Book of abstracts[1]

Automorphic Forms in Budapest 2022
Erdős Center of the Alfréd Rényi Institute of Mathematics

2022 September 5-9

[1]based on the overleaf template of LianTze Lim

Contents

Links to timetables

Schedule of the whole conference, including invited lectures
Schedule of contributed talks

Invited lectures

Automorphic density theorems

Sept 5
9.00–10.00
Main Lecture Hall

Blomer, Valentin

University of Bonn

The motivating example is very basic: given a matrix in $\mathrm{SL}_n(\mathbb{Z}/q\mathbb{Z})$, how large, measured in terms of some fixed matrix norm, is its smallest preimage in $\mathrm{SL}_n(\mathbb{Z})$? This seemingly simple arithmetic question – which is reminiscent of finding the smallest prime in an arithmetic progression – is surprisingly difficult to answer. I will explain how it can be translated into the world of automorphic forms and depends ultimately on the density of exceptional eigenvalues, i.e. a quantitative analysis of the possible failure of the Ramanujan conjecture. Such bounds are called density theorems, and I will explain how to use to the Kuznetsov formula on $\mathrm{GL}(n)$ to obtain density theorems in various situations. (This is partly joint work with E. Assing.)

Modular completions

Sept 5
14.00–15.00
Main Lecture Hall

Bringmann, Kathrin

University of Cologne

In my talk I discuss various ways to turn not quite modular objects into ones that are modular.

Sept 9
11.30–12.30
Main Lecture Hall

The mixing conjecture of Michel–Venkatesh

Brumley, Farrell
Université Sorbonne Paris Nord

Let G be the unit group of a quaternion algebra over a number field. The Linnik problems, solved in many cases by Duke over thirty years ago, are concerned with the equidistribution of periodic torus orbits of large discriminant on certain homogeneous spaces associated with G. Concrete examples over $\mathbb{Q}$ include the uniform distribution of integer points on the sphere and CM points on the modular surface. The full resolution of the Linnik problems was achieved by Michel and Venkatesh, and marked a fruitful period of exchange between ergodic theory and automorphic forms. In the 2006 Proceedings of the ICM, Michel and Venkatesh proposed a finer way to measure the complexity of these periodic torus orbits. The "mixing conjecture", as it is now known, is a sort of quadratic refinement of the Linnik problems and can itself be formulated as an equidistribution statement on the product $G \times G$. After discussing the progression of these ideas, I will sketch a proof of the mixing conjecture, conditional on the generalized Riemann hypothesis, using techniques in analytic number theory and automorphic periods. This is joint work with Valentin Blomer and Ilya Khayutin.

Sept 9
14.00–15.00
Main Lecture Hall

An update on the GL(3) Kuznetsov formulas and GL(n) Bessel functions

Buttcane, Jack
University of Maine

The Kuznetsov formula (aka relative trace formula) for a reductive group relates a sum over Fourier coefficients of automorphic forms to sums of certain types of exponential sums, called Kloosterman sums, by equating the spectral and Bruhat expansions of a Poincaré series over a discrete subgroup. On GL(3), this involves three types of automorphic forms – spherical, non-spherical principal series and generalized principal series as well as two new exponential sums (over the classical Kloosterman sums) – the so-called "long-element" (or "big cell") Kloosterman sums and (essentially) the hyper-Kloosterman sums. I will discuss the spectral Kuznetsov formulas for studying Fourier coefficients of automorphic forms and the arithmetic (aka "reverse") Kuznetsov formulas which allows us to study smooth averages of these exponential sums. The new result here is a sort of Kuznetsov formula for the hyper-Kloosterman sums. In the general case on GL(n), we still want more information about the (conjectural) kernel functions occurring in the Kuznetsov formulas. I will discuss what is known about these functions and give some new results in the particular case of GL(4).

