

Abstracts: Groups, Property (T), and Expansion Conference

Lodha Mathematical Sciences Institute

Name: Anshul Advé

Title: A Converse Theorem for Hyperbolic Surface Spectra and the Conformal Bootstrap

Abstract: Given a compact hyperbolic surface of fixed topology, we consider its Laplace eigenvalues together with the structure constants for multiplication with respect to a suitable orthonormal basis of Laplace eigenforms. These numbers obey algebraic constraints analogous to the conformal bootstrap equations in physics. The main result of this talk is a converse theorem for these constraints: any collection of numbers satisfying the constraints must come from a hyperbolic surface. I will also briefly mention applications of these constraints to upper bounds for spectral gaps and subconvex bounds for L-functions. No knowledge of physics or L-functions will be assumed.

Name: Hyein Choi

Title: Quasi-isometric embeddings of Ramanujan complexes

Abstract: Euclidean buildings (a.k.a. affine buildings and Bruhat-Tits buildings) are considered as a p-adic analogue of symmetric spaces. We show that there is no quasi-isometric embedding between the symmetric space of $SL(n, \mathbb{R})$ and the Euclidean building of $SL(n, \mathbb{Q}_p)$. Generalizing this, we distinguish Ramanujan complexes constructed by Lubotzky-Samuels-Vishne as finite quotients of Euclidean buildings of $PGL(n, \mathbb{F}_p((y)))$ up to quasi-isometric embeddings. These complexes serve as high dimensional expanders with fruitful applications in mathematics and computer science.

Name: Chris Connell

Title: The Natural Flow: Recent Developments in Nonpositive Curvature

Abstract:

I will discuss recent developments in the theory and applications of the natural flow on nonpositively curved manifolds and locally symmetric spaces. After briefly recalling its construction from conformal densities at infinity, I will explain how its volume-contraction properties yield new geometric and topological consequences. These include linear isoperimetric inequalities, lower bounds for higher Cheeger constants, and a resolution of the Dey–Kapovich conjecture on compact complex subvarieties in complex hyperbolic manifolds.

I will then describe recent homological and cohomological dimension bounds, highlighting both the power of the flow and the subtleties introduced by topology at infinity. In higher rank, new estimates relating the flow to growth indicators yield homological dimension gaps proportional to the real rank under suitable hypotheses, with stronger bounds for subgroups with regular limit cones, including Borel–Anosov subgroups. The unifying theme is how these developments turn asymptotic growth data into constraints on the geometry and topology of infinite-volume manifolds. This is joint work with D. B. McReynolds and Shi Wang.

Name: Shubhabrata Das

Title: Amenable actions for groups with weak hyperbolicity properties

Abstract: Amenability of a group action is a dynamical generalisation of amenability for groups, with many interesting applications. Many (non-amenable) groups, like the Gromov hyperbolic groups, relatively hyperbolic groups, mapping class groups of surfaces, and the group of outer automorphisms of a free group admit amenable actions. In this talk we will define amenable action of a group and outline two constructions of amenable actions for (i) acylindrically hyperbolic groups and (ii) hierarchically hyperbolic groups, which generalise the above classes of groups. This is based on a joint work with Partha Sarathi Ghosh.

Name: Damien Gaboriau

Title: On the Measure Equivalence classification of the Baumslag-Solitar groups $BS(p, q)$, of the automorphism group of their associated trees, and of lcsc treeable groups.

Abstract: More than 25 years ago, the classification of the Baumslag-Solitar groups up to quasi-isometry was achieved. Since then, the question as to their measure equivalence (ME) in the sense of Gromov has remained a tantalizingly open problem.

We solve this problem by showing that all the $BS(p, q)$ for $p > q > 1$ are ME to each other.

In order to do this we are led to a detour through the ME theory of non-unimodular groups and actions which preserve only the class of the measure (type III).

We reduce the problem to the ME classification of automorphisms of tree, which boils down to a result in the theory of measured graphs in this framework.

This is all joint work with A. Poulin, A. Tserunyan, R. Tucker-Drob and K. Wrobel, and this is 100% AI-free.

Name: Ilya Gekhtman

Title: Almost stationary measures and growth of injectivity radius.

Abstract: We introduce and systematically study the concept of almost stationary measures for group actions, ie those perturbed only a small amount under convolution with a random walk.

We prove a Nevo-Zimmer type classification of almost stationary actions of higher rank simple Lie groups, showing that such an action (in a sense I will make precise during the talk) is either “almost invariant” (and hence “close to a lattice”) or “close to a projective factor.”

We use this classification to obtain a number of geometric results, in particular giving a quantitative lower bound for growth of injectivity radius in infinite volume higher rank locally symmetric spaces.

This is joint work with Simon Machado, Omri Solan, and Yuval Yifrach.

