Abstracts: Introductory School

Lodha Mathematical Sciences Institute

August 10 – 21, 2026 | Shared with the Analytic Group Theory programme

A two-week introductory school, structured across two weeks. Week 1 runs in the style of an Arbeitsgemeinschaft, with participants working in smaller groups on introductory material and presenting to each other; Week 2 consists of mini-courses on more advanced aspects of the introductory topics. The school is accessible to graduate students and postdocs, and open to participants of both programmes.

Abstracts & Course Outlines

Minicourse 1: Invariant and stationary random subgroups of hyperbolic groups and their applications to subgroup growth

Speaker: Ilya Gekhtman

Dates: August 11, 12, 13, 2026, 2:00 – 3:00 p.m.

Abstract:

Invariant random subgroups are conjugation invariant measures on the space of subgroups of a given group G. Their study provides a fertile playground for the interaction of algebra, geometry, probability and ergodic theory. On one hand, they arise as point stabilizers for probability measure preserving actions. On the other hand, they provide a vast generalization of both normal subgroups of countable groups and lattices in Lie groups. They (and their relatives, the so-called stationary random subgroups) have applications ranging from proving Margulis's celebrated normal subgroup theorem (which asserts that any normal subgroup of a lattice in a higher rank simple Lie group is finite index) to compactifying the moduli space of Riemann surfaces, to studying the injectivity radius of hyperbolic manifolds. This talk will give an overview of invariant and stationary random subgroups and their applications, with special attention to invariant random subgroups of semisimple Lie groups and of hyperbolic groups.

Course outline:

Lecture 1: Introduction to invariant random subgroups - definitions, examples, basic properties and applications.

Lecture 2: Random walks on groups and stationary random subgroups. Growth rates of invariant and stationary random subgroups of Lie groups and hyperbolic groups.

Lecture 3: Applications of stationary random subgroups to injectivity radius of hyperbolic manifolds and other locally symmetric spaces. Time permitting, a preview of a new theory of "almost stationary" measures, which has further applications.

Minicourse 2: An introduction to character varieties

Speaker: Ishan Banerjee

Dates: August 10, 12, 13, 2026 (10th: 2:00 – 3:00 p.m.; 12th: 11:00 a.m. – 12:00 p.m.; 13th: 3:30 – 4:30 p.m.)

Abstract:

A 3-part lecture series defining representation varieties and character varieties, and discussing some basic properties of them. If time permits, some features of the mapping class group action on these varieties may also be discussed.

Course outline:

Lecture 1: Defining representation varieties and computing the Zariski tangent spaces to representation varieties of surface groups. Discussion begins on the conjugation action on representation varieties and why the naive quotient may fail to be Hausdorff.

Lecture 2: Defining the GIT quotient of the representation variety, reviewing relevant algebraic geometry, and discussing what the points of the GIT quotient look like.

Lecture 3: Topic to be decided. A possible topic is the proof of Goldman and Xia that the mapping class group acts ergodically on SU(2) character varieties.

Minicourse 3: Discrete subgroups in higher rank and geometric structures

Speaker: Mitul Islam

Dates: August 10, 11, 13, 2026, 11:00 a.m. – 12:00 p.m.

Abstract:

This course covers discrete subgroups of higher rank Lie groups, beyond lattices, and the various kinds of geometric structures associated with them. Convex co-compact Kleinian groups are a classic family of such examples in the rank 1 Lie group SL(2,C), and have been extensively studied using hyperbolic geometry. In higher rank, their analogs are Anosov subgroups, and these are studied using geometric structures modelled on (partial) flag varieties. This mini-course will be an exposition on Anosov subgroups and these associated geometric structures, and will not assume much background beyond hyperbolic geometry.

Minicourse 4: A walk in Outer Space

Speaker: Radhika Gupta

Dates: August 17, 19, 2026, 11:00 a.m. – 12:00 p.m.; August 20, 2026, 2:00 – 3:00 p.m.

Abstract:

The study of automorphisms of free groups Out(Fn) is highly motivated by the study of mapping class groups. The goal of this mini-course is to introduce the analog of Teichmüller space for Out(Fn), called Outer space, define an analog of Thurston's Lipschitz metric on it, and understand a particular kind of geodesic called folding paths between two points in Outer space. Since points in Outer space correspond to free group actions on trees, the course will start with a brief introduction to Bass-Serre theory.

Minicourse 5: An introduction to geodesic currents

Speaker: Jing Tao

Dates: August 18, 21, 2026, 11:00 a.m. – 12:00 p.m.; August 20, 2026, 3:30 – 4:30 p.m.

Abstract:

Geodesic currents provide a common framework for curves, measured laminations, and hyperbolic metrics on a surface. Defined as invariant measures on the space of geodesics in the universal cover, they form a topological cone with a continuous intersection pairing extending geometric intersection number and, through Liouville currents, hyperbolic length. This mini-course will introduce the topology of current space, the density of weighted closed curves, the intersection form, and the embeddings of measured lamination space and Teichmüller space. Time permitting, applications to Thurston compactification, length-spectrum rigidity, and mapping class group dynamics will also be discussed.

Minicourse 6: Hyperbolic reflection groups: a trip to the zoo

Speaker: Sami Douba

Dates: August 19, 21, 2026, 2:00 – 3:00 p.m.; August 20, 2026, 11:00 a.m. – 12:00 p.m.

Abstract:

A hyperbolic reflection group is a discrete subgroup of the isometry group PO(V) of some real hyperbolic space generated by hyperplane reflections. While among the most classical examples of group-theoretically intricate discrete subgroups of Lie groups, due to the profound interplay between their algebraic, geometric, and combinatorial properties, they remain a rich source of low-dimensional discrete subgroups of PO(V), both of finite

and infinite covolume, and indeed a rich source of infinite-index subgroups of lattices themselves. This mini-course will be an attempt to illustrate these points, with an emphasis on examples and applications.

Minicourse 7: Measures and dynamics in higher rank

Speaker: Vicky Wen

Dates: August 17, 18, 2026, 2:00 – 3:00 p.m.; August 21, 2026, 3:30 – 4:30 p.m.

Abstract: When studying the dynamical properties of discrete subgroup Γ of Isom($\H^n$), Patterson-Sullivan (PS) measures are an important measure class that is Γ invariant and record how the group grows and concentrates on the boundary $\p_{\infty}\H^n$. Using this, one can explore the ergodic properties of the geodesic flow in the hyperbolic space and study the associated counting and equidistribution problems. It is then natural to ask, to what extent can the powerful tools in PS theory be extended to subgroups of higher rank Lie groups. In this mini course, I plan to devote the first lecture to introducing Sullivan's construction of such measures in the hyperbolic case and their basic properties. I will also explain how they are used to construct the Bowen-Margulis-Sullivan (BMS) measures on the unit tangent bundle and present some classic results about the dynamics of the geodesic flow.

In the following lectures, I will introduce some basic Lie theory about higher rank Lie groups and draw the connection to their rank one counterparts. From there, I will present the recent developments of PS theory for Anosov, relative Anosov, and transverse subgroups. Lastly, we will survey some related results, such as Hopf-Tsuji-Sullivan dichotomy of the appropriate flow in the higher rank setting, counting and equidistribution results, and a criterion for finite BMS measures in higher rank.