On the p-adic etale cohomology of coverings of Drinfeld upper half-plane

Sept 6
10.00–11.00
Main Lecture Hall

Colmez, Pierre
CNRS, Jussieu

We will explain a factorization of the p-adic etale cohomology of coverings of Drinfeld upper half-plane. This factorization involves the p-adic local Langlands correspondence and bears some resemblance to Emerton's factorization of the completed cohomology of the tower of modular curves, with Hecke algebras replaced by Kisin rings. This is joint work with Wiesława Nizioł and Gabriel Dospinescu.

Braids, scanning, and moments of L-functions

Sept 8
9.00–10.00
Main Lecture Hall

Diaconu, Adrian
University of Minnesota Twin Cities

In this talk, I will discuss recent results, in joint work with Bergström, Petersen, and Westerland, concerning the relationship between the conjectural asymptotic formula for moments of quadratic Dirichlet L-series in the function field setting, and the stable homology of braid groups with coefficients in symplectic representations.

Spectral reciprocity and applications

Sept 7
11.30–12.30
Main Lecture Hall

Humphries, Peter
University of Virginia

Spectral reciprocity is a phenomenon in which certain moments of L-functions are shown to be exactly equal to other moments of L-functions. A quintessential example is Motohashi's formula, which relates the fourth moment of the Riemann zeta function to the third moment of L-functions associated to GL(2) automorphic forms. I will discuss generalisations of Motohashi's formula, how to prove these formulae using tools from the theory of automorphic forms, and applications of these formulae to problems in analytic number theory, including the L^4-norm problem for automorphic forms.

Drinfeld's lemma and automorphic applications

Sept 6
9.00–10.00
Main Lecture Hall

Kedlaya, Kiran S
University of California San Diego

In his original proof of the Langlands correspondence for GL(2) over a function field, Drinfeld introduced a striking result on the fundamental groups of schemes in characteristic p. We survey a number of recent variations of Drinfeld's lemma relevant to other instances of the Langlands correspondence.

Sept 6
14.00–15.00
Main Lecture Hall

An extension of Venkatesh's converse theorem to the Selberg class

Lee, Min

University of Bristol

The converse theorem for automorphic forms has a long history beginning with the work of Hecke (1936) and a work of Weil (1967): relating the automorphy relations satisfied by classical modular forms to analytic properties of their L-functions and the L-functions twisted by Dirichlet characters. The classical converse theorems were reformulated and generalised in the setting of automorphic representations for GL(2) by Jacquet and Langlands (1970). Since then, the converse theorem has been a cornerstone of the theory of automorphic representations.

Venkatesh (2002), in his thesis, gave new proof of the classical converse theorem for modular forms of level 1 in the context of Langlands' "Beyond Endoscopy". In this talk, we extend Venkatesh's proof of the converse theorem to forms of arbitrary levels and characters with the gamma factors of the Selberg class type. This is joint work with Andrew R. Booker and Michael Farmer.

Sept 7
9.00–10.00
Main Lecture Hall

Quantum ergodicity in the level aspect

Matz, Jasmin

Einstein Institute

For a closed Riemannian manifold M with an orthonormal basis B of Laplace eigenfunctions in $L^2(M)$ a classical result of Shnirelman and others proves that if the geodesic flow on the cotangent bundle of M is ergodic, then M is quantum ergodic. This in particular means that on average the measures $|f|^2dx$ on M converges towards the Riemannian measure dx on M as f runs over elements in B with growing Laplace eigenvalue. Following ideas of Abert, Bergeron, Le Masson, and Sahlsten, we look at a related situation: Instead of taking a fixed manifold and high energy eigenfunctions, we take a sequence of Benjamini-Schramm convergent compact Riemannian manifolds M_j together with Laplace eigenfunctions with eigenvalues varying in short intervals. In my talk I want to discuss joint work with F. Brumley in which we study this situation in higher rank for sequences of compact quotients of $\mathrm{SL}(n, \mathbb{R})/\mathrm{SO}(n)$.