Name: Michael Glasner

Title: Character Rigidity and the Stuck-Zimmer Conjecture for Nonuniform Lattices

Abstract: The theory of characters of infinite groups, is a generalization of the representation theory of finite groups. More explicitly, a character of a group is an extremal conjugation invariant positive definite function. A group is said to be character rigid if every character of the group is either supported on the center or comes from a

finite dimensional representation. Connes conjectured that any irreducible lattice in a higher rank semisimple Lie group is character rigid. Surprisingly, this conjecture generalizes the celebrated Margulis normal subgroup theorem and the Stuck-Zimmer conjecture on IRS rigidity. I will discuss a recent joint work with Alon Dogon, Yuval Gorfine, Liam Hanany, and Arie Levit showing that any nonuniform higher rank lattice is character rigid, proving the Stuck-Zimmer conjecture for such lattices.

Name: Christian Gorski

Title: Weak mixing and the semigroup of self-couplings

Abstract: I will speak a bit about the algebra of the semigroup of self-couplings of a probability measure, and argue that this is a potentially useful lens through which to view probability-measure-preserving (semi)group actions. As an illustration of the perspective, I will give a cute (I believe new) characterization of weak mixing of an amenable group action, which makes the following classic dichotomy from ergodic theory very simple to prove: an action either mixes along no subsequence, or it mixes along a sequence of full density. If time allows I will indicate how one can also use this perspective to give an alternative construction of the Kronecker factor of a non-weakly mixing system.

Name: Alessandra Iozzi

Title: The real spectrum compactification of character varieties

Abstract: We describe properties of a compactification of general character varieties with good topological properties and give various interpretations of its ideal points. This is a joint work with Marc Burger, Anne Parreau and Maria Beatrice Pozzetti.

Name: Annette Karrer

Title: Morse boundaries of right-angled Coxeter groups and beyond

Abstract: Every finitely generated group G has an associated topological space, called the Morse boundary, which captures the hyperbolic-like behavior of G at infinity. The Morse boundary was introduced by Cordes and Charney–Sultan.

For certain affine-free Coxeter groups, the Morse boundary detects certain hierarchies in the underlying group, which we call Morse hierarchies. In this talk, we will study these hierarchies and use them to obtain a combinatorial characterization of the stabilizers of connected components of the Morse boundary, focusing on the case of right-angled Coxeter groups. This is joint work in progress with Matthew Cordes and Kim Ruane.

Name: Monika Kudłinska

Title: L_2 -subgroup rigidity and Thurston norms

Abstract: The twisted L_2 -Betti numbers of a group measure the L_2 -homology of kernels of maps to $\mathbb{Z}$. We prove that the twisted L_2 -Betti numbers induce seminorms on the first cohomology of any L_2 -acyclic group which satisfies the Atiyah conjecture. In the case that G is free-by-cyclic, we show that the degree-one twisted L_2 -Betti numbers detect the minimal Euler characteristic of dual splittings over finitely presented subgroups, in close analogy with the Thurston norm for 3-manifolds. The key new technical result is L_2 -subgroup rigidity for virtually free-by-cyclic groups. This is based on joint work with Andrei Jaikin-Zapirain and Pablo Sanchez-Peralta.

Name: Luzie Kupffer

Title: Bi-infinite random walk paths and geodesic flow on hyperbolic groups

Abstract: It is well-established that Patterson-Sullivan measures on the boundary of a hyperbolic space, along with the associated Bowen-Margulis-Sullivan measure, provide valuable insights into the action of a group of isometries on the space's boundary through analysis of the geodesic flow. Given that paths of a random walk on a hyperbolic group lie close to the group's quasi-geodesics, it is natural to ask whether similar behaviour can also be seen in the flow along bi-infinite random walk paths.

In this talk, I will show how studying bi-infinite random walks on a discrete hyperbolic group G leads to an analogue of the Patterson-Sullivan measure on $\partial^2 G$. This measure can be constructed in multiple measure-equivalent ways, each giving distinct perspectives on its intrinsic structure. Moreover, as in the classical case, the action of G on $\partial^2 G$ is ergodic with respect to this measure. Central to the construction of these measures is the almost sure convergence of the random walk to the boundary ∂G and the study of the distribution of the hitting points. This talk is based on joint work with Mahan Mj and Chiranjib Mukherjee.

Name: Waltraud Lederle

Title: Boomerang subgroups, Schreier graphs and avoiding invariant measures

Abstract: Boomerang subgroups, introduced in joint work with Yair Glasner, are subgroups (of a countable group) that are recurrent points in the Chabauty space for the action of each group element separately. The motivation behind has been that, given any invariant random subgroup (IRS), almost every subgroup is a boomerang; and consequently we like to think of them as “deterministic instances of IRSs”. In many lattices of high rank, this is accurate. This talk focuses on various aspects in which this is not true in the free group.

