THE INSTITUTE OF MATHEMATICAL SCIENCES

C. I. T. Campus, Taramani,

Chennai - 600 113.

ANNUAL REPORT

Apr 2023 - Mar 2024

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Foreword

I am very pleased to present the annual report of the Institute for the year 2023-2024 and bring out the distinctive achievements of its members during the year along with a perspective for the future.

The Institute offers two doctoral programs in Mathematics, Physics, Theoretical Computer Science, Computational Biology - the Ph.D and Integrated Ph.D for graduate students. Graduate students at IMSc typically spend around a year or two doing course and project work in preparation for research. Preparatory coursework is intensive, the students often begin to explore research problems on their own, using seminars, scientific meetings and the opportunity to interact with both Institute members and visitors.

During the period April 2023 - March 2024, 131 students were pursuing their Ph.D and 62 scholars as post-doctoral fellows at IMSc. A total of 16 students were awarded Ph.D degree, 14 students submitted their PhD thesis and 6 students got M.Sc degree by Research.

I am happy to inform you that the research output of the members of the Institute has been excellent throughout the year. Several high-quality research works were reported in national and international journals, and some of them were presented at National/International conferences. A total of 44 lecture courses were conducted at the Institute throughout the year. The Institute hosted 59 International and 194 National visitors as part of its Visitors Program. In addition, we organized and also co-sponsored several workshops and conferences.

For instance, Advanced Topics in Finite Fields, Network Biology Day, Modelling and Tackling Complex Biological Systems, Remembering Amal Kumar Raychaudhuri (AKR): the celebration of the centenary year,Clinical data, machine learning and modelling, A Conference on Pulsar Timing Array Experiments: Present and Future of Indian Contribution, Contemporary Perspectives in Computational Biology, Chennai Soft Matter Days, FRACMEET 2024, One day conference in number theory, are to name a few.

The Institute hosted Institute Seminar days, an annual event that provides a platform for researchers to concisely present their work to general but informed audience. This year's event featured 40 talks, spread across two days.

IMSc organised a conference to celebrate the birth centenary of the Institute's founder-director Prof Alladi Ramakrishnan was organised during December 16-18, 2023. The inaugural event featured a speech by Mr N R Narayanamurthy (Founder, Infosys) and he also unveiled a bust of Prof Ramakrishnan on the institute campus.

During this year IMSc organised several outreach programmes for school children, teachers, and the general public. These include Vigyan Pratibha Regional Workshop (KVS / JNV / AECS), Amal Kumar Raychaudhuri (AKR) centenary program (one day Outreach program for college students), Teacher's Enrichment Workshop, Facets - outreach program for advanced undergraduate and postgraduate students of mathematics, kaNita-kAnakam: for students of class X - XII of corporation schools, Mathematics Toy Development workshop, Vigyan Pratibha Teachers Workshop (TN govt schools Chennai region), TNSF Lecture series:

Nobel Prize in Physics, Women, Science and Media, Vigyan Pratibha Regional Workshop (KVS JNV), IMSc Ganakam program, and our flagship Science at the Sabha to name a few.

IMSc HPC facility is augmented with a Cluster solution to the tune of 300TF (Tera FLOPS) of theoretical compute power on HPL (turbo off) which can be scaled up further in future. The Cluster is equipped with 56 compute nodes, 112 CPUs (3584 Cores). I extend my gratitude to the DAE for funding many of the aforementioned programs through the APEX project.

We are proud to note the awards and honors bestowed on our faculty for their contributions: Prof. Meena Mahajan, was awarded Recipient of J. C. Bose Fellowship, for 2024, by the SERB-DST, Govt of India, Prof. Meena Mahajan, was featured in the "Vigyan Vidushi: 75 Women Trailblazers of Science" - a book portraying the valuable contributions of 75 Indian women scientists, published by Vigyan Prasar.

This report was compiled through the efforts of the IMSc Annual Report Committee consisting of Prof. Vijay Kodiyalam, Prof. Sibasish Ghosh, Dr. Arnab Pal, Dr. Sandeep Choubey, Dr. Padnamath. M, Dr. Ramya. C, and Shri Maruthu Pandiyan. I owe my gratitude to all of them.

April, 2024 **V. Ravindran**

Contents

Chapter 1

The Institute

The Institute of Mathematical Sciences (IMSc), founded in 1962, is a national institution for fundamental research in the Mathematical and Physical Sciences.
The Institute is funded by the Department of Atomic Energy of the Government of India.
Institute members work primarily in the areas of Mathematics, Theoretical Computer Science, Theoretical Physics and Computational Biology.
The Institute is governed by a Governing Board and an Executive Council. Academic personnel at the Institute are grouped as Faculty, Post-Doctoral Fellows, Junior Research Fellows and Senior Research Fellows. The academic programmes are ably supported by an administrative set-up. The Director is assisted by the Faculty in academic matters and by the Registrar in financial and administrative matters.
Out of a sanctioned strength of 61 at present 52 faculty members are in position. This year there were 62 post-doctoral fellows from all over the world pursuing research at IMSc. In addition there are about 53 personnel at various levels working here on different projects both academic and non-academic. The number of doctoral students (JRFs & SRFs) is 131 this year. The Institute has 30 members of non-academic staff which include staff of Scientific, Administrative and Accounts.
IMSc has an outstanding scientific library, an excellent computing environment including a tera-flop class cluster computer and a dedicated high-speed network. The Institute hosts several national and international scientific / academic conferences / workshops and meetings every year.
This report briefly describes the programmes and activities of the Institute as well as its achievements in the past year. More details are available in the detailed annual report.

1.1 Governing Board

Thiru. **R.S. Rajakannappan**,
Hon'ble Minister for Higher Education,
Government of Tamil Nadu, Fort St.George, Chennai
(**Chairman**)

Dr. **Ajit Kumar Mohanty**,
Chairman, AEC & Secretary to Government of India,
Department of Atomic Energy, CSM Marg, Mumbai
(**Co-Chairman**)

Prof. **Amitava Raychaudhuri**,
Former Director, HRI,
Professor Emeritus, Department of Physics,
University of Calcutta, Kolkata
(**Member**)

Prof. **Mustansir Barma**,
Former Director, TIFR,
Professor Emeritus, TIFR Centre for
Interdisciplinary Sciences (TCIS),
Hyderabad
(**Member**)

Prof. **Sudhanshu Jha**,
Former Director, TIFR,
402, Vigyanshila, Juhu-Versova Link Road,
Seven Bungalows,
Andheri(W), Mumbai
(**Member**)

Vice-Chancellor, University of Madras,
Chepauk, Chennai
(**Member**)

Smt. **Sushma Taishete**, CSS,
Joint Secretary (R&D) to Govt. of India,
Department of Atomic Energy,
CSM Marg, Mumbai
(**Member**)

Ms. **Richa Bagla**, IAS,
Joint Secretary (Finance) to Govt. of India,
Department of Atomic Energy,
CSM Marg, Mumbai
(**Member**)

Shri. **A. Karthik**, IAS,
Principal Secretary to Government, Higher
Education Department,
Secretariat, Fort St.George, Chennai
(**Member**)

Prof. **V. Ravindran**,
Director, Institute of Mathematical Sciences,
CIT Campus, Taramani, Chennai
(**Member Secretary**)

1.2 Executive Council

Dr. **Ajit Kumar Mohanty**,
Chairman, AEC, & Secretary to Government of India,
Department of Atomic Energy, CSM Marg, Mumbai
(**Chairman**)

Prof. **Amitava Raychaudhuri**,
Professor Emeritus, Former Director, HRI,
Department of Physics, University of Calcutta, Kolkata
(**Member**)

Prof. **Mustansir Barma**,
Former Director, TIFR,
Professor Emeritus, TIFR Centre for Interdisciplinary Sciences (TCIS), Hyderabad
(**Member**)

Prof. **Manindra Agrawal**,
Department of Computer Sciences and Engineering,
Indian Institute of Technology, Kanpur
(**Member**)

Smt. **Sushma Taishete**, CSS,
Joint Secretary (R&D) to Govt. of India,
Department of Atomic Energy,
CSM Marg, Mumbai
(**Member**)

Ms. **Richa Bagla**, IAS
Joint Secretary(Finance) to Govt. of India,
Department of Atomic Energy, Mumbai
(**Member**)

Shri. **A. Karthik**, IAS
Principal Secretary to Government, Higher Education Department,
Secretariat, Fort St.George, Chennai
(**Member**)

Prof. **V. Ravindran**,
Director,
The Institute of Mathematical Sciences, Chennai
(**Member Secretary**)

1.2.1 Profiles of Governing Board and Executive Council Members

Thiru **R.S. Rajakannappan**, Hon'ble Minister for Higher Education, Government of Tamilnadu, Chennai
(**Chairman**, *Governing Board*)

Dr. Ajit Kumar Mohanty, Chairman, Atomic Energy Commission & Secretary to Govt. of India,
Department of Atomic Energy, CSM Marg, Mumbai.
(**Co-Chairman**, *Governing Board*) & (**Chairman**, *Executive Council*)

Ajit Kumar Mohanty, was born in Odisha in 1959. He graduated with Honours in Physics from the MPC College in Baripada in 1979 and later completed his post-graduation from Ravenshaw College in Cuttack. In 1983, he joined the Nuclear Physics Division of the BARC after completing his training from the BARC Training School's 26th batch. He earned his doctorate from Mumbai University and worked on various nuclear physics-related areas covering collision energy from the sub-Coulomb barrier to the relativistic regime using the Pelletron accelerator at TIFR, PHENIX and CMS experiments at BNL in the United States and CERN, Geneva. In addition to his work at BARC, he also held various honorary positions such as general secretary and president of the Indian Physics Association (IPA), spokesperson for the India-CMS collaboration, director of the Saha Institute of Nuclear Physics, and director of the Physics Group at BARC. He has also served as the CERN Scientific Associate twice, first during 2002-2004 and again during 2010-2011.

