

Annual Talks 2025

February 03 – 04, 2025

Schedule and Abstracts of Talks

**School of Mathematics
Tata Institute of Fundamental Research**

Title of Talks

Mahan Mj

Commensurations

Balarka Sen

Positive scalar curvature metrics on circle bundles over 4-manifolds

Soumyadip Sahu

Derived Hecke action on the trivial cohomology of division algebra

Tanmay Deshpande

The geometric Whittaker model, central sheaves and vanishing sheaves

Ritankar Nath

On the K-Theory and Homology Theories of Quotient Deligne-Mumford stacks

Abstracts

Monday, 3 February 2025 (10:30-11:30)

Speaker : Mahan Mj
Title : Commensurations

A group G is said to commensurate a subgroup H if, for all $g \in G$, the intersection $H^g \cap H$ has finite index in both H and H^g , where H^g denotes the conjugate of H by g . The commensuration action of G on H can be analyzed dynamically. In this talk, we will explore a range of theorems and conjectures in this area, starting with the foundational work of Margulis and progressing to contemporary developments.

Monday, 3 February 2025 (11:45-12:15)

Speaker : Balarka Sen
Title : Positive scalar curvature metrics on circle bundles over 4-manifolds

In this talk, I will report on some findings pertaining to positive scalar curvature (psc) metrics on (trivial and non-trivial) circle bundles over 4-manifolds. The highlight of our work are the following results: (a) We give examples of enlargeable manifolds in all dimensions greater than 3, which admit (non-trivial) circle bundles with total space admitting psc metrics. This answers a question of M. Gromov. (b) For a simply connected closed 4-manifold M , we show $M \times S^1$ admits a psc metric if and only if M possesses a smooth structure admitting a psc metric. This addresses the “ S^1 -stability” conjecture of J. Rosenberg, in dimension 4. (c) Let M be a simply connected closed 4-manifold such that no smooth structure on M admits a psc metric. Then, if a Riemannian band $M \times [-1, 1]$ is uniformly psc, we show that the width of the band is bounded above by a dimensional constant. This addresses the “band-width inequality” conjecture of M. Gromov, in dimension 4.

The main techniques used are: symplectic geometry for (a), minimal surface methods and four dimensional surgery theory for (b), (c). While (b),(c) were known in dimensions 2,3,5,6 without altering the underlying smooth structure, that is false in dimension 4 due to obstructions from Seiberg-Witten theory. Thus, our results in this sense are optimal. We also discuss versions of (b) and (c) for non-simply connected 4-manifolds, which are part of on-going work. These results are joint works with Aditya Kumar (JHU).

Monday, 3 February 2025 (02:00-02:30)

Speaker : Anantadulal Paul
Title : TBA

Monday, 3 February 2025 (02:45-03:15)

Speaker : Rashmita Hore
Title : TBA

Monday, 3 February 2025 (03:30-04:30)

Speaker : Eknath Ghate
Title : TBA

Monday, 3 February 2025 (05:00-05:30)

Speaker : Soumyadip Sahu
Title : Derived Hecke action on the trivial cohomology of division algebra

This talk aims to describe a generalization of A. Venkatesh's structure theorem for the action of derived Hecke algebra on the Hecke trivial cohomology of division algebras over number fields. In particular, we show that the Hecke trivial cohomology of a division algebra is a free module for the action of the strict derived Hecke algebra. Moreover, the strict derived Hecke algebra possesses a rational form that preserves the canonical rational structure on the cohomology during the derived Hecke action. The main ingredients in our improvement are a careful study of the congruence classes in the torsion cohomology of the arithmetic manifold and my new result on the reduction map in the K-theory of the ring of integers in number fields.

Monday, 4 February 2025 (09:30-10:30)

Speaker : Tanmay Deshpande
Title : The geometric Whittaker model, central sheaves and vanishing sheaves

Let G be a reductive algebraic group over an algebraically closed field. In this talk I will introduce the bi-Whittaker equivariant Hecke category of G . This monoidal category is a geometric analogue of the endomorphism algebra of an induced representation from a non-degenerate multiplicative character of a maximal unipotent subgroup. A classical result of Gelfand-Graev states that such induced representations are multiplicity free and contain “most” of the irreducible representations of G .

I will discuss the equivalence of the above bi-Whittaker Hecke category to a certain category of central sheaves on the maximal torus as well as the relationship of these categories with a certain category of vanishing conjugation equivariant sheaves on G . I will relate these results to the above result of Gelfand-Graev and the theory of character sheaves on reductive groups. This is based on joint work with R. Bezrukavnikov.

Monday, 4 February 2025 (11:00-11:30)

Speaker : Ritankar Nath
Title : On the K-Theory and Homology Theories of Quotient Deligne-Mumford stacks

A fundamental problem in the algebraic K -theory of stacks (or of equivariant K theory) is to determine how far it is from the ordinary K theory of schemes or algebraic spaces, especially that of a smooth (or étale) cover of the underlying stack. The much celebrated Atiyah Segal Completion theorem deals with this problem and we have various versions of the theorem for different comparisons between the K theories. We will discuss one such version which compares the algebraic K -theory of a quotient Deligne-Mumford stack with the Čech hypercohomology of the K -theory spectra of its inertia stack. This version of the completion problem has occurred previously in the works of Edidin-Graham(2005) and Krishna-Sreedhar(2017). We will then extend this to the Hochschild homology and its cyclic counterparts, under suitable circumstances. This is based on a joint work with Amalendu Krishna.

Monday, 4 February 2025 (11:45-12:15)

Speaker : Amartya Muthal
Title : TBA

Monday, 4 February 2025(02:00-02:30)

Speaker : Viswanathan S
Title : TBA

Monday, 4 February 2025(02:45-03:45)

Speaker : Yaan Bugeaud
Title : TBA