

# SCHEDULE

(All talks in the Conference Center of the Grand Hotel San Michel)

## Monday, July 22

**8:45 - 9:15: Registration**

**9:15 - 9:30: Welcome**

**9:30 - 10:20: Ye Tian:  $p$ -Converse of CM elliptic curves**

*Let  $E$  be a CM elliptic curve over  $\mathbb{Q}$  and  $p$  an ordinary prime for  $E$ . We show that if the  $p$ -Selmer group of  $E$  has rank not larger than 1, then its rank is equal to the vanishing order of its  $L$ -series at the center. This is a joint work with Burungale and Skinner*

**10:30 - 11:00: Coffee Break**

**11:00 - 11:50: Christopher Skinner: Some recent results on Euler and Kolyvagin Systems**

*Euler systems remain one of the best tools for understanding the structure of Selmer groups and even for relating Selmer groups to special  $L$ -values. In this talk we describe some recent work on Euler systems, which includes some new aspects in the anticyclotomic setting as well as some constructions of new Euler systems in the cyclotomic setting.*

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**5:00 - 5:50: Ziyang Gao: Application of functional transcendence to counting rational points on curves**

*With Philipp Habegger we recently proved a height inequality, using which one can bound the number of rational points on 1-parameter families of curves in terms of the genus, the degree of the number field and the Mordell-Weil rank (but no dependence on the Faltings height). This gives an affirmative answer to a conjecture of Mazur for pencils of curves. In this talk I will give a blueprint to generalize this method to an arbitrary family of curves. In particular I will focus on: (1) how establishing a criterion for the Betti map to be immersive leads to the desired bound; (2) how to apply mixed Ax-Schanuel to establish such a criterion. This work is partly joint with Vesselin Dimitrov and Philipp Habegger.*

**6:00 - 6:50: Yifeng Liu: Recent progress on Beilinson-Bloch-Kato conjecture**

*In this talk, we will introduce the recent progress on Beilinson-Bloch-Kato conjecture, which generalizes the BSD conjecture, for Rankin-Selberg motives of arbitrary ranks. We will also discuss some ingredients in the proof. This is based on a joint work with Y. Tian, L. Xiao, W. Zhang, and X. Zhu.*

## Tuesday, July 23

### 9:30 - 10:20: Wen-Wei Li: Some new zeta integrals associated with real prehomogeneous vector spaces

The Godement-Jacquet zeta integrals and Sato's prehomogeneous zeta integrals share a common feature: they both involve Schwartz functions and Fourier transforms on prehomogeneous vector spaces. In this talk I will sketch a common generalization in the local Archimedean case. Specifically, for a reductive prehomogeneous vector space which is also a spherical variety, I will define the zeta integrals of generalized matrix coefficients of admissible representations against Schwartz functions, prove their convergence and meromorphic continuation, and establish the local functional equation. Our arguments are based on various estimates on generalized matrix coefficients and Knop's work on invariant differential operators..

### 10:30 - 11:00: Coffee Break

### 11:00 - 11:50:: Anna Cadoret: Ultraproduct Weil II for curves and $\mathbb{Z}_\ell$ companions

I will briefly explain how to define a category of lisse sheaves with ultraproduct coefficients and construct, in this setting, a partial formalism of Frobenius weights where, at least, the corresponding version of the fundamental theorem of Weil II for curves is available. Combining this result with geometric arguments, one can deduce (without restriction on the dimension of the variety) most of the classical corollaries of Weil II (purity, geometric semisimplicity, Tannakian Cebotarev etc.). This ultraproduct formalism has applications to integral models in compatible systems of lisse  $l$ -adic sheaves: asymptotic unicity of integral models, asymptotic geometric semisimplicity of the reduction modulo- $l$ , generalization of Gabber's torsion freeness theorem for higher direct images etc. From these results, one also deduce the Langlands correspondance for ultraproduct coefficients and an asymptotic form of a Langlands correspondance modulo- $l$ , which implies the asymptotic existence and unicity of the lift in de Jong's conjecture on modulo- $l$  representation of the tale fundamental group.

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### 5:00 - 5:50: Ritabrata Munshi: Bounds for $GL(2) \times GL(2)$ Rankin-Selberg L-functions

A standard version of the circle method can be used to obtain strong bounds for  $GL(3) \times GL(2)$  Rankin-Selberg  $L$ -functions in various aspects. As a consequence one obtains several known cases of sub-convexity from one general set-up.

### 6:00 - 6:50: Kanan Soundararajan: Integral Factorial Ratios

I will describe a new approach to classifying integral factorial ratios, obtaining a direct proof of a result of Bober. These results generalize an observation going back to Chebyshev that  $\frac{(30n)! \cdot n!}{((15n)! \cdot (10n)! \cdot (6n)!)}$  is an integer for all natural numbers  $n$ . Due to the work of Rodriguez-Villegas and Beukers and Heckman, this problem is closely related to classifying hypergeometric functions with finite monodromy groups, and the result of Bober was originally derived as a consequence of the work of Beukers-Heckman. The new proof is elementary and makes partial progress on other related questions.

