IISC–IISER JOINT MATH SYMPOSIUM
17–18 SEPTEMBER 2021 (FRI–SAT)

List of speakers (and links to their talks)

The talks will be in the following broad areas:

- **A&NT** = *Algebra & Number Theory*
- **A&PDE** = *Analysis & PDE*
- **G&T** = *Geometry & Topology*
- **PT&DM** = *Probability Theory & Discrete Mathematics*

Here are the speakers clustered by 'broad area' – note that a speaker can feature under multiple headings. Each speaker's day-and-time is hyperlinked to their title and abstract.

To see all titles-and-abstracts say under 'G&T', simply ⟨ctrl-F⟩ in this file for the phrase 'G&T'.

Algebra & Number Theory

Shaunak V. Deo (IISc) – Fri, 09:40
Radhika Ganapathy (IISc) – Fri, 10:20
K. Hariram (IISc) – Sat, 11:45
Neha Malik (IISER) – Fri, 14:00
Sudipa Mondal (IISER) – Fri, 11:05
Basudev Pattanayak (IISER) – Fri, 11:45
Rakesh Pawar (IISER) – Sat, 14:40
Supriya Pisolkar (IISER) – Sat, 10:20
Neha Prabhu (IISER) – Sat, 11:05
Vivek Rai (IISER) – Fri, 12:25
Kaneenika Sinha (IISER) – Sat, 09:40
Steven Spallone (IISER) – Fri, 14:40
G.V.K. Teja (IISc) – Fri, 16:50
R. Venkatesh (IISc) – Fri, 16:10

Analysis & PDE

Aashirwad N. Ballal (IISc) – Sat, 11:05
Mousomi Bhakta (IISER) – Sat 17:00
Divyang Bhimani (IISER) – Fri 12:25
Diganta Borah (IISER) – Sat 12:25
Anisa Chorwadwala (IISER) – Sat, 14:00
Ved V. Datar (IISc) – Sat, 10:20
Pritam Ganguly (IISc) – Fri, 10:20
Purvi Gupta (IISc) – Fri, 09:00
Aakanksha Jain (IISc) – Fri, 09:40
Lakshmi Priya (IISc) – Fri, 11:45
Shubham Rastogi (IISc) – Fri, 11:05
Ramesh Sau (IISc) – Sat, 14:40
Abu Sufian (IISc) – Sat, 15:30

Geometry & Topology

Aashirwad N. Ballal (IISc) – Sat, 11:05
Diganta Borah (IISER) – Sat 12:25
Jyoti Dasgupta (IISER) – Sat, 15:30
Ved V. Datar (IISc) – Sat, 10:20
Purvi Gupta (IISc) – Fri, 09:00
Subhojoy Gupta (IISc) – Sat, 11:45
Tejas Kalelkar (IISER) – Sat, 09:00
Bivas Khan (IISER) – Sat, 16:10
Rakesh Pawar (IISER) – Sat, 14:40
Kartik Roy (IISER) – Sat, 14:00
Harish Seshadri (IISc) – Sat, 09:40
Steven Spallone (IISER) – Fri, 14:40

Probability Theory & Discrete Math

Arvind Ayyer (IISc) – Fri, 14:00
Biltu Dan (IISc) – Fri, 16:50
Anindya Goswami (IISER) – Sat, 16:10
Srikanth K. Iyer (IISc) – Fri, 15:30
Tejas Kalelkar (IISER) – Sat, 09:00
Soumen Maity (IISER) – Fri, 15:30
Moumanti Podder (IISER) – Fri, 14:40
Lakshmi Priya (IISc) – Fri, 11:45
Sanchayan Sen (IISc) – Fri, 16:10
Kaneenika Sinha (IISER) – Sat, 09:40
R. Venkatesh (IISc) – Fri, 16:10

Schedule of talks

All times below are in Indian Standard Time (IST) – this is GMT + 05:30.

(All talks are 30 minutes long, with 5 minutes for Q&A.)

September 17, Friday

Time	Session 1	Session 2
09:00	Purvi Gupta	⟵ *Chair: S. Thangavelu* (+ opening remarks)
Chair	*S. Thangavelu*	*Debargha Banerjee*
09:40	Aakanksha Jain	Shaunak V. Deo
10:20	Pritam Ganguly	Radhika Ganapathy
10:55	-*Chair: Tirthankar Bhattacharyya*-	—*Chair: Mahesh Kakde*—
11:05	Shubham Rastogi	Sudipa Mondal
11:45	Lakshmi Priya	Basudev Pattanayak
12:25	Divyang Bhimani	Vivek Rai
13:00	—*Lunch*—	—*Lunch*—
Chair	*Manjunath Krishnapur*	*Apoorva Khare*
14:00	Arvind Ayyer	Neha Malik
14:40	Moumanti Podder	Steven Spallone
15:15	—*Chair: Anup Biswas*—	—*Chair: Chandrasheel Bhagwat*—
15:30	Srikanth K. Iyer	Soumen Maity
16:10	Sanchayan Sen	R. Venkatesh
16:50	Biltu Dan	G.V.K. Teja

