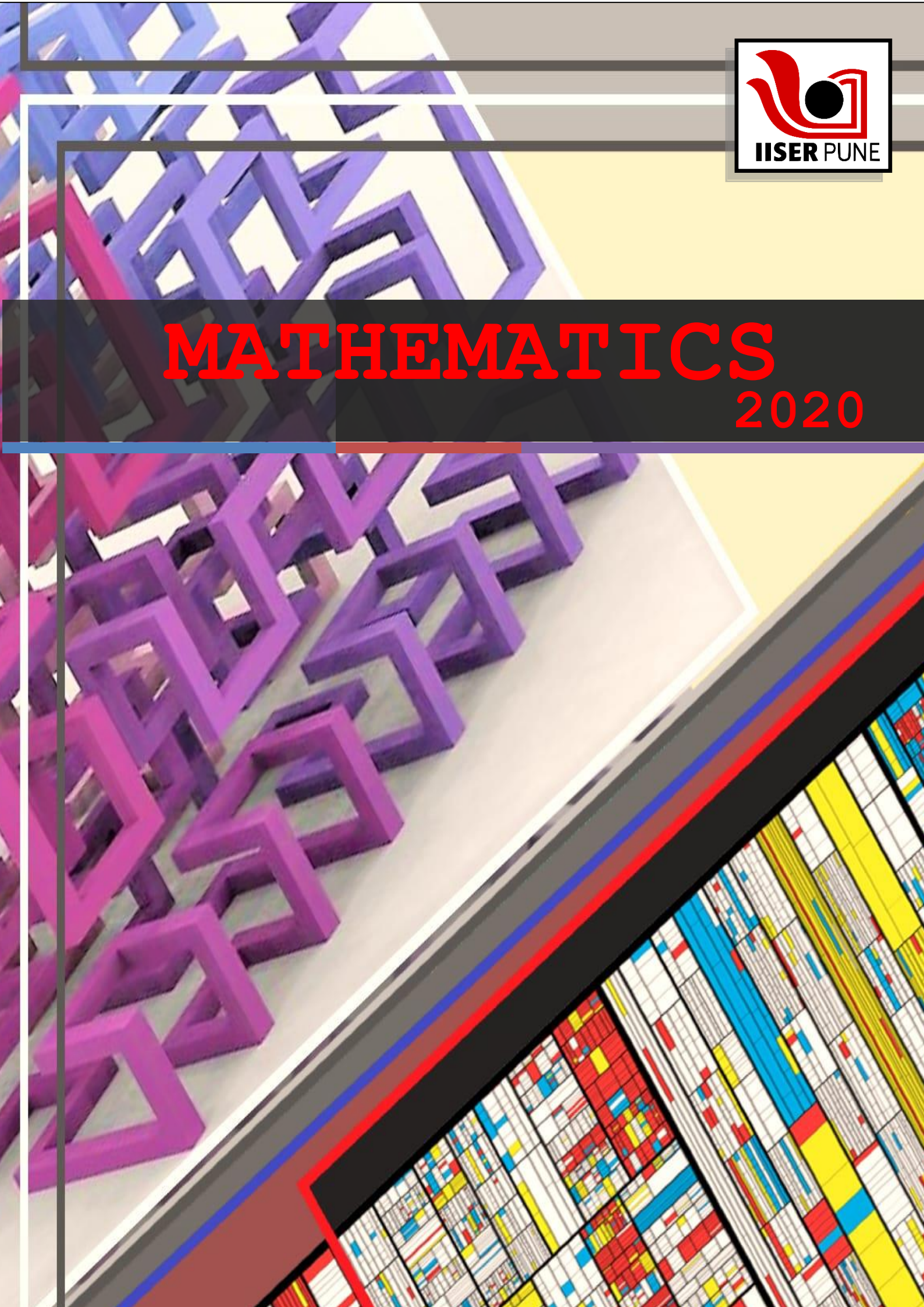
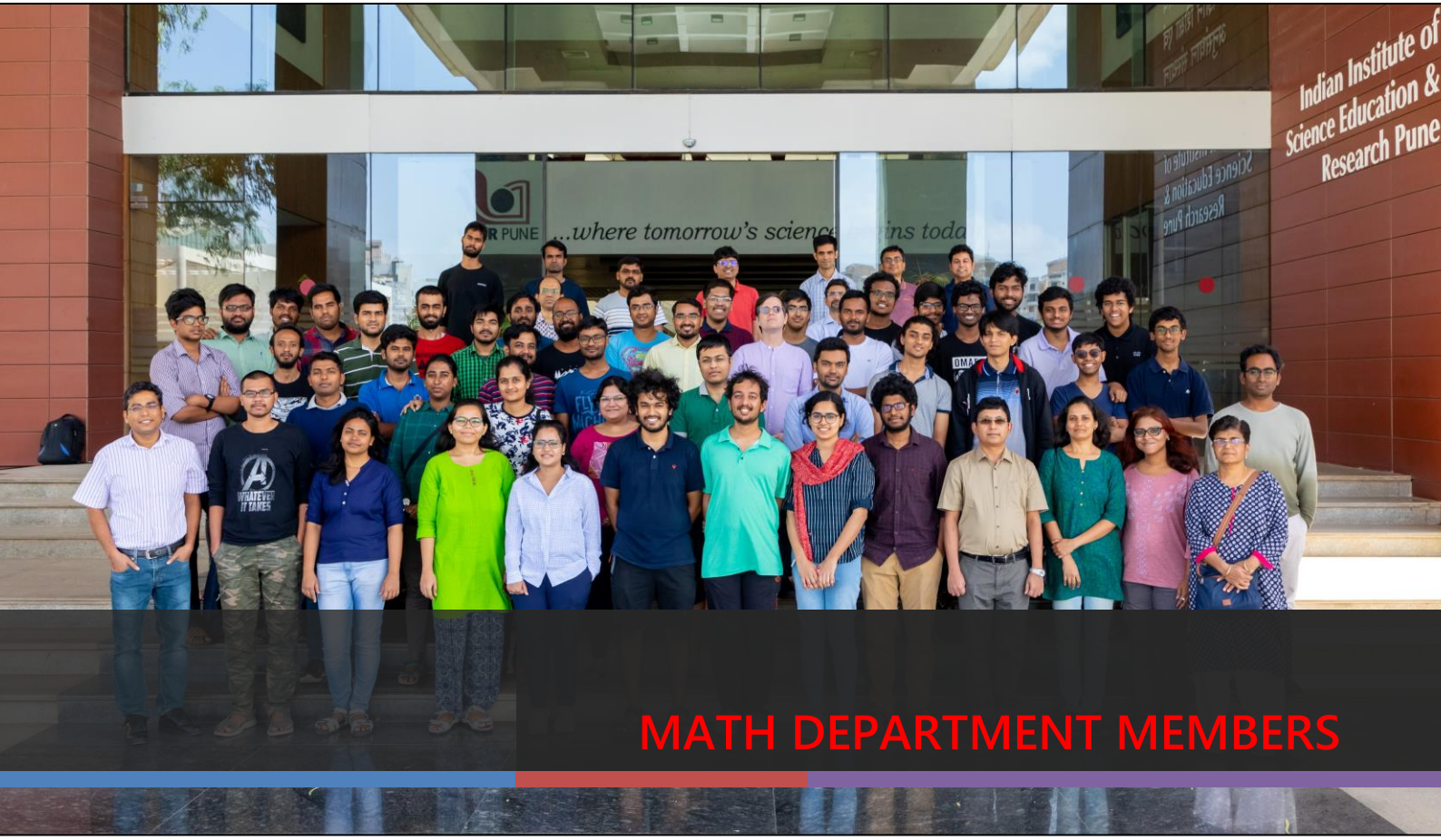

IISER PUNE
MATHEMATICS
2020



MATH DEPARTMENT MEMBERS

A. Raghuram
Abhishek Adimurthi
Adithyan P
Advait Phanse
Ajinkya Gaikwad
Amit Hogadi
Anindya Goswami
Anisa Chorwadwala
Anjali Bhatnagar
Anup Biswas
Anupam Kumar Singh
Archi Roy
Arghya Rakshit
Ayan Mahalanobis
Aysha Basheer
Baskar Balasubramanyam
Basudev Pattanayak
Bivas Khan
Chaitanya Ambi
Chandrasheel Bhagwat
Chitrabhanu Chaudhuri
Debaprasanna Kar
Debargha Banerjee

Dhruv Bhasin
Diganta Borah
Garima Agrawal
Girish Kulkarni
Harsha Nyapathi
Hitendra Kumar
Jaideep Mahajan
Jewel Mahajan
Jishu Das
Jyoti Dasgupta
Kaneenika Sinha
Kartik Roy
Krishna Kaipa
Kunal
Kuntal Chakraborty
Mainak Poddar
Manidipa Pal
Manish Mishra
Mitesh Modasiya
Mousomi Bhakta
Namrata Arvind
Narayanan P
Nasit Darshan Prafulbhai
Nazia V.

Neeraj Deshmukh
Neha Malik
Nikhil Gupta
Nishad Bapat Dhar
Parul Gupta
Pavankumar Dighe
Pranav Niturkar
Pranjal Vishwakarma
Prashant Anant Gitte
Prasun Roychowdhury
Rabeya Basu
Rajdeep Haldar
Rama Mishra
Ramya Nair
Ravishankar Yadav
Rijubrata Kundu
Rithwik S V
Ronit Debnath
Sagar Kalane
Saikat Panja
Samarpita Ray
Sayantika Mondal
Shubham Jaiswal
Shuvamkant Tripathi

Siddharth Ramakrishnan
Snehal Sambhaji Lawande
Somnath Pradhan
Soumen Maity
Souptik Chakraborty
Sriram Raghunath
Steven Spallone
Sudipa Mondal
Sujeet Bhalerao
Sujeet Dhamore
Supriya Pisolkar
Surajprakash Yadav
Suvarna Gharat
Tejas Kalelkar
Tumpa Mahato
Uttara Naik-Nimbalkar
Varun Kulkarni
Vikas Shukla
Visakh Narayanan
Vishnu N
Vishwajeet Bhoite
Vivek Mohan Mallick
Vivek Kumar Rai
Yogesh Kolap

CHAIR'S WELCOME MESSAGE

The mathematics department of IISER Pune brings all areas of pure and applied mathematics, statistics and also theoretical computer science under one umbrella.

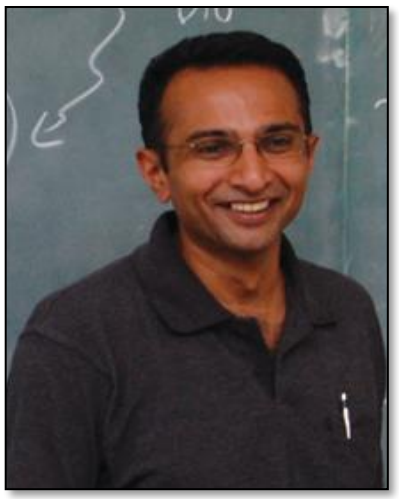
The new BS-MS curriculum pattern in which students can start opting for electives starting from the second year (instead of the third) will be implemented starting this year. This will allow the math department to offer more courses and an opportunity to the students to go deeper into a subject of their choice. A lot of work has gone into finalising the course work for this new pattern. Faculty members from the mathematics department, notably Anindya Goswami, are also playing important role in devising of curriculum for the upcoming data science department at IISER Pune.

This year we have hosted several workshops and conferences. This includes training programs for PhD students all over the country through the NCM funded AIS/ATM programs, several pedagogical workshops organised in Baskara Lab and last but not the least advanced workshops and conferences in specialised areas : Topology, Bloch Kato Conjecture, Pune Mumbai Number Theory Seminar, Group Theory, Parametrised Algorithms, ACM school on geometric algorithms, etc.

Following are some recent achievements : Two of our PhD students, Pranjal Vishwakarma and Darshan Nashit, have received the prestigious Prime Minister's research fellowship. One of our PhD students, Suraj Yadav has been selected for Fullbright-Nehru research fellowship and will be spending a year in the University of Southern California, USA. Two faculty members, Soumen Maity and Manish Mishra have received the Fullbright-Nehru academic and professional excellence award.

Amit Hogadi

Chair, Mathematics IISER Pune



A RAGHURAM

Professor
raghuram@iiserpune.ac.in

After getting a BTech in Computer Science and Engineering from IIT Kanpur, Raghuram moved to Mathematics and got a PhD in Mathematics in 2001 from the TIFR, Mumbai. He had postdoctoral positions at University of Toronto, Canada and TIFR, Mumbai and visiting assistant professorships at Purdue University and University of Iowa, USA. He joined Oklahoma State University, USA in 2006 as a tenure-track assistant professor and was promoted to associate professor with tenure in 2011. Raghuram joined IISER Pune in December 2011 as a Professor.

NUMBER THEORY, REPRESENTATION THEORY AND AUTOMORPHIC FORMS

My group is currently studying the arithmetic properties of special values of automorphic L-functions.

The earliest prototype of a special value of an L-function is the classical formula by Euler which says that the sum $\sum 1/n^2$ of reciprocals of squares of all positive integers is $\pi^2/6$. Generally, if $M = \{a_n\}$ is a sequence of numbers coming from some interesting data, for example, a_p can be the number of solutions of an equation modulo a prime p, then a guiding principle in modern number theory says that to study the sequence M one should study the L-function $L(s, M) = \sum a_n/n^s$. One can glean much information about M by studying first the analytic properties, and second the arithmetic properties of L(s,M).

The Langlands program bridges different areas of mathematics, like geometry, number theory and representation theory. The central theme making these bridges possible is the notion of an L-function.

Our work uses the results and techniques of the Langlands program to prove theorems about special values of various L-functions. These values encode within them a lot of arithmetic and geometric information of the objects to which the L-functions are attached. In earlier work stemming from my thesis, we have also studied the representation theory and harmonic analysis of *p*-adic groups.

SELECTED PUBLICATIONS AND EDITORIAL WORK

Harder, Günter; Raghuram, A. (2020) Eisenstein cohomology for GL(N) and the special values of Rankin-Selberg L-functions. Annals of Mathematics Studies, Volume 203. Princeton University Press, Princeton, NJ, 2020. xi+220 pp.

Bhagwat, C., and Raghuram, A. Special values for L-functions for orthogonal groups. To appear in *C. R. Math. Acad. Sci. Paris*.