## Wednesday, July 24

### 9:30 - 10:20: Raphael Beuzart-Plessis: A new proof of the Jacquet-Rallis fundamental lemma

*The Jacquet-Rallis fundamental lemma is a local identity between (relative) orbital integrals which originates from the relative trace formula approach to the Gan-Gross-Prasad conjecture for unitary groups and is a crucial ingredient in the recent results of W. Zhang on this conjecture. It was established soon after its formulation by Z. Yun in positive characteristic using the same geometric ideas as in Ng's proof of the endoscopic fundamental lemma and transferred to characteristic 0 by J. Gordon by model-theoretic techniques. In this talk, I will present an alternative proof of this fundamental lemma in characteristic zero which is purely local and based on harmonic analytic tools.*

### 10:30 - 11:00: Coffee Break

### 11:00 - 11:50: Wei Zhang: The arithmetic fundamental lemma for diagonal cycles

*The arithmetic Gan-Gross-Prasad conjecture, a high dimensional generalization of the Gross-Zagier theorem, relates the height pairing of arithmetic diagonal cycles on certain product Shimura varieties to the first central derivative of Rankin-Selberg tensor product L-functions. The arithmetic fundamental lemma conjecture arises from the relative trace formula approach to this conjecture. I will recall the statement of the arithmetic fundamental lemma and present (a sketch of) a proof.*

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### 4:30 - 5:20: Alexander Smith: $2^k$ -Selmer groups and Goldfeld's conjecture

*Take  $E$  to be an elliptic curve over a number field whose four torsion obeys certain technical conditions. In this talk, we will outline a proof that 100% of the quadratic twists of  $E$  have rank at most one. To do this, we will find the distribution of  $2^k$ -Selmer ranks in this family for every  $k > 1$ . Using this framework, we will also find the distribution of the  $2^k$ -class ranks of the imaginary quadratic fields for all  $k > 1$ .*

### 5:30 - 6:20: Jennifer Balakrishnan: Rational points on the cursed curve

*The split Cartan modular curve of level 13, also known as the "cursed curve," is a genus 3 curve defined over the rationals. By Faltings' proof of Mordell's conjecture, we know that it has finitely many rational points. However, Faltings' proof does not give an algorithm for finding these points. We discuss how to determine rational points on this curve using "quadratic Chabauty," part of Kim's nonabelian Chabauty program. This is joint work with Netan Dogra, Steffen Mueller, Jan Tuitman, and Jan Vonk.*

### 6:30 - 7:00: Awarding of the David Goss Prize

## Thursday, July 25

### 9:30 - 10:20: Maksym Radziwill: The local Fourier uniformity conjecture for multiplicative functions

*I will motivate and describe the progress on the so-called "local Fourier uniformity conjecture" and its consequences for our understanding of triple correlations of multiplicative functions, such as the Liouville or divisor function. This is joint work with Matomaki and Tao.*

### 10:30 - 11:00: Coffee Break

### 11:00 - 11:50: Henri Darmon: On the RM values of the Dedekind-Rademacher cocycle

*A conjecture formulated by Samit Dasgupta and the speaker around 2002 asserts that the values of their so-called "Dedekind-Rademacher rigid analytic cocycle" at real quadratic arguments in Drinfeld's  $p$ -adic upper half plane are global  $p$ -units in narrow ring class fields of real quadratic fields. Partial evidence for this was obtained around 2006 by Dasgupta, Robert Pollack and the speaker as a consequence of their proof of the Gross  $p$ -adic variant of the Stark conjecture. The full conjecture has been settled recently by Dasgupta and Mahesh Kakde through a remarkable extension of this strategy to Gross "tame refinement of the Gross-Stark conjecture". I will present these ideas and describe an alternate approach to the study of RM values of the Dedekind Rademacher cocycle, based on the diagonal restrictions of  $p$ -adic families of incoherent families of Hilbert modular Eisenstein series. The latter is an account of work in progress with Alice Pozzi and Jan Vonk.*

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### 5:00 - 5:50: Jacob Tsimerman: Bound 5-torsion in class groups using Elliptic Curves

*(Joint with Arul Shankar) We discuss a new method to bound 5-torsion in class groups using elliptic curves. The most natural trivial bound on the  $n$ -torsion is to bound it by the size of the entire class group, for which one has a global class number formula. We explain how to make sense of the  $n$ -torsion of a class group intrinsically as a dimension 0 Selmer group, and by embedding it into an appropriate Elliptic curve we can bound its size by the Tate-Shafarevich group which we can bound using the BSD conjecture. This fits into a general paradigm where one bounds dimension 0 selmer groups by embedding into global objects, and using class number formulas.*

### 6:00 - 6:50: Yves André: Singularities and perfectoid geometry

*This will be a non-technical overview of recent work by the speaker, and of some subsequent other works, on application of perfectoid geometry to homological commutative algebra and singularity theory. The progresses take place in mixed characteristic, but also work as a bridge between characteristic  $p$  and characteristic 0.*

## Friday, July 26

### 9:00 - 9:50: Andrei Yafaev: $\overline{\mathbb{Q}}$ structures on hermitian symmetric spaces

*This is a joint work in progress with Emmanuel Ullmo and consists largely of conjectures and speculations. Inspired by the analogy with the exponential function we define  $\overline{\mathbb{Q}}$  structures on a hermitian symmetric space  $X$  uniformising a Shimura variety  $S$ , formulate a ‘hyperbolic analytic subgroup theorem’ and explore its consequences.*

### 10:00 - 10:30: Coffee Break

### 10:30 - 11:20: Ilya Khayutin: Fourth Moment of Automorphic Periods

*I will describe a method to study the fourth moment of periods of Hecke eigenforms using a second moment pre-trace formula. The second moment pre-trace formula is constructed out of the usual pre-trace formula using non-standard test functions involving all Hecke operators. Our main application is to the sup-norm problem for  $GL_2$ . Joint work with Raphael Steiner.*

### 11:30 - 12:20: Aaron Levin Greatest common divisors and Diophantine approximation

*In 2003, Bugeaud, Corvaja, and Zannier gave an upper bound for the greatest common divisor  $\gcd(a^n - 1, b^n - 1)$ , where  $a$  and  $b$  are fixed integers and  $n$  varies over the positive integers. In contrast to the elementary statement of their result, the proof required deep results from Diophantine approximation. I will discuss a higher-dimensional generalization of their result and some recent work in related directions.*