September 18, Saturday

Time	Session 1	Session 2
Chair	*Siddhartha Gadgil*	*Baskar Balasubramanyam*
09:00	Tejas Kalelkar	—*Break*—
09:40	Harish Seshadri	Kaneenika Sinha
10:20	Ved V. Datar	Supriya Pisolkar
10:55	—*Vamsi P. Pingali*—	—*Break*—
11:05	Aashirwad N. Ballal	Neha Prabhu
11:45	Subhojoy Gupta	K. Hariram
12:25	Diganta Borah	—*Break*—
13:00	—*Lunch*—	—*Lunch*—
Chair	*Amalendu Krishna*	*A. K. Nandakumaran*
14:00	Kartik Roy	Anisa Chorwadwala
14:40	Rakesh Pawar	Ramesh Sau
15:15	—*Chair: Mainak Poddar*—	—*Chair: Thirupati Gudi*—
15:30	Jyoti Dasgupta	Abu Sufian
16:10	Bivas Khan	Anindya Goswami
17:00	*Chair: M. Poddar* (+ closing remarks) ⟶	Mousomi Bhakta

Titles and abstracts – in alphabetical order of speaker-names

All times below are in Indian Standard Time (IST) – this is GMT + 05:30.

Arvind Ayyer (IISc) (PT&DM)

Title: GOE Fluctuations for Alternating Sign Matrices **17 Sep (Fri) 14:00 pm**

Abstract: The six-vertex model is an important toy-model in statistical mechanics for two-dimensional ice with a natural parameter Δ. When $\Delta = 0$, the so-called free-fermion point, the model is in natural correspondence with domino tilings of the Aztec diamond.

We focus on the six-vertex model with domain wall boundary conditions at $\Delta = 1/2$, where it corresponds to alternating sign matrices (ASMs). We consider the level lines in a height function representation of ASMs and show that the maximum of the topmost level line for a uniformly random ASMs has the GOE Tracy–Widom distribution after appropriate rescaling. As far as we know, this is the first edge fluctuation result away from the tangency points for the domain-wall six-vertex model away from the free fermion case.

This is joint work with S. Chhita and K. Johansson.

Aashirwad N. Ballal (IISc) (G&T, A&PDE)

Title: The supercritical deformed Hermitian Yang–Mills equation on compact projective manifolds **18 Sep (Sat) 11:05 am**

Abstract: We extend a result of Gao Chen regarding the solvability of the twisted deformed Hermitian Yang–Mills equations on compact Kähler manifolds to allow for the twisting function to be non-constant and slightly negative in all dimensions. Using this result and the methods in a paper of Datar and Pingali, we prove that the twisted dHYM equation on compact, projective manifolds can be solved provided certain numerical conditions are satisfied.

Mousomi Bhakta (IISER) (A&PDE)

Title: Lane–Emden equations with Hardy potential and measure data **18 Sep (Sat) 17:00 pm**

Abstract: I will discuss the multiplicity of positive solutions to Lane–Emden equations and systems of equations with Hardy potential and measure data, namely equation of the form

$$-\Delta u - \frac{\mu}{\delta^2} u = u^p \text{ in } \Omega, \quad u = \rho\nu \quad \text{ on } \partial\Omega,$$

where $\delta(x) = \text{dist}(x, \partial\Omega)$, μ and ρ are positive parameters and μ is strictly smaller than the best Hardy constant. ν is a positive Radon measure on $\partial\Omega$ with norm 1 and $1 < p < N_\mu$, with N_μ being a critical exponent depending on N and μ.

Divyang Bhimani (IISER) (A&PDE)

Title: Bimodal Wilson system in L^2 **17 Sep (Fri) 12:25 pm**

Abstract: The Balian–Low Theorem (BLT) states that there is no well-localized window function either in time or frequency for an exact Gabor frame; this is undesirable in many situations. The motivation of this talk is to beat BLT.

For this we introduce a bimodal Wilson system consisting of linear combinations of at most two elements from an associated Gabor frame with window function ϕ. For a class of window functions ϕ, we show that the Gabor system is a tight frame of arbitrary redundancy if and only if the Wilson system is a Parseval system for L^2. Examples of smooth rapidly decaying generators ϕ (well-localized) are constructed. This is a joint work with Kasso Okoudjou.

Diganta Borah (IISER) (A&PDE, G&T)

Title: Limits of an increasing sequence of complex manifolds **18 Sep (Sat) 12:25 pm**

Abstract: Let M be a complex manifold which is the union of an increasing sequence of open subsets M_j each of which is biholomorphic to a fixed domain $\Omega \subset \mathbb{C}^n$. Fornaess and Sibony investigated the question of describing M in terms of Ω and this problem will be referred to as the *union problem*. Under the assumption that Ω is Kobayashi hyperbolic and $\Omega/\mathrm{Aut}(\Omega)$ is compact they were able to identify M in the following two cases: (i) M is Kobayashi hyperbolic and (ii) M has Kobayashi corank one—in the first case M is biholomorphic to Ω and in the second case M is biholomorphic to a locally trivial fibre bundle with fibre $\mathbb{C}$ over a holomorphic retract of Ω. In this talk, we will attempt to study the union problem for a broader class of domains Ω that do not admit a compact quotient under the action of $\mathrm{Aut}(\Omega)$. Holomorphic retracts of some special domains in $\mathbb{C}^n$ will also be identified.