Beyond the spherical sup-norm problem

Sept 8
14.00–15.00
Main Lecture Hall

Milićević, Djordje

Bryn Mawr College

The sup-norm problem on arithmetic Riemannian manifolds is among the central problems in the analytic theory of automorphic forms. It asks about the sup-norm of L^2-normalized eigenforms (thus, joint eigenfunctions of invariant differential operators and Hecke operators), most classically in terms of their Laplace eigenvalues (as in the QUE problem for high-energy eigenstates), but also in terms of the volume of the manifold and other parameters. Motivation and approaches to the sup-norm problem straddle harmonic analysis, number theory, and quantum mechanics.

In this talk, I will describe recent results, joint with Blomer, Harcos, and Maga, which for the first time solve the sup-norm problem for non-spherical Maaß forms of an increasing *dimension* of the associated K-type, on an arithmetic quotient of $G = \mathrm{SL}(2, \mathbb{C})$, with $K = \mathrm{SU}(2)$. We combine representation theory, spectral analysis, and diophantine arguments, developing new Paley–Wiener theory for G and sharp estimates on spherical trace functions of arbitrary K-type on the way to a novel counting problem of Hecke correspondences close to various special submanifolds of G.

Bounds for standard L-functions

Sept 9
9.00–10.00
Main Lecture Hall

Nelson, Paul

ETH Zürich

We consider the standard L-function attached to a cuspidal automorphic representation of a general linear group. We present a proof of a subconvex bound in the t-aspect. More generally, we address the spectral aspect in the case of uniform parameter growth.

These results are the subject of third paper linked below, building on the first two.

https://arxiv.org/abs/1805.07750
https://arxiv.org/abs/2012.02187
https://arxiv.org/abs/2109.15230

Sept 8
10.00–11.00
Main Lecture Hall

Weyl group Multiple Dirichlet Series

Paşol, Vicenţiu
Institute of Mathematics "Simion Stoilow" of the Romanian Academy

We present several results exhibiting properties of Weyl group Multiple Dirichlet Series for finite and affine (simply laced) Coxeter groups. In particular, for low rank affine Coxeter groups, we show the existence of an extra functional equation which allows us to explicitly perform the computation of the residues of the WMDS. In turn, this provides enough information to write the exact relation (in the case of affine D_4) between the WMDS and the MDS axiomatically defined together with A. Diaconu. This is based on joint work with Adrian Diaconu, Bogdan Ion and Alexandru Popa.

Sept 5
10.00–11.00
Main Lecture Hall

Weyl subconvexity, generalized PGL_2 Kuznetsov formulas, and optimal large sieves

Petrow, Ian
University College London

We give a generalized Kuznetsov formula arising from the relative trace formula perspective, and discuss applications to spectral large sieve inequalities and subconvexity. This is work in progress with M. P. Young and Y. Hu.

Sept 8
11.30–12.30
Main Lecture Hall

The trace formula for Hecke operators on congruence subgroups

Popa, Alex
Institute of Mathematics "Simion Stoilow" of the Romanian Academy

I will present a new proof of the trace formula for Hecke operators on modular forms for congruence subgroups. As a sample application, we compute the limit of the trace of a fixed Hecke operator as the level of the subgroup goes to infinity. The proof is based on joint work with Don Zagier for the modular group, but rather than using the space of period polynomials, the proof computes an Euler–Poincaré type trace of Hecke operators on the cohomology of the congruence subgroup.

Sept 5
15.30–16.30
Main Lecture Hall

Automorphic forms and quantum unique ergodicity

Raulf, Nicole
University of Lille

In this talk I will discuss various results related to quantum unique ergodicity and its refinements with a focus on dimensions 2 and 3. This is joint work with D. Chatzakos, R. Frot and Y. Petridis, M. Risager.

Quantum Unique Ergodicity for Saito–Kurokawa lifts

Sept 6
15.30–16.30
Main Lecture Hall

Saha, Abhishek
Queen Mary University of London

We investigate the analogue of the Quantum Unique Ergodicity (QUE) conjecture in the weight aspect for Siegel cusp forms of degree 2 and full level. Assuming the Generalized Riemann Hypothesis (GRH) we establish QUE for Saito–Kurokawa lifts as the weight tends to infinity. This is joint work with Jesse Jaasaari and Steve Lester.