Prof. Mustansir Barma Professor Emeritus, Former Director, TIFR, TIFR Center for interdisciplinary Science, Hyderabad
(**Member**, *Governing Board & Executive Council*)

Prof. Barma was a faculty member at TIFR Mumbai and was Director, TIFR Mumbai. For his contributions to physics Prof. Barma has received numerous awards, including the Bhatnagar prize and the "S.N. Bose Birth Centenary Award". Prof. Barma is member of many national and international science academies including the Indian National Science Academy. For his contributions he was awarded "Padma Shri" by Government of India.

Prof. Amitava Raychaudhuri Former Director, Sir Tarak Nath Palit Professor of Physics, Professor Emeritus, University of Calcutta, Kolkata.
(**Member**, *Governing Board & Executive Council*)

Prof. Raychaudhuri has held numerous academic positions in India and abroad. He was the 'Sir Tarak Nath Palit Professor' at Calcutta University, and he was Director HRI, Allahabad. For his research contributions in physics, Prof. Raychaudhuri has received several awards, including the 'Bhatnagar Prize' and the 'J.C. Bose fellowship'. He is member of several science academies, including the Indian National Science Academy. Prof. Raychaudhuri was conferred the honour of International Alumnus of the Year by the University of Maryland.

Prof. Sudhanshu Jha, Former Director, TIFR,
402, Vigyanshila, Juhu-Versova Link Road, Seven Bungalows, Andheri (W) Mumbai.
(**Member**, *Governing Board*)

Prof. Sudhanshu Jha was faculty member at TIFR, Mumbai and is a former Director, TIFR, Mumbai. For his contributions in physics, Prof. Jha has received many awards including the 'Bhatnagar Prize' and the 'S.N. Bose Medal'. He is a member of several national and international academies, including the Indian National Science Academy and the Third World Academy of Sciences.

Prof. **Manindra Agrawal**,
Department of Computer Sciences and Engineering,
Indian Institute of Technology, Kanpur
(**Member**, *Executive Council*)

Prof. Manindra Agrawal is a professor at the Department of Computer Science and Engineering and the Deputy Director at the Indian Institute of Technology, Kanpur. He was also the recipient of the first Infosys Prize for Mathematics and the Shanti Swarup Bhatnagar Award in Mathematical Sciences in 2003. He has been honored with Padma Shri in 2013.

Prof. V. Ravindran, Director, IMSc Chennai
(**Member Secretary**, *Governing Board & Executive Council*)

Prof. V. Ravindran was a faculty member at Harish-Chandra Research Institute, Allahabad, prior to joining IMSc as a faculty member. His research interests are in theoretical high energy physics and in the perturbative structure of quantum field theories. He is Fellow of Indian Academy of Science (IAS) since 2012, and Fellow of Indian National Science Academy (INSA) since 2019.

[**Vacant**], Vice-Chancellor, University of Madras, Chennai
(**Member**, *Governing Board*)

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Smt. Sushma Taishete, CSS, Joint Secretary (R & D), Department of Atomic Energy, CSM Marg, Mumbai.
(**Member**, *Governing Board & Executive Council*)

Ms. Richa Bagla, IAS
Joint Secretary(Finance) to Govt. of India,
Department of Atomic Energy, Mumbai
(**Member**, *Governing Board & Executive Council*)

Shri. **A. Karthik**, IAS
Principal Secretary to Government,
Secretariat, Higher Education Dept., Government of Tamilnadu, Chennai
(**Member**, *Governing Board & Executive Council*)

1.2.2 Director's Advisory Committees

Annual Report Committee

Vijay Kodiyalam	Chair
Ramya, C.	
Sibasish Ghosh	
Sandeep Choubey	
Arnab Pal	
Padmanath, M.	
Maruthu Pandiyan, B.	SO'D'(Library)

Alumni Committee

Indumathi, D.	Chair
Sundar, S.	
Maruthu Pandiyan, B.	SO'D'(Library)
Raveendra Reddy, B.	SO'F'(Systems)

Computer Media & Web Committee

Pinaki Chaudhuri	Chair
Amritanshu Prasad	
Rahul Siddharthan	
Areejit Samal	
Sanoli Gun	
Sayantan Sharma	
Dhiraj Kumar Hazra	
Sushmita Gupta	
Ajit Balram	
Raveendra Reddy, B.	SO'F'(Systems)
Nagamalleswara Rao, U.	SO'C'(Systems)
A student representative	(nominated by the Chair)

Events Committee
(Outreach, Social Media, National Science Day, Institute Seminar Day, Open Day and Science at the Sabha committee)

Viswanath, S.	Chair
Arnab Pal	
Sandeep Choubey	
Padmanath, M.	
Sushmita Gupta	
Varuni Prabhakar	PSO

Internal Complaints Committee (Gender Bias Redressal)

Sushmita Venugopalan	Chair
Sibasish Ghosh	
Ramya, C.	
Vinayalatha, S.	Registrar
Indra, R.	Administrative Officer
Geetha, V.	(External Member)
A Student Representative	(Nominated by the Chair)

Grievance Redressal Committee

Meena Mahajan	Chair
Sibasish Ghosh	Chair
Anirban Mukhopadhyay	
Sanatan Digal	
Partha Mukhopadhyay	

Guest House Advisory Committee

Saket Saurabh	Chair
Indumathi, D.	
Syed R. Hassan	
Shrihari Gopalakrishna	
Dishant Pancholi	
Roji Pius	
Vinayalatha, S.	Registrar
A Student Representative	(Nominated by the Chair)

HBNI Coordinators Committee

Amritanshu Prasad	Dean, Student Affairs
Satyavani Vemparala	Dean, Physical Sciences
Srinivas, K.	Dean, Mathematical Sciences
Sitabhra Sinha	Dean, Life Sciences

Hostel Faculty Counselor Committee
(This Committee will also serve as the Anti-Ragging Committee)

Indumathi, D.	Chair
Nemani, V.S.	
Syed R. Hassan	
Prakash Saivasan	
Anup B Dixit	
Debayan Chakraborty	
Padmanath, M.	

Housing & Up-Keep Committee

Syed R. Hassan	Chair
Anup Dixit	
Dhiraj Kumar Hazra	
Roji Pius	
Vinayalatha	Registrar
Indra, R.	Administrative Officer

Library Committee

Sitabhra Sinha	Chair
Amritanshu Prasad	
Sayantan Sharma	
Arnab Pal	
Ramya, C.	
Maruthu Pandiyan, B.	SO'D'(Library)
Sathish Kumar, V.	SRF, (Mathematics)

Official Language Implementation Committee

Ravindran, V.	Chair
Srinivas, K.	
Anup Dixit	
Sandeep Choubey	
Vinayalatha, S.	Registrar
A Student Representative	(nominated by the Chair)

PDF Committees

Sanoli Gun & **Sundar, S.**	Mathematics
Dhiraj Kumar Hazra & **Sayantan Sharma**	Physics (HEP)
Arnab Pal	Physics (LEP)
Vikram Sharma	TCS
Areejit Samal	CB

Right To Information Act [RTI] Committee

Anirban Mukhopadyay	Appellate Authority
Vinayalatha , S.	Public Information Officer
Indra, R.	Assistant Public Information Officer

Committee for Space Planning, Allocation & Infrastructure

Syed R. Hassan	Chair
Venkatesh Raman	
Saket Saurabh	
Sushmita Venugopalan	
Sayantan Sharma	
Anup Dixit	
Dhiraj Kumar Hazra	

Vinayalatha, S.	Registrar
Mohan, S.	Scientific Officer - F (Electrical)
Sundar, M.	Scientific Officer - D (Civil)

Tender Committee

Sitabhra Sinha
Sanatan Digal
Ajit Balram
Sushmita Gupta

Sports/GYM Committee

Vikram Sharma	Chair
Dishant Pancholi	
Sundar, S.	
Debayan Chakraborty	

Student Members : One student representative for Cricket, Badminton, Football, and Table Tennis (nominated by the Chair)

Approval Coordinators

Shrihari Gopalakrishna	Physics
Anirban Mukhopadhyay	Mathematics
Meena Mahajan	TCS
Areejit Samal	CB

Colloquium Committee

Sayantan Sharma	Physics
Amritanshu Prasad	Mathematics
Prakash Saivasan	TCS
Sandeep Choubey	CB

Summer Research Programme Committee

Sushmita Gupta	TCS
Pinaki Chaudhuri	Physics
Viswanath, S.	Mathematics
Sandeep Choubey	CB

Associateship Programme Committee

Nemani, V.S.	Chair
Vikram Sharma	TCS
Viswanath, S. & **Sundar, S.**	Mathematics
Roji Pius & **Ajit Balram**	Physics
Sitabhra Sinha	CB

Academic Coordinators Committee

Sujay Ashok	Physics
Sanoli Gun	Mathematics
Vikram Sharma	TCS
Areejit Samal	CB

JEST/NBHM/JGEEBILS Coordinators Committee

Anup Dixit & Sushmita Venugopalan	Mathematics(NBHM)
Vikram Sharma & Prakash Saivasan	TCS
Pinaki Chaudhuri & Padmanath, M.	Physics
Areejit Samal	CB(JGEEBILS)

Group Conveners Committee

Vijay Kodiyalam	Mathematics
Venkatesh Raman	TCS
Areejit Samal	CB
Arnab Pal	LEP
Sayantan Sharma	HEP

Medical Committee

Sanoli Gun	Chair
Saket Saurabh	
Sayed R. Hassan	
Ajit Balram	
Vinayalatha S	Registrar

1.3 Faculty

Name	*Userid*

Computational Biology

Choubey, Sandeep	sandeep
Samal, Areejit	asamal
Siddharthan, Rahul	rsidd
Sinha, Sitabhra	sitabhra

Mathematics

Chatterjee, Pralay	pralay
Dixit, Anup Biswanath	anupdixit
Gun, Sanoli	sanoli
Gupta, Rahul	rahulgupta
Iyer, Jaya N.	jniyer
Kodiyalam, Vijay	vijay
Mohari, Anilesh	anilesh
Mukhopadhyay, Anirban	anirban
Pancholi, Dishant Mayurbhai	dishant
Prasad, Amritanshu	amri
Raghavan, K. N.	knr
Srinivas, K.	srini
Sundar, S.	ssundar
Sushmita Venugopalan	sushmita
Viswanath, S.	svis