Balasubramanyam, B., and Raghuram, A. Special values of adjoint L-functions and congruences for automorphic forms on GL(n) over a number field. *American Journal of Mathematics* (To appear).

Bhagwat, C., and Raghuram, A. Endoscopy and Cohomology of GL(n). To appear in special volume of the *Bulletin of Iranian Mathematical Society* dedicated to Freydoon Shahidi.

Raghuram, A. (2016). Critical values for Rankin-Selberg L-functions for GL(n) x GL(n-1) and the symmetric cube L-functions for GL (2). *Forum Mathematicum* 28(3):457-489.

Grobner, H. and Raghuram, A. (2014). On the arithmetic of Shalika models and the critical values of L-functions for GL(2n). With an appendix by Wee Teck Gan. *American Journal of Mathematics* 136:675-728.

Bhagwat, C., and Raghuram, A. (2013). Ratios of periods of tensor product motives. *Mathematical Research Letters* 20(4):615-628.

Gan, W.T. and Raghuram, A. (2013). Arithmeticity for periods of automorphic forms. 187-229, Tata Inst. Fund. Res. Stu. Math. No. 22, TIFR, Mumbai.

AMIT HOGADI

Associate Professor and Chair
amit@iiserpune.ac.in

Amit Hogadi received PhD from Princeton University, USA in 2007. He was at Tata Institute of Fundamental Research (TIFR), Mumbai, India before joining IISER Pune in December 2013.

ALGEBRAIC GEOMETRY

One can describe algebraic geometry as the study of varieties, which are spaces defined by vanishing of polynomial equations. I have been interested in moduli spaces which are special types of varieties which parametrize geometric objects.

In the last couple of decades, people have succeeded in applying ideas from topology, especially homotopy theory, to the study of algebraic varieties. This interplay between homotopy theory and algebraic geometry has been one of my latest fascinations.

Currently, I am working on problems which are sometimes clubbed under the title homotopical algebraic geometry and have applications to K-theory, motivic cohomology and also classical topics like Brauer groups.

SELECTED PUBLICATIONS

With Indranil Biswas. Fundamental group of quotient singularities. To appear in *International Mathematics Research Notices*.

Esnault, H. and Hogadi, A. (2012). On the algebraic fundamental group of smooth varieties in characteristic p>0. *Transactions of the American Mathematical Society* 364:2429-2442.

Hogadi, A. and Mehta, V. (2011). Birational invariance of the S-fundamental group scheme. *Pure and Applied Mathematical Quarterly* 7(4):1361-1370.

Hogadi, A. and Pisolkar, P. (2011). On the cohomology of Witt vectors of *p*-adic integers and a conjecture of Hesselholt. *Journal of Number Theory* 131(10):1797-1807.

Hogadi, A. and Xu, C. (2009). Degenerations of rationally connected varieties. *Transactions of the American Mathematical Society* 361(7):3931-3394.

ANINDYA GOSWAMI

Associate Professor
anindya@iiserpune.ac.in

Anindya Goswami received his Bachelor's degree in Mathematics from St. Xavier's College, Calcutta in 2002. He got his PhD from IISc, Bangalore in 2008. Following this, he held postdoctoral positions at the Universiteit Twente in Enschede, The Netherlands; INRIA in Rennes, France; and Technion in Haifa, Israel before joining IISER Pune in 2011. He has received the SPM fellowship as part of the National Award for best performance in National Eligibility Test in Mathematical Sciences. He was reappointed at the same department as an Associate Professor in spring, 2018.

STOCHASTIC CONTROL – GAME THEORY, MATH FINANCE, QUEUING NETWORKS, RENEWAL

I am exploring various topics in Applied Probability. Those include generalization of Black-Sholes-Merton PDE for options in semi-Markov modulated market, Föllmer Schweizer decomposition of an unattainable contingent claim, equilibrium of non-cooperative semi-Markov game under ergodic cost, optimal control under risk sensitive cost, portfolio optimization, large deviation limit, fluid limit in queuing network, PDE techniques in stochastic control and differential games etc.

I use Markov models, filtering techniques, stochastic calculus, infinitesimal generator for semigroup of operators, mild solution technique for parabolic equations, viscosity solution method for HJB/HJI equations, stability analysis of numerical schemes for solving PDE or IE, convergence of value iteration schemes, marginalization technique in rare event simulation for hybrid processes, martingale formulation for Markov processes etc.

SELECTED PUBLICATIONS

Goswami, A. and Das M. K. (2019). Testing of Binary Regime Switching Models using Squeeze Duration Analysis. Int. J. Financ. Eng. 6 (2019), no. 1, 1950006 (20 pages)

Biswas, A., Goswami, A. and Overbeck, L.(2018). Option Pricing in a Regime Switching Stochastic Volatility Model. Statistics & Probability Letters. 138:116-126.

Das MK., Goswami, A. and Patankar T. (2018). Pricing Derivatives in a Regime Switching Market with Time Inhomogeneous Volatility. Stoch. Anal. Appl. 36(4):700-725.

Das, MK., Goswami, A. and Rana N. (2018). Risk Sensitive Portfolio Optimization in a Jump Diffusion Model with Regimes. SIAM J. Control Optim. 56(2):1550–1576.

Goswami, A., Patel, J. and Sevgaonkar, P. (2016). A system of non-local parabolic PDE and application to option pricing. *Stoch. Anal. Appl.* 34(5):893-905.

Goswami, A. and Nandan, S. (2016). Convergence of estimated option price in a regime switching market. *Indian Journal of Pure and Applied Mathematics* 47(2), 169-182

Atar, R., Goswami, A. and Shwartz, A. (2014). On the risk-sensitive cost for a Markovian multiclass queue with priority. *Electronic Communications in Probability* 19(11):1-13.

Atar, R., Goswami, A. and Shwartz, A. (2013). Risk-sensitive control for the parallel server model. *SIAM Journal on Control and Optimization* 51:4363-4386.

ANISA M H CHORWADWALA

Assistant Professor
anisa@iiserpune.ac.in

Anisa Chorwadwala received her PhD from University of Mumbai in 2007. Following this, she held postdoctoral positions at the Institute of Mathematical Sciences (IMSc), Chennai; Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy; and Tata Institute of Fundamental Research (TIFR), Mumbai. She has been on the faculty of IISER Pune since April 2011.

SHAPE OPTIMIZATION PROBLEMS

My research work falls mainly in the following two branches of Mathematics: Partial Differential Equations and Riemannian Geometry. There is a research area involving these two branches of Mathematics called Geometric Analysis. I work on Shape Optimization Problems. A typical shape optimization problem is to find a shape which is optimal in the sense that it minimizes a certain cost functional while satisfying given constraints. In many cases, the functional being minimized depends on the solution of a given partial differential equation defined on a variable domain.

We have solved some shape optimization problems for different classes of doubly connected domains over some Riemannian manifolds. We have considered both the energy minimization and the eigenvalue optimization problems for Dirichlet Boundary Value Problems involving the Laplace Beltrami Operator and also for a nonlinear operator, namely the p-Laplacian for the Euclidean case.

SELECTED PUBLICATIONS

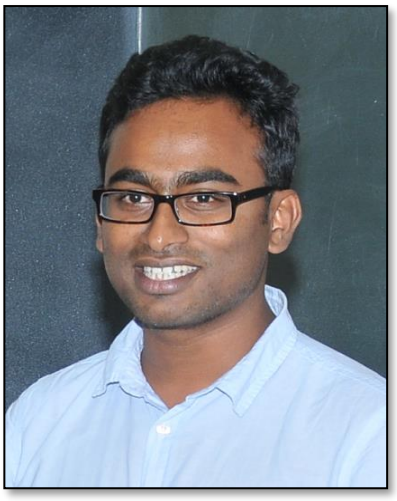
Anisa M. H. Chorwadwala and M. K. Vemuri, "Two functionals connected to the Laplacian in a class of doubly connected domains on rank one symmetric spaces of non-compact type", *Geometriae Dedicata,* Vol 167, Issue 1, December 2013, pp. 11-21. DOI: 10.1007/s10711-012-9800-7.

Anisa Chorwadwala, Rajesh Mahadevan and Francisco Toledo, "On the Faber-Krahn Inequality for the Dirichlet p-Laplacian", *ESAIM: Control, Optimization and Calculus of Variations*, Vol 21, Issue 1, 2015, pp. 60-71. DOI: 10.1051/cocv/2014017.

Anisa Chorwadwala and Rajesh Mahadevan, "An eigenvalue optimisation problem for the p-Laplacian", *Proceedings of the Royal Society of Edinburgh: Section A Mathematics*, Vol 145, Issue 6, 2015, pp. 1145-1151. DOI: 10.1017/S0308210515000232.

Anisa M H Chorwadwala, "A glimpse of Shape Optimization Problems", CURRENT SCIENCE, VOL. 112, NO. 7, 10 APRIL 2017. doi:10.18520/cs/v112/i07/1474-1477.

Anisa M. H. Chorwadwala and Souvik Roy, "How to Place an Obstacle Having a Dihedral Symmetry Inside a Disk so as to Optimize the Fundamental Dirichlet Eigenvalue", Journal of Optimization Theory and Applications, Springer Nature, Volume 184, Number 1, January 2020, pp. 162-187. doi: 10.1007/s10957-019-01483-1.



ANUP BISWAS

Associate Professor and Co-Chair
anup@iiserpune.ac.in

Anup Biswas received his PhD from TIFR-Centre for Applicable Mathematics, Bangalore, India in 2011. He held postdoctoral positions at Technion, Israel, and University of Texas, Austin, USA before joining IISER Pune.

STOCHASTIC CONTROLS AND QUEUEING THEORY

My broad research area falls under Applied Probability. I am mainly interested in stochastic controls, small noise diffusion, asymptotics of queueing networks and many other related models.

In the last couple of years, I have worked on problems from queueing theory that involves measure-valued process. Such processes have proven powerful in modeling queueing networks with general service and reneging distributions. Another important area of queueing theory is scheduling control where one looks for a policy that optimizes certain cost associated to the model. I also work on such control problems.

SELECTED PUBLICATIONS

Biswas, A., Hitoshi, I., Subhamay, S. and Lin, W. (2017). On viscosity solution of HJB equations with state constraints and reflection control. *SIAM J. of Control and Optimization* 55(1):365-396.

Arapostathis, A., Biswas, A. and Johnson, C. (2017). On solutions of mean field games with ergodic cost. *Journal de Mathematiques Pures et Appliquees* 107:205-251.

Arapostathis, A., Biswas, A. and Luis, C. (2016). The Dirichlet problem for stable-like operatorsand related probabilistic representations. *Communications in PDE* 41(9):1472-1511.

Arapostathis, A., Biswas, A. and Pang, G. (2015). Ergodic control of multi-class M/M/N+M queues in the Halfin-Whitt regime. *Annals of Applied Probability* 25(6):3511-3570.

Atar, R., Biswas, A. and Kaspi, H. (2015). Fluid limits of G/G/ 1+G queues under non-preemptive Earliest-Deadline-First discipline. *Mathematics of Operation Research* 40(3):683-702.

Biswas, A. (2014). Risk-sensitive control for the multiclass many-server queues in the moderate deviation regime. *Mathematics of Operation Research* 39(3):908-929.

Atar, R. and Biswas, A. (2014). Control of the multiclass G/G/1 queue in the moderate deviation regime. *Annals of Applied Probability* 24(5):2033-2069.

ANUPAM KUMAR SINGH

Associate Professor
anupam@iiserpune.ac.in

After doing MSc (Mathematics) from Indian Institute of Technology (IIT) Kanpur, Anupam Singh worked for his doctorate at Harish Chandra Research Institute, Allahabad and Indian Statistical Institute (ISI), Bangalore, India and got PhD from ISI in 2007. He held postdoctoral positions at Tata Institute of Fundamental Research (TIFR), Mumbai and Institute of Mathematical Sciences (IMSc), Chennai, India before joining the faculty of IISER Pune in 2008.

CONJUGACY QUESTIONS AND REPRESENTATION THEORY OF GROUPS

Conjugacy questions in group theory have been of interest for its connection with the representation theory and they have not been understood very well for Algebraic Groups over arbitrary field. Usually groups are difficult objects and one studies them via their representations to get a better understanding.

Let G (e.g. GL_n) be an algebraic group defined over a field k. We denote the k points of G by G(k) (e.g. GL_n (k) , SL_n(k) etc.). An element t of G (k) is said to be real if it is conjugate to its own inverse in G(k). I have been concerned with finding real elements in algebraic groups. Very interestingly often it relates to finding strongly real elements (the elements which are product of two involutions in G(k)).
Apart from studying structure of real elements in Algebraic Groups over k, I also looked at many examples such as linear groups, orthogonal groups, symplectic groups and the groups of type G_2 to get better understanding of the problem. Finding real elements helps in the understanding of real characters of the group which in turn give information about those complex representations of the group which are either orthogonal or symplectic.

SELECTED PUBLICATIONS

Gates, Z., Singh, A. and Ryan Vinroot, C. Strongly real classes in finite Unitary groups of odd characteristic. To appear in the *Journal of Group Theory*.

Kulshrestha, A. and Singh, A. (2011). Real elements and Schur indices of a group. *The Mathematics Student* 80:73-84.

Gill, N. and Singh, A. (2011). Real and strongly real classes in $PGL_n(q)$ and quasi-simple covers of $PSL_n(q)$. *Journal of Group Theory* 14: 461-489.

Gill, N. and Singh, A. (2011). Real and strongly real classes in $SL_n(q)$. *Journal of Group Theory* 14:437-459.

AYAN MAHALANOBIS

Assistant Professor
ayanm@iiserpune.ac.in

Ayan Mahalanobis obtained his PhD from Florida Atlantic University, Boca Raton, USA in 2005. He was a Visiting Assistant Professor at the Stevens Institute of Technology, New Jersey, USA for a few years before joining IISER Pune in 2009.

PUBLIC KEY CRYPTOGRAPHY

I work at the intersection of pure mathematics (group theory) and public key cryptography. Cryptography, especially public key cryptography, is the backbone of a modern society. It serves us with the required tools for online transactions and trading, *i.e.*, online commerce.

My research aims to find new cryptograhic primitives and to build secure protocols from that. We look for groups in which the discrete logarithm problem is secure. My recent work has shown that the group of non-singular circulant matrices over a finite field has some properties that make them attractive over the discrete logarithm problem on a finite field. This new finding has opened a new avenue in research of public key cryptography.