This is joint work with G. P. Balakumar, Prachi Mahajan, and Kaushal Verma.

Anisa Chorwadwala (IISER) (A&PDE)

Title: An application of SCP for the p-Laplacian **18 Sep (Sat) 14:00 pm**

Abstract: We consider the optimization problem for the first Dirichlet eigenvalue $\lambda_1(\Omega)$ of the p-Laplacian Δ_p, $1 < p < \infty$, over a family of doubly connected planar domains $\Omega = B \setminus P$, where B is an open disk and $P \subset B$ is a domain which is invariant under the action of a dihedral group D_n for some $n \geq 2$, $n \in \mathbb{N}$. We study the behaviour of λ_1 with respect to the rotations of P about its center. We prove that the extremal configurations correspond to the cases where Ω is symmetric with respect to the line containing both the centers. Among these optimizing domains, the OFF configurations correspond to the minimizing ones while the ON configurations correspond to the maximizing ones. Furthermore, we obtain symmetry (periodicity) and monotonicity properties of λ_1 with respect to these rotations. In particular, we prove that a previous conjecture for n odd and $p = 2$ holds true. As a consequence of our monotonicity results, we show that if the nodal set of a second eigenfunction of the p-Laplacian possesses a dihedral symmetry of the same order as that of P, then it can not enclose P.

Biltu Dan (IISc) (PT&DM)

Title: The discrete membrane model on trees **17 Sep (Fri) 16:50 pm**

Abstract: The discrete membrane model (MM) is a random interface model for separating surfaces that tend to preserve curvature. It is a Gaussian interface whose inverse covariance is given by the discrete biharmonic operator. It is a very close relative of the discrete Gaussian free field (DGFF), for which the inverse covariance is given by the discrete harmonic operator. However, working with the two models presents some key differences. In particular, a lot of tools (electrical networks, random walk representation of the covariance) are available for the DGFF and lack in the MM. In this talk we will investigate a random walk representation for the covariance of the MM and by means of it will define and study the MM on regular trees. In particular, we will study the scaling limit of the maximum of the MM on regular trees.

This talk is based on a joint work with Alessandra Cipriani (TU Delft), Rajat Subhra Hazra (University of Leiden) and Rounak Ray (TU/e).

Jyoti Dasgupta (IISER) (G&T)

Title: Classification, reduction and stability of toric principal bundles **18 Sep (Sat) 15:30 pm**

Abstract: In this talk, we describe a classification of torus equivariant principal G-bundles over a complex nonsingular toric variety where G is a complex linear algebraic group. When G is connected and reductive, we characterize their equivariant automorphisms and relate this description to the equivariant reduction of structure group. As an application, we show the principal bundle analogue of Kaneyama's theorem on the existence of equivariant splitting of any torus equivariant vector bundle of rank $r < n$ over a projective space of dimension n. We also show that for nonsingular projective toric varieties, equivariant stability of a principal bundle implies that the bundle is stable. This talk is based on a joint work with Indranil Biswas, Arijit Dey, Bivas Khan and Mainak Poddar.

Ved V. Datar (IISc) (G&T, A&PDE)

Title: Non-linear PDEs and positivity conditions in algebraic geometry **18 Sep (Sat) 10:20 am**

Abstract: The Nakai criteria characterises the cone of positive (1,1) classes on a projective manifold in terms of positivity of some intersection numbers. Somewhat surprisingly the extension of the Nakai criteria to general Kähler manifolds, proved by Demailly and Paun, relies on Yau's solution to the Calabi conjecture, and the solvability of complex Monge–Ampere equations. Inspired by this it was conjectured by Lejmi–Szekelyhidi that the solvability of a large class of non-linear PDEs on Kähler manifolds must be related to some algebro-geometric positivity conditions. In my talk I will introduce this circle of ideas and then describe some recent work with Vamsi Pingali on the resolution of the Lejmi–Szekelyhidi conjecture on projective manifolds.

Shaunak V. Deo (IISc) (A&NT)

Title: Density of modular points in pseudo-deformation rings **17 Sep (Fri) 09:40 am**

Abstract: Let N be an integer, p be an odd prime and $\bar{\rho}_0$ be a continuous, odd and reducible 2-dimensional representation of $G_{\mathbb{Q},Np}$ over a finite field of characteristic p. We will prove that the maximal reduced quotient of the universal deformation ring of the pseudo-representation corresponding to $\bar{\rho}_0$ (pseudo-deformation ring) is isomorphic to the local component of the big p-adic Hecke algebra of level N corresponding to $\bar{\rho}_0$, if a certain global Galois cohomology group has dimension 1. This partially extends the results of Böckle to the case of residually reducible representations. As an application of our methods and results, we will see a level-raising result for newforms lifting $\bar{\rho}_0$ in the spirit of Diamond–Taylor which gives a partial answer to a conjecture of Billerey–Menares.