Physics

Adhikari, Ronojoy	rjoy
Ashok, Sujay K.	sashok
Bagchi, Manjari	manjari
Banerjee, Shankha	shankhab
Balram, Ajit C.	ajit
Chandrashekar, C.M.	chandru
Chakraborty, Debayan	debayan
Chaudhuri, Pinaki	pinakic
Digal, Sanatan	digal
Ghosh, Sibasish	sibasish
Gopalakrishna, Shrihari	shri
Hassan, Syed Raghib	shassan
Hazra, Dhiraj Kumar	dhiraj
Indumathi, D.	indu
Laad, Mukul S.	mslaad
Madanagopalan, Padmanath	padmanath
Menon, Gautam I.	menon

Mukhopadhyay, Partha	parthamu
Nemani, Venkata Suryanarayana	nemani
Pal, Arnab	arnabpal
Pius, Roji	rojipius
Rajesh, Ravindran	rrajesh
Ravindran, V.	ravindra
Sharma,Sayantan	sayantans
Vemparala, Satyavani	vani

Theoretical Computer Science

Gupta, Sushmita	sushmitagupta
Mahajan, Meena	meena
Raman, Venkatesh	vraman
Ramya, C.	ramyac
Saivasan, Prakash	prakashs
Saurabh, Saket	saket
Sharma, Vikram	vikram
Subramanian, C.R.	crs

1.4 Emeritus Faculty Members

Balasubramanian, R.	balu
Rajasekaran, G.	graj

1.5 Scientific Staff

Raveendra Reddy B.	ravi
Paul Pandian M.	pandian
Mohan S.	smohan
Sundar M.	msundar
Maruthu Pandiyan B.	maruthu
Unguturu Nagamalleswara Rao	unrao
Ilayaraja, M.	ilayarajam

1.6 Administrative & Accounts Staff members

Vinayalatha S.	Registrar
Indra R.	Administrative Officer
Seenivasa Raghavan N.	Accounts Officer
Shankaran, K.P.	Purchase & Stores Officer
Parthiban, V.	Junior Administrative Officer (Establishment)
Babu, B.	Junior Administrative Officer (Admininstration)

Padmanabhan, T.	Junior Administrative Officer (Accounts)

Usha Otheeswaran	**Ashfack Ahmed, G.**
Geetha, M.	**Prema, P.**
Jayanthi, S.	**Johnson, P.**
Gopinath, S.	**Archana Shukla**
Baskaran, R.	**Ravichandran, N.**
Moorthy, E.	**Rajasekaran, N.**
Munuswamy, N.	**Janakiraman, J.**
Manikandamurthy, E.	**Chandra Sekar, P.S.**

1.7 Project Staff

1.7.1 Project Staff [Non Academic]

Name	*Userid*
Balachander M.	mbchander
Dhinesh Singh A	dineshs
Doguparthi Ganesh Kumar	dgkumar
Gayathri S.	gayathris
Hari Priya T.V.	tvhpriya
Krishna Balaji R.	rkbalaji
Manikandan Sambasivam	
Moovendan M.	moovendan
Raj Kumar S.	srajkumar
Rethinasamy D.	drsamy
Sadhana R.	sadhana
Sakthivel Murugan E.	esakthi
Sasi Kumar K.	sasikumark
Siva Perumal	sivaperumal
Srinivasan G.	gsvasan
Thennarasu S.D.	sdthennarasu
Vijayakumar V.	vvkumar
Vimalraj J.	vimalraj
Yogeshwaran M.	yogeshm

1.7.2 Project Staff [Scientific/Academic]

Name	*Userid*
Ashraf Izhar MD	ashraf
Anantha Narayanan. R	
Anuran Pal. M	anuranp
Anusree Vinod	anusreevk

Arbinda Beheru	
Arul Anne Elden. A	arulae
Debabrata Deb	debabratadeb
Deepak Kumar	deepak
Disha J Kuzhively	dishajk
Geetha. R	rgeetha
Gokul Balaji. D	gokulb
Hareesh, J	hareeshj
Irine Skeiviya	irenesj
Ishitva Gupta	ishitvag
Ishwarya M	ishwaryam
Jayalakshmi. A	jayalakshmi
Kamal Tripathi	kamalt
Kishan Kumar	kishank
Kundhanathan. R	kundhanathan
Mrinal Kanti Pal	mrinalkantipal
Nandini Mitra	nmitra
Pulkit Ojha	pulkitojha
Rajesh. R	rajeshrajan
Ranjith Venkatrama	ranjithv
Saumitra Kulkarni	ranjithv
Shakthi N. Menon	shakthi
Smruti Dixit	
Solingyur Zimik Kachui	soling
Soumyadip Banerjee	soumyadipb
Vanisha Verma	vanishav
Varuni Prabhakar	varuni
Vikash Tripathi	vikasht
Vinayak T	vinayakt
Vinay Vaibhav	vinayv

1.8 Post-Doctoral Fellows

Name	*Userid*
Computational Biology	
Pinakinarayan A P Swain	pinakiswain
Solingyur Zimik Kachui	soling
Mathematics	
Arghya Pramanik	arghayap
Bais Shubham Rameshsingh	shubhambais
Dwaipauam Mazumder	mazumderd
Hassain M.	hassainm

Hitesh Ramesh Raundal	hiteshrr
Jagannath Bhanja	jbhanja
Lalit Vaishya	lalitvaishya
Malay Mandal	malaymandal
Manikandan, S.	manikandans
Md Amir Hossain	amirh
Mrityunjoy Charan	mcharan
Namrata Arvind	namrataa
Nishu Kumari	nishukumari
Pasupulati Sunil Kumar	sunilkp
Priyanshu Chakraborthy	priyanshu
Ramya Nair	ramyanair
Richa Sharma	richasharma
Rijubrata Kundu	rijubratak
Santanu Tantubay	santanut
Sayan Goswami	sayangoswami
Selvakumar A.	selvakumar
Selvi R.	selvir
Shankar V.	shankarv
Vidhya, A.	vidhyaa

Physics

Aman Abhishek	amanabhi
Aneesh P.B.	aneeshpb
Arghya Das	arghyadas
Arkaprabha Ghosal	arkaghosh
Ashutosh Rajendra Dubey	ashutoshrd
Athulya K.P.	athulyakp
Biswajit Das	biswajitd
Chandan Kumar	chandansharma
Debabrata Adak	debuadak
Debodirna Ghosh	debodirna
Deeptak Biswas	deeptakb
Iyyappan I.	iyyappan
Jetin E. Thomas	jetinthomas
Manu Akavoor	amanu
Md. Abhishek	mdabhishek
Mohd Taher	taherm
Moumita Naskar	moumitan
Navdeep Singh Dhindsa	navdeepsingh
Oindrila Gangauly	oindrilag
Pratik Tarafdar	pratikt
Ratan Sarkar	ratansarkar
Reshmi Roy	reshmiroy
Rohit Kumar Shukla	rohitshukla
Sanhita Parihar	sanhitap
Sitender Pratap Kashyap	sitenderpk

Soumyadip Banerjee	soumyadipb
Subramanya, Hegde	subbuh
Suprabh Prakash	suprabh

Theoretical Computer Science

Mohana Priya A	mohana
Om Prakash	omprakashsingh
Palak Pandoh	palakpandoh
Satyabrata Jana	satyabrataj
Sayani Das	sayanidas
Shaily Verma	shailyverma
Sriram Bhyravarapu	sriramb
Vikash Tripathi	vikasht

1.9 Ph.D. Students

Name	*Userid*

Computational Biology

Ajay Subbaroyan	sajay
Ajaya Kumar Sahoo	ajayaks
Amrutamaya Behera	amrutamaya
Ananta Dutta	anantadutta
Aniruddha, N.	naniruddha
Anuran Pal	anuranp
Chandrani Kumari	chandranik
Farhina Mozaffer	farihinam
Hareesh J	hareeshj
Kalyani Murali	kalyanim
Madhumita Mondal	madhumitam
Nikhil Chivukula	nikhilc
Pavitra S.	spavitra
Priyotosh Sil	priyotosh
Reshma M	reshmam
Rohit Kumar Singh	rohits
Roni Saiba	ronis
Saptarshi Chakraborty	saptarshic
Shanmuga Priya B.	shanmugapriya
Shreyes Rajam Madhamkar	shreyesrm
Sreevidya T.S	tssreevidya

Mathematics

Abhirup Chatterjee	abhirupc
Ankur Sarkar	ankurs
Aritra Bhattacharya	baritra
Arunabha Mukhopadhyay	arunabham
Astrid Swizell Dias	astridsd
Dhananjaya Sahu	dhananjayas
Gaurav Kumar	gauravkr
Gayathri, M.	dhananjayas
Jayakumar R.	rjayakumar
Manas Mandal	manasm
Manav Gaddam	manavg
Manika Gupta	manikag
Namitha C.H	namithach
Papiya Sur	papiyasur
Piyasa Sarkar	psarkar
Rashi Sanjay Lunia	rashisl
Ratheesh T.V	ratheeshtv
Sathish Kumar, V.	vsathish
Saurav Holme Choudhury	sauravhe
Siddheswar Kundu	siddheswark
Soumyadip Sarkar	soumyadips
Subrat Panigrahi	subratp
Suhas Rao Devraj	suhasrao
Sunil L Naik	sunilnaik
Suraj Rajendra Kularni	surajrk
Sushant	sushant
Tanmoy Bera	tanmoyb
Tirtharaj Basu	tirtharajb
Velmurugan S	velmurugan

Physics

Abhishek MS	abhims
Adarsh Sudhakar	adarshsu
Adarsh Vishwakarma	adarshv
Akhil Antony	akhilantony
Amir Suhail	amirs
Amit Kumar	kamit
Amit Suthar	amitsuthar
Anjali Kundalpady	anjalik
Anupam Sarkar	asarkar
Apurba Biswas, G.	apurbab
Arindam Mitra	amitra
Arpan Kundu	akundu
Arup Biswas	arupb
Bhabani Sankor Tripathy	bhabanist

