil Groups as Galois Modules

Lewis Matthews

We consider the p-adic completion of the Mordell-Weil group of an elliptic curve. This gives a $\mathbb{Z}_p[G]$ module where G denotes the Galois group of the field over which our elliptic curve is defined. We apply established results in integral representation theory to completely determine the structure of these groups for different reduction types.

The motivic Galois group for a double zeta value

Kenza Memlouk

In this talk, we consider multiple zeta values, which are periods of unramified mixed Tate motives. For a given multiple zeta value ζ, there exists a unique minimal motive so that ζ is a period of this motive. In general, this motive is complicated to compute. In the specific case of double zeta values, we can compute such a minimal motive. It is done by exploiting the Tannakian formalism. We will give this minimal motive, the Tannakian group associated to it and discuss its dimension. We will then formulate a conjecture about algebraic relations between double and single multiple zeta values.

Cryptographic Applications of Polylogarithmic Groups

Saheb Mohapatra

Put simply, polylogarithmic groups encode the non-trivial integer relations among polylogarithmic values $\mathrm{Li}_s(z) = \sum_{n=1}^{\infty} \frac{z^n}{n^s}$. In this talk, we first recall the relevant mathematics of these groups before discussing ongoing work on their potential application to post-quantum cryptography. ”

Computing Darmon–Dasgupta units via generating series

Mateo Crabit Nicolau

In 2006, Darmon and Dasgupta constructed a p-adic invariant $u(\omega)$ attached to a real quadratic irrationality ω. The p-adic number $u(\omega)$ is defined as a multiplicative integral with respect to a p-adic measure. They formulated an algebraicity conjecture for this p-adic invariant, predicting that $u(\omega)$ is a p-unit in the narrow ring class field H_ω of $\mathbb{Q}(\omega)$. Their explicit formula for $u(\omega)$ makes it a genuine refinement of the Gross–Stark conjecture.

Their conjecture was recently proved by Dasgupta and Kakde. Building on this construction and on recent work of Charollois, I will describe a new algorithm for computing these families of p-units. The key idea is to construct a generating series whose coefficients are special moments of the p-adic measure appearing in the definition of $u(\omega)$. We show that these moments contain enough information to recover $u(\omega)$ to any prescribed p-adic precision. This method allows us to carry out computations for primes p as large as 1000, and to achieve up to 1000 digits of p-adic precision for small primes.

Integral Norms via Selmer Groups

Ruth Raistrick

Let K be a number field and a a unit of K. As we vary over quadratic extensions L/K, we ask: how often is a an integral norm from L? We restrict to the family where a is everywhere locally an integral norm, else a local obstruction gives that our desired density is 0. The first case of this, Stevenhagen's conjecture, has recently been solved by Koymans and Pagano. In this talk, I lay out how Selmer groups can be used to study the distribution of integral norms in quadratic extensions. Time permitting, I will discuss its link to the question of the distribution of class groups.

Phenomenon of ℓ-independence

Suvir Rathore

We will discuss the phenomenon of ℓ-independence of systems of representations attached to varieties as predicted by the theory of motives, following a string of conjectures: the Weil conjectures, Deligne's conjectures and a more recent conjecture by Drinfeld. The Langlands programme also hints at certain ℓ-independent statements for curves, and we will see how it helps in proving some of these conjectures.

Modular forms in quadratic Chabauty for modular curves

Isabel Rendell

Quadratic Chabauty is a method to explicitly compute the rational points on certain modular curves of genus at least 2. The current algorithm, due to Balakrishnan-Dogra-Müller-Tuitman-Vonk, requires an explicit plane model of the curve. The coefficients of such models grow rapidly with the genus and so are inefficient to compute with when the genus is sufficiently large. Therefore, we would like to replace this input with certain modular forms associated to the curve, hence creating a 'model-free' algorithm. In this talk I will provide an overview of an algorithm to compute the first stage of quadratic Chabauty on Atkin-Lehner quotients of modular curves using weakly holomorphic modular forms. Time permitting, I will mention some joint work with Marius Leonhardt on generalising this approach to normaliser of non-split Cartan modular curves.

A geometric model for the Appell hypergeometric function F_2

Thais Gomes Ribeiro

In this talk I would like to present a geometric model for the Appell hypergeometric function F_2. It consists of (a family of) algebraic varieties (over a finite field $\mathbb{F}_q$) whose number of points can be described in terms of finite-field Appell hypergeometric functions and other simpler terms such as finite-field Gaussian hypergeometric functions and Jacobi sums. A similar result previously known in the literature had some restrictive assumptions in order to guarantee that no degenerate hypergeometric parameters would appear in the point counts. We eliminate some of these assumptions and, using a reduction formula, prove a more general result that, in particular, recovers the previous one.