Around the classicality of p-adic automorphic forms

Sept 6
11.30–12.30
Main Lecture Hall

Schraen, Benjamin
Université Paris-Sud

I will discuss some results concerning the question whether a given overconvergent p-adic automorphic eigenform is classical or not. I'll give an example where, even if its system of eigenvalues is classical, the automorphic form itself is non classical. This negative result is linked to the geometry of the eigenvariety and has also consequences on the conjectural p-adic Langlands correspondence for GL_3.

Fourth moments of automorphic forms

Sept 7
10.00–11.00
Main Lecture Hall

Steiner, Raphael
ETH Zürich

It is a classical problem in harmonic analysis to bound L^p-norms of eigenfunctions of the Laplacian on (compact) Riemannian manifolds in terms of the eigenvalue. A sharp general result in that direction was given by Hörmander and Sogge. However, in an arithmetic setting, one ought to do better. Indeed, it is a classical result of Iwaniec and Sarnak that exactly that is true for Hecke-Maass forms on arithmetic hyperbolic surfaces. They achieved their result by considering an amplified second moment of Hecke eigenforms. Their technique has since been adapted to numerous other settings. In my talk, I shall explain how to use Shimizu's theta function to express a fourth moment of Hecke eigenforms in geometric terms suitable for further analysis. In joint work with Ilya Khayutin and Paul D. Nelson, we give sharp bounds for said fourth moments in the weight and square-free level aspect. As a consequence, we improve upon the best known bounds for the sup-norm in these aspects. In particular, we prove a stronger than Weyl-type subconvexity result.

Sept 5
11.30–12.30
Main Lecture Hall

Periodic torus orbits and Artin L-functions

Thorner, Jesse
University of Illinois Urbana Champaign

Let p be a fixed prime, let $\mathcal{F}_p$ be the set of all pairwise-nonisomorphic number fields F with $[F : \mathbb{Q}] = p$, and let $\mathcal{F}_p(Q) = \{F \in \mathcal{F}_p \colon D_F \leq Q\}$, where D_F is the absolute discriminant of F. Let $\zeta_F(s)$ be the Dedekind zeta function of $F \in \mathcal{F}_p$. When $p = 2$ or 3, work of Duke and Einsiedler–Lindenstrauss–Michel–Venkatesh shows that the periodic torus orbits attached to the ideal classes of all totally real $F \in \mathcal{F}_p$ equidistribute on $\mathrm{PGL}_p(\mathbb{Z})\backslash\mathrm{PGL}_p(\mathbb{R})$ with respect to Haar measure. I will discuss work showing that for any fixed $p \geq 5$, the above result holds with "all totally real $F \in \mathcal{F}_p$" replaced by "almost all totally real $F \in \mathcal{F}_p$". This is a consequence of proving, for all $\epsilon > 0$, that for all except $O_\epsilon(Q^\epsilon)$ of the $F \in \mathcal{F}_p(Q)$, the ratio $\zeta_F(s)/\zeta(s)$ is holomorphic and nonvanishing in the region

$$\mathrm{Re}(s) \geq 1 - \frac{\epsilon}{20(p!)^2}, \qquad |\mathrm{Im}(s)| \leq D_F.$$

(Joint work with Robert Lemke Oliver and Asif Zaman.)

Sept 9
10.00–11.00
Main Lecture Hall

Large sieve inequalities for families of automorphic forms

Young, Matthew
Texas A&M University

The large sieve inequalities are powerful and flexible tools for understanding families of automorphic forms or their L-functions. There is an unexpectedly rich variety of behaviors that can occur for different families, and there is not even a recipe for conjecturing the true size of the large sieve bound. This will be illustrated by some examples. I will also focus on the recent proof of a sharp large sieve inequality for families of Eisenstein series with trivial central character on GL_2 with varying level. This can alternatively be seen as a large sieve inequality for rational numbers.