Deep Maity	deepmaity
Gopal Prakash	gopalp
Goutham R	gouthamr
Hariharan	arjunh
Harshit Pandey	harshitp
Himanshu Badhani	himanshub
Hitesh Garg	hiteshgarg
Jatin Ghai	jghai
Jitin Rajoria	jitinr
Jyotijwal Debnath	jdebnath
Koyena Bose	koyenb
Krishna Jalan	krishnajalan
Mamale Vinod Suryakant	mvinod
Manish	manishd
Manoj Negi	manojn
Nayan Mondal	nayanm
Nirmal Ghorai	nirmalg
Nishant Gupta	nishantg
Pavan Dharanipragada	pavand
Prabhat Butola	prabhatb
Prateek Chawla	prateekc
Prem Kumar	premk
Rabindranatha Mallick	rmallick
Raghvendra Singh	raghvendra
Rahul Das	rahuldas
Rahul Nayak	rahulnayak
Rakesh Kumar Dora	prakeshdora
Ravi Shanker	rshanker
Ravi T	travi
Sahil	sahilmd
Samim Akhtar	saminakhtar
Sandeep Sharma	sandeeps
Sanjoy Saha	sanjoysaha
Sarbartha Sengupta	sarbartha
Sashikanta Mohapatra	sashikanta
Saurav Goyal	sauravg
Sayak Guin	smallik
Sayantan Ghosh	sayantang
Shubham Rajesh Kumar Das	shubhamdas
Siddhartha Paul	siddarthap
Soumya Sur	soumyasur
Subashri, V.	subashriv
Sumit Shaw	sumitshaw
Sushovan Mondal	smondal
Swagatam Tah	swagatamt
Tanishk Shrimal	tanishks
Tanmay Saha	sahatanmay
Tanmoy Sengupta	tsengupta
Toshali Mitra	toshalim

Umang A. Dattani	umangad
Vaibhav Pathak	vaibhavp
Vigneshwaran K.	vigneshwaran
Vishwajeet Kumar	vishwajeet

Theoretical Computer Science

Abhijit R Nair	abhijitrn
Abhimanyu Choudhury	abhimanyuc
Anannya Upasana	anannyaupas
Hitesh Vilas Wankhede	hiteshw
Ishan Chakraborty	ishanc
Koduri Siddharth Choudary	kodurisc
Pratik Shastri	pratiks
Pritesh Kumar	priteshk
Sanjay Seetharaman	sanjays
Satya Amar	satyaamar
Singanporia Kushal Piyushkumar	kushalps
Sobyasachi Chatterjee	sobyasachic
Sounak Modak	sounakm
Souvik Saha	souviks

1.10 Summer Students

Every summer, a small number of students from various Institutes/Universities come to our institute and work on some learning/research projects with some faculty member for a period of four to six weeks. The following students visited the institute during Apr, 2023 - Mar, 2024.

Student	**Faculty**
Computational Biology	
Aruna Padmalakshmi Thangadurai, Shiv Nadar University	Choubey, Sandeep
Gauranga Kumar Baishya, IIT Kharagpur	Choubey, Sandeep
Nimal Archish Kannan, NISER Bhubaneshwar	Choubey, Sandeep
Nivetha B., PSG College of Technology, Coimbatore	Samal, Areejit
Sohani Nayak NIT, Rourkela	Samal, Areejit
Pranav Prabhu, Shiv Nadar University	Siddharthan, Rahul
Sabdhayini K B, IISER Tirupathi	Siddharthan, Rahul
Raghuvansh S, BITS Pilani (Goa Campus)	Sinha, Sitabhra
Sapna Raja, IIT Madras	Sinha, Sitabhra

Mathematics

Abhishek Jha, IIIT- Delhi	Dixit, Anup Biswanath
Godhuli Mukherjee, ISI- Kolkata	Gun, Sanoli
Shibam Mondal, Ramakrishna Mission Vidyamandira, Belur	Gun, Sanoli
Akash Gaur, University of Delhi	Pancholi, Dishant M
Mr.Subhanshu Prasad, NISER Bhubaneshwar	Srinivas, K
A, Anushree, Azim PremJi University	Srinivas, K.

Physics

Ganesh Hanchanahal, BITS Goa	Ghosh, Sibasish
Md Asif Zia, IIT Gandhinagar	Ghosh, Sibasish
Ms.Trinanda Bhuyan, Tezpur University	Balram, Ajit C
Rishi Paresh Joshi, NISER Bhubaneshwar	Balram, Ajit C
Venkatavaradhan Sundararajan, IISER Mohali	Balram, Ajit C
Anjali Madangarli, Ashoka University, Haryana	Mukhopadhyay, Partha
Joydeep Sarkar, IIT Kharagpur	Mukhopadhyay, Partha
Aravinth Ram K, IIT Kharagpur	Padmanath, M.
C Karthik, IISER Pune	Pal, Arnab
Mrinmoyee Saha, IIT Hyderabad	Pal, Arnab
Ganesh Hanchanahal, BITS Goa	Pal, Arnab
Mahesh S, NISER Bhubaneshwar	Sinha, Sitabhra
Samyak Parashar, IISER Bhopal	Sinha, Sitabhra
Sukshith P H, IISER Pune	Sinha, Sitabhra
Anurag Agarwal, University Of Hyderabad	Vemparala, Satyavani

Theoretical Computer Science

Bhaskar Goyal, NISER Bhubaneshwar	Raman, Venkatesh
Mano Prakash, IIT Madras	Raman, Venkatesh
Mr Arjun Vijayan Nair, IISER Trivandrum	Raman, Venkatesh
Shashankh Chandarr, IIT Kanpur	Raman, Venkatesh
Siddharth G, IISER Trivandrum	Raman, Venkatesh
Ishan Chakraborty, IMSc Chennai	Saurabh, Saket
Sinha, Arnav, IISER Mohali	Gupta, Sushmita
Iyer, Vighnesh, Azim Premji University	Saivasan, Prakash
SB, Sreenanda, University of Hyderabad	Saivasan, Prakash

1.10.1 Other Students

Students also do their projects under the supervision of our faculty during the academic year. The following student has visited the institute during Apr, 2023 - Mar, 2024.

Student	Faculty
Mathematics	
Shah, Varun, IISER Pune	Prasad, Amritanshu
Bhattacharya, Abhipsa, IISER, Thiruvanantapuram	Srinivas, K.
Yadav, Prabhakar Ratipal, ISI, Delhi	Srinivas, K.
Ghosh, Arkabrata, Central Michigan University, USA	Srinivas, K.
Physics	
Mallikarjun, Rahul, St. Stephen's College, Delhi	Pal, Arnab
Dinesh, Rishi , Shiv Nadar Institution of Eminence	Ghosh, Sibasish
Jayasri, J., National Center for Ultrafast Processes, Madras University	Ghosh, Sibasish
Kumar, Aswin, University of Madras	Gopalakrishna, Shrihari
Ramesh, Aparna, University of Madras	Gopalakrishna, Shrihari

Chapter 2

Research and Teaching

2.1 Computational Biology

2.1.1 Research Summary

Computational Biology

Boolean models are a well-established framework to model developmental gene regulatory networks for acquisition of cellular identities. During the reconstruction of Boolean DGRNs, even if the network structure is given, there is generally a large number of combinations of Boolean functions that will reproduce the different cell fates (biological attractors). In a recent study, the authors leverage the developmental landscape to enable model selection on such ensembles using the relative stability of the attractors. First they show that previously proposed measures of relative stability are strongly correlated and they stress the usefulness of the one that captures best the cell state transitions via the mean first passage time (MFPT) as it also allows the construction of a cellular lineage tree. A property of great computational importance is the insensitivity of the different stability measures to changes in noise intensities. That allows to use stochastic approaches to estimate the MFPT and thereby scale up the computations to large networks. Given this methodology, they revisit different Boolean models of Arabidopsis thaliana root development, showing that a most recent one does not respect the biologically expected hierarchy of cell states based on relative stabilities. They therefore developed an iterative greedy algorithm that searches for models which satisfy the expected hierarchy of cell states and found that its application to the root development model yields many models that meet this expectation. Their methodology thus provides new tools that can enable reconstruction of more realistic and accurate Boolean models of developmental gene regulatory networks. The results from this study are contained in published manuscript [**Su**].

Boolean models of gene regulatory networks (GRNs) can easily recapitulate cellular phenotypes via their attractor states. The overall dynamics of such Boolean models is embodied in a state transition graph (STG). Indeed, two Boolean networks with the same network structure and attractors can have drastically different STGs depending on the type of Boolean functions (BFs) employed. In a recent study, they have systematically delineated the effects

of different classes of BFs on the structural features of the STG of reconstructed Boolean GRNs while keeping network structure and biological attractors fixed, and thereafter, they explored the characteristics of BFs that drive those features. Using 10 reconstructed Boolean GRNs, they generated ensembles that differ in BFs and computed from their STGs the rate of contraction or 'bushiness' and rate of 'convergence' of dynamics, quantified with measures inspired from cellular automata that are based on the garden-of-Eden (GoE) states. They find that biologically meaningful BFs lead to higher STG 'bushiness' and 'convergence' than random ones. Obtaining such 'global' measures gets computationally expensive with larger network sizes, stressing the need for feasible proxies. So they adapt Wuensche's Z-parameter in cellular automata to BFs in Boolean networks and provide four natural variants, which, along with the average sensitivity of BFs computed at the network level, comprise their descriptors of local dynamics. Notably, they find some of the descriptors of local dynamics to be good proxies for bushiness. Finally, they provide an excellent proxy for the 'convergence' based on computing transient lengths originating at random states rather than GoE states. The results from this study have been communicated to a journal and available as a preprint [**Sil2**].