Explicit valuation criterion for the surjectivity of (T)-adic Galois representations of Drinfeld A-modules of rank 3

Dwipanjana S.

Let $\mathbb{F}_q$ be a finite field and $A := \mathbb{F}_q[T]$. In this article, we establish an explicit valuation criterion for the surjectivity of the associated (T)-adic Galois representations of Drinfeld A-modules of rank 3, formulated entirely in terms of the valuations of their coefficients. Furthermore, we compute the exact density of the class of Drinfeld A-modules of rank 3 satisfying this valuation criterion. We also obtain a corresponding criterion for rank 2, thus relaxing the hypotheses imposed in earlier work by Anwesh Ray. This is a joint work with Prof. Narasimha Kumar.

The stack BG, and why you should join the dark side

Katerina Santicola

It is difficult to prove that something doesn't exist. Nevertheless, we can sometimes prove that an equation does not have a rational solution thanks to the Brauer–Manin obstruction. The stack BG is a wonderful object whose "rational points" correspond to G-Galois extensions. In this talk, I will convince you that studying the rational points on BG is a much cooler way of studying number fields.

Plane curve singularities and reduction types of curves

Jakab Schrettner

Curves of genus at most 2 over a local field have been classified in terms of their reduction type. Such a reduction type consists of a description of the configuration of components in the special fibre of a minimal regular model, along with some numerical data and a description of the singularities involved (e.g. node in Kodaira type I_1 or cusp in type II). It is however not clear how this classification extends to higher genus, as the singularities may become arbitrarily complicated. In this talk I will propose a way to classify reduction types of curves of arbitrary genus in terms of their minimal regular models, by keeping track of certain invariants of the singularities on their special fibre. I will also discuss how this relates to the classification in terms of the special fibre of the minimal normal crossings model.

The number of soluble fibres in a conic bundle, via the LSD method

Alistair Severn

The three classical questions in rational points are:

1. Given a variety, does it have a rational point?
2. Given a variety with at least one rational point, are there infinitely many rational points?
3. Given a variety with infinitely many rational points, what is their asymptotic distribution?

In this talk we will not address any of these, but rather answer a fourth question, originally studied by Serre: Given an infinite family of varieties - how many of them have a rational point, and what is their asymptotic distribution? We will show how this problem may be studied for certain families of conics using ternary quadratic forms and the LSD method.

A Note On Restricted H-Fold Signed Sumsets

Madhav Sharma

Let $A = \{a_1, a_2, \ldots, a_k\}$ be a non-empty finite subset of an abelian group G, and let h be any positive integer. Then *restricted h-fold signed sumset* is defined as:

$$h_{\pm}A = \left\{ \sum_{i=1}^{k} r_i a_i : r_i \in \{-1, 0, 1\},\ \sum_{i=1}^{k} |r_i| = h \right\}.$$

Furthermore, the union $\bigcup_{h\in H} h_{\hat{\pm}}A$, where H is a finite subset of positive integers, is called *restricted H-fold signed sumset* $H_{\hat{\pm}}A$. In this paper, we proved the direct and inverse problems for the restricted H-fold signed sumset $H_{\hat{\pm}}A$ when A is a k-set of non-negative integers.

On the Abundance and Rarity of BSD Twins of Elliptic Curves

Asuka Shiga

The Birch and Swinnerton-Dyer conjecture for an elliptic curve asserts that the leading Taylor coefficient of its L-function at $s = 1$ is expressed in terms of arithmetic invariants of the curve, including the Tate–Shafarevich group, the period, the regulator, and the Tamagawa numbers. We consider the question of to what extent the isomorphism class of an elliptic curve can be uniquely recovered from these invariants. Let us call a pair of non-isomorphic elliptic curves with the same BSD invariants a pair of BSD twins. In this talk, we construct an infinite family of BSD twins over $\mathbb{Q}$ such that all the j-invariants occurring in the family are pairwise distinct. We further show that infinitely many pairs of BSD twins over $\mathbb{Q}$ exist even under the stronger requirement that their minimal discriminants and Kodaira symbols also coincide. On the other hand, the real period, which is one of the BSD invariants, has remarkably strong power to recover an elliptic curve. We present a result illustrating the rarity of BSD twins: the isomorphism class of an elliptic curve over $\mathbb{Q}$ can be recovered from invariants closely related to the BSD data, namely its archimedean Tamagawa number and the period of a single negative quadratic twist. Time permitting, we will also discuss possible extensions to elliptic curves over number fields and explain, from the viewpoint of Mazur's theory of visibility, how one may find BSD twins with nontrivial Tate–Shafarevich groups.