SELECTED PUBLICATIONS

Mahalanobis, A. The ElGamal cryptosystem over circulant matrices (Submitted).

Mahalanobis, A. and Shah, J. (2014). A new guess-and-determine attack on the A5/1 stream cipher. *Computer and Information Science* 7(1):115-124.

Mahalanobis, A. (2013). Are matrices useful in public-key cryptography? *International Mathematical Forum* 8(39):1939-1953.

Mahalanobis, A. The MOR cryptosystem and extra-special p-groups. Proceedings of WCC 2012, Castro Urdiales, Spain July 9-13, 2012 & To appear in *Journal of Discrete Mathematics and Cryptography*.

Mahalanobis, A. (2013). The automorphism group of the group of unitriangular matrices over a field. *International Journal of Algebra* 7(15):723-733.

Mahalanobis, A. (2012). A simple generalization of the ElGamal cryptosystem to non-abelian groups II. *Communications in Algebra* 40:3583-3596.

Mahalanobis, A. (2010). The discrete logarithm problem in the group of non-singular circulant matrices. *Groups Complexity Cryptology* 2:83-89.

BASKAR BALASUBRAMANYAM

Associate Professor
baskar@iiserpune.ac.in

Baskar Balasubramanyam completed his PhD from Brandeis University, USA in 2007. In 2007-08, he was a postdoctoral fellow at the Center for Advanced Study in Mathematics at the Ben-Gurion University of the Negev in Israel. Following this, he was a Bateman Instructor at California Institute of Technology, USA during 2008-10. He has been with IISER Pune since September 2010.

MODULAR FORMS AND GALOIS REPRESENTATIONS

My research interests are in Number Theory. A modular form is essentially a function defined on the complex upper half-plane (everything above the real axis) that behaves in a good way under transformations of certain 2x2 matrices with integer entries. The expansion at infinity of such a function gives us a power series whose coefficients have interesting arithmetic properties. An important example of numbers that arise in such a way is the Ramanujan Tau function $\tau(n)$. In order to understand these coefficients, it is useful to consider an object attached to it called the *L*-function (these are generalizations of the Riemann zeta function).

A Galois group is a set of permutations of roots of an irreducible polynomial. For example, complex conjugation permutes the roots of x^2+1. It is possible to represent such permutations by matrices. One of the problems in Number Theory is to try and understand the Galois group by studying its representations. One can also attach *L*-functions to Galois representations and in some cases modular forms and Galois representations are related through their *L*-functions.

SELECTED PUBLICATIONS

Balasubramanyam, B. and Raghuram, A. Special values of adjoint *L*-functions and congruences for automorphic forms on *GL*(*n*) over a number field *American Journal of Mathematics* (To appear).

Balasubramanyam, B., Ghate, E. and Vatsal, V. (2013). On local Galois representations over totally real fields. *Manuscripta Mathematica* 142:513-524.

Balasubramanyam, B. and Longo, M. (2010). $\wedge$-adic modular symbols over totally real fields. *Commenterii Mathematici Helvetici* 86:841-865.

CHANDRASHEEL BHAGWAT

Associate Professor
cbhagwat@iiserpune.ac.in

Chandrasheel Bhagwat completed his PhD in Mathematics from TIFR, Mumbai, India in 2011 and spent a few months as a post-doctoral fellow at IISER Pune. He has received the DST-INSPIRE faculty award and research grant in 2011 and has joined IISER Pune as INSPIRE Faculty in March 2012. From December 1, 2014 till January 29, 2020, he has worked as an Assistant Professor at IISER Pune and as an Associate Professor at IISER Pune from January 30, 2020.

REPRESENTATION THEORY, ANALYSIS & GEOMETRY OF LOCALLY SYMMETRIC SPACES, NUMBER THEORY

Broadly speaking, my recent work is in the following areas in mathematics: **(a) Automorphic forms and arithmetic of L-functions and (b) Harmonic Analysis on symmetric spaces and Graphs**.

In a recent joint work with Prof. Raghuram, we have proved a theorem on special values for degree 2n-automorphic L-function for Orthogonal group O(2n+2) using techniques like Eisenstein Cohomology and Langlands' theorem on constant term. Our result that the ratios successive critical values of the L-function are 'rational' and Galois equivariant in a suitable sense. My current graduate student Sudipa is working on problems on estimation of cuspidal cohomology on Symmetric power transfer for GL_2.

In another recent work with my graduate student Dr. Ayesha Fatima, we established analogues of Multiplicity one Theorems for periodic graphs. I have also worked on some problems in Spectral Graph Theory with Prof. G. Ambika, Dr. Snehal Shekatkar and Amol Hinge.

Previously, I have proved theorems about L^2-spectrum for discrete subgroups of Lie groups (jointly with Prof. C. S. Rajan, Dr. Supriya Pisolkar). My present fifth year MS thesis student Nazia V. and me are currently working on some other problems related to harmonic analysis on p-adic symmetric spaces.

SELECTED PUBLICATIONS

Bhagwat C. and Ayesha Fatima, *On The Length Spectra of Simple Regular Periodic Graph*, Accepted for publication in Journal of Ramanujan Mathematical Society, 2019 (arxiv link: arXiv:1711.07706)

Bhagwat C., Raghuram A., *Special values of L-functions for orthogonal groups*, Comptes Rendus Mathematique, 355 (3), p. 263-267, 2017, arxiv link: arXiv:1607.04991

Bhagwat C., Raghuram A., *Endoscopy and the cohomology of GL(N)*, Volume 43, Issue 4 (Special Issue), August 2017, Page 317-335, 2017, arxiv link: arXiv:1506.01941

Bhagwat C., Pisolkar S., *On uniform lattices in real semisimple groups*, Proc. Amer. Math. Soc. 144(7) , p. 3151-3156, 2016, arxiv link: arXiv:1507.00653 Shekatkar S. M., Bhagwat C., Ambika G., *Divisibility patterns of natural numbers as a complex network*, Scientific Reports , 5:14280, 2015, arxiv link: arXiv:1505.01694

CHITRABHANU CHAUDHURI

INSPIRE Faculty
chitrabhanu@iiserpune.ac.in

Chitrabhanu did his PhD in Mathematics from Northwestern University 2007-2013 and was a postdoctoral fellow at Max Plank Institute for Mathematics (2013-2014) before joining IISER Pune.

TOPOLOGY AND GEOMETRY OF MODULI OF CURVES

The Moduli of Curves parametrizes algebraic curves or Riemann surfaces up to isomorphism. It has been a central topic in mathematical research for several decades and brings various fields of mathematics together, for example Algebraic Geometry, Geometric Group theory and Enumerative geometry. It has important connections with physics as well.

Recently in collaboration with Debargha Banerjee and Diganta Borah we studied aspects of Arakelov geometry of certain moduli spaces of elliptic curves. This work has applications in Number theory, specifically the theory of Modular forms.

SELECTED PUBLICATIONS

Stable arithmetic self-intersection of Modular Curves $X_0(p^2)$; with Debargha Banerjee, submitted.
Self intersection of relative dualizing sheaf for minimal regular model of modular curve $X_0(p^2)$; with Debargha Banerjee and Diganta Borah, Submitted.
Equivariant cohomology of certain moduli of weighted pointed rational curves; Manuscripta Math. 150 (2016), no. 1-2, 137-150.
The Cohomological Excess of Certain Moduli Spaces of Curves of Genus g; IMRN 2015, no. 4, 1056-1074.

DEBARGHA BANERJEE

Associate Professor
debargha@iiserpune.ac.in

Debargha Banerjee received his PhD degree from Tata Institute of Fundamental Research, Mumbai. He earned his Master's degree in Mathematics from Indian Statistical Institute and BSc from St Xavier's College, Kolkata. He got the Australian Research council Discovery postdoctoral fellowship for 2 years at the Australian National University, Canberra, Australia. He was a visiting scientist at the IMSC, Chennai, India and later a guest scientist at the Max Planck institute of Mathematics, Bonn, Germany before joining IISER Pune in November 2013.

AUTOMORPHIC FORMS AND ARITHMETIC

In arithmetic geometry, we study the integral solutions of polynomial equations. We usually work over non-algebraically closed fields, and often in fields of non-zero characteristic (like finite fields), and we may even restrict ourselves even to rings that are not a field (like integers). We use the rich theory of modular forms (more generally, automorphic representations) to find these solutions.

Modular/Automorphic forms are generalizations of the periodic functions. The theory of modular forms made major contributions in several important discoveries in modern mathematics, including the uniform boundedness of torsion point of elliptic curves.

I am interested in understanding objects in geometry called "motives" and objects in analysis called automorphic representations. The overarching bridge/conjecture of Langlands connects these two fairly faraway worlds. I am interested in understanding the integral and p-adic bridges that connect these two beautiful universes.

In the automorphic universe, I wish to focus on modular symbols and special values of L-functions (one of the main objects of study in the Langlands' program). Motives can be described by different cohomology theories. I wish to understand and use different cohomology theories using modular symbols, which in turn give insights into special values of L-functions.

SELECTED PUBLICATIONS

Differential modular forms on the Shimura curves over totally real fields, *Journal of Number theory*.
http://www.sciencedirect.com/science/article/pii/S0022314X13002412

The Eisenstein elements for level product of two odd primes, joint with S. Krishnamoorthy, the *Pacific Journal of Mathematics*, Vol. 281, No. 2, 2016

The Eisenstein cycles as modular symbols, joint with Loic Merel, *the Journal of the London Mathematical Society*:
https://londmathsoc.onlinelibrary.wiley.com/doi/full/10.1112/jlms.12136

Supercuspidal ramifications and traces of adjoint lifts, joint with Tathagata Mandal, *Journal of Number theory*:
https://www.sciencedirect.com/science/article/pii/S0022314X19300939?via%3Dihub

A note on quadratic twisting of epsilon factors for modular forms with arbitrary nebentypus, joint with Tathagata Mandal. To appear in the *Proceedings of the American Mathemical Society*

Semi-stable models of modular curves $X_0(p^2)$ and some arithmetic applications, joint with Chitrabhanu Chaudhuri. To appear in the Israel Journal of Mathematics

Self intersection numbers of minimal regular models of modular curves $X_0(p^2)$ over rational numbers, joint with Diganta Borah and Chitrabhanu Chaudhuri, to appear in the journal Mathematische Zeitschrift

DIGANTA BORAH

Associate Professor
dborah@iiserpune.ac.in

Diganta Borah received his PhD from the Indian Institute of Science (IISc), Bangalore, India in 2010 and was a Research Associate there until 2011. He joined IISER Pune in January 2012.

SEVERAL COMPLEX VARIABLES

My research interests are in complex analysis, more specifically in several complex variables. Several complex variables is the study of holomorphic functions defined on domains in $\mathbf{C}^n$, or more generally on complex manifolds. The subject established itself as a new independent area of research in the early twentieth century when F. Hartogs discovered a surprising extension phenomenon in the theory of functions of several complex variables which is absent in the theory in one variable. In the complex plane, every domain is a domain of holomorphy, i.e., there exists a holomorphic function on the domain which has no holomorphic extension to a strictly larger domain. Hartogs showed that this is no longer true in higher dimension. Another astonishing feature of several complex variables is the absence of the Riemann mapping theorem which was discovered by Poincare around the same time by showing that the unit ball and the unit polydisc in $\mathbf{C}^n$, $n \geq 2$, are not biholomorphic though both of them are simply connected.

In the past, I investigated several questions related to the Robin metric on bounded pseudoconvex domains in $\mathbf{C}^n$, capacity metric on planar domains, and the multidimensional Suita conjecture. Some of my current projects are to understand a class of weighted Bergman metrics, the volume elements of Carathéodory and Kobayashi-Eisenman, and various aspects of the squeezing function and its dual Fridman invariant.

SELECTED PUBLICATIONS

(With G.P. Balakumar, P. Mahajan and K. Verma) Remarks on the higher dimensional Suita conjecture, accepted for publication in the Proceedings of the AMS.
(With P. Haridas and K. Verm-a) Comments on the Green's function of a planar domain, Anal. Math. Phys. 8 (2018), 383–414. Remarks on the metric induced by the Robin function II, Michigan Math. J. 62 (2013), 581–630.
(With K. Verma) Remarks on the metric induced by the Robin function, Indiana Univ. Math. J. 60 (2011), no. 3, 751–802.

KANEENIKA SINHA

Associate Professor
kaneenika@iiserpune.ac.in

Kaneenika Sinha completed her PhD from Queen's University, Canada in 2006. She has held postdoctoral fellowships at University of Toronto, University of Alberta and Mathematical Sciences Research Institute, Berkeley. She was an assistant professor in IISER Kolkata before joining IISER Pune in December 2012.

ANALYTIC NUMBER THEORY, HARMONIC ANALYSIS AND ARITHMETIC GEOMETRY

My primary research interests are number theory and arithmetic geometry. One of my primary goals is to investigate statistical phenomena in the distribution of sequences that arise from the theory of modular forms, zeta functions of curves over finite fields and eigenvalues of adjacency matrices of certain kinds of graphs.

Take an irrational number T, look at its multiples T, 2T, 3T, etc. and record the sequence of its decimal parts. Weyl discovered that each and every part of the interval [0,1) gets its fair share of elements from the sequence. That is, this sequence is equidistributed in the interval [0,1). In showing this, Weyl discovered and outlined a beautiful technique that was capable of answering generalizations of this question in a wider paradigm. This technique relates the phenomenon of equidistribution to that of studying what are called exponential sums in number theory and places this phenomenon in a wider landscape of harmonic analysis.

Many sequences arising in number theory follow a distribution pattern that can be defined by elegant functions. One of the major breakthroughs in recent times is the discovery that certain sequences arising from the Fourier coefficients of modular forms (certain complex-analytic functions with rich inner symmetries and growth conditions) follow the Sato-Tate law.

My primary research work focuses on equidistribution of various such families and sequences arising in the context of modular forms, arithmetic geometry and graph theory. I am investigating deeper statistical phenomena associated with such families, for example fluctuations in the distribution and pair correlation.