The dynamics of Boolean networks depend on the network architecture and regulatory logic rules, i.e., Boolean functions (BFs), associated with nodes. In an earlier study, the authors have shown that Nested canalyzing functions (NCFs) are enriched among the BFs in the large-scale studies of reconstructed Boolean models. In a recent study, they addressed the question as to whether that enrichment is due to certain subtypes of NCFs. They build on one subtype of NCFs, the chain functions (or chain-0 functions) proposed by Gat-Viks and Shamir. Firstly, they propose two other subtypes of NCFs, namely, the class of chain-1 functions and generalized chain functions, the union of the chain-0 and chain-1 types. Next, they find that the fraction of NCFs that are chain-0 (also holds for chain-1) functions decreases exponentially with the number of inputs. Further, they provide analytical treatment for this and other observations on BFs. Then, by analysing three different datasets of reconstructed Boolean models they find that generalized chain functions are significantly enriched within the NCFs. Lastly, they illustrate that upon imposing the constraints of generalized chain functions on three different GRNs, they are able to obtain biologically viable Boolean models. The results from this study are contained in published manuscript [**Sil1**].

As part of the objectives of the Max Planck Partner Group, the authors have developed discrete Ricci curvatures as edge-based measures for the analysis of networks and high-order networks. Furthermore, they have applied their geometry-inspired measures to several real-world networks. In a recent study, they used discrete Ricci curvatures to compare functional connectivity networks of healthy young and old subjects from the Max Planck Institute Leipzig Study for Mind-Body-Emotion Interactions (MPI-LEMON) dataset. They found that discrete Ricci curvatures show brain-wide and region-level differences in functional connectivity related to healthy ageing. Further investigation into the behavioural relevance of age-related differences revealed that curvatures can identify brain regions that are associated with the domains of movement, affective processing, and somatosensory processing. Further, they found that curvatures can capture brain regions whose non-invasive stimulation shows evidence for improvement in motor performance of healthy older adults. Overall, their past and present research demonstrates the utility of discrete Ricci curvatures in identifying clinically-relevant brain regions and informing future interventions for preserving cognitive function during neurodevelopmental disorders and healthy age-

ing. The results from this study are contained in published manuscript [**Y**]. All the datasets and computer programs generated during this study are openly accessible at: https://github.com/asamallab/Curvature-FCN-Aging.

In earlier research, the authors have employed geometry-inspired measures (specifically, discrete Ricci curvatures) and topological data analysis (TDA) (specifically, persistent homology) for characterising the higher-order structure of networks. In a recent study, they performed a comparative analysis of two approaches, discrete Ricci curvatures and persistent homology, in assessing the fragility and systemic risk in the Indian stock markets, which is known for its high volatility and risk. To this end, they analysed the time series of daily log-returns of stocks comprising the National Stock Exchange (NSE) and the Bombay Stock Exchange (BSE). Specifically, they monitored the changes in standard network measures, edge-centric discrete Ricci curvatures, and persistent homology based topological measures computed from cross-correlation matrices of stocks. The Indian stock markets are known to be less diverse in comparison to the US stock market, and therefore, provides us with an interesting example. In this study, they clearly show that discrete Ricci curvatures are potent indicators of crashes in Indian stock markets. Further, among the persistent homology based topological measures, they find that persistent entropy is simple and more robust than L1-norm and L2-norm of persistence landscape. The results from this study have been communicated to a journal and available as a preprint [**K**].

In another recent study, the authors have investigated Bakry-Emery-Ricci (BER) curvature, a notion of discrete Ricci curvature that had been considerably studied in geometry, but had not been applied to real-world networks. Specifically, they explored the utility of BER curvature in both model and real-world networks, and moreover, compared the statistics with other notions of discrete Ricci curvatures. they observed that most vertices typically have negative BER curvature. Random and small-world networks exhibit a narrow BER curvature distribution whereas other classes and most of the real-world networks possess a wide BER curvature distribution. When they compare BER curvature with two other discrete notions of Ricci-curvature, Forman-Ricci (FR) and Ollivier-Ricci (OR) curvature for both model and real-world networks, they observed a high positive correlation between BER and both FR and OR curvature, and in particular with the augmented version of FR curvature. BER curvature also exhibited a high negative correlation with the vertex centrality measure and degree for most of the model and real-world networks. However, BER curvature does not correlate with the clustering coefficient. Also, they investigated the importance of vertices with highly negative BER curvature values to maintain communication efficiency in the network. The computational time for BER curvature is shorter than that required for OR curvature but higher than for Augmented FR curvature. In sum, they conclude that for empirical network analysis, the latter is the tool of choice. The results from this study have been communicated to a journal and available as a preprint [**Sil2**].

The authors have leveraged their IMPPAT phytochemical library specific to Indian medicinal plants to predict potential small molecule inhibitors of key protein targets in emerging viral diseases. Specifically, Rift Valley fever is a zoonotic disease that can spread through livestock and mosquitoes, and its symptoms include retinitis, photophobia, hemorrhagic fever and neurological effects. The World Health Organization has identified Rift Valley fever as one of the viral infections that has potential to cause a future epidemic. Hence, efforts are urgently needed toward development of therapeutics and vaccines against this infectious

disease. Notably, the causative virus namely, the Rift Valley fever virus (RVFV), utilises the cap-snatching mechanism for viral transcription, rendering its cap-binding domain (CBD) as an effective antiviral target. Before their work, there were no published studies towards identification of potential small molecule inhibitors for the CBD of RVFV. In a recent study, they employed a virtual screening workflow consisting of molecular docking and molecular dynamics simulation, to identify 5 potential phytochemical inhibitors of the CBD of RVFV. These 5 phytochemical inhibitors can be sourced from Indian medicinal plants used in traditional medicine. In short, the 5 phytochemical inhibitors of the CBD of RVFV identified by this computational study are promising drug lead molecules which can be considered for detailed experimental validation against RVFV infection. The results from this study are contained in published manuscript [**Mu**].

Vitiligo is a complex disease wherein the environmental factors, in conjunction with the underlying genetic predispositions, trigger the autoimmune destruction of melanocytes, ultimately leading to depigmented patches on the skin. While genetic factors have been extensively studied, the knowledge on environmental triggers remains sparse and less understood. To address this knowledge gap, the authors built the first comprehensive knowledgebase of vitiligo-triggering chemicals namely, Vitiligo-linked Chemical Exposome Knowledgebase (ViCEKb). ViCEKb involves an extensive and systematic manual effort in curation of published literature and subsequent compilation of 113 unique chemical triggers of vitiligo. ViCEKb standardised various chemical information, and categorised the chemicals based on the associated evidence and sources of exposure. Importantly, ViCEKb contains a wide range of metrics necessary for different toxicological evaluations. Notably, they observed that ViCEKb chemicals are present in a variety of consumer products. Furthermore, an extensive cheminformatics-based investigation revealed that ViCEKb chemical space is structurally diverse and comprises unique chemical scaffolds in comparison with skin specific regulatory lists. Finally, a transcriptomics-based analysis of ViCEKb chemical perturbations in skin cell samples highlighted the commonality in their linked biological processes. They believe their resource will enable efforts to decipher the complex aetiology of vitiligo and aid in the characterization of human chemical exposome. ViCEKb is freely available for academic research at: https://cb.imsc.res.in/vicekb. The results from this study are contained in published manuscript [**C1**].

The authors have leveraged their previously built exposome resource, ExHuMId, to build a machine learning based toxicity prediction model. Briefly, breast milk serves as a vital source of essential nutrients for infants. However, human milk contamination via transfer of environmental chemicals from maternal exposome is a significant concern for infant health. The Milk to Plasma concentration (M/P) ratio is a critical metric that quantifies the extent to which these chemicals transfer from maternal plasma into breast milk, impacting infant exposure. Machine learning based predictive toxicology models can be valuable in predicting chemicals with high propensity to transfer into human milk. To this end, they build such classification- and regression-based models by employing multiple machine learning algorithms and leveraging the largest curated dataset to date of 375 chemicals with known Milk to Plasma concentration (M/P) ratios. Their Support Vector Machine (SVM) based classifier outperforms other models in terms of different performance metrics, when evaluated on both (internal) test data and external test dataset. Specifically, the SVM based classifier on (internal) test data achieved a classification accuracy of 77.33%, specificity of 84%, sensitivity of 64%, and F-score of 65.31%. When evaluated on an external test dataset, their SVM based classifier

is found to be generalizable with sensitivity of 77.78%. While they were able to build highly predictive classification models, their best regression models for predicting the M/P ratio of chemicals could achieve only moderate R2 values on the (internal) test data. As noted in earlier literature, their study also highlights the challenges in developing accurate regression models for predicting the M/P ratio of xenobiotic chemicals. Overall, this study attests the immense potential of predictive computational toxicology models in characterising the myriad chemicals in the human exposome. The results from this study are contained in published manuscript [**V**]. Their study also takes a step toward achieving FAIR principles compliance by publicly releasing their curated chemical data sets and computer codes through the associated GitHub repository (https://github.com/asamallab/M-by-P-ratio-Pred).