Radhika Ganapathy (IISc) (A&NT)

Title: Some presentations of the Hecke algebra of a reductive p-adic group with I_n-level structure **17 Sep (Fri) 10:20 am**

Abstract: Let G be a semisimple, simply connected group over a non-archimedean local field F. Consider the Iwahori Hecke algebra $\mathcal{H}(G(F), I_0)$, where I_0 is an Iwahori subgroup of $G(F)$. This is an affine Hecke algebra and there are two well-known presentations of this Hecke algebra; the first one is the Iwahori–Matsumoto presentation and it is given in terms of generators T_w where w runs through the elements of the affine Weyl group and the second one (which can be seen as a refinement of the first) is given in terms of generators T_s where s runs through a Coxeter generating set of the affine Weyl group. More generally, given a connected, reductive group G over F and an Iwahori subgroup $I_0 \subset G(F)$, the group I_0 admits a nice descending filtration $I_n \subset I_0$ and the Hecke algebra $\mathcal{H}(G(F), I_n)$ is of interest in the representation theory of p-adic groups. In this talk, we will discuss analogues of the two presentations mentioned above for the Hecke algebra $\mathcal{H}(G(F), I_n), n \geq 1$. This is based on joint work with Xuhua He.

Pritam Ganguly (IISc) (A&PDE)

Title: On a theorem of Chernoff for quasi-analytic functions **17 Sep (Fri) 10:20 am**

Abstract: The classical Denjoy–Carleman theorem provides a characterization of quasi-analytic class of functions on $\mathbb{R}$ in terms of certain growth conditions on the L^∞-norms of the functions and their derivatives. In 1975, P.R. Chernoff used iterates of the Laplacian on $\mathbb{R}^n$ to prove an L^2 version of the Denjoy–Carleman theorem, which provides a sufficient condition for a smooth function on $\mathbb{R}^n$ to be quasi-analytic. The problem of finding analogues of that result on different Lie groups and symmetric spaces has received considerable attention in recent years. In this talk, we will discuss various analogues of Chernoff's theorem in the setting of the Heisenberg group and Riemannian symmetric spaces studied lately. Moreover, we will describe several open problems in this direction.

Anindya Goswami (IISER) (PT&DM)

Title: Data-driven option pricing using single and multi-asset supervised learning **18 Sep (Sat) 16:10 pm**

Abstract: We propose three different data-driven approaches for pricing European-style call options using supervised machine-learning algorithms. These approaches yield models that give a range of fair prices instead of a single price point. The performance of the models are tested on two stock market indices: NIFTY50 and BANKNIFTY from the Indian equity market. Although neither historical nor implied volatility is used as an input, the results show that the trained models have been able to capture the option pricing mechanism better than or similar to the Black–Scholes formula for all the experiments. Our choice of scale free I/O allows us to train models using combined data of multiple different assets from a financial market. This not only allows the models to achieve far better generalization and predictive capability, but also solves the problem of paucity of data, the primary limitation of using machine learning techniques. We also illustrate the performance of the trained models in the period leading up to the 2020 Stock Market Crash (Jan 2019 to April 2020).

This is joint work with Sharan Rajani and Atharva Tanksale (in IJFE, 2021).

Purvi Gupta (IISc) (A&PDE, G&T)

Title: On the stability of holomorphic discs attached to an n-sphere in $\mathbb{C}^n$ **17 Sep (Fri) 09:00 am**

Abstract: The phenomenon of simultaneous analytic continuation in several complex variables gives rise to various notions of hulls for compact sets in complex spaces. Although these hulls are abstractly defined as maximal ideal spaces of certain uniform algebras, in certain cases, these hulls can be identified with sets that are foliated by analytic discs (or varieties) attached to the given compact set.

This problem has been studied extensively for curves in $\mathbb{C}^n$, and for 2-spheres in $\mathbb{C}^2$, where one obtains solutions to the so-called complex Plateau problem in the former case, and the Levi-flat Plateau problem in the latter case. Far less is known about the hulls of generic n-spheres in $\mathbb{C}^n$ when $n \geq 3$. In this talk, we will discuss a stability result in this direction. We will note the main distinctions from the $n = 2$ case and elaborate on the role of Riemann–Hilbert boundary problems in this study. This is joint work with Chloe U. Wawrzyniak.

Subhojoy Gupta (IISc) (G&T)

Title: Dynamics of the mapping class group on the PSL(2,$\mathbb{C}$) character-variety **18 Sep (Sat) 11:45 am**

Abstract: For a surface S, the PSL$(2,\mathbb{C})$ character-variety is the space of representations of the fundamental group of S into PSL$(2,\mathbb{C})$ up to conjugation. This space admits an action of the mapping class group of S, and much is unknown about the dynamics of this action. In this talk I shall introduce these, mention Goldman's conjecture about this action (which is still open), and describe some results that are known. Amongst them is the characterization of bounded orbits, which is joint work with Indranil Biswas, Mahan Mj and Junho Whang.