SELECTED PUBLICATIONS

Deterministic completion of rectangular matrices using Ramanujan bigraphs - II: Explicit constructions and phase transitions, Shantanu Prasad Burnwal, Mathukumalli Vidyasagar and Kaneenika Sinha, submitted

Central limit theorems for elliptic curves and modular forms with smooth weight functions, Stephan Baier, Neha Prabhu and Kaneenika Sinha, Journal of Mathematical Analysis and Applications, 485 (2020), no. 1, (Article no. 123709)

Pair correlation statistics for Sato-Tate sequences, Baskar Balasubramanyam and Kaneenika Sinha, Journal of Number Theory, Vol. 202 (September, 2019), 107-140

Fluctuations in the distribution of Hecke eigenvalues about the Sato-Tate measure, Neha Prabhu and Kaneenika Sinha, International Mathematics Research Notices, Vol. 2019, Issue 12, 3768-3811

The generalized Dedekind determinant, M. Ram Murty and Kaneenika Sinha, SCHOLAR, Contemporary Mathematics, Vol. 655 (2015), 153-164

KRISHNA KAIPA

Associate Professor
kaipa@iiserpune.ac.in

Krishna Kaipa obtained a BTech from IIT Bombay and an MS degree from University of Maryland College Park, both in Mechanical Engineering. He then pursued a PhD in Mathematics from University of Maryland, College Park. He held assistant professor positions at IIT Bombay and IISER Bhopal before moving to IISER Pune in 2014.

CODING THEORY AND COMBINATORICS

My research in recent years focuses on some fundamental open problems in the theory of Error Correcting Codes (Coding Theory). One such problem is the resolution of the MDS conjecture in finite algebraic geometry. Another problem is to establish the analytical properties like convexity and differentiability for the asymptotic information rate function for codes, as well as to improve on the best known upper and lower bounds for this function.

To motivate the MDS conjecture, consider k by n matrices over a finite field with q elements (say q is odd) such that all k by k minors of this matrix are nonzero. let us call such a matrix MDS.

Question: What can we say about 3 by q+1 MDS matrices?
Beniamino Segre showed that any such matrix is row equivalent to a matrix whose columns lie on the conic $y^2 = xz$.

Question: Do there exist k by q+2 MDS matrices when k <q?
The negative answer to this question is the MDS conjecture.

SELECTED PUBLICATIONS

An improvement of the asymptotic Elias bound for non-binary codes , IEEE Transactions on Information Theory, vol. 64, Issue 7, 2018.

Deep holes and MDS extensions of Reed-Solomon codes, IEEE Transactions on Information Theory, Vol. 63, Issue 8, 2017.

With P. Beelen, T. Hoholdt and D. Glynn. Counting Generalized Reed-Solomon codes. Advances in the Mathematics of Communication, Volume 11, Issue 4, 2017

With I. Cardinali, L. Giuzzi, and A. Pasini (2016). Line polar Grassmann codes of orthogonal type. Journal of Pure and Applied Algebra, 220(5):1924-1934.

MAINAK PODDAR

Professor
mainak@iiserpune.ac.in

Mainak Poddar obtained his PhD in 2001 from the University of Wisconsin-Madison. He held postdoctoral positions at Michigan State University and the University of Waterloo. Before joining IISER Pune, he has been a faculty member at the Indian Statistical Institute Kolkata, the Los Andes University in Bogota and the Northern Cyprus Campus of the Middle East Technical University.

GEOMETRY AND TOPOLOGY

I work mainly at the interface of complex algebraic geometry, symplectic geometry and differential topology. A significant part of my work is devoted to the impact of symmetries on geometric invariants. Often these invariants are of quantum type like Floer homology or Chen-Ruan cohomology. My recent work focuses on (equivariant) vector and principal bundles. I have also become very interested in generalized complex geometry.

SELECTED PUBLICATIONS

Poddar, M. and Thakur, A. S. (2018). Group actions, non-Kahler complex manifolds and SKT structures. Complex Manifolds 5, 9-25.

Biswas, I., Dey, A. and Poddar, M. (2018). On equivariant Serre problem for principal bundles. Internat. J. Math. 29, no. 9, 1850054, 7 pp.

Biswas, I., Dey, A. and Poddar, M. (2016). Equivariant principal bundles and logarithmic connections on toric varieties. Pacific J. Math. 280, no. 2, 315–325.

Cho C.-H. and Poddar, M. (2014). Holomorphic orbi-discs and Lagrangian Floer cohomology of symplectic toric orbifolds. J. Differential Geom. 98, no. 1, 21–116.

MANISH MISHRA

Assistant Professor
manish@iiserpune.ac.in

Manish Mishra did his B.Tech. in Materials & Metallurgical Engineering from Indian Institute of Technology (IIT) Kanpur. He then moved to mathematics. He got his Ph.D. in mathematics in 2013 from Purdue University, USA. He then held postdoctoral positions at the Hebrew University of Jerusalem, Israel and the Heidelberg University, Germany. He joined IISER Pune in August 2016.

LOCAL LANGLANDS PROGRAM, REPRESENTATION THEORY OF REDUCTIVE GROUPS OVER LOCAL FIELDS

One way of defining number theory is that it is the study of the existence of rational solutions of polynomials equations defined over integers. This amounts to studying the absolute Galois group Γ of the field of rational numbers. The group Γ is very large and is difficult even to write down particular elements of it. One studies it by studying its action on linear spaces, i.e., by studying its space of representations. The Langlands program is a scheme of organizing this vast information. It relates Galois representations with certain, more concretely defined, analytic objects called automorphic representations from which arithmetic information can be extracted. Important applications of the Langlands program to some of the famous problems in number theory include the Artin's conjecture on L-functions, Fermat's Last Theorem, the Sato-Tate conjecture, and the behavior of Hasse-Weil zeta functions.

The conjectures within the Langlands program are quite precise and technical. My current research is about the local Langlands program. The projects I am working on are about/related to – study of Hecke algebras associated to Bernstein blocks and the centers of these blocks, describing Langlands-Shelstad transfer via Hecke algebra morphisms, ABPS conjecture and the stable Bernstein center conjecture.

SELECTED PUBLICATIONS

(with Jeffrey Adler) Regular Bernstein blocks, arXiv:1909.09966, submitted
(with Jeffrey Adler) Self-dual cuspidal representations, Representation Theory of the AMS, to appear
(with Amy Philip) A generalization of the 3d distance theorem, Archiv der Mathematik, (2020), DOI: 10.1007/s00013-020-01450-7 .
(with Bertrand Lemaire) Matching of orbital integrals (geometric transfer) and Roche Hecke algebra isomorphisms, Compositio Mathematica, Vol. 156, No. 3 (2020), 533-603
Bernstein center of supercuspidal blocks, Journal für die reine und angewandte Mathematik (Crelle's Journal), Vol. 748 (2019), 297-304
(with Basudev Pattanayak) A note on depth preservation, Journal of the Ramanujan Mathematical Society, Vol. 34, No.4 (2019), 393–400
(with Mirko Rösner) Genericity under parahoric restriction, Manuscripta Mathematica, Vol. 152 (2017), No. 1-2, 241-245
Generic representations in L-Packets, International Journal of Number Theory, Vol. 12, No. 6 (2016), 1613–1624
Langlands parameters associated to special maximal parahoric spherical representations, Proceedings of the American Mathematical Society, Vol. 143 (2015), 1933-1941
A Galois side analogue of a theorem of Bernstein, Journal of the Ramanujan Mathematical Society, Vol. 30, No. 4 (2015), 397-402

MOUSOMI BHAKTA

Associate Professor
mousomi@iiserpune.ac.in

Mousomi Bhakta received her PhD from TIFR-Centre for Applicable Mathematics, Bangalore, India in August, 2011. After that she held visiting scientist position in ICTP, Trieste, Italy for two months. Next, she had postdoctoral positions at Technion, Israel for two years and University of New England, NSW, Australia for a year before joining IISER Pune in August 2014.

ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS

My research interest includes local and nonlocal type semilinear and quasilinear elliptic partial differential equations and system of equations arising from geometry and physics. I study existence/nonexistence of positive/sign-changing solutions, qualitative properties of solutions, various estimates of solutions and asymptotic analysis of the profile of solutions using the techniques from nonlinear analysis. Another important area of my research is studying elliptic equations (local and nonlocal type) with measure data and generalized boundary trace.

SELECTED PUBLICATIONS

Bhakta, M.; Nguyen, P. T., Boundary value problems with measures for fractional elliptic equations involving source nonlinearities, (submitted) arXiv:1801.01544

Bhakta, M.; Nguyen, P. T., On the existence and multiplicity of solutions to fractional Lane-Emden elliptic systems involving measures, (submitted) arXiv:1809.07909

Bhakta, M.; Mukherjee, D., Nonlocal scalar field equations: qualitative properties, asymptotic profiles and local uniqueness of solutions, to appear in J. Differential Equations. (2019).

Bhakta, M.; Mukherjee, D., Multiplicity results for (p, q) fractional Laplace equations involving critical nonlinearities, Adv. Differential Equations Volume 24, Numbers 3-4 (2019), 185-228.

Bhakta, M.; Mukherjee, D. and S. Santra, Profile of solutions for nonlocal equations with critical and supercritical nonlinearities Commun. Contemp. Math. Vol. 21, No. 1 (2019).

Bhakta, M.; Santra, S., On singular equations with critical and supercritical exponents. J. Differential Equations 263 (2017), no. 5, 2886–2953.

Bhakta, M; Mukherjee, D., Multiplicity results and sign changing solutions of non-local equations with concave-convex nonlinearities. Differential Integral Equations 30 (2017), no. 5-6, 387–422.

Bhakta, M.; Marcus, M., Semilinear elliptic equations admitting similarity transformations. J. Funct. Anal. 267 (2014), no. 10, 3894–3930.

Bhakta, M.; Marcus, M., Reduced limit for semilinear boundary value problems with measure data. J. Differential Equations 256 (2014), no. 8, 2691–2710.

Bhakta, M.; Musina, R., Entire solutions for a class of variational problems involving the biharmonic operator and Rellich potentials. Nonlinear Anal. 75 (2012), no. 9, 3836–3848.

Bhakta, Mousomi; Sandeep, K. Poincaré-Sobolev equations in the hyperbolic space. Calc. Var. Partial Differential Equations 44 (2012) No. 1-2, 247–269.

RABEYA BASU

Associate Professor
rbasu@iiserpune.ac.in

Rabeya Basu received her PhD from Tata Institute of Fundamental Research (TIFR), Mumbai, India in 2007. She then undertook postdoctoral work initially at Harish Chandra Research Institute, Allahabad and later as an NBHM Fellow at the Indian Statistical Institute, Kolkata, India. She was in IISER Kolkata as an assistant professor before joining IISER Pune in 2010.

CLASSICAL ALGEBRAIC K-THEORY

My work is based on problems in classical K-theory which are related to Serre's problem on projective modules. This famous theorem says that finitely generated projective modules over a polynomial ring over field are free. This involves problems in lower K-theory, in particular study of the Whitehead group $K1$ due to Hyman Bass, which generalizes the group of units of a ring. Initially, these problems were studied for the general linear groups. Then people started generalizing those results for other classical groups and also for the relative cases. At present, I am working on similar problems for the general quadratic and the general Hermitian groups introduced by Anthony Bak. In addition, I am also trying to study few such problems for the higher K-groups.

Recently, I have developed my interest in a very newly developed subject, viz. Leavitt path algebras (LPA), which is making a bridge between algebra and functional analysis. In the future, I would like to work on the algebraic and K-theoretic aspects of LPA.

SELECTED PUBLICATIONS

R. Basu; Local-Global Principle for the General Quadratic and the General Hermitian Groups and the Nilpotence of KH_1. Zap. Nauchn. Sem. S.-Peterburg. Otdel. Mat. Inst. Steklov. (POMI) 452 (2016), Voprosy Teorii Predstavleniĭ Algebr i Grupp. 30, 5—31; English Translation in J. Math. Sci. (N.Y.) 232 (2018), no. 5, 591–609.

R. Basu; On Transvection Subgroups of General Quadratic Modules. Journal of Algebra and Its Application. Vol. 17, No. 11, 1850217 (2018).

R. Basu, Ravi A. Rao, Reema Khanna; Pillars of relative Quillen--Suslin Theory. (Partially accepted for the book "Leavitt Path Algebras and K-theory", ISI Series, Springer)

R. Basu, Manish Kumar Singh; On Quillen--Suslin Theory for Classical Groups; Revisited over Graded Rings. (Accepted in Contemporary Math. Volume in honor of Professor S.K. Jain.)

RAMA MISHRA

Professor
r.mishra@iiserpune.ac.in

Rama Mishra has obtained her PhD from Indian Institute of Technology (IIT) Bombay, India in 1994. She spent a few years with Harish Chandra Research Institute, Allahabad and Indian Statistical Institute, Delhi as a postdoctoral fellow and then served as a faculty at IIT Kharagpur and IIT Delhi for several years. She worked as a JSPS fellow at Osaka City University, Japan for a year and as a visiting faculty at Boise State University, USA before joining IISER Pune.

LOW DIMENSIONAL TOPOLOGY

Quantum topology is one of the emerging research areas. Many knot invariants naturally arise through nice matrix algebra representation of interesting quantum groups. They have been related to several models in statistical mechanics. I would like to explore some models that are related to Singular knot theory.

I am also interested in classical knot invariants and their application in mathematics and biological sciences. My joint work with Prof Louis Kauffman on *nodal parity invariants of knotted rigid vertex graphs* discusses the application of this invariant on protein folding classification. I am currently focusing on the following projects dealing with knots and links:

1) Represent knots by rational functions using least possible degree
2) Compute some of the quantum invariants such as Khovanov Homology and Colored Jones polynomials and their categorifications for as many families of knot as possible either by using simple techniques by hand or write effective programs that can perform the computations.
3) Develop some models for DNA as well as RNA/Proteins that can explain folding phenomenon and find a way to design drugs.

For (1) and (2), we use the tools from Real algebraic geometry and+ Representation Theory. For (3) besides understanding both the subjects knot theory and biology, we need some interaction with experimental biologists who can show us how to use electron microscopy so that we can observe knots in concrete situations.

SELECTED PUBLICATIONS

Constructing real rational knots by gluing, joint with Shane D'Mello, Topology and its applications, Vol. 237, 2018, Pages 67-81.