Thyroid stimulating hormone receptor (TSHR) is crucial in thyroid hormone production in humans, and dysregulation in TSHR activation can lead to adverse health effects such as hypothyroidism and Grave's disease. Further, animal studies have shown that binding of EDCs with TSHR can lead to developmental toxicity. Hence, several such chemicals have been screened for their adverse physiological effects in human cell lines via high-throughput assays in the ToxCast project. The invaluable data generated by the ToxCast project has enabled the development of toxicity predictors, but they can be limited in their predictive ability due to the heterogeneity in structure-activity relationships among chemicals. In a recent study, the authors systematically investigated the heterogeneity in structure-activity as well as structure-mechanism relationships among the TSHR binding chemicals from ToxCast. By employing structure-activity similarity (SAS) map, they identified 79 activity cliffs among 509 chemicals in TSHR agonist dataset and 69 activity cliffs among 650 chemicals in TSHR antagonist dataset. Further, by using the matched molecular pair (MMP) approach, they find that the resultant activity cliffs (MMP-cliffs) are a subset of activity cliffs identified via the SAS map approach. Subsequently, by leveraging ToxCast mechanism of action (MOA) annotations for chemicals common to both TSHR agonist and TSHR antagonist datasets, they identified 3 chemical pairs as Strong MOA-cliffs and 19 chemical pairs as Weak MOA-cliffs. The results from this study are contained in published manuscript [**S1**]

The ToxCast project has generated the largest resource on the chemical-receptor activity data for environmental chemicals that were screened across various endocrine receptors. However, the heterogeneity in the multi-target structure-activity landscape of such chemicals is not yet explored. In another recent study, the authors systematically curated the chemicals targeting eight human endocrine receptors, their activity values and biological endpoints from the ToxCast chemical library. they employed dual-activity difference and triple-activity difference maps to identify single-, dual-, and triple-target cliffs across different target combinations. They annotated the identified activity cliffs through MMP based approach, and observed that a small fraction of activity cliffs form MMPs. Further, structurally classified the activity cliffs and observed that R-group cliffs form the highest fraction among the cliffs identified in various target combinations. Finally, they leveraged the MOA annotations to analyse structure-mechanism relationships, identified strong MOA-cliffs and weak MOA-cliffs, for each of the eight endocrine receptors. Overall, insights from this first study analysing the structure-activity landscape of environmental chemicals targeting multiple human endocrine receptors, will likely contribute towards the development of better toxicity prediction models for characterising the human chemical exposome. The results from this study are contained in published manuscript [**B2**].

Cadmium is a prominent toxic heavy metal that contaminates both terrestrial and aquatic environments. Owing to its high biological half-life and low excretion rates, cadmium causes a variety of adverse biological outcomes. AOP networks were envisioned to systematically capture toxicological information to enable risk assessment and chemical regulation. In a recent study, the authors leveraged AOP-Wiki and integrated heterogeneous data from four other exposome-relevant resources to build the first AOP network relevant for inorganic cadmium-induced toxicity. From AOP-Wiki, they filtered 309 high confidence AOPs, identified 312 key events (KEs) associated with inorganic cadmium, and thereafter, curated 30 cadmium relevant AOPs (cadmium-AOPs), using a data-centric approach. By constructing the undirected AOP network, they identified a large connected component of 18 cadmium-AOPs. Further, analysed the directed network of 59 KEs and 82 key event relationships (KERs) in the largest component using graph-theoretic approaches. Subsequently, they mined published literature using artificial intelligence-based tools to provide auxiliary evidence of cadmium association for all KEs in the largest component. Finally, they performed case studies to verify the rationality of cadmium-induced toxicity in humans and aquatic species. Overall, the cadmium-AOP network constructed in this study will aid ongoing research in systems toxicology and chemical exposome. This work was a collaborative effort with researchers at the National Centre for Coastal Research (NCCR), Ministry of Earth Sciences (MoES), Chennai, and results from this study are contained in a published manuscript [**S2**].

Plastics are widespread pollutants found in atmospheric, terrestrial and aquatic ecosystems due to their extensive usage and environmental persistence. Plastic additives, that are utilised to achieve specific functionality in plastics, leach into the environment upon plastic degradation and pose considerable risk to ecological and human health. Limited knowledge concerning the presence of plastic additives throughout the plastic life cycle has hindered their effective regulation, thereby posing risks to product safety. In another recent study, the authors leveraged the AOP framework to understand the mechanisms underlying plastic additives-induced toxicities. They first identified an exhaustive list of 6470 plastic additives from chemicals documented to be found in plastics. Next, they leveraged heterogenous toxicogenomics and biological endpoints data from five exposome-relevant resources, and identified associations between 1287 plastic additives and 322 complete and high quality AOPs within AOP-Wiki. Based on these plastic additive-AOP associations, constructed a stressor-centric AOP network, wherein the stressors are categorised into 10 priority use sectors and AOPs are linked to 27 disease categories. They visualised the plastic additives-AOP network for each of the 1287 plastic additives which are available via a resource: https://cb.imsc.res.in/saopadditives/. Finally, they showed the utility of the constructed plastic additives-AOP network by identifying 28 highly relevant AOPs associated with benzo[a]pyrene, and thereafter, explored the associated toxicity pathways leading to respiratory and gastrointestinal system diseases in humans and developmental disorders in aquatic species. Overall, the constructed plastic additives-AOP network will enable regulatory risk assessment of plastic additives, thereby contributing towards a toxic-free circular economy for plastics. This work was a collaborative effort with researchers at NCCR, MoES, Chennai, and results from this study have been communicated to a journal and available as a preprint [**S3**].

The authors have also expanded their research in the area of human exposome from chemical stressors to physical stressors, in particular, ultraviolet (UV) radiation. Humans encounter

diverse environmental factors which can have an impact on their health. One such environmental factor is UV radiation. UV radiation is the leading cause of skin cancer and is a significant global health concern. A large body of published research has been conducted to uncover the mechanisms underlying the adverse outcomes of UV radiation exposure on living beings. These studies involve identifying the biomolecules induced upon UV radiation exposure. A few previous efforts have attempted to compile this information in the form of a database, but such earlier efforts have certain limitations. To fill this gap, they built a structured database named UVREK, containing manually curated data on biomolecules induced by UV radiation exposure from published literature. UVREK has compiled information on 985 genes, 470 proteins, 54 metabolites and 77 miRNAs along with their metadata. Thereafter, an enrichment analysis performed on the human gene set of UVREK database showed the importance of transcription related processes in UV related response, and enrichment of pathways involved in cancer and ageing. While significantly contributing towards characterising the physical component of the exposome, they expect the compiled data in UVREK will serve as a valuable resource for development of better UV protection mechanisms such as UV sensors and sunscreens. UVREK is openly accessible at: https://cb.imsc.res.in/uvrek/. The results from this study have been communicated to a journal and available as a preprint [**B1**]

T9SS is one of the least characterised secretion systems exclusively found in the Bacteroidetes phylum, which comprises various environmental and economically relevant bacteria. While T9SS plays a central role in bacterial movement termed gliding motility, survival, and pathogenicity, there was an unmet need for a comprehensive tool that predicts T9SS, gliding motility, and proteins secreted via T9SS in sequenced bacteria. To this end, the authors have developed such a computational tool, Type 9 secretion system and Gliding motility Prediction (T9GPred). To build this tool, they manually curated published experimental evidence and identified mandatory components for T9SS and gliding motility prediction. They also compiled experimentally characterised proteins secreted via T9SS and determined the presence of three unique types of C-terminal domain signals, and these insights were leveraged to predict proteins secreted via T9SS. Notably, using recently published experimental evidence, they show that T9GPred has high predictive power. Further, they used T9GPred to predict the presence of T9SS, gliding motility, and associated secreted proteins across 693 completely sequenced Bacteroidetes strains. T9GPred predicted 402 strains to have T9SS, of which 327 strains are also predicted to exhibit gliding motility. Further, T9GPred also predicted putative secreted proteins for the 402 strains. In sum, T9GPred is a novel computational tool for systems-level prediction of T9SS and streamlining future experimentation. The source code of the computational tool is available in their GitHub repository: https://github.com/asamallab/T9GPred. The tool and its predicted results are compiled in a web server available at: https://cb.imsc.res.in/t9gpred/. This work was carried out in collaboration with Dr. Celin Acharya (Molecular Biology Division, BARC). The results from this study are contained in published manuscript [**S4**]

In a recent study, the authors created the first resource compiling published expression signatures associated with Ectopic pregnancy. Ectopic pregnancy is one of the leading causes of maternal mortality, wherein the fertilized embryo grows outside of the uterus. Previous efforts have been made to identify possible gene or protein markers associated with ectopic pregnancy in humans through expression studies. Before their work, there was no dedicated resource that compiles the genes associated with ectopic pregnancy from such expression

studies. To this end, they created a computational resource, Ectopic Pregnancy Expression Knowledgebase (EPEK), that involves manual compilation and curation of expression profiles of ectopic pregnancy in humans from published articles. In EPEK, they compiled information on 314 differentially expressed genes, 17 metabolites, and 3 SNPs associated with ectopic pregnancy. Subsequently, they performed extensive network-centric analyses on the gene set compiled in EPEK to show the implication of cellular signalling processes in ectopic pregnancy. They also identified possible exosome markers that could be clinically relevant in the diagnosis of ectopic pregnancy. EPEK is accessible at: https://cb.imsc.res.in/epek. The results from this study are contained in published manuscript [**C2**]

In terms of collaborations with experimental biology groups, the authors have played an enabling role in the following projects. In one project led by the group of Prof. Amit Singh (IISc Bengaluru), they analysed the transposon mutagenesis-deep sequencing (TnSeq) data for Mycobacterium tuberculosis within the context of biological networks, and this led to building hypotheses and discovery of rv0158 as a coordinator of redox homeostasis in the pathogen. The results from this study are contained in published manuscript [**Sa2**].

In another project led by the groups of Prof. Vinay Nandicoori (CCMB Hyderabad) and Prof. Dhiraj Kumar (ICGEB New Delhi), they have analysed phosphoproteomics data in Mycobacterium tuberculosis and helped in establishing the role played by phosphorylation in virulence of the pathogen. The results from this study are contained in a published manuscript [**R**].

In another project led by Dr. Ashish Srivastava (Nuclear Agriculture and Biotechnology Division, BARC), they have created an open-access transcriptome database hosted in IMSc, namely SesuviumKB (https://cb.imsc.res.in/sesuviumkb/) to enable scientific community to conduct wide-scale functional studies of Sesuvium portulacastrum (L.) genes, that could pave the way to engineer salt tolerance in crops. Notably, Sesuvium portulacastrum (L.) is a halophyte, adapted to grow naturally under saline environments. The results from this study are contained in published manuscript [**Ra**].

