SCHEDULE OF TALKS

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

Wednesday, August 21

9:00 - 9:30: Registration

9:30 - 10:20: Lior Bary-Soroker: Irreducibility of random polynomials

Consider a random polynomial f with independent plus minus 1 coefficients. A folklore conjecture says that f is irreducible with probability $1 - o(1)$ as the degree goes to infinity. While this conjecture is still open, there was a lot of recent progress in recent years. The talk aims to survey the recent results, and if time permits to discuss variants coming from random matrix theory and from graph theory.

10:30 - 11:00: Coffee Break

11:00 - 11:50: Adrian Diaconu:

Moments of quadratic L-functions over function fields

In 2001, Conrey, Farmer, Keating, Rubinstein, and Snaith developed a *"recipe"* utilizing heuristic arguments to predict the asymptotics of moments of various families of L-functions. This heuristic was later extended by Andrade and Keating to include moments and ratios of the family of L-functions associated to hyperelliptic curves of genus g over a fixed finite field.

In joint work with Bergstrm, Petersen, and Westerland, we related the moment conjecture of Andrade and Keating to the problem of understanding the homology of the braid group with symplectic coefficients. We computed the stable homology groups of the braid groups with these coefficients, together with their structure as Galois representations, and showed that the answer matches the number-theoretic predictions. Our results, combined with a recent homological stability theorem of Miller, Patzt, Petersen, and Randal-Williams, imply the conjectured asymptotics for all moments in the function field case, for all large enough odd prime powers q.

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5:00 - 5:50: Alexander Dunn:

Quartic Gauss sums over primes and metaplectic theta functions

We improve 1987 estimates of Patterson for sums of quartic Gauss sums over primes. Our Type-I and Type-II estimates feature new ideas, including use of the quadratic large sieve over the Gaussian quadratic field, and Suzuki's evaluation of the Fourier-Whittaker coefficients of quartic theta functions at squares. We also conjecture asymptotics for certain moments of quartic Gauss sums over primes. This is a joint work with C.David, A.Hamieh, and H.Lin.

6:00 - 6:50: Dubi Kelmer:

Values of generic inhomogeneous quadratic forms and the strong spectral gap

Following Margulis's proof of the Oppenheim conjecture we know that integer values of an irrational indefinite quadratic form, Q in $n \geq 3$ variables are dense. The same is true for an inhomogeneous form $Q_\alpha(v) = Q(v+\alpha)$ if either Q or α is irrational. In this talk I will describe effective results that hold for a fixed rational form Q and almost all α. This turns out to be related to interesting questions regarding the spectral gap of certain representations of the orthogonal group $\mathrm{SO}_Q(\mathbb{R})$ that I will also discuss. This is based on joint work with Anish Ghosh and Shucheng Yu.

Thursday, August 22

9:30 - 10:20: Levent Alpoge:

Conditional algorithmic Mordell

We all know there is a Turing machine T_{mwrank} with the following properties.
1. On input E/K an elliptic curve over a number field, if T_{mwrank} terminates, it outputs rank $E(K)$.
2. Assuming standard conjectures T_{mwrank} terminates on all inputs.

In fact T_{mwrank} terminates in reasonable time in practice and the conjecture involved is "only" the finiteness of a p-part of a Tate-Shafarevich group. It would be amusing to have the same situation for rational points on curves. This talk will focus on the following.

Theorem (A.-Brian Lawrence): *There is a Turing machine T_{Mordell} with the following properties.* **1.** *On input C/K a smooth projective hyperbolic curve over a number field, if T_{Mordell} terminates, it outputs $C(K)$.* **2.** *Assuming standard conjectures T_{Mordell} terminates on all inputs.*

As a comparison with T_{mwrank}, this algorithm is full of brute-force searching and so is fundamentally hopeless to run in practice. Also, the relevant conjectures are the Hodge, Tate, and Fontaine-Mazur conjectures, which I consider much more hopeless. If I have time I will mention how one can produce a totally unconditional statement for certain curves over an infinite family of number fields by using potential modularity theorems.

10:30 - 11:00: Coffee Break

11:00 - 11:50: Hector Pasten:

Can finitely many orbits explain a Zariski dense set of rational points?