Some spaces of polynomial knots, joint with Hitesh Raundal, Topology and its applications, Vol. 218, 2017, Pages 66–92

Spaces of Polynomial knots in low degree, joint with Hitesh Raundal, Journal of knot theory and its Ramifications, Volume 24, Issue 14, December 2015

SOUMEN MAITY

Associate Professor
soumen@iiserpune.ac.in

Soumen Maity received a PhD from the Theoretical Statistics & Mathematics Unit at Indian Statistical Institute, Kolkata, India in 2002. He has postdoctoral experience from Lund University Sweden; Indian Institute of Management (IIM) Kolkata, India; and University of Ottawa, Canada. Prior to joining IISER Pune in 2009, he was at Indian Institute of Technology (IIT) Guwahati and Indian Institute of Technology (IIT) Kharagpur, India.

DISCRETE MATHEMATICS AND ALGORITHMS

Many problems we want to solve are often NP-hard or worse, but somehow, they need to get solved. What can we do? Over the years multiple paradigms for coping with NP-hardness have been introduced: for instance, approximation algorithms, average-case analysis, and randomized algorithms were all borne out of a desire to solve hard problems by relaxing the problem or strengthening the model.

Within the last 20 years, a new paradigm has been introduced, where one measures the time complexity of an algorithm not just in terms of the *input length* but also a small side *parameter*. A priori, the parameter can be anything, but the interesting case is when complex instances of the problem still have relatively small parameter values.

The overall goal is to identify interesting parameterizations of hard problems where we can design algorithms running in time polynomial in the input length but possibly exponential (or worse) in the small parameter. Such an algorithm is called "**fixed-parameter tractable**" and it is the gold standard for parameterized algorithms. We work on the parametrized complexity of fair feedback vertex set problem, the minimum neighbourhood problem, alliances on graphs problem, and satisfactory partition problems.

SELECTED PUBLICATIONS

Lawqueen Kanesh, Soumen Maity, Komal Muluk and Saket Saurabh, Parameterized Complexity of Fair Feedback Vertex Set Problem, Computer Science in Russia 2020, Lecture Notes in Computer Science (to appear)

Maity, S., Akhtar, Y., Chandrasekharan, R.C., and Colbourn, C.J., Improved strength four covering arrays with three symbols, Graphs and Combinatorics, Vol. 34, Issue 1, pp. 223-239, 2018

Akhtar, Y. and Maity, S., Mixed covering arrays on 3-uniform hypergraphs, Discrete Applied Mathematics , Vol. 232, pp. 8-22, 2017.

Akhtar, Y. and Maity, S., Covering Arrays on Product Graphs, Graphs and Combinatorics, Vol. 33, Issue 4, pp. 635-652, 2017.

STEVEN SPALLONE

Associate Professor
sspallone@iiserpune.ac.in

Steven Spallone received his PhD from the University of Chicago, USA in 2004. Afterwards he did postdoctoral work at the Max-Planck Institute in Bonn, at Purdue University, and at the University of Oklahoma, USA. He also visited the Tata Institute of Fundamental Research (TIFR) Mumbai, India. He joined the faculty of IISER Pune in July 2012.

SPIN STRUCTURES ON REPRESENTATIONS

A representation of a group on a vector space gives rise to a vector bundle. When does this vector bundle have a spin structure? My research group has answered this question for symmetric groups, for connected compact Lie groups, and for general linear groups over finite fields of odd characteristic. The relevant invariants here are the first and second Stiefel-Whitney classes in the mod 2 group cohomology. Currently, we are extending our results to related groups, and determining higher SW classes.

SELECTED PUBLICATIONS

J. Ganguly and S. Spallone, Spinorial Representations of Symmetric Groups, J. Algebra 544 (2020) 29-46.
D. Ghosh and S. Spallone, Determinants of Representations of Coxeter Groups, J. Algebraic Combin. 49(3) (2019), 229-265.
A. Ayyer, A. Prasad, and S. Spallone, Representations of symmetric groups with non-trivial determinant, J. Combin. Theory Ser. A 150 (2017) 208-232.

SUPRIYA PISOLKAR

Assistant Professor
supriya@iiserpune.ac.in

Supriya Pisolkar obtained her PhD degree from Harish Chandra Research Institute, Allahabad, India in 2010. She was a postdoctoral fellow at Tata Institute of Fundamental Research, Mumbai for about three years before joining IISER Pune in December 2013.

NUMBER THEORY, GALOIS COHOMOLOGY, ARITHMETIC ASPECTS OF SYMMETRIC SPACES

Broadly speaking, my area of research is number theory and I have been working on problems mostly related to local fields. My thesis deals with questions having a common theme of understanding behavior of norm maps in Galois extensions of local fields. As an application, I computed the Chow group of Zero-cycles of degree zero on Châtelet surfaces over local fields. This work relies on the work of Bloch, Swinnerton-Dyer, Colliot-Téllène, Sansuc.

In joint work with Dr A Hogadi, we proved a conjecture of Hesselholt which predicts the vanishing of the cohomology group $H^1(G(L/K), W(O_L))$ for a Galois extension of local fields L/K. This can be seen as an analogue of Hilbert theorem-90. In the future, I would like to work on generalizations of this result.

Over the last couple of years, I have also been fascinated by arithmetic aspects of locally symmetric spaces which are special type of manifolds. The theory of locally symmetric spaces is a beautiful amalgamation of theory of Lie groups, algebraic groups, analysis, differential geometry, representation theory. In a joint work with Prof CS Rajan and Dr C Bhagwat we have studied questions related to commensurability type problems of these spaces.

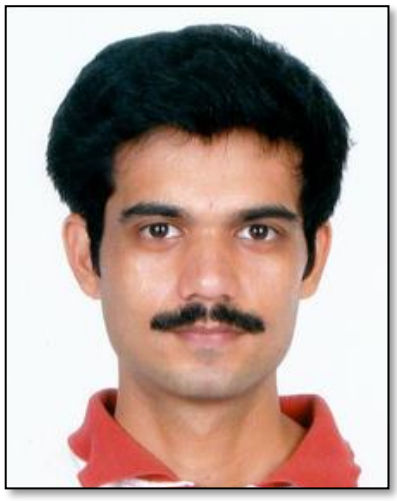
Currently, I am interested in understanding the work of Gopal Prasad and Rapinchuk which establishes a connection between arithmetic and geometric aspects of these spaces, giving rise to series of questions in this area.

SELECTED PUBLICATIONS

Pisolkar, S. and Rajan, C.S. (2016). On the splitting fields of generic elements in Zariski dense subgroups. *Journal of Algebra* 457:106-128.

Bhagwat, C.S. and Pisolkar, S. (2016). On uniform lattices in real semisimple groups. *Proceedings of the American Mathematical Society* 144, no. 7, 3151–3156.

Bhagwat, C., Pisolkar, S. and Rajan, C.S. (2014). Commensurability and representation equivalent arithmetic lattices. *International Mathematical Research Notices International Mathematical Research Notices* No. 8:2017–2036.



TEJAS KALELKAR

Assistant Professor
tejas@iiserpune.ac.in

After completing his MSc from Indian Institute of Technology, Bombay, Tejas Kalelkar got his PhD from Indian Statistical Institute, Bangalore in 2010. He was then a postdoctoral fellow at Institute of Mathematical Sciences, Chennai and a Chauvenet Postdoctoral Fellow at the Washington University in St Louis, USA. He joined IISER Pune in December 2013.

LOW DIMENSIONAL TOPOLOGY

My area of research is low-dimensional topology. This is a very active area of research with several longstanding conjectures proved fairly recently, like Thurston's Geometrization conjecture (which implies the Poincare conjecture) and the Virtual Fibering conjecture. Within low-dimensional topology I focus mainly on foliations, triangulations and Heegaard splittings of 3-dimensional manifolds.

A closed book looks like a solid 3-dimensional object, but on closer analysis is observed to consist of 2-dimensional pages stacked tightly together. Similarly, every 3-manifold can be built by stacking 2-dimensional surfaces tightly together into what is called a foliation. I am studying a special class of foliations called taut foliations which tell us useful topological properties of the 3-manifold.

On cutting open a 3-manifold along a special embedded surface, called the Heegaard-splitting surface, we end up with two simple pieces called handlebodies. Every closed 3-manifold has such a splitting surface which may not be unique. I am currently working on a structure for these splitting surfaces when a 3-manifold has infinitely many of them.

Every 3-manifold can be built by suitably sticking tetraheda together. Normal surfaces are surfaces embedded particularly `nicely' with respect to such a triangulation. I have proved several results using normal surfaces, such as a weak converse of Haken's well-known result about normality of incompressible surfaces with respect to every triangulation of the 3-manifold.

SELECTED PUBLICATIONS

Kalelkar, T. and Phanse, A. An upper bound on Pachner moves relating geometric triangulations (submitted)

Kalelkar, T. and Roberts, R. (2015). Taut foliations in surface bundles with multiple boundary components. *Pacific Journal of Mathematics* 273(2):257-275.

Gadgil, S. and Kalelkar, T. (2013). A Chain complex and Quadrilaterals for normal surfaces. *Rocky Mountain Journal of Mathematics*, 43(2):479-487.

Kalelkar, T. (2009). Incompressibility and normal minimal surfaces. *Geometriae Dedicata* 142(1):61-70.

Kalelkar, T. (2008). Euler characteristic and quadrilaterals of normal surfaces. *Proceedings of the Indian Academy of Sciences Mathematical Sciences* 118(2):227-233.

Geometric moves relate geometric triangulations, Kalelkar, T. and Phanse, A. (submitted)

Strongly irreducible heegaard splittings of hyperbolic 3-manifolds, Kalelkar, T. (submitted)

UTTARA NAIK-NIMBALKAR

Visiting Faculty
uvnaik@iiserpune.ac.in

Uttara Naik-Nimbalkar joined IISER in February 2015. She has about thirty years of teaching and research experience at the University of Pune with visiting positions at the Michigan State University, the University of Edinburgh and University of Waterloo.

STATISTICAL INFERENCE AND MODELLING

My research interests are in the areas of inference in stochastic processes, survival analysis reliability theory and statistics in finance. Currently I am working on two problems.

(i) Modeling and analysis of statistical dependence: for example, in load sharing systems the failure of a component may reduce (increase) the lifetimes of the surviving components resulting in dependence between their lifetimes.

(ii) Hypothesis testing problems in competing risks with missing causes of failure: the failure of a unit is caused by one of the several risks acting on it. It is of interest to know whether some risk dominates the others but sometimes the actual cause of failure for some units is missing.

SELECTED PUBLICATIONS

Dewan, I. and Naik-Nimbalkar, U. On competing risks with masked failures. IMBIC volume "Mathematical and Statistical Applications in Biology, Engineering, Environment and Information Science" edited by Y. P. Chaubey et al., Springer (Accepted for Publication).

Naik Nimbalkar, U. (2016). Likelihood, estimating functions and method of moments. *Mathematics Student* 85(1-2): 63-78.

Sutar, S.S. and Naik-Nimbalkar, U.V. (2016). A model for k-out-of-m load sharing systems. *Communications in Statistics - Theory and Methods* 45(20):5946-5960.

Sutar, S.S. and Naik-Nimbalkar, U.V. (2014). Accelerated failure time models for loadsharing systems. *IEEE Transactions on Reliability* 63(3):706-714.

Deshpande, J.V., Dewan, I. and Naik-Nimbalkar, U.V. (2010). A family of distributions to model load sharing systems. *Journal of Statistical Planning and Inference* 140(6):1441-1451.

Lam, K.F., Deshpande, J.V., Lau, E.H., Naik-Nimbalkar, U.V., Yip, P.S. and Xu, Y. (2009). A test for constant fatality rate of an emerging epidemic, with applications to the SARS syndrome in Hong Kong and Beijing. *Biometrics* 64(3):869-876.

VIVEK MOHAN MALLICK

Assistant Professor
vmallick@iiserpune.ac.in

After completing B.Stat (1999) and M.Stat (2001) from Indian Statistical Institute, Vivek Mallick got his PhD from Tata Institute of Fundamental Research (TIFR) Mumbai, India in 2008. He has joined IISER Pune in 2012 after completing his postdoctoral research at the Institute of Mathematical Sciences in Chennai and Centre de Recerca Matematica in Barcelona, Spain.

ALGEBRAIC GEOMETRY

My research can be divided into three categories: intersection theory, derived categories, and T-varieties.

Intersection theory
In intersection theory, one defines invariants of algebraically defined geometric spaces in terms of how the spaces lying on the given space intersect each other. One can study those invariants to determine deep geometric properties of the space.

Derived category
Given a variety (a type of algebraically define geometric space), one can define another algebraic object called derived category. It is known that a lot of the geometric properties of the space translate to algebraic properties of the derived category.

T-variety
While studying an object one many times first determine its group of symmetries. The same holds for varieties. When the group of symmetries contain a torus, one can, with some additional hypothesis describe a variety purely in terms of some combinatorial data. Currently I am working on such varieties.

SELECTED PUBLICATIONS

Dubey, U.V. and Mallick, V.M. (2012). Reconstruction of a superscheme from its derived category. *Journal of the Ramanujan Mathematical Society* 27(4).

Dubey, U.V., Mallick, V.M. (2012). Spectrum of some triangulated categories. *Journal of Algebra* 364:90-118.

Mallick, V.M. (2009). Roitman's theorem for singular projective varieties in arbitrary characteristic. *Journal of K-Theory* 3:501-531.

POST - DOCS

SOMNATH PRADHAN

(Faculty Advisor(s) : Dr. Anup Biswas and Dr. Anindya Goswami)
somnath@iiserpune.ac.in

- MS : IISc, Bangalore (in 2015)
- PhD : IISc, Bangalore (in 2019)
- Post-Doc : IISER Pune (since 2019)

STOCHASTIC OPTIMAL CONTROL AND DIFFERENTIAL GAMES

Currently working on Principal eigenvalue problems and its application to risk-sensitive controls.