To survive, adapt, and develop, cells respond to external and internal stimuli by tightly regulating transcription. Transcriptional regulation involves the combinatorial binding of a repertoire of transcription factors to DNA, which often results in switch-like binary outputs akin to Boolean logic gates. Recent experimental studies have demonstrated that in eukaryotes, transcription factor binding to DNA often involves energy expenditure, thereby driving the system out of equilibrium. The governing principles of transcriptional logic operations out of equilibrium remain unexplored. Here, [**D**] they employ a simple two-input, single-locus model of transcription that can accommodate both equilibrium and nonequilibrium mechanisms. Using this model, they find that nonequilibrium regimes can give rise to all the logic operations accessible in equilibrium. Strikingly, energy expenditure alters the regulatory function of the two transcription factors in a mutually exclusive manner. This allows for the emergence of new logic operations that are inaccessible in equilibrium. Overall, their results show that energy expenditure can expand the range of cellular decision-making without the need for more complex promoter architectures.

The three-dimensional organization of chromatin is influenced by DNA-binding proteins, through specific and non-specific interactions. However, the role of DNA sequence and interaction between binding proteins in influencing chromatin structure is not yet fully under-

stood. By employing a simple polymer-based model of chromatin, that explicitly considers sequence-dependent binding of proteins to DNA and protein-protein interactions, the authors elucidate a mechanism for chromatin organization. They find that: (1) Tuning of protein-protein interaction and protein concentration is sufficient to either promote or inhibit the compartmentalization of chromatin. (2) The presence of chromatin acts as a nucleating site for the condensation of the proteins at a density lower than in isolated protein systems. (3) The exponents describing the spatial distance between the different parts of the chromatin, and their contact probabilities are strongly influenced by both sequence and the protein-protein attraction. Their findings [**Sw**] have the potential application of re-interpreting data obtained from various chromosome conformation capture technologies, thereby laying the groundwork for advancing their understanding of chromatin organization.

Cellular actin dynamics result from collective action of hundreds of regulatory proteins, majority of which target actin filaments at their barbed ends. Three key actin binding proteins - profilin, cofilin and twinfilin individually depolymerize filament barbed ends. Notwithstanding recent leaps in their understanding of their individual action, how they collectively regulate filament dynamics remains an open question. In absence of direct and simultaneous visualization of these proteins at barbed ends, gaining mechanistic insights has been challenging. The authors have here investigated multicomponent dynamics of profilin, cofilin and twinfilin using a hybrid approach that combines high throughput single filament experiments with theory. They discovered that while twinfilin competes with profilin, it promotes binding of cofilin to filament sides. Interestingly, contrary to previous expectations, they found that profilin and cofilin can simultaneously bind the same filament barbed end resulting in its accelerated depolymerization. Their study [**Ch**] reveals that pair-wise interactions can effectively capture depolymerization dynamics in simultaneous presence of all three proteins. They thus believe that their approach of employing a theory-experiment dialog can potentially help decipher multicomponent regulation of actin dynamics.

The eukaryotic genome is organized within the cell nucleus through three-dimensional compaction. The physical principles that govern genome organization in vivo remain less understood. Phase separation of protein and DNA has emerged as an attractive mechanism for reshaping chromatin and compacting the genome. In vitro studies have shed light on the biophysical principles of protein-DNA condensates driven by protein-protein and protein-DNA interactions. However, the role of DNA sequence and its impact on protein-DNA condensation remains elusive. Guided by experiments, this paper presents a simple polymer-based model of protein-mediated DNA condensation that explicitly incorporates the influence of DNA sequence on protein binding. Using coarse-grained Brownian dynamics simulations, the authors demonstrate that, in the case of a homogeneous DNA, only one condensate forms in equilibrium. In sharp contrast, DNA sequence heterogeneity can result in the coexistence of multiple condensates, giving rise to the formation of structures resembling pearl-necklaces. Interestingly, they observe that protein binding affinity of interfacial DNA governs the capillary forces arising from the protein-DNA condensates. To demonstrate the usefulness of their modeling framework, they compare the simulation results against published data for co-condensation of Dps, Sox2, and HP1. They find that while Dps exhibits sequence-independent binding, DNA sequence heterogeneity dictates the co-condensation of Sox2 and HP1 with DNA. Overall, the framework developed here [**Sin**] can be harnessed to gain mechanistic insights into the role of DNA sequence on protein-DNA co-condensation and pave the way for developing a deeper understanding of genome organisation.

2.1.2 List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript *; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.

[**B1**]
Shanmuga Priya Baskaran, Janani Ravichandran, Priya Shree, Vinayak Thengumthottathil, Bagavathy Shanmugam Karthikeyan, and Areejit Samal.
UVREK: Development and analysis of an expression profile knowledgebase of biomolecules induced by ultraviolet radiation exposure.
2024.
(Preprint: bioRxiv 2024.03.31.587452).

[**B2**]
Shanmuga Priya Baskaran, Ajaya Kumar Sahoo, Nikhil Chivukula, Kishan Kumar, and Areejit Samal.
Cheminformatics analysis of the multitarget structure activity landscape of environmental chemicals binding to human endocrine receptors.
ACS Omega, **8(51)**, 49383–49395, 2023.
https://doi.org/10.1021/acsomega.3c07920

[**C1**]
Nikhil Chivukula, Kundhanathan Ramesh, Ajay Subbaroyan, Ajaya Kumar Sahoo, Gokul Balaji Dhanakoti, Janani Ravichandran, and Areejit Samal.
ViCEKb: Vitiligo-linked chemical exposome knowledgebase.
Science of The Total Environment, **913**, 169711, 2024.
https://doi.org/10.1016/j.scitotenv.2023.169711

[**C2**]
Ananya Natarajan*, **Nikhil Chivukula, Gokul Balaji Dhanakoti, Ajaya Kumar Sahoo, Janani Ravichandran, and Areejit Samal**.
EPEK: Creation and analysis of an ectopic pregnancy expression knowledgebase.
Computational Biology and Chemistry, **104**, 107866, 2023.
https://doi.org/10.1016/j.compbiolchem.2023.107866

[**Ch**]
Ankita Ankita*, **Sandeep Choubey, and Shashank Shekhar***.
Multicomponent rendezvous of cofilin, profilin and twinfilin at the actin filament barbed end.
2023.
(Preprint: arXiv:2311.06457).

[**D**]
Smruti Dixit, Teije C. Middelkoop*, **and Sandeep Choubey**.
Governing principles of transcriptional logic out of equilibrium.

Biophysical Journal, **123(8)**, 1015–1029, 2024.
https://doi.org/10.1016/j.bpj.2024.03.020

[K]
Saumitra Kulkarni, Hridesh K. Pharasi*, Sudharsan Vijayaraghavan, Anirban Chakraborti*, and Areejit Samal.
Investigation of Indian stock markets using topological data analysis and geometry-inspired network measures.
2023.
(Preprint: arXiv:2311.17016).

[Ku1]
Mayank Jain*, Chandrani Kumari, Avnish Kumar*, and Soumyabrata Dev*.
Using meteosat cloud masks for solar irradiance nowcasting.
In *IGARSS 2023 - 2023 IEEE International Geoscience and Remote Sensing Symposium*, pages 3938–3941. IEEE, Jul 2023.
https://doi.org/10.1109/IGARSS52108.2023.10283418

[Ku2]
Chandrani Kumari and Rahul Siddharthan.
MMM and MMMSynth: Clustering of heterogeneous tabular data, and synthetic data generation.
PLOS ONE, 2024.
https://doi.org/10.48550/arXiv.2310.19454 (To be published).

[M]
Amruta Vasudevan*, Reshma Maiya, Keertana Venkatesh*, Vinod Kumar, Parul Sood*, Kausalya Murthy*, Sandhya P. Koushika*, and Gautam I Menon.
Transport of synaptic vesicles is modulated by vesicular reversals and stationary cargo clusters.
Journal of cell science, **136(12)**, jcs261223, 2023.
https://doi.org/10.1242/jcs.261223

[Mu]
Ishwarya Muralitharan, Ajaya Kumar Sahoo, Priya Dharshini Augusthian, and Areejit Samal.
Computational prediction of phytochemical inhibitors against the cap-binding domain of rift valley fever virus.
Molecular Diversity, 2023.
https://doi.org/10.1007/s11030-023-10702-x (Submitted).

[N]
Rakesh Netha Vadnala, Sridhar Hannenhalli*, Leelavati Narlikar*, and Rahul Siddharthan.
Transcription factors organize into functional groups on the linear genome and in 3D chromatin.

Heliyon, **9(8)**, 18211, 2023.
https://doi.org/10.1016/j.heliyon.2023.e18211

[**R**]
Basanti Malakar*, Komal Chauhan*, Priyadarshini Sanyal*, Saba Naz*, Haroon Kalam*, Vivek-Ananth R. P., Lakshya Veer Singh*, Areejit Samal, Dhiraj Kumar*, and Vinay Kumar Nandicoori*.
Phosphorylation of CFP10 modulates mycobacterium tuberculosis virulence.
mBio, **14(5)**, e01232–23, 2023.
https://doi.org/10.1128/mbio.01232-23

[**Ra**]
Jayant Kulkarni*, Sripati A. Sahoo*, Pawel Herzyk*, Vitthal T. Barvkar*, Sanjukta A. Kumar*, Janani Ravichandran, Areejit Samal, Anna Amtmann*, Mahesh Borde*, Penna Suprasanna*, and Ashish K. Srivastava*.
Early-responsive molecular signatures associated with halophytic adaptation in sesuvium portulacastrum (L.).
Plant, Cell & Environment, **47(3)**, 961–975, 2024.
https://doi.org/10.1111/pce.14767

[**S1**]
Ajaya Kumar Sahoo, Shanmuga Priya Baskaran, Nikhil Chivukula, Kishan Kumar, and Areejit Samal.
Analysis of structure–activity and structure–mechanism relationships among thyroid stimulating hormone receptor binding chemicals by leveraging the toxcast library.
RSC Advances, **13(34)**, 23461–23471, 2023.
https://doi.org/10.1039/D3RA04452A

[**S2**]
Ajaya Kumar Sahoo, Nikhil Chivukula, Ramesh Kundhanathan, Jasmine Singha*, Shambanagouda Rudragouda Marigoudar*, Krishna Venkatarama Sharma*, and Areejit Samal.
An integrative data-centric approach to derivation and characterization of an adverse outcome pathway network for cadmium-induced toxicity.
Science of The Total Environment, **920**, 170968, 2024.
https://doi.org/10.1016/j.scitotenv.2024.170968

[**S3**]
Ajaya Kumar Sahoo, Nikhil Chivukula, Shreyes Rajan Madgaonkar, Kundhanathan Ramesh, Shambanagouda Rudragouda Marigoudar*, Krishna Venkatarama Sharma*, and Areejit Samal.
Leveraging integrative toxicogenomic approach towards development of stressor–centric adverse outcome pathway networks for plastic additives.
2024.
(Preprint: bioRxiv 2024.03.27.586984).