I will present some recent joint work with J. Silverman that suggests that the answer to the question in the title is negative. More precisely, we expect the following: Given a smooth projective variety X over a number field k with a Zariski dense set of rational points and a self-morphism f, there is a finite extension L/k such that there is no finite union of orbits of f (staring at L-rational points) that covers all of $X(L)$. We are able to prove this conjecture in several cases, including when $\dim(X) = 2$. The conjecture naturally fits among a few other conjectural statements and I will explain the implications between them.

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5:00 - 5:50: David Urbanik:

G-functions and finiteness of Special Moduli

Given a family $f : X \to S$ of smooth projective algebraic varieties over a number field, one is interested in algebraic points $s \in S$ where the fibre X_s acquires extra structure. When such points are "atypical" — a notion from unlikely intersection theory — one expects they are only finite in number. We explain how studying G-functions arising from a degeneration of f can give results on such questions.

6:00 - 6:50: Ananth Shankar:

Integral models of Shimura varieties and special points mod p

I will discuss canonicity of integral models of Shimura varieties and various applications, including to special points mod p and p-adic hyperbolicity. This is joint work with Ben Bakker and Jacob Tsimerman.

Friday, August 23 (Morning)

9:30 - 10:20: Gal Binyamini: Effective o-minimality for number-theorists

In recent years o-minimality has been increasingly used to study transcendental objects that come up in algebraic/arithmetic geometry. Since algebraic problems have a natural notion of complexity (degree, height) it has been a lingering issue to determine whether the corresponding o-minimal theories can be "effectivized", replacing existential finiteness statements by explicit bounds depending on complexity. I will discuss a new o-minimal structure R_{LN} of "Log-Noetherian" functions and its extension $R_{\mathrm{LN,exp}}$ which admit this type of effectivization, and which seem to contain all the key examples used in applications. The construction of these new structures rests on a proof of Khovanskii's conjecture from the early eighties generalizing his theory of Pfaffian functions to general systems of nonlinear ODE's.

In the first part of the talk I'll explain the basics of $R_{\mathrm{LN,exp}}$ and how number-theorists can use it as a black-box to effectivize various statements. In the second part I'll explain why $R_{\mathrm{LN,exp}}$ is actually much closer to the algebro-geometric perspective than might seem from the black-box account of it.

10:30 - 11:00: Coffee Break

11:00 - 11:50: Peter Jossen:

Exponential periods, E-functions and Geometry (with J.Fresán)

Exponential periods are those complex numbers which appear in the period pairing of exponential motives over number fields. Typically, they can be expressed as definite integrals of algebraic differential forms, twisted by an exponential. To give only a few examples: Exponentials and logarithms of algebraic numbers, values of the Gamma function at rational arguments, or values of the Bessel functions at rational arguments are all exponential periods. While trying to understand the transcendence nature of exponential periods, we discovered that many of these numbers seem to be related to special values of so-called E-functions, a special type of formal power series introduced by Siegel in the 1930's. Now we have a rather precise understanding of why and how E-functions show up in this context.

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Friday, August 23 (Afternoon)

4:30 - 5:20: Lue Pan:

Completed cohomology of Hilbert modular varieties below middle degree

In an upcoming joint work with Kai-Wen Lan, we show that sufficiently regular infinitesimal characters can only show up in the middle degree of the (locally analytic) completed cohomology of a Shimura variety. The goal of this talk is to explain a much more refined result in the case of Hilbert modular varieties via study of various differential operators at the infinite level.

5:30 - 6:20: Salim Tayou:

Modularity of special cycles in orthogonal and unitary Shimura varieties

Since the work of Jacobi and Siegel, it is well known that Theta series of quadratic lattices produce modular forms. In a vast generalization, Kudla and Millson have proved that the generating series of special cycles in orthogonal and unitary Shimura varieties are modular forms. In this talk, I will explain an extension of these results to toroidal compactifications where we prove that when these cycles are corrected by certain boundary cycles, the resulting generating series is still a modular form in the case of divisors in orthogonal Shimura varieties and cycles of any codimension in unitary Shimura varieties.

The results of this talk are joint work with Philip Engel and Francois Greer, and joint work in progress with François Greer.

6:30 - 7:00: AWARDING OF THE DAVID GOSS PRIZE

Saturday, August 24

9:30 - 10:20: Chris Daw:

Large Galois orbits under multiplicative degeneration

The Pila-Zannier strategy is a powerful technique for proving results in unlikely intersections. In this talk, I will recall the Zilber-Pink conjecture for Shimura varieties and describe how Pila-Zannier works in this setting. I will highlight the most difficult outstanding obstacle to implementing the strategy the so-called Large Galois Orbits conjecture and I will explain recent progress towards this conjecture, building on the works of Andr and Bombieri. This is joint with Martin Orr (Manchester).