PUBLICATIONS

Arapostathis, A., Biswas, A., and Pradhan, S. `Policy improvement algorithm for ergodic risk-sensitive control,'2019. Preprint

Ghosh, M. K., Suresh, K., Pal, C. and Pradhan, S. ` Nonzero-Sum Risk-Sensitive Stochastic Differential Game in R^d', 2019. Preprint

Ghosh, M. K., and Pradhan, S. `Ergodic Risk-Sensitive Stochastic Differential Game with Reflecting Diffusions,' 2019. Preprint

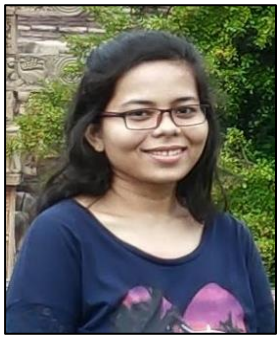
Ghosh, M. K., and Pradhan, S., `Zero-Sum Risk-Sensitive Stochastic Differential Games with Reflecting Diffusions in Orthant,' 2019. Preprint

Ghosh, M. K., and Pradhan, S., `A Nonzero-Sum Risk-Sensitive Stochastic Differential Game in Orthant,' 2019. Preprint

Pradhan, S. `Risk-Sensitive Ergodic Control of Reflected Diffusion Processes in Orthant,' To appear in Applied Mathematics and Optimization. 2019.

Pal, C., and Pradhan, S. `Risk Sensitive Control of Pure Jump Processes on a General State Space," Stochastics: An International Journal of Probability and Stochastic Processes, 2018, Vol-91, No-2, pp. 155-174.

Ghosh, M. K., and Pradhan, S. ` Risk-sensitive stochastic differential game with reflecting diffusions,' Stochastic Analysis and Applications. 2018, Vol-36, No-1, pp.1-27.



JYOTI DASGUPTA

(Faculty Advisor : Dr. Mainak Poddar)
jyoti@iiserpune.ac.in

- BSc : Scottish Church College(under Calcutta University) (in 2012)
- MSc : IIT Bombay (in 2014)
- PhD : IIT Madras (in 2019)
- Post-Doc : IISER Pune (since 2019)

ALGEBRAIC GEOMETRY AND ALGEBRAIC TOPOLOGY

Currently working on Toric principal bundles.

PUBLICATIONS

Cohomology of torus manifold bundles (with Bivas Khan and V. Uma), Math. Slovaca, Vol 69, 2019, No. 3, 685-698.
Equivariant K-theory of quasitoric manifolds (with Bivas Khan and V. Uma), Proc. Indian Acad. Sci. Math. Sci., Vol 129(2019), No 5, Art.72, 13pp.
Toric vector bundles on Bott tower (with Bivas Khan), Bulletin des Sciences Mathématiques, 155(2019), 74-91.

BIVAS KHAN

(Faculty Advisor : Dr. Mainnak Poddar)
bivas@iiserpune.ac.in

- BSc : Ramakrishna Mission Vidyamandira (in 2012)
- MSc : IIT Bombay (in 2014)
- PhD : IIT Madras (in 2019)
- Post-Doc : IISER Pune (since 2019)

ALGEBRAIC GEOMETRY AND ALGEBRAIC TOPOLOGY

Currently working on classification of toric principal bundles over toric varieties.

PUBLICATIONS

Toric vector bundles on Bott tower (with Jyoti Dasgupta), Bull. Sci. Math., Vol 155, 2019, 74-91, doi:\\ https://doi.org/10.1016/j.bulsci.2019.04.003}{doi.org/10.1016/j.bulsci.2019.04.003}.
Cohomology of torus manifold bundles (with Jyoti Dasgupta and V. Uma), Math. Slovaca, Vol 69, 2019, No. 3, 685 698, doi: https://doi.org/10.1515/ms-2017-0257}{doi.org/10.1515/ms-2017-0257}.
Equivariant K-theory of quasitoric manifolds (with Jyoti Dasgupta and V. Uma), to appear in Proc. Indian Acad. Sci. Math. Sci., available at https://arxiv.org/abs/1804.05147}{arXiv:1805.11373}.

SAMARPITA RAY

(Faculty Advisor : Dr. Vivek Mohan Mallick)
samarpita@iiserpune.ac.in

- BSc : Jadavpur University, Kolkata (in 2011)
- Int.PhD : IISc, Bangalore (in 2019)
- Post-Doc : IISER Pune (since 2019)

CATEGORICAL ALGEBRA, COMMUTATIVE ALGEBRA AND ALBEBRAIC GEOMETRY

Currently working on:

(i) Special classes of morphisms for monoid schemes and blue schemes (with Oliver Lorscheid),
(ii) Hopf action theory on tensor-triangulated categories (with Vivek Mohan Mallick), and,
(iii) Topological enrichment of Tropical Nullstellensatz (with J.Jun and J.Tolliver).

PUBLICATIONS

S. Ray, Closure operations, Continuous valuations on monoids and Spectral spaces, Journal of Algebra and Its Applications (2018), doi: 10.1142/S0219498820500061.

M.Balodi, A.Banerjee, S.Ray, Cohomology of modules over H-categories and co-H-categories (2019), arXiv:1901.00320 (to appear in Canadian Journal of Mathematics).

M.Balodi, A.Banerjee, S.Ray, Entwined modules over linear categories (2020), arXiv:1901.00323 (to appear in Israel Journal of Mathematics).

VIVEK KUMAR RAI

(Faculty Advisor : Dr. Debargha Banerjee)
vvkrai@iiserpune.ac.in

- BSc : Institute of Mathematics and Applications, Bhubaneshwar (in 2011)
- MSc : Central University of Hyderabad (in 2014)
- PhD : TIFR, Mumbai (in 2019)
- Post-Doc : IISER Pune (since 2019)

NUMBER THEORY AND REPRESENTATION THEORY

Currently working on Reductions of crystalline Galois representations and completed cohomology of Shimura curves.

KUNTAL CHAKRABORTY

(Faculty Advisor : Dr. Rabeya Basu)
kuntal@iiserpune.ac.in

- BSc : Ramakrishna Mission Vidyamandira (in 2012)
- M.Math : ISI Kolkata (in 2014)
- PhD : TIFR, Mumbai (in 2019)
- Post-Doc : IISER Pune (since 2019)

CLASSICAL K-THEORY AND PROJECTIVE MODULES

Currently doing a problem on generalizing Local Global Principles on relative quadratic groups and for graded situation.

PUBLICATIONS

On a theorem of Keune, Kuntal Chakraborty, Ravi A. Rao, preprint.
A note on relative Vaserstein symbol, Kuntal Chakraborty, preprint.

KALANE SAGAR BALASAHEB

(Faculty Advisor : Dr. Tejas Kalelkar)
sagarkalane@iiserpune.ac.in

- BSc : SP College, Pune (in 2012)
- MSc : IIT Madras (in 2014)
- PhD : IISER Mohali (in 2019)
- Post-Doc : IISER Pune (since 2019)

GEOMETRY AND TOPOLOGY

Currently working on finding linking pairs in Sp(n,1) and some other algebraic groups.

PUBLICATIONS

Quaternionic hyperbolic Fenchel-Nielsen coordinates (with Krishnendu Gongopadhyay), Geom. Dedicata. 199 (2019), no. 1, 247–271.
On conjugation orbits of semisimple pairs in rank one (with Krishnendu Gongopadhyay), Forum Math. 31 (2019), no. 5, 1097–1118.

PARUL GUPTA

(Faculty Advisor : Dr. Anupam Kumar Singh)
parul.gupta@iiserpune.ac.in

- BS-MS : IISER Mohali (in 2012)
- PhD : Jointly from Universities of Antwerp, Belgium and Konstanz, Germany (in 2018)
- Post-Doc : IISER Pune (since 2020)

QUADRATIC FORMS AND RELATED OBJECTS

Quadratic forms are homogeneous polynomials of degree two. They are studied for several centuries in particular in the context of problems of representation of numbers by sums of 2, 3 or 4 squares or by other quadratic forms. A famous result in algebraic number theory is the Hasse-Minkowski Theorem which provides a complete solution to the problem of determining whether a given quadratic form over a number field is isotropic (represents zero nontrivially).
Theorems like Hasse-Minkowski are also known as local-global principles. Local-global principles often imply a bound on the u-invariant of the field which is defined as the maximum of dimensions of anisotropic quadratic forms.

I am studying local-global principles in a broader context, namely over fields such as finitely generated extensions of transcendence degree one over certain base fields and their implications on the u-invariant. I am in particular interested in the cases where the base field is a complete discretely valued field or a quasi-finite field. I am also interested in understanding valuations over similar fields.
Other algebraic objects of my research interests are central simple algebras, hermitian forms, linear algebraic groups which can be seen as natural generalizations of quadratic forms.

PUBLICATIONS

A ruled residue theorem for function fields of conics, (with K.J. Becher), Submitted (2019), https://arxiv.org/abs/1910.00479
Strong linkage for function fields of surfaces, (with K.J. Becher), Submitted (2019), https://arxiv.org/abs/2001.02924

PhD STUDENTS

GIRISH KULKARNI

(Faculty Advisor : Dr. Amit Hogadi)
girish.kulkarni@students.iiserpune.ac.in

ALGEBRAIC GEOMETRY

Algebraic Geometry and homotopy theory are the broad areas I am interested in. To be specific I am now studying A^1-homotopy theory. A^1-homotopy theory is an attempt to apply techniques in Topology in Algebraic Geometry.

Publications

Hogadi, A. & Kulkarni, G. (2018). Gabber's presentation lemma for finite fields. Journal für die reine und angewandte Mathematik (Crelles Journal), 2020(759), pp. 265-289. Retrieved 6 Feb. 2020,from doi:10.1515/crelle-2017-0049

CHAITANYA AMBI

(Faculty Advisor : Dr. A.Raghuram)
chaitanya.ambi@students.iiserpune.ac.in

NUMBER THEORY

Mainly study about Langlands' Programme.

ADVAIT SUDHIR PHANSE

(Faculty Advisor : Dr. Tejas Kalelkar)
advait.phanse@students.iiserpune.ac.in

LOW DIMENSIONAL TOPOLOGY

I work with geometric triangulations of constant curvature manifolds.

NEERAJ DESHMUKH

(Faculty Advisor : Dr. Amit Hogadi)
neeraj.deshmukh@students.iiserpune.ac.in

ALGEBRAIC GEOMETRY

My research centers around algebraic stacks. Algebraic Stacks provide a uniform framework to study both groups actions as well as moduli problems and generalize both schemes as well as algebraic spaces. They were first introduced by Deligne and Mumford in their seminal paper "The irreducibility of the space of curves of a given genus" (1969), and later generalised by Artin (1970) to their current form.

SOUPTIK CHAKRABORTY

(Faculty Advisor : Dr. Mousomi Bhakta)
souptik.chakraborty@students.iiserpune.ac.in

PARTIAL DIFFERENTIAL EQUATIONS

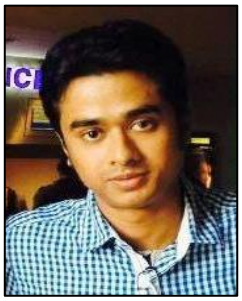
I mainly work on Fractional PDE and Variational methods.

Publications

Existence and Multiplicity of positive solutions of certain non-local scalar field equations, (with M. Bhakta and D. Ganguly) (Submitted 2019) (arXiv:1910.07919).

RIJUBRATA KUNDU

(Faculty Advisor : Dr. Anupam Kumar Singh)
rijubrata.kundu@students.iiserpune.ac.in



GROUP THEORY

My object of research is Linear Algebraic groups. More particularly, I am studying Word maps, on Linear Algebraic groups over finite fields.

SUDIPA MONDAL

(Faculty Advisor : Dr. Chandrasheel Bhagwat)
Sudipa.mondal@students.iiserpune.ac.in

AUTOMORPHIC FORMS AND REPRESENTATIONS

I mainly study Automorphic forms and their representations.

RAMYA NAIR

(Faculty Advisor : Dr. Tejas Kalelkar)
nair.ramya@students.iiserpune.ac.in

LOW DIMENSIONAL TOPOLOGY

I'm looking for taut foliations in certain knot complements.

BASUDEV PATTANAYAK

(Faculty Advisor : Dr. Manish Mishra)
basudev.pattanayak@students.iiserpune.ac.in

REPRESENTATION THEORY OF P-ADIC GROUPS

I'm studying Hecke Algebra.

KARTIK ROY

(Faculty Advisor : Dr. Vivek Mohan Mallick)
kartik.roy@students.iiserpune.ac.in

ALGEBRAIC GEOMETRY

I study derived category of coherent sheaves on multi-homogeneous spaces.

SURAJ PRAKASH YADAV

(Faculty Advisor : Dr. Amit Hogadi)
surajprakash.yadav@students.iiserpune.ac.in

ALGEBRAIC GEOMETRY AND HOMOTOPY THEORY

Currently I am working on problems in Motivic homotopy theory, an area where techniques from Algebraic topology are applied in an Algebraic geometric setting.

NAMRATA ARVIND

(Faculty Advisor : Dr. Manish Mishra)
namrata.aravind@students.iiserpune.ac.in

REPRESENTATION THEORY

I am working in the field of representation theory. In particular I am studying the representations of finte groups of lie type.

YADAV RAVISHANKAR KAPILDEV

(Faculty Advisor : Dr. Anindya Goswami)
ravishankar.kapildevyadav@students.iiserpune.ac.in

STOCHASTIC DIFFERENTIAL EQUATIONS

Stability analysis of Stochastic Differential equation modulated with a semi markov process.

SAIKAT PANJA

(Faculty Advisor : Dr. Anupam Kumar Singh)
saikat.panja@students.iiserpune.ac.in

GROUP THEORY

I work on the Waring type problem.

PRASUN ROYCHOWDHURY

(Faculty Advisor : Dr. Anup Biswas)
prasun.roychowdhury@students.iiserpune.ac.in

PARTIAL DIFFERENTIAL EQUATIONS

I am currently studying properties of different eigenvalues for nonlinear operator in unbounded domain. Besides that, I am working on Functional inequalities and Criticality theory for elliptic second order partial differential operator.

Publications

Improved second order Poincare Inequalities on the Hyperbolic space and Model manifolds, (with D. Ganguly, E. Berchio), (In preparation, preprint available on request).

Stochastically completeness, L^1-Lioville and Skew product of second order elliptic operators, (with D. Ganguly), (In preparation, preprint available on request).

VISAKH NARAYANAN

(Faculty Advisor : Dr. Rama Mishra)
visakh.narayanan@students.iiserpune.ac.in

KNOT THEORY & LOW DIMENSIONAL TOPOLOGY

I am interested in studying the invariants of knots and 3-manifolds arising from the Jones-Witten theory. I would also like to explore more general perspectives on topological quantum field theories.