K. Hariram (IISc) (A&NT)

Title: Bounds for the Bergman kernel and the sup-norm of holomorphic Siegel cusp forms **18 Sep (Sat) 11:45 am**

Abstract: We prove an upper bound for the sup-norm of an L^2-normalised scalar-valued holomorphic Siegel cusp form of degree n and weight k. When $n = 2$, our bound for the sup-norm is $O_\epsilon(k^{9/4+\epsilon})$, which is the best possible from the expected bound of the corresponding Bergman kernel.

Srikanth K. Iyer (IISc) (PT&DM)

Title: Phase transitions and percolation at criticality in enhanced random connection models **17 Sep (Fri) 15:30 pm**

Abstract: We study phase transition and percolation at criticality for three random graph models on the plane, viz., the homogeneous and inhomogeneous enhanced random connection models (RCM) and the Poisson stick model. These models are built on a homogeneous Poisson point process $\mathcal{P}_\lambda$ in $\mathbb{R}^2$ of intensity λ. In the homogeneous RCM, the vertices at x, y are connected with probability $g(|x-y|)$, independent of everything else, where $g : [0,\infty) \to [0,1]$ and $|\cdot|$ is the Euclidean norm. In the inhomogeneous version of the model, points of $\mathcal{P}_\lambda$ are endowed with weights that are non-negative independent random variables with distribution $P(W > w) = w^{-\beta}1_{[1,\infty)}(w)$, $\beta > 0$. Vertices located at x, y with weights W_x, W_y are connected with probability $1 - \exp\left(-\frac{\eta W_x W_y}{|x-y|^\alpha}\right)$, $\eta, \alpha > 0$, independent of all else. The graphs are enhanced by considering the edges of the graph as straight line segments starting and ending at points of $\mathcal{P}_\lambda$. A path in the graph is a continuous curve that is a subset of the union of all these line segments. The Poisson stick model consists of line segments of independent random lengths and orientation with the mid point of each segment located at a distinct point of $\mathcal{P}_\lambda$. Intersecting lines form a path in the graph. A graph is said to percolate if there is an infinite connected component or path. We derive conditions for the existence of a phase transition and show that there is no percolation at criticality.

Aakanksha Jain (IISc) (A&PDE)

Title: Transformation formula for the reduced Bergman kernel **17 Sep (Fri) 09:40 am**

Abstract: We prove the transformation formula for the reduced Bergman kernels under proper correspondences between bounded domains in the complex plane. We also establish the transformation formula for the weighted reduced Bergman kernels under proper holomorphic maps. Finally, we provide an application. (Joint with Sahil Gehlawat and Amar Deep Sarkar.)

Tejas Kalelkar (IISER) (G&T, PT&DM)

Title: An algorithm to identify hyperbolic manifolds using their geometric triangulations **18 Sep (Sat) 09:00 am**

Abstract: A geometric triangulation of a Riemannian manifold is a triangulation by totally geodesic simplexes. Any two triangulations of a PL manifold are related by a sequence of local combinatorial changes to the triangulation called Pachner moves We give a bound on the length of this sequence for closed hyperbolic, spherical and Euclidean n-manifolds (after taking a bounded number of barycentric subdivisions) and for cusped complete hyperbolic 3-manifolds. These bounds are in terms of the dimension of the manifold, number of top dimensional simplexes and upper bounds on lengths of edges in the compact case and lower bounds on dihedral angles in the cusped case. This leads to an algorithm to check from the combinatorics of the triangulations and bounds on the lengths of edges or dihedral angles, if two geometrically triangulated closed hyperbolic n-manifolds or cusped hyperbolic 3-manifolds are isometric or not. This is joint work with Advait Phanse and Sriram Raghunath.

Bivas Khan (IISER) (G&T)

Title: Seshadri constants of equivariant vector bundles on toric varieties **18 Sep (Sat) 16:10 pm**

Abstract: Seshadri constants quantify how much of the positivity of an ample line bundle can be localized at a given point of a variety. They were introduced by Demailly, motivated by Seshadri's ampleness criterion for line bundles. Later, Hacon generalized the notion of Seshadri constants to vector bundles. In general, Seshadri constants are not easy to compute, and a lot of research is aimed at finding good estimates. In this talk, we consider torus equivariant vector bundles on toric varieties. Assuming certain conditions on the vector bundle, we give the precise value of Seshadri constants at arbitrary points on projective spaces and Bott towers of height at most 3. This is a joint work with Jyoti Dasgupta and Aditya Subramaniam.

Soumen Maity (IISER) (PT&DM)

Title: Maximum minimal defensive alliance in graph **17 Sep (Fri) 15:30 pm**

Abstract: A set S of vertices of a graph is a defensive alliance if, for each element of S, the majority of its neighbours is in S. We are interested in minimal defensive alliance of maximum size. This problem is known to be NP-hard but its parameterized complexity remains open until now. In this talk we will introduce the basic concepts in parameterized complexity and discuss the parameterized algorithms for the maximum size minimal defensive alliance problem. This is a joint work with Ajinkya Gaikwad.