10:30 - 11:00: Coffee Break

11:00 - 11:50: Gabriel Dill: Likely intersections in algebraic tori

In the last quarter-century, intersections that are deemed to be "unlikely" for dimension reasons have been proved to deserve their name in various contexts, ranging from intersections with algebraic subgroups of algebraic tori to intersections with special subvarieties of moduli spaces of abelian varieties.

In my talk, I will report on joint work in progress with Francesco Gallinaro, where we show that, in an algebraic torus, also intersections with algebraic subgroups that are deemed to be "likely" for dimension reasons deserve their name in the sense that they are almost never empty as soon as we assume a mild technical condition, satisfied for example by all algebraic curves which are not contained in a coset of a subtorus. This is also related to Zilber's Exponential-Algebraic Closedness Conjecture.

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5:00 - 5:50: Myrto Mavraki:

Bounded geometry for PCF-special subvarieties

A rational map is postcritically finite (PCF) if its critical orbits are finite. Postcritically finite maps play an important role in dynamics. It was suggested by Silverman that PCF points on the moduli space of degree d rational maps M_d play a role analogous to CM elliptic elliptic curves. Inspired in part by the Pink-Zilber conjectures in unlikely intersections, Baker and DeMarco formulated a conjecture aiming to describe the subvarieties of M_d that contain a Zariski dense set of PCF ("special") points. Their conjecture, now known as dynamical Andr–Oort (or DAO) was recently resolved in the case of curves by Ji–Xie, but remains open in higher dimensions. In this talk we will describe recent work with DeMarco and Ye, providing uniform bounds on the configurations of PCF points in families of subvarieties in M_d. We also provide a gap principle in the spirit of Dimitrov–Gao–Habegger's, Khne's, and Gao–Ge–Khne's work on the uniform Mordell–Lang conjecture.

6:00 - 6:50: Junyi Xie: Geometric Bombieri–Lang Conjecture

The geometric Bombieri–Lang conjecture is an analogue of the Bombieri-Lang conjecture over function fields. With Yuan, we find a mechanism to realize Vojta's dictionary in a reasonably concrete way and proved the geometric Bombieri–Lang conjecture for varieties having a finite map to an abelian variety under mild conditions.

Sunday, August 25

9:00 - 9:50: Julian Demeio:

The Grunwald Problem for solvable groups

Let K be a number field. The Grunwald problem for a finite group (scheme) G/K asks what is the closure of the image of $H^1(K,G) \to \prod_{v\in M_K} H^1(K_v,G)$. For a general G, there is a BrauerManin obstruction (BMO) to the problem, and this is conjectured to be the only one. In 2017, Harpaz and Wittenberg introduced a technique that managed to give a positive answer (BMO is the only one) for supersolvable groups. I present a positive answer for all solvable groups, obtained by combining the approach of Harpaz and Wittenberg with a new fibration theorem over quasi-trivial tori. This new theorem fundamentally relies on a general combinatorial principle first noted by Alexander Smith in the context of Class and Selmer Groups.

Partial results were also obtained independently by Harpaz and Wittenberg.

10:00 - 10:50: Giada Grossi:

Kolyvagin systems and Selmer group bounds

Since their origins in the works of Thaine and Kolyvagin, Euler systems have been used to produce bounds on certain Selmer groups (e.g. class groups of totally real fields, Tate-Shafarevic groups of rational elliptic curves,). In this talk, I will explain how improving such bounds for twists of the Galois representation studied, combined with some known results in the Iwasawa theory of elliptic curves, leads to the proof of Kolyvagins conjecture on the non-vanishing of the Heegner point Kolyvagin system (as well as the analogous results for Katos Euler system).

11:00 - 11:30: Coffee Break

11:30 - 12:20: Eric Urban:

On Euler systems for ordinary Siegel modular forms

I will describe works in progress that provide the construction of p-adic Iwasawa-Euler systems for ordinary Siegel modular forms attached to their odd orthogonal Galois representations, and the corresponding p-adic L-function via an explicit reciprocity law. The method is via a construction and study of Klingen-Eisenstein congruences of all weight and level that uses crucially the p-adic Langlands correspondance for $\mathrm{GL}_2(\mathbb{Q}_p)$.