TUMPA MAHATO

(Faculty Advisor : Dr. Rama Mishra)
tumpa.mahato@students.iiserpune.ac.in

KNOT THEORY

Right now, I am studying about 2 bridge knots and links and their complements.

JEWEL MAHAJAN

(Faculty Advisor : Dr. Kaneenika Sinha)
jewel.mahajan@students.iiserpune.ac.in

ANALYTIC NUMBER THEORY

Study of Modular Forms and the explicit Sato-Tate conjecture and densities.

JISHU DAS

(Faculty Advisor(s) : Dr. Baskar Balasubramanyam and Dr. Kaneenika Sinha)
jishu.das@students.iiserpune.ac.in

NUMBER THEORY

I am currently trying to understand basics of Modular forms.

PAVANKUMAR RAMESH DIGHE

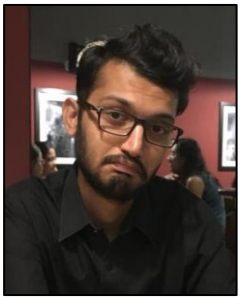
(Faculty Advisor : Dr. Vivek Mohan Mallick)
pavankumar.dighe@students.iiserpune.ac.in

ALGEBRAIC GEOMETRY

Derived Categories in Algebraic Geometry.

MITESH MODASIYA

(Faculty Advisor : Dr. Anup Biswas)
mitesh.modasiya@students.iiserpune.ac.in



PARTIAL DIFFERENTIAL EQUATIONS

AJINKYA RAMDAS GAIKWAD

(Faculty Advisor : Dr. Rama Mishra)
ajinkya.gaikwad@students.iiserpune.ac.in

DISCRETE MATHEMATICS

I am interested in questions from graph theory and combinations.

ANJALI BHATNAGAR

(Faculty Advisor : Dr. Mousomi Bhakta)
anjali.bhatnagar@students.iiserpune.ac.in

ANALYSIS

I am currently working on Partial differential equations.

SUJEET KISHOR DHAMORE

sujeet.dhamore@students.iiserpune.ac.in

ALGEBRAIC GEOMETRY

DEBJIT PAL

(Faculty Advisor : Dr. Mainak Poddar)
debjit.pal@students.iiserpune.ac.in

TOPOLOGY

My research interests lie in Topology and Geometry. More specifically on Algebraic Topology, Differential Topology and Algebraic Geometry. Such studies have led me further afield to areas such as Differential Geometry, Lie Groups and Commutative Algebra etc.

NASIT DARSHAN PRAFULBHAI

nasit.darshan@students.iiserpune.ac.in

AUTOMORPHIC FORMS, L-FUNCTIONS AND ALGEBRAIC GEOMETRY

Given any sequence of complex number, one can define L series corresponding to sequence. For example, L series corresponds to non-zero constant sequence is Riemann Zeta function. L series associated with Automorphic forms have similar properties as Riemann zeta function. The zeros of such L functions and value of L function at 'some' special points are helpful to study arithmetic of automorphic forms.

iPhD STUDENTS

DEBAPRASANNA KAR

(Faculty Advisor : Dr. Diganta Borah)
debaprasanna.kar@students.iiserpune.ac.in

SEVERAL COMPLEX VARIABLES

I am studying the boundary behavior of the Robin metric on various class of domains.

Publications

Boundary behaviour of the Caratheodory and Kobayashi-Eisenman volume elements (Accepted for publication in Illinois Journal of Mathematics, 2019)

NEHA MALIK

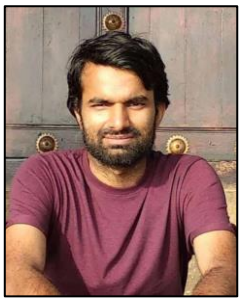
(Faculty Advisor : Dr. Steven Spallone)
neha.malik@students.iiserpune.ac.in

REPRESENTATION THEORY

An orthogonal representation (ρ, V) of a finite group G is called spinorial if it can be lifted to Pin(V), where Pin(V) is a non-trivial topological double cover of O(V). Now, the question that we wish to answer is : which of the orthogonal representations of the special linear group of degree 'n' over a finite field (F_q), q odd are spinorial?

SHUVAM KANT TRIPATHI

(Faculty Advisor : Dr. Soumen Maity)
tripathi.shuvamkant@students.iiserpune.ac.in



ALGORITHMS

In computer science, parameterized complexity is a branch of computational complexity theory that focuses on classifying computational problems according to their inherent difficulty with respect to multiple parameters of the input or output. The complexity of a problem is then measured as a function of those parameters. This allows the classification of NP-hard problems on a finer scale than in the classical setting, where the complexity of a problem is only measured by the number of bits in the input.

RONIT DEBNATH

(Faculty Advisor : Dr. Debargha Banerjee)
debnath.ronit@students.iiserpune.ac.in

SIEGEL MODULAR FORMS

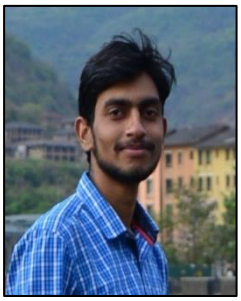
I am working on Siegel Modular Forms for genus 2.

PRANJAL VISHWAKARMA

(Faculty Advisor : Dr. Debargha Banerjee)
pranjal.vishwakarma@students.iiserpune.ac.in

BIANCHI MODULAR FORMS

The main work of the project is to extend the study of Eisenstein elements to Bianchi



HITENDRA KUMAR

(Faculty Advisor : Dr. Kaneenika Sinha)
sahu.hitendrakumar@students.iiserpune.ac.in

ANALYTIC NUMBER THEORY

My project lies at the interface of probabilistic number theory, graph theory and the theory of modular forms.I would like to investigate probabilistic questions about eigenvalues of various families of Ramanujan graphs.

SHUBHAM SHRAVAN JAISWAL

jaiswal.shubham@students.iiserpune.ac.in

ALGEBRA

Commutative Algebra, Algebraic Geometry, Algebraic Number theory, Galois theory, Groups, etc.

ARCHI ROY

(Faculty Advisor : Dr. Kaneenika Sinha)
roy.archi@students.iiserpune.ac.in

APPLIED MATHEMATICS

NARAYANAN P

narayanan.p@students.iiserpune.ac.in

ALGEBRAIC NUMBER THEORY AND REPRESENTATION THEORY

Studying the properties of number fields (finite extensions of rational numbers) by embedding it in the restricted direct product of its completions, at every prime ideal in the ring of integers.

DHRUV BHASIN

dhruv.bhasin@students.iiserpune.ac.in

COMBINATORICS, ALGORITHMS AND FOUNDATIONS OF MATHEMATICS

My interests lie in the field of combinatorics and algorithms because the field is full of fun open problems that can be explained to a child but are crazily difficult for example, Prime labelling conjecture, Union closed sets conjecture, P vs. NP problem, Graph isomorphism problem and the list goes on and on. The interest in the field of set theory comes from the progress people have made to PROVE that we cannot PROVE or DISPROVE the Continuum Hypothesis in the ZFC model. It is both beautiful and crazy how someone can prove the decidability of mathematical statements themselves. The way out? Let's figure out.

KUNAL ARORA

(Faculty Advisor : Dr. Debargha Banerjee)
arora.kunal@students.iiserpune.ac.in

Number Theory

Algebraic number theory uses techniques from algebra to answer questions from number theory.my interest lies in knowing about these techniques.

PRANAV NITURKAR

(Faculty Advisor : Dr. Soumen Maity)
niturkar.pranav@students.iiserpune.ac.in

Stable and fair matching problem.

5th YEAR STUDENTS

NISHAD BAPATDHAR

(Faculty Advisor : Dr. Manjunath Krishnapur (IISc))
nishad.bapatdhar@students.iiserpune.ac.in

PARTIAL DIFFERENTIAL EQUATIONS

I am studying the Laplace operator in various settings such as the graph Laplacian, the Stürm-Liouville operator on compact domains in R and the Laplace (elliptic) operator on bounded domains in $R^{\{n\}}$,Properties such as the asymptotics of the eigenvalues and nodal domains of the eigenfunctions are of particular interest.

ADITHYAN P

(Faculty Advisor : Dr. Rama Mishra)
adithyan.p@students.iiserpune.ac.in

LOW DIMENSIONAL TOPOLOGY AND KNOT THEORY

My Master's thesis is on `Geometric Knot theory'. It discusses the relationship between the geometry and topology of knots. I study the geometric invariants which are invariants arising from geometric properties of the space curve parameterized by some special functions and the topology of spaces of knots represented by specific functions, mainly spaces of polygonal and polynomial knots.

JAIDEEP MAHAJAN

(Faculty Advisor : Dr. Arup Bose (ISI Kolkata))
jaideep.mahajan@students.iiserpune.ac.in

RESAMPLING MODELS

Resampling is a major area of statistics. Though the idea of re-using the sample dates back to a long time, the area got its major impetus around 1980. Since that time, progress on the theory and applications of resampling has been tremendous. I wish to learn the subject from the basics and work my way towards achieving expertise and finally work on some contemporary problems in both theory and applications on resampling, specially in dependants in high dimensional models.

RAJDEEP HALDAR

(Faculty Advisor : Dr. Anindya Goswami)
rajdeep.haldar@students.iiserpune.ac.in

TOPOLOGICAL DATA ANALYSIS

Topological data analysis borrows concepts from algebraic topology to extract geometrical features of the data disregarded by standard statistical techniques. Within topological data analysis I specialize in methods like persistent homology and mapper algorithm.

NIKHIL GUPTA

(Faculty Advisor : Dr. Manish Mishra)
nikhil.gupta@students.iiserpune.ac.in

NUMBER THEORY

I am working on Rigid Analysis for my Master's Thesis. Rigid Analytic Spaces are the non-Archemdean analogues of complex analytic spaces and have gained impetus after Scholze's recent Fields medal winning work.

VISHNU N

(Faculty Advisor : Dr. Vamsi Pingali (IISc))
vishnu.n@students.iiserpune.ac.in

DIFFERENTIAL GEOMETRY, GEOMETRIC ANALYSIS AND KAHLER GEOMETRY

The Calabi Conjecture describes existence of Kahler metrics with “nice” curvature properties on some compact complex manifolds. This conjecture was resolved in many cases by Aubin and Yau. The remaining cases are much harder and only recently completed. Through my 5th year I am studying the basics of complex geometry and nonlinear partial differential equations with a view of studying the Calabi Conjecture’s proof in the cases studied by Aubin and Yau (namely, c1(M)=0, <0). Also, will look into some applications and a sneak peek into the c1>0 case.

ABHISHEK ADIMURTHI

(Faculty Advisor : Dr. Shyam Ghoshal (TIFR))
abhishek.adimurthi@students.iiserpune.ac.in

ANALYSIS

Fine properties of measurable functions and it's applications to PDE.

SRIRAM RAGHUNATH

(Faculty Advisor : Dr. Tejas Kalelkar)
sriram.raghunath@students.iiserpune.ac.in

GEOMETRIC TOPOLOGY

I am studying geometric triangulations of hyperbolic manifolds.

RITHWIK S V

(Faculty Advisor : Dr. Tejas Kalelkar)
rithwik.sv@students.iiserpune.ac.in

DIFFERENTIAL GEOMETRY

I am studying about the Hodge Decomposition Theorem.

HARSHA NYAPATHI

(Faculty Advisor : Dr. Siddhartha Gadgil (IISc))
harsha.nyapathi@students.iiserpune.ac.in

HOMOTOPY TYPE THEORY AND COMPUTABILITY

I am studying basics of dependant and homotopy type theory, and formal verification. I would like to study the relation of computability to the underlying algebraic topology of types.

SIDDHARTH RAMAKRISHNAN

(Faculty Advisor : Dr. Chandrasheel Bhagwat)
siddharth.ramakrishnan@students.iiserpune.ac.in

NUMBER THEORY

I am currently studying Class Field theory envisaged by the cohomological approach envisaged by Artin and Tate.

NAZIA V

(Faculty Advisor : Dr. Chandrasheel Bhagwat)
nazia.v@students.iiserpune.ac.in

REPRESENTATION THEORY AND NUMBER THEORY

My master's thesis is on 'The local Langlands conjecture for GL(2, F)' where F is a non-archimedean local field. This is a central theme in modern number theory and is a generalization of local class field theory. Another aim of the project involves the study of adjacency operator of the Bruhat-Tits tree for GL(2, F).

SUJEET BHALERAO

(Faculty Advisor : Dr. Steven Spallone)
sujeet.bhalerao@students.iiserpune.ac.in

REPRESENTATION THEORY

Stiefel-Whitney classes of a representation of a finite group are interesting invariants which arise naturally when studying spinoriality of representations. I am studying the Stiefel-Whitney classes of representations of dihedral and symmetric groups.

SAYANTIKA MONDAL

(Faculty Advisor : Dr. Joan Licata (Australian National University))
sayantika.mondal@students.iiserpune.ac.in

CONTACT TOPOLOGY

Understanding relation between Contact structures and Foliations via Open books.

ARGHYA RAKSHIT

(Faculty Advisor : Dr. Mousomi Bhakta)
arghya.rakshit@students.iiserpune.ac.in

PARTIAL DIFFERENTIAL EQUATIONS AND GEOMETRIC ANALYSIS

I am studying Elliptic PDEs and the Variational Method.

VIKAS L SHUKLA

(Faculty Advisor : Dr. Anindya Goswami)
vikas.shukla@students.iiserpune.ac.in

STOCHASTIC PROCESS

I am currently Studying Stochastic Differential Equation and Integration under Semimartingale processes and previously studied math Finance.

NIMA ROSE MANJILA

(Faculty Advisor : Dr. Anisa Chorwadwala)
nimarose.manjila@students.iiserpune.ac.in

ALGEBRAIC GEOMETRY AND COMMUTATIVE ALGEBRA

I am studying the set theoretic completion of affine n space.

AYSHA BASHEER

(Faculty Advisor : Uttara Naik-Nimbalkar)
aysha.b@students.iiserpune.ac.in

TOPOLOGICAL DATA ANALYSIS

I study the collection of data analysis methods that find structure in a given data. The methods range from the classical to the more recent ones based on topological and geometrical methods. These include clustering, persistent homology, manifold estimation etc, and the application of some techniques to analyse real data sets.