Neha Malik (IISER) (A&NT)

Title: The total Stiefel–Whitney Class of an orthogonal representation of $SL(n, q)$ **17 Sep (Fri) 14:00 pm**

Abstract: Orthogonal representations π of a finite group G have invariants $w_i(\pi)$ in the i^{th} degree cohomology group $H^i(G, \mathbb{Z}/2\mathbb{Z})$, called Stiefel–Whitney Classes (SWCs). Their sum $w(\pi) = 1 + w_1(\pi) + w_2(\pi) + \cdots$ is called the total SWC of π.

There are no explicit calculations in the literature of the total SWCs for any class of non-abelian groups. We have computed the total SWCs for special linear groups $SL(n, q)$ in the following cases: (i) $n = 2$ for any q, (ii) $n = 3$ with q odd, and (iii) n is odd and $q \equiv 3 (\text{mod } 4)$. In this talk, we give an overview of these results.

Kartik Roy (IISER) (G&T)

Title: Quotients of algebraic varieties by tori **18 Sep (Sat) 14:00 pm**

Abstract: We study various constructions in the literature coming out of quotients of algebraic varieties by tori and their relation.

Sudipa Mondal (IISER) (A&NT)

Title: On the growth of cuspidal cohomology of GL_4 by symmetric cube transfer **17 Sep (Fri) 11:05 am**

Abstract: In this talk, we will discuss about an asymptotic estimate on the number of cuspidal automorphic representations of $\mathrm{GL}_4(\mathbb{A}_{\mathbb{Q}})$ which contribute to the cuspidal cohomology of GL_4 and are obtained from symmetric cube transfer of automorphic representations of $\mathrm{GL}_2(\mathbb{A}_{\mathbb{Q}})$ of a given weight and with varying level structure. This generalises the recent work of C. Ambi about the similar problem for GL_3. This is a joint work with my supervisor Dr. Chandrasheel Bhagwat which has been recently published in JNT.

Basudev Pattanayak (IISER) (A&NT)

Title: Principal series component of Gelfand–Graev representation **17 Sep (Fri) 11:45 am**

Abstract: Let G be a connected reductive group defined over a non-archimedean local field F. Let B be a minimal F-parabolic subgroup with Levi factor T and unipotent radical U. Let ψ be a non-degenerate character of $U(F)$ and λ a character of $T(F)$. Let (K, ρ) be a Bushnell–Kutzko type associated to the Bernstein block of $G(F)$ determined by the pair $(T(F), \lambda)$. We study the ρ-isotypical component π^ρ of the Gelfand–Graev representation $\pi = c\text{-ind}_{U(F)}^{G(F)}(\psi)$ associated to the Whittaker character ψ. We show that π^ρ is a cyclic module for the Hecke algebra $\mathcal{H}(G, \rho)$ associated to the pair (K, ρ). When T is split, we describe it more explicitly in terms of $\mathcal{H}(G, \rho)$. Our results generalize the main result of "Iwahori component of the Gelfand–Graev representation" by Kei Yuen Chan and Gordan Savin, who treated the case of $\lambda = 1$ when T is split. This is joint work with Manish Mishra.

Rakesh Pawar (IISER) (G&T, A&NT)

Title: A remark on relative Gersten's complex for Milnor K-theory **18 Sep (Sat) 14:40 pm**

Abstract: In this talk we recall the Milnor K-theory for fields and consider the relative Gersten's complex for Milnor K-theory over a regular Henselian domain S. We prove that in degrees $\geq \dim S \geq 1$, the Gersten's complex of an essentially smooth Henselian local S-scheme is exact.

Supriya Pisolkar (IISER) (A&NT)

Title: Fontaine–Mazur Conjecture and analytic pro-p groups **18 Sep (Sat) 10:20 am**

Abstract: The Fontaine–Mazur Conjecture is one of the core statements in modern arithmetic geometry. Several formulations were given since its original statement in 1993, and various angles have been adopted by numerous authors to try to tackle it.

A range of tools, though much less famous among young arithmetic geometers, goes back to Boston's papers in 1992 and 1999 which focus on the group-theoretic methods than the representation-theoretic ones to prove the special cases of this conjecture. This talk aims at what is known in this direction.

Moumanti Podder (IISER) (PT&DM)

Title: Some combinatorial games on rooted multi-type Galton–Watson trees **17 Sep (Fri) 14:40 pm**

Abstract: In a rooted multi-type Galton–Watson branching process, the root is assigned a colour from a finite set Σ of colours according to some probability distribution $\mathbf{p}$, and a vertex of the tree, conditioned on its colour $\sigma \in \Sigma$, gives birth to offspring according to some probability distribution χ_σ on $\mathbb{N}_0^\Sigma$. In particular, one may consider $\Sigma = \{\text{red}, \text{blue}\}$ and the resulting random tree, denoted $\mathcal{T}$, can be viewed as a directed random graph if each edge is attributed a direction from parent to child. I consider the *normal*, *misére* and *escape* games on $\mathcal{T}$, each played between P1 and P2, with P1 being allowed to move the token *only* along monochromatic directed edges and P2 being allowed to move the token *only* along non-monochromatic directed edges. I then investigate the probabilities of win, loss and (where pertinent) draw of each player as fixed points of distributional recursions, establish inequalities between win / loss / draw probabilities of the players across different games, seek possible phase transitions in win / loss / draw probabilities as the parameters involved in the offspring distributions are made to vary etc.