Contributed talks

Hyperbolic angles from Heegner points

Sept 7
15.50–16.10
Kutyás Room

Cherubini, Giacomo
Charles University, Prague

We prove equidistribution of hyperbolic angles attached to lattice points on circles in the hyperbolic plane centred at Heegner points of class number one. This is joint work with A. Fazzari.

The Kuznetsov formula for GSp(4)

Sept 7
14.20–14.40
Tondo Room

Comtat, Félicien
Queen Mary University of London

In this talk, I will present my work on the Kuznetsov formula for GSp(4). The latter relates Whittaker coefficients of Maass forms on GSp(4) for a certain congruence subgroup to sums of generalised Kloosterman sums. In the first part of the talk, I will give an overview of how the Kuznetsov formula for GSp(4) can be proved by integrating a pre-trace formula against a character of the unipotent subgroup. I will then present an application to equidistribution of Satake parameters of GSp(4) Maass forms with respect to the Sato-Tate measure as the level tends to infinity, providing some evidence towards the Generalised Ramanujan Conjecture in this setting.

Dissipation of correlations of holomorphic cusp forms

Sept 7
15.30–15.50
Tondo Room

Constantinescu, Petru
École Polytechnique Fédérale de Lausanne

Mass equidistribution of eigenfunctions is a central topic in quantum chaos and number theory. In this talk we highlight a generalisation of the Quantum Unique Ergodicity for holomorphic cusp forms in the weight aspect. We show that correlations of masses coming from off-diagonal terms dissipate as the weight tends to infinity. This corresponds to classifying the possible quantum limits along any sequence of Hecke eigenforms of increasing weight.

Sept 7
14.40–15.00
Kutyás Room

Fourier coefficients of Hilbert modular forms at cusps

Davis, Tim

Queen Mary University of London

In this talk we give an answer to the following question: given a Hilbert newform and a matrix in the Hilbert modular group what is the explicit number field which contains all the Fourier coefficients of the Hilbert newform at that cusp? This generalises a result by Brunault and Neururer who answered this question in the setting of classical newforms. We will give an overview of the method used to prove our result which differs from the method of Brunault and Neuruer and relies on the properties of local Whittaker newforms.

Sept 7
14.40–15.00
Tondo Room

The second term of Siegel–Eisenstein series

Hasegawa, Yasuko

The Jikei University School of Medicine

We will establish a Kronecker type of limit formula for the Siegel–Eisenstein series of degree 2. This formula gives the constant term in the Laurent expansion of the Eisenstein series at $s = 3$ which includes a function similar to the Dedekind's eta function appeared in classical Kronecker's limit formula. We will show that the function is harmonic on the Siegel upper half-space and satisfies a certain kind of automorphic property. It will be also mentioned that the relationship with the class number formula.

Sept 7
15.30–15.50
Main Lecture Hall

Growth of Eisenstein series and application

Jana, Subhajit

Queen Mary University of London

We will discuss recent works with Amitay Kamber on estimating the L^2-growth of the Eisenstein series on general reductive groups. As an application, we will discuss how such estimates help to improve the Diophantine exponent (defined by Ghosh–Gorodnik–Nevo) for $\mathrm{SL}(n)$.

Zeros of L-functions with additive twists

Sept 7
14.00–14.20
Main Lecture Hall

Kim, Doyon

In 1921, Hardy and Littlewood proved that the Riemann ζ-function has infinitely many zeros on the critical line by constructing a real-valued function $Z(t)$ on the real line that has the same modulus as $\zeta(1/2 + it)$ and showing that the function $Z(t)$ changes the sign infinitely many times.

In this talk, I will introduce a variant of Hardy–Littlewood method that uses automorphic distributions. The distributional variant avoids the use of exponential sums, and this makes the method particularly effective in taking care of complications due to half-integral weights or additive twists. I will introduce the notion of automorphic distributions attached to holomorphic modular forms, and describe how they can be used to prove that there are infinitely many zeros of certain L-functions of the modular forms on the critical line.