EXTERNAL TAs

PRASHANT ANANT GITTE

prashantgitte7777@gmail.com

COMMUTATIVE ALGEBRA

I am highly interested in studying Artin Rings and Noetherian Rings, along with certain local rings

SNEHAL SAMBHAJI LAWANDE

snehal@acads.iiserpune.ac.in

I have obtained an MSc Degree in mathematics from Savitribai Phule Pune University in 2018. I am highly interested in pursuing the various applicative aspects of mathematics in real life.

VARUN KULKARNI

varun@acads.iiserpune.ac.in

I have obtained my BS-MS Dual Degree from IISER Bhopal, with a major interest in mathematics. I am currently interested in studying the classification of quadratic forms and Witt Rings.

DEEPA SAHCHARI

sahchari.deepa@gmail.com

SUPPORT PERSONNEL

SUVARNA BHARDWAJ

Office Assistant

gsuvarna@iiserpune.ac.in

I Completed my BSc. Degree in Physics from The Fergusson College Pune, and subsequently pursued my post-graduation Degree from Modern College, Pune. I am Presently assisting the Department of Mathematics at IISER Pune through various administrative responsibilities.

YOGESH KOLAP

Junior Office Assistant

yogesh.kolap@iiserpune.ac.in

I have acquired my Bachelor of Arts Degree in Economics, and am currently supporting the Department of Mathematics at IISER Pune in its various administrative duties as a multi-skilled office assistant.

PUBLICATIONS BY MEMBERS OF THE DEPARTMENT

(SINCE 2018)

2018

1) A. Mitra and S. Spallone, Towards a Goldberg-Shahidi pairing for classical groups, Forum Math. 30 (2018), no. 2, 347-384.

2) Arapostathis, Ari, and Anup Biswas. "Infinite horizon risk-sensitive control of diffusions without any blanket stability assumptions." *Stochastic Processes and their Applications* 128.5 (2018): 1485-1524.

3) Arapostathis, Ari, Anup Biswas, and Vivek S. Borkar. "Controlled equilibrium selection in stochastically perturbed dynamics." *The Annals of Probability* 46.5 (2018): 2749-2799.

4) Atar, Rami, Anup Biswas, and Haya Kaspi. "Law of large numbers for the many-server earliest-deadline-first queue." *Stochastic Processes and their Applications* 128.7 (2018): 2270-2296.

5) Banerjee, Debargha, and Loïc Merel. "The Eisenstein cycles as modular symbols." *Journal of the London Mathematical Society* 98.2 (2018): 329-348.

6) Basu, Rabeya. "A note on general quadratic groups." *Journal of Algebra and Its Applications* 17.11 (2018): 1850217.

7) Bhakta, Mousomi, and Debangana Mukherjee. "Sign changing solutions of $ p $-fractional equations with concave-convex nonlinearities." *Topological Methods in Nonlinear Analysis* 51.2 (2018): 511-544.

8) Biswas, Anup, and József Lőrinczi. "Maximum principles for time-fractional Cauchy problems with spatially non-local components." *Fractional Calculus and Applied Analysis* 21.5 (2018): 1335-1359.

9) Biswas, Anup, et al. "A Skorokhod map on measure-valued paths with applications to priority queues Rami Atar, Anup Biswas, Haya Kaspi, and Kavita Ramanan." (2018).

10) Borah, Diganta, Pranav Haridas, and Kaushal Verma. "Comments on the Green's function of a planar domain." *Analysis and Mathematical Physics* 8.3 (2018): 383-414.

11) Das, Milan Kumar, Anindya Goswami, and Nimit Rana. "Risk sensitive portfolio optimization in a jump diffusion model with regimes." *SIAM Journal on Control and Optimization* 56.2 (2018): 1550-1576.

12) Das, Milan Kumar, Anindya Goswami, and Tanmay S. Patankar. "Pricing derivatives in a regime switching market with time inhomogenous volatility." *Stochastic Analysis and Applications* 36.4 (2018): 700-725.

13) Hogadi, Amit, and Supriya Pisolkar. "On the comparison of two constructions of Witt vectors of non-commutative rings." *Journal of Algebra* 506 (2018): 379-396.

14) Kaipa, Krishna. "An improvement of the asymptotic Elias bound for non-binary codes." *IEEE Transactions on Information Theory* 64.7 (2018): 5170-5178.

15) Kapshikar, Upendra, and Ayan Mahalanobis. "A quantum-secure Niederreiter Cryptosystem using quasi-cyclic codes." *arXiv preprint arXiv:1803.07827* (2018).

2019

16) Arapostathis, Ari, Anup Biswas, and Debdip Ganguly. "Certain Liouville properties of eigenfunctions of elliptic operators." *Transactions of the American Mathematical Society* 371.6 (2019): 4377-4409.

17) Arapostathis, Ari, Anup Biswas, and Luis Caffarelli. "On uniqueness of solutions to viscous HJB equations with a subquadratic nonlinearity in the gradient." *Communications in Partial Differential Equations* 44.12 (2019): 1466-1480.

18) Arapostathis, Ari, Anup Biswas, and Subhamay Saha. "Strict monotonicity of principal eigenvalues of elliptic operators in Rd and risk-sensitive control." *Journal de Mathématiques Pures et Appliquées* 124 (2019): 169-219.

19) Balasubramanyam, Baskar, and Kaneenika Sinha. "Pair correlation statistics for Sato–Tate sequences." *Journal of Number Theory* 202 (2019): 107-140.

20) Bhakta, Mousomi, and Debangana Mukherjee. "Multiplicity results for $(p, q) $ fractional elliptic equations involving critical nonlinearities." *Advances in Differential Equations* 24.3/4 (2019): 185-228.

21) Bhakta, Mousomi, and Debangana Mukherjee. "Nonlocal scalar field equations: Qualitative properties, asymptotic profiles and local uniqueness of solutions." *Journal of Differential Equations* 266.11 (2019): 6985-7037.

22) Bhakta, Mousomi, and Phuoc-Tai Nguyen. "Nonlinear fractional elliptic systems with boundary measure data: existence and a priori estimates." *Journal of Mathematical Analysis and Applications* 475.2 (2019): 1614-1635.

23) Bhakta, Mousomi, Debangana Mukherjee, and Sanjiban Santra. "Profile of solutions for nonlocal equations with critical and supercritical nonlinearities." *Communications in Contemporary Mathematics* 21.01 (2019): 1750099.

24) Bhunia, Sushil, and Anupam Singh. "Conjugacy classes of centralizers in unitary groups." *Journal of Group Theory* 22.2 (2019): 231-251.

25) Biswas, Anup, and József Lörinczi. "Maximum Principles and Aleksandrov--Bakelman--Pucci Type Estimates for NonLocal Schrödinger Equations with Exterior Conditions." *SIAM Journal on Mathematical Analysis* 51.3 (2019): 1543-1581.

26) Biswas, Anup, and József Lőrinczi. "Universal constraints on the location of extrema of eigenfunctions of non-local Schrödinger operators." *Journal of Differential Equations* 267.1 (2019): 267-306.

27) Biswas, Anup. "Liouville type results for systems of equations involving fractional Laplacian in exterior domains." *Nonlinearity* 32.6 (2019): 2246.

28) Borah, Diganta, et al. "Remarks on the higher dimensional Suita conjecture." *Proceedings of the American Mathematical Society* 147.8 (2019): 3401-3411.

29) SDas, Milan Kumar, and Anindya Goswami. "Testing of binary regime switching models using squeeze duration analysis." *International Journal of Financial Engineering* 6.01 (2019): 1950006.

30) Ghosh, Debarun, and Steven Spallone. "Determinants of representations of Coxeter groups." *Journal of Algebraic Combinatorics* 49.3 (2019): 229-265.

31) Mishra, Manish, and Basudev Pattanayak. "A note on depth preservation." Journal of the Ramanujan Mathematical Society, 34, No.4, (2019), 393 - 400

32) NAIK-NIMBALKAR, U.V., et al. "Tests for specific nonparametric relations between two distribution functions with applications." *Applied Stochastic Models in Business and Industry* 35.2 (2019): 247-259.

33) Prabhu, Neha, and Kaneenika Sinha. "Fluctuations in the distribution of Hecke eigenvalues about the Sato–Tate measure." *International Mathematics Research Notices* 2019.12 (2019): 3768-3811.

34) Singh, Anupam, et al. "On Shalev's conjecture for type An and $2An$." *Journal of Group Theory* 22.4 (2019): 713-728.

35) Sutar, Santosh, and U. V. Naik-Nimbalkar. "A load share model for non-identical components of a k-out-of-m system." *Applied Mathematical Modelling* 72 (2019): 486-498.

2020

36) BANERJEE, DEBARGHA, and CHITRABHANU CHAUDHURI. "Semi-stable models of modular curves $ X_0 (p^ 2) $ and some arithmetic applications." (2020).

37) Banerjee, Debargha, and Tathagata Mandal. "A note on quadratic twisting of epsilon factors for modular forms with arbitrary nebentypus." *Proceedings of the American Mathematical Society* (2020).

38) Biswas, Anup, and Sven Jarohs. "On overdetermined problems for a general class of nonlocal operators." *Journal of Differential Equations* 268.5 (2020): 2368-2393.

39) Chorwadwala, Anisa MH, and Souvik Roy. "How to Place an Obstacle Having a Dihedral Symmetry Inside a Disk so as to Optimize the Fundamental Dirichlet Eigenvalue." *Journal of Optimization Theory and Applications* 184.1 (2020): 162-187.

40) Dubey, Umesh V., and Vivek Mohan Mallick. "On the differential graded Eilenberg–Moore construction." *Journal of Algebra* 541 (2020): 174-218.

41) Ganguly, Jyotirmoy, and Steven Spallone. "Spinorial representations of symmetric groups." *Journal of Algebra* 544 (2020): 29-46.

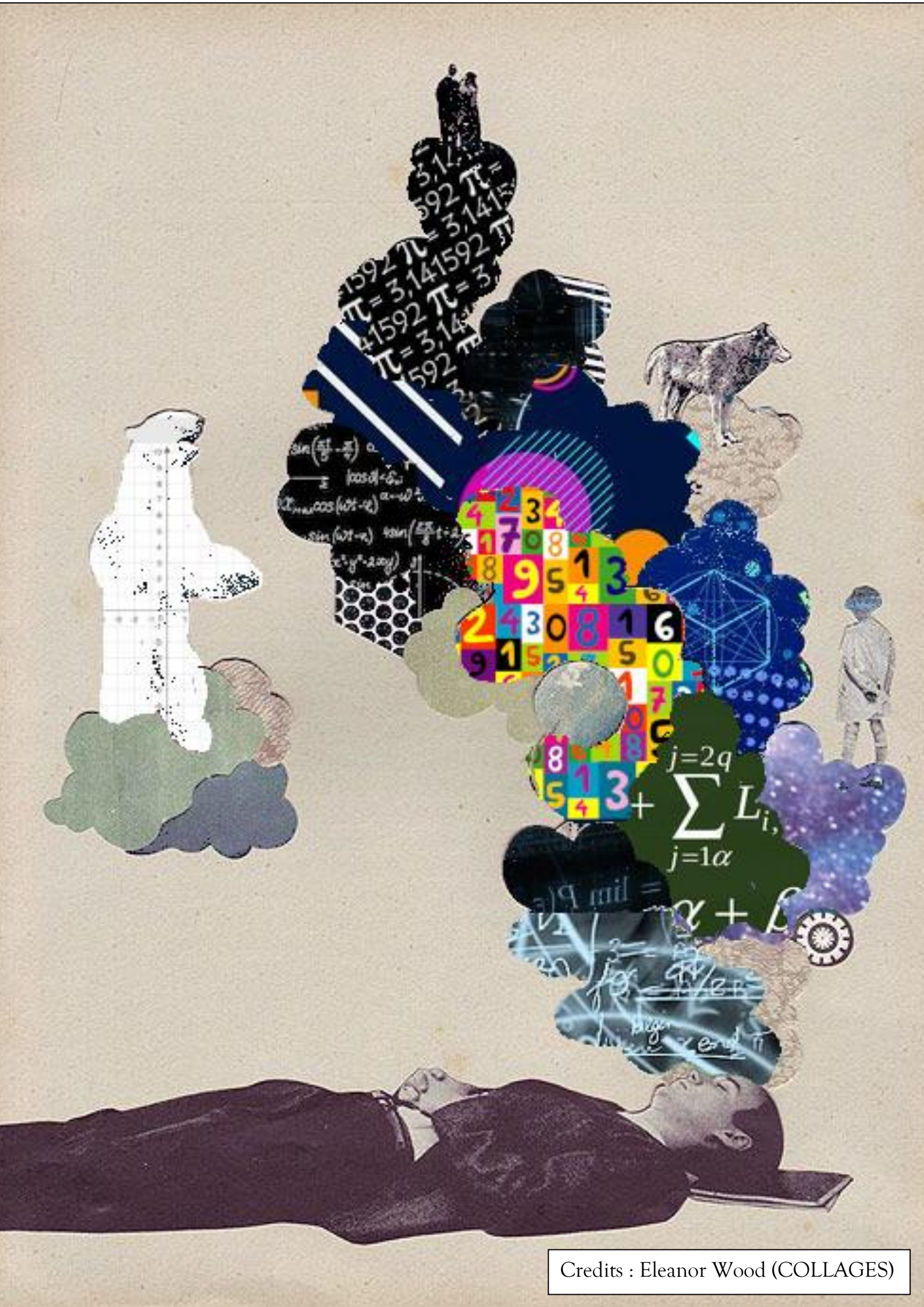
42) Harder, Günter; Raghuram, A. (2020) Eisenstein cohomology for GL(N) and the special values of Rankin-Selberg L-functions.Annals of Mathematics Studies, Vol. 203. Princeton University Press, Princeton, NJ, 2020.xi+220 pp

43) Mishra, Manish and Bertrand Lemaire, “Matching of orbital integrals (geometric transfer) and Roche Hecke algebra isomorphisms”, Compositio Mathematica, Vol. 156, No. 3 (2020), 533 – 603

44) Mishra, Manish with Amy Philip, A generalisation of the 3d distance theorem, Archiv der Mathematik, (2020), DOI: 10.1007/s00013-020-01450-7

Profile Booklet Credits

Cover Page Design (front)	:	Bhavana Musunuri
Cover Page Design (Back)	:	Shaswat Nair
Compilation of Profiles	:	Hrishikesh V
Structural Organisation	:	Mihir Neve


Credits : Eleanor Wood (COLLAGES)