Neha Prabhu (IISER) (A&NT)

Title: A joint distribution theorem with applications to extremal primes **18 Sep (Sat) 11:05 am**

Abstract: An extremal prime p for an elliptic curve E is one for which the trace of the Frobenius, denoted $a_p(E)$, is maximal or minimal in view of the Hasse bound. In this talk, assuming the Generalized Riemann Hypothesis, we present a joint distribution result involving the Chebotarev Density Theorem. As a consequence, we obtain a non-trivial upper bound for the number of primes p up to x, such that $a_p(E)$ satisfies the extremal property modulo q for a large prime q. This is joint work with Amita Malik.

Lakshmi Priya (IISc) (PT&DM, A&PDE)

Title: Nodal sets of Gaussian Laplace eigenfunctions **17 Sep (Fri) 11:45 am**

Abstract: Laplace eigenfunctions on Riemannian manifolds enjoy a host of regularity properties which also reflect on their nodal sets. Several studies have been devoted to understanding different aspects of the nodal sets of Laplace eigenfunctions; Courant's nodal domain theorem, asymptotics of nodal volume are a couple of the many well known results in this field. More recently, there has been a lot of interest and progress in understanding several features of the nodal sets of random functions in general and random Laplace eigenfunctions in particular. Nodal component count, nodal volume are some of the aspects of the nodal sets which have been studied about these random functions. We introduce the subject, mention some of the challenges involved in this study and present some of the important developments made in this field.

Vivek Rai (IISER) (A&NT)

Title: Towards a mod p Lubin–Tate theory for GL_2 over totally real fields **17 Sep (Fri) 12:25 pm**

Abstract: We show that the conjectural mod p local Langlands correspondence can be realised in the mod p cohomology of the Lubin–Tate towers. The proof utilises a well known conjecture of Buzzard–Diamond–Jarvis, a study of completed cohomology of ordinary and supersingular locus of the Shimura curves and of mod $l(\neq p)$ local Langlands correspondence as given by Emerton–Helm. In case of modular curves a similar result was obtained by Chojecki. This is a joint work with Debargha Banerjee.

Shubham Rastogi (IISc) (A&PDE)

Title: On the structure and the joint spectrum of a pair of commuting isometries **17 Sep (Fri) 11:05 am**

Abstract: The study of a pair (V_1, V_2) of commuting isometries is a classical theme. We shine new light on it by using the defect operator

$$C(V_1, V_2) = I - V_1V_1^* - V_2V_2^* + V_1V_2V_2^*V_1^*.$$

In the cases when the defect operator is zero or positive, the structure of (V_1, V_2) is known in the literature. We provide the structure (model) for (V_1, V_2) when the defect operator is negative or the difference of two mutually orthogonal projections with ranges adding up to the kernel of $(V_1V_2)^*$.

We find the Taylor joint spectrum $\sigma(V_1, V_2)$ of (V_1, V_2) in each of the four cases above using the structure theorems. A pair of operator valued functions (φ_1, φ_2) is canonically associated by Berger, Coburn and Lebow with (V_1, V_2). If (V_1, V_2) is a pure pair, then in each case above we show that $\sigma(V_1, V_2) = \overline{\cup_{z\in\mathbb{D}}\sigma(\varphi_1(z), \varphi_2(z))}$. This is a joint work with Tirthankar Bhattacharyya and Vijaya Kumar U.

Ramesh Sau (IISc) (A&PDE)

Title: Finite element analysis of the constrained Dirichlet boundary control problem governed by the Diffusion Equation **18 Sep (Sat) 14:40 pm**

Abstract: The study of optimal control problems governed by partial differential equations (PDEs) is an important area in applied mathematics. The optimal control problem entails finding a control variable that minimizes a cost function subject to a PDE. This talk will focus on the finite element analysis of a Dirichlet boundary optimal control problem governed by the Poisson equation. We propose a new energy space-based approach for the Dirichlet boundary optimal control problem with control constraints. The optimality system results in a simplified Signorini type problem for control which is coupled with boundary value problems for state and costate variables. We propose a finite element-based numerical method using the linear Lagrange finite element spaces with discrete control constraints at the Lagrange nodes. *A priori* error estimates of optimal order in the energy norm are derived up to the regularity of the solution. The theoretical results are corroborated by a variety of numerical tests.