Based on joint works with Glasner and Hartnick, and Bontemps and Kalma.

Name: Arghya Mondal

Title: Modified GNS constructions and relative Property (T) for semidirect products

Abstract: The definition of Relative Property (T) for a pair (H, N) involves information about unitary representations of H . But if H is of the form $N \rtimes G$ and N is abelian, then it can be characterized in terms of representations of N and the G action on it, due to work of Ioana and Cornuier-Tessera. In this talk we will discuss how the abelian assumption on N can be removed following a work of Fima-Mukherjee-Patri in the context of compact quantum groups. The emphasis will be on a subproblem, which involves a modification of the GNS correspondence to allow for cyclic representations to be identified upto unitary equivalence without keeping track of a chosen cyclic vector. An interesting analogous question can be asked for affine isometric actions as well. This is based on an ongoing joint work with Partha Sarathi Ghosh and Dwaipayan Sharma.

Name: Amos Nevo

Title: Rough radial analysis on discrete geometric groups and the Hardy-Littlewood maximal operator.

Abstract: We consider the Hardy-Littlewood maximal operator associated with ball averages on discrete groups, with balls defined by invariant metrics associated with a variety of length functions. Under natural assumptions on the rough radial structure of the group under consideration, we establish a weak-type maximal inequality for the Hardy-Littlewood operator. These assumptions are related to the almost exact polynomial-exponential growth of balls, and the rough radial rapid decay property, or the coarse rough median property.

We give a variety of examples where the rough radial structure assumptions hold, including any lattice in a connected semisimple Lie group with finite center, with respect to the Riemannian distance on the symmetric space restricted to an orbit of the lattice. Other examples include right-angled Artin groups, Coxeter groups and braid groups, with a suitable choice of word metric.

For non-elementary word-hyperbolic groups we establish that the Hardy-Littlewood maximal operator with respect to balls defined by a word metric satisfies the weak-type (1,1)-maximal inequality, which is the optimal result.

Name: Antoine Poulin

Title: The cost of one-relator groups.

Abstract: In this talk, we will prove that the cost of one-relator groups is equal to their first ℓ_2 -Betti number +1. This includes many new examples of groups with cost > 1 that do not split as free products or amalgams. We will also discuss recent developments in the theory of cost. This is joint work with K. Wróbel.

Name: Riddhi Shah

Title: Twisted conjugacy classes in Lie groups.

Abstract: For a continuous automorphism ϕ of a connected Lie group G , we discuss the ϕ -twisted conjugacy classes $[x]_\phi = \{gx\phi(g^{-1}) | g \in G\}$, $x \in G$. While it is shown that the number of conjugacy classes in G is infinite, it is not the case for ϕ -twisted conjugacy classes for a general ϕ . We find conditions under which they are finite / infinite. The proofs use the structure of G and its automorphism group, properties of Cartan subgroups in G and a result by Borel and Mostow. This talk is based on (published and ongoing) joint works with Ravi Prakash; see Transformation Groups (2026) <https://doi.org/10.1007/s00031-026-09967-x>

Name: Miri Son

Title: Classification $SL(n, \mathbb{R})$ -actions on manifolds and Smooth Local Linearization

Abstract: Fisher and Melnick classified smooth and real-analytic actions of $SL(n, \mathbb{R})$ on closed n -dimensional manifolds for $n \geq 3$. In this talk, we generalize their work by classifying smooth and real-analytic $SL(n, \mathbb{R})$ -actions on closed m -dimensional manifolds for $3 \leq n \leq m \leq 2n-3$. This problem is motivated by the Zimmer program, since any action of a Lie group restricts to an action of its lattices.

A key ingredient in the classification is the local linearization of actions near fixed points. For the real-analytic actions, such linearization for semi simple Lie group actions was proved by Kushnirenko and independently, by Guillemin-Sternberg. For the smooth actions, smooth linearization depends on the derivative representation. We discuss the smooth case for $SL(n, \mathbb{R})$ -actions, which is joint work in progress with Insung Park.

Name: Ralph Spatzier

Title: On Hyperbolic Dynamics and the Zimmer Program

Abstract: The Zimmer Program hopes to classify actions of higher rank semisimple Lie groups and their lattices on compact manifolds. It has made huge strides in recent years, starting with the (partial) resolution of Zimmer's conjecture concerning the existence of actions in (relatively) low dimension.

At the opposite end, and especially for arbitrary manifolds of possibly high dimension, stand actions with complicated dynamics, in particular with elements that act uniformly or partially hyperbolically. In joint work with Damjanovic, Vinhage and Xu, we recently classified such actions up smooth conjugacy to an “algebraic” action. I will describe the results and some elements of the proofs.