Spectral aspect subconvex bounds for L-functions

Sept 7
15.50–16.10
Main Lecture Hall

Kumar, Sumit

In this short talk, we will discuss sub-convexity estimates for the central values of the Rankin–Selberg L-functions associated to a GL(3) form and a GL(2) form in the spectral aspect.

Dąbrowski–Reeder decomposition of Kloosterman sums

Sept 7
14.20–14.40
Main Lecture Hall

Man, Siu Hang

Kloosterman sums over reductive groups have important applications in automorphic forms, but are rather poorly understood. In this talk we will explore the decomposition of Kloosterman sums by Dąbrowski and Reeder. Through this decomposition we establish new, non-trivial bounds for GL(n) Kloosterman sums. As an application we establish a density result beyond Sarnak's density conjecture for the principal congruence subgroup of prime level for GL(n). This is joint work with Valentin Blomer.

Duke's theorem for closed geodesics in homology

Sept 7
14.00–14.20
Kutyás Room

Nordentoft, Asbjorn
Paris 13

A celebrated result of Duke states that the closed geodesics on the modular curve equidistribute as the associated discriminant tends to infinity. We will explain an analogues result for the distribution of geodesics in the homology of modular curves. The result is a convergence of the classes of the closed geodesics to the Eisenstein element in homology.

Sept 7
14.00–14.20
Tondo Room

Rigorous computation of Maass cusp forms

Seymour-Howell, Andrei

A well known algorithm for computing the Laplace eigenvalues of Maass cusp forms is due to Hejhal from the 1990's, however this relies on a heuristic argument and thus does not certify the correctness of the values. In this talk I will describe a method to numerically compute and rigorously certify the Laplace eigenvalues of Maass cusp forms of squarefree level and trivial character. The main tool of this method is an explicit version of the Selberg trace formula that includes Hecke operators derived by Strömbergsson.

Sept 7
15.50–16.10
Tondo Room

Constant terms of Hilbert Eisenstein series and its arithmetic applications

Shih, Sheng-Chi
University of Vienna

In this talk, we will first discuss the construction of holomorphic Hilbert Eisenstein series in terms of auromorphic forms in order to compute their constant terms at varies cusps. We then report its applications to the recent works on the geometry of the Hilbert cuspidal eigenvariety at weight one Eisenstein intersection points (joint with Adel Betina and Mladen Dimitrov) and on the Iwasawa main conjecture for modular forms (joint with Jun Wang).

Sept 7
15.30–15.50
Kutyás Room

Equidistribution of exponential sums restricted to subgroups

Untrau, Théo
University of Bordeaux

Kloosterman sums are exponential sums which occur in the Fourier expansion of some specific automorphic forms called Poincaré series. Despite their elementary-looking definition, many questions about their absolute value and their asymptotic distribution required decades before being answered. For instance, the answer to the question of finding the optimal upper bound for their absolute value follows from the work of Weil on the Riemann hypothesis for curves defined over finite fields. The determination of the asymptotic distribution of the appropriately renormalized Kloosterman sums is due to Katz. In this talk, I will present a uniform distribution result for Kloosterman sums restricted to subgroups of fixed cardinality and explain how it extends to more general exponential sums.

A new error term bound for partition function

Sept 7
14.20–14.40
Kutyás Room

Wu, Han

We present an upper bound for the error term in the Hardy–Ramanujan–Rademacher formula for the partition function. The main input is a generalization of a bound of the cubic moment of quadratic twists of L-functions attached to Maass cusp forms due to Mathew Young. This is a joint work with Nick Andersen at BYU.

Integral non-vanishing criteria for Poincaré series

Sept 7
14.40–15.00
Main Lecture Hall

Zunar, Sonja
University of Zagreb

The question when a cusp form defined by a Poincaré series vanishes identically was recognized as interesting and complicated as early as 1882 by H. Poincaré. Most existing approaches to this problem are based on estimating Fourier coefficients of cusp forms in question. In this talk, we will discuss a different approach, which uses integral non-vanishing criteria developed from Muić's integral non-vanishing criterion for Poincaré series on unimodular locally compact groups.

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