Periods of E-operators

Ben Snodgrass

We discuss E-functions, a class of entire functions generalising the exponential function whose special values have remarkable transcendence properties. We use them to introduce a class of complex numbers given by integrals of E-functions pulled back to some algebraic variety, and discuss how they can be realised as the matrix elements of a comparison isomorphism, justifying their being termed 'periods'. They contain the exponential (and thus classical) periods as subsets, as well as many interesting numbers that are thought not to be exponential periods.

Integral Models of Modular Curves

Lucas Valle Thiele

A very fruitful idea in arithmetic geometry is that of a moduli space. Isomorphism classes of elliptic curves assemble into a geometric object, the modular curve $Y(1)$. Similarly, isomorphism classes of pairs (E, C), consisting of an elliptic curve E and a cyclic subgroup C of E of order N, give rise to the modular curve $Y_0(N)$. In this talk, I will make sense of and answer the following question:

For a prime p, what does the forgetful map $Y_0(p) \to Y(1)$ sending (E, C) to E look like modulo p?

The geometric description has concrete consequences for elliptic curves, such as the classical Kronecker congruence for the modular polynomial. Our discussion will also serve as a gentle introduction to integral models of Shimura varieties, providing hands-on examples of technical notions that arise in the theory."

Sufficiency of the Brauer-Manin Obstruction over Global Function Fields

Jed Thorpe

Solving Diophantine equations (i.e. determining the rational points of a variety over a global field K) is an ancient and generally very difficult problem. Perhaps the most basic question one can ask is that of the existence of a rational point. A necessary condition is local solubility - the existence of points over each completion of K. When the converse is true for a family of varieties, we say the Hasse principle holds for that family; this is true for example of quadrics. However, the Hasse principle can fail in general, and so a more refined obstruction is needed to explain these failures - the Brauer-Manin obstruction is such a refinement. A natural next question then is for which families of varieties is the Brauer-Manin obstruction enough to account for the non-existence of rational points? Over number fields, results in this direction are largely conjectural. However, over global function fields, results have been obtained for some large classes of varieties. We shall discuss some of these results, and why the situation between the two types of global field differs. No prior knowledge of the Brauer-Manin obstruction will be assumed.

Computing a presentation for Bianchi groups

Sara Varljen

Bianchi groups are groups of the form $\mathrm{PSL}_2(\mathcal{O}_k)$, where $\mathcal{O}_k$ is the ring of integers of an imaginary quadratic field k. In this talk, I will give an introduction to Bianchi groups and their action on the hyperbolic 3-space. I will then present a computational approach to defining a deformation retract of the hyperbolic 3-space which is invariant under this action. We will also see some pictures of how this deformation retract looks like. Finally, I will outline how one can obtain a presentation of the group from the deformation retract.

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p-adic L-functions and Iwasawa Theory

Philipp Wiedemann

It is a natural question to ask whether a real/complex analytic object has a p-adic analogue, e.g. one can define a p-adic exponential map via the usual Taylor series to obtain a function which satisfies the usual properties one would expect from an exponential map, except for, say, entire convergence. We apply this question to Dirichlet L-functions for which there is an affirmative but less direct answer, given by essentially constructing a function which interpolates at non-positive integer values, where it is known the L-function takes algebraic values (in the field generated by the Dirichlet character). Once we have established p-adic L-functions, we will see how they relate to the Iwasawa-theoretic analogue of class groups via the Iwasawa main conjecture.

Continued Fractions in the Field of p-adic Numbers

Antau Yang

In the real numbers, the floor function gives a canonical notion of "integer part", underlying the classical continued fraction algorithm. The p-adic field carries no natural ordering, so this notion is no longer canonical: different choices of digit set give rise to genuinely different algorithms, the classical examples being those of Ruban and Browkin. Unlike the real case, where Lagrange's theorem completely characterises periodicity of quadratic irrationals, periodicity under these p-adic algorithms remains poorly understood. This talk discusses such algorithms and presents my own work on the topic.

Local global compatibility of weight one modular forms

Yicheng Yang

In this talk, I will construct modular forms of level $\Gamma_1(p)$ in characteristic p and prove a local-global compatibility theorem for weight-one forms. This generalizes a theorem of Gross and Coleman–Voloch, which states that the Galois representations associated with mod-p weight-one modular forms are unramified at p. If time permits, I will discuss an application proving an $R = T$-type theorem using the Calegari–Geraghty method.

Formalising the modular j-function in Lean

Xiangmiao Yin

The modular j-function is a holomorphic function on the upper half-plane with q-expansion $j(\tau) = q^{-1} + 744 + 196884q + \cdots$. It generates the function field of the modular curve $X(1)$, and is famously connected to the Monster group through monstrous moonshine. I have been formalising aspects of its theory in the Lean theorem prover. In this talk, I will introduce the j-function, give an overview of Lean, and discuss some of the difficulties encountered in the formalisation.

List of Participants

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