Sanchayan Sen (IISc) (PT&DM)

Title: New universality classes for minimal spanning trees **17 Sep (Fri) 16:10 pm**

Abstract: It is conjectured that distances in the minimal spanning tree (MST) of a wide array of supercritical random graphs with degree exponent $\tau \in (3, 4)$ scale like $n^{(\tau-3)/(\tau-1)}$. We report on recent progress where we give the first proof of this conjecture for a class of random graphs closely related to Aldous's multiplicative coalescent. We further show that the scaling limit of the MST in the Gromov–Hausdorff topology is a random compact metric space with Minkowski dimension $(\tau - 1)/(\tau - 3)$. This yields new universality classes of possible MST scaling limits. We expect these limiting spaces to be the candidates for the scaling limits of the MSTs of various heavy-tailed random graph models including random graphs with given heavy-tailed degree sequences and dense graphs converging to an L^p graphon where $p \in (2, 3)$. Based on joint work with Shankar Bhamidi.

Harish Seshadri (IISc) (G&T)

Title: Volume and diameter of positively curved Kähler manifolds **18 Sep (Sat) 09:40 am**

Abstract: I will discuss comparison theorems for volume and diameter in the Kähler and Riemannian settings. Part of the talk will be about joint work with Ved Datar.

Kaneenika Sinha (IISER) (A&NT, PT&DM)

Title: Central limit theorems in number theory and graph theory **18 Sep (Sat) 09:40 am**

Abstract: We will discuss some central-limit type theorems that appear in the eigenvalue distribution of certain families of operators acting on spaces of modular forms. This has a strong analogy with the distribution of eigenvalues in families of regular graphs. We discuss this analogy and also report on some work in progress with Moumanti Podder.

Steven Spallone (IISER) (A&NT, G&T)

Title: Stiefel–Whitney Classes of representations **17 Sep (Fri) 14:40 pm**

Abstract: An orthogonal representation of a finite group has invariants living in the (mod 2) group cohomology, called Stiefel–Whitney Classes (SWCs). The first two SWCs vanish iff the representation lifts to the spin group. In this talk we discuss recent work in computing SWCs for familiar groups, as well as the spinoriality problem.

Abu Sufian (IISc) (A&PDE)

Title: Strong contrasting diffusivity in general oscillating domains: Homogenization of optimal control problems **18 Sep (Sat) 15:30 pm**

Abstract: This talk will discuss problems in high oscillating domains, where the oscillatory part is made of two materials with high contrasting conductivities (or diffusivity). In the first part, we will see the homogenization of an elliptic equation on the considered domain. The main discussion in this talk is the study of optimal control problems based on the unfolding method. The interesting result is the difference in the limit behavior of the optimal control problem, which depends on the control's action, whether it is on the conductive part or insulating part. In both cases, we derive the two-scale limit controls problems which are pretty similar as far as analysis is concerned. But, if the controls are acting on the conductive region, a complete-scale separation is available, whereas a complete separation is not visible in the insulating case due to the intrinsic nature of the problem.

G.V.K. Teja (IISc) (A&NT)

Title: Two generalisations of the partial sum property, with two applications to highest weight modules **17 Sep (Fri) 16:50 pm**

Abstract: A basic result for Kac–Moody algebras is the partial sum property: every positive root is a sum of simple roots, whose partial sums are all roots. We shall discuss two generalisations of this property, for arbitrary Kac–Moody algebras:

(A) On the level of roots, we prove a parabolic generalisation, which we call the Parabolic partial sum property. In fact we will prove this at the level of Lie words, for any Lie algebra graded over any free abelian semigroup.

(B) On the level of representations, we show for large classes of highest weight modules that one can go between any two comparable weights of the module via a chain of weights. This generalises the 2016 results of A. Khare and S. Kumar in finite type.

We then present two applications of the above two generalisations, once again for arbitrary Kac–Moody algebras:

(1) A 'minimal' description for the formulas (due to Dhillon–Khare, 2017) for the weights of arbitrary simple highest weight modules.

(2) A Minkowski difference formula for the weights of every highest weight module, generalising the aforementioned formulas for simple modules.

This talk is based on the preprint titled "Moving between weights of weights modules" (2020).

R. Venkatesh (IISc) (A&NT, PT&DM)

Title: Graph polynomials from Lie algebras **17 Sep (Fri) 16:10 pm**

Abstract: Let G be a simple graph. C. D. Godsil showed that there is a tree $T = T(G)$ such that $m(G-u,x)/m(G,x) = m(T-r,x)/m(T,x)$, where $m(G,x)$ denotes the matching polynomial of G, and he used this identity to obtain real rootedness of $m(G,x)$. He also used this identity to get some sharp bounds of roots of $m(G,x)$. These root bounds are very important, for example this was used to show the existence of Ramanujan graphs. Similar identities are available in the literature for independence polynomial of G. We are particularly interested in the identity that comes from stable path tree of G (studied by Ferenc Bencs, 2018). Multi-variate generalisations of "these identities" can be viewed as the characters of highest weight representations of Borcherds–Kac–Moody Lie algebras of G. So this suggests that these identities have a much deeper connection at the level of the representations. We prove indeed this is true and the multi-variate version of "these identities" come from the corresponding isomorphisms of the respective highest weight representations of Borcherds–Kac–Moody Lie algebras. This is a joint work with Kartik Singh.