[**S4**]
Ajaya Kumar Sahoo, Vivek-Ananth R. P., Nikhil Chivukula, Vishalini Rajaram,

Karthikeyan Mohanraj*, Devanshi Khare*, Acharya Celin*, and Areejit Samal.
T9GPred: A comprehensive computational tool for the prediction of type 9 secretion system, gliding motility, and the associated secreted proteins.
American Chemical Society, **8(37)**, 34091–34102, 2023.
https://doi.org/10.1021/acsomega.3c05155

[**Sa1**]
Cloé Roger*, Adèle Paul*, Emmanuel Fort*, Céline Lamouroux*, Areejit Samal, Johan Spinosi*, and Barbara Charbotel*.
Changes in the European union definition for endocrine disruptors: how many molecules remain a cause for concern? the example of crop protection products used in agriculture in France in the six last decades.
Frontiers in Public Health, **11**, 1–11, 2024.
https://doi.org/10.3389/fpubh.2023.1343047

[**Sa2**]
Somnath Shee*, Reshma T. Veetil*, Karthikeyan Mohanraj*, Mayashree Das*, Nitish Malhotra*, Devleena Bandopadhyay*, Hussain Beig*, Shalini Birua*, Shreyas Niphadkar*, Sathya Narayanan Nagarajan*, Vikrant Kumar Sinha*, Chandrani Thakur*, Raju S. Rajmani*, Nagasuma Chandra*, Sunil Laxman*, Mahavir Singh*, Areejit Samal, Aswin N. Seshasayee*, and Amit Singh*.
Biosensor–integrated transposon mutagenesis reveals rv0158 as a coordinator of redox homeostasis in mycobacterium tuberculosis.
eLife, **12**, e80218, 2023.
https://doi.org/10.7554/eLife.80218

[**Se1**]
Aswathy Narayanan*, Pavitra Selvakumar, Rahul Siddharthan, and Kaustuv Sanyal*.
Identification of C. auris clade 5 isolates using claID.
Medical Mycology, **62(3)**, myae018, 2024.
https://doi.org/10.1093/mmy/myae018

[**Se2**]
Pavitra Selvakumar and Rahul Siddharthan.
Position-specific evolution in transcription factor binding sites, and a fast likelihood calculation for the F81 model.
Royal Society Open Science, **11(1)**, 231088, 2024.
https://doi.org/10.1098/rsos.231088

[**Si1**]
Durga Parkhi*, Nishanthi Periyathambi*, Yonas Weldeselassie*, Vinod Patel*, Nithya Sukumar*, Rahul Siddharthan, Leelavati Narlikar*, and Ponnusamy Saravanan*.
Machine-learning prediction of early postpartum glucose intolerance in women with gestational diabetes mellitus.
In *The Global Health Network Conference Proceedings 2022*. The Global Health Network,

Jun 2023.
https://doi.org/10.21428/3d48c34a.796d7f22

[Si2]
Durga Parkhi*, Nishanthi Periyathambi*, Yonas Ghebremichael-Weldeselassi Ghebremichael-Weldeselassi*, Vinod Patel*, Nithya Sukumar*, Rahul Siddharthan, Leelavati Narlikar*, and Ponnusamy Saravanan*.
Prediction of postpartum prediabetes by machine learning methods in women with gestational diabetes mellitus.
iScience, **26(10)**, 107846, 2023.
https://doi.org/10.1016/j.isci.2023.107846

[Sil1]
Suchetana Mitra*, Priyotosh Sil, Ajay Subbaroyan, Olivier C. Martin*, and Areejit Samal.
Preponderance of generalized chain functions in reconstructed Boolean models of biological networks.
Scientific Reports, **14**, 6734, 2024.
https://doi.org/10.1038/s41598-024-57086-y

[Sil2]
Priyotosh Sil, Ajay Subbaroyan, Saumitra Kulkarni, Olivier C. Martin *, and Areejit Samal.
Biologically meaningful regulatory logic enhances the convergence rate in Boolean networks and bushiness of their state transition graph.
2023.
(Preprint: bioRxiv 2023.07.17.549398).

[Sin]
Rohit Kumar Singh, Pinaki Swain, Mahipal Ganji*, and Sandeep Choubey.
Decoding the role of dna sequence on protein-dna co-condensation.
2024.
(Preprint: https://doi.org/10.1101/2024.02.24.581870).

[Su]
Ajay Subbaroyan, Priyotosh Sil, Olivier C Martin*, and Areejit Samal.
Leveraging developmental landscapes for model selection in Boolean gene regulatory networks.
Briefings in Bioinformatics, **24(3)**, bbad160, 2023.
https://doi.org/10.1093/bib/bbad160

[Sw]
Pinaki Swain, Sandeep Choubey, and Satyavani Vemparala.
Role of protein-protein interactions on model chromatin organization.
2024.
(Preprint: https://doi.org/10.1101/2024.03.03.583162).

[**V**]

Sudharsan Vijayaraghavan, Akshaya Lakshminarayanan*, Naman Bhargava*, Janani Ravichandran, R. Vivek-Ananth, and Areejit Samal.

Machine learning models for prediction of xenobiotic chemicals with high propensity to transfer into human milk.

ACS Omega, **9(11)**, 13006–13016, 2024.

https://doi.org/10.1021/acsomega.3c09392

[**Y**]

Yasharth Yadav, Pavithra Elumalai, Nitin Williams*, Jurgen Jost*, and Areejit Samal.

Discrete ricci curvatures capture age-related changes in human brain functional connectivity networks.

Frontiers in Aging Neuroscience, **15**, 1–19, 2023.

https://doi.org/10.3389/fnagi.2023.1120846

[**Z**]

Mahesh Kumar Mulimani*, Soling Zimik, Jaya Kumar Alageshan*, and Rahul Pandit*.

Spiral-wave dynamics in excitable media: Insights from dynamic mode decomposition.

Communications in Nonlinear Science and Numerical Simulation, **126**, 107428, 2023.

https://doi.org/10.1016/j.cnsns.2023.107428 (Submitted).

2.2 Mathematics

2.2.1 Research Summary

Algebra

In [K2], the authors characterise ideals in two-dimensional regular local rings that arise as ideals of maximal minors of indecomposable integrally closed modules of rank three.

Algebraic Geometry

The author's research interest have been centred on topics related to Algebraic Geometry. In recent years they have been studying Arithmetic properties of Algebraic varieties. This gave rise to period-index questions/conjectures on curves over number fields. With R.Parimala they solve the conjecture when genus is two. This manuscript is under review. Work is in progress for higher genus curves. The Brauer group of moduli stacks and equivariant Brauer groups is introduced, and discussed with R.Joshua. They provide general statements for triviality of these groups under some hypothesis. This manuscript is under review. Work is in progress to compute Brauer groups of specific moduli spaces/stacks over any field and DVR. With K.Banerjee, they continue to investigate Chow Lefschetz conjectures on ample smooth divisors inside smooth projective varieties over complex numbers. Other directions include questions on moduli spaces of quiver bundles over curves,with students and Postdocs.

Algebraic Number Theory

In [Ko2], it is shown that certain generalized Laguerre polynomials are irreducible over rationals. The results are obtained by a novel application of the concept of ϕ-Newton polygon and some results on the distribution of primes.

Let $\mathbb{Z}_K$ denote the ring integers of $K = \mathbb{Q}(\theta)$, where θ is a root of an irreducible polynomial $f(x) = x^n + a(bx^k + c)^m \in \mathbb{Z}[x]$, $1 \leq km < n$. In [Ko1], the discriminant of $f(x)$ is. explicitly computed, necessary and sufficient conditions are given for $f(x)$ to be monogenic, involving only a, b, c, m, k, n. Furthermore, a class of monogenic polynomials having non square-free discriminant and having Galois group S_n are provided.

In [Gu2] authors prove that, for every modulus q, every class of the narrow ray class group $H_q(K)$ of an arbitrary number field K contains a product of three unramified prime ideals P of degree one with $N(P)$ bounded by $(t(K)N(q))^3$, where $t(K)$ is an explicit function of K.

To achieve this result, authors first obtain a sharp explicit Brun-Titchmarsh Theorem for ray classes and then an equally explicit improved Brun-Titchmarsh Theorem for large subgroups of narrow ray class groups.

En route, authors deduce an explicit upper bound for the least prime ideal in a quadratic subgroup of a narrow ray class group and also for the size of the least ideal that is a product of degree one primes in any given class of $H_q(K)$.

The Euler-Kronecker constant γ_K associated to a number field K is an arithmetic invariant the size and nature of which is linked to some of the deepest questions in number theory. In [**Lu2**], the authors study the analogous constants associated to the narrow ray class fields of an imaginary quadratic field. They show that for such families, the conditional bounds obtained by Ihara can be improved on average, again under GRH for Dedekind zeta functions. Further, the family of number fields that they consider are non-abelian while such average bounds have earlier been studied for cyclotomic fields.

Analytic Number Theory

Let $d_k(n), k \geq 1$, denotes the number of partitions obtained by summing the links of the k-elongated plane partition diamonds of length n. In [**Ks**], some infinite families of congruences modulo 3 and 5 for 5-elongated and 6-elongated partition diamonds have been established.

In [**Be**], the authors study the pair correlation statistic for higher dimensional sequences. They show that for any $d \geq 2$, strictly increasing sequences $(a_n^{(1)}), \ldots, (a_n^{(d)})$ of natural numbers have *metric Poissonian pair correlation* with respect to sup-norm if their *joint additive energy* is $O(N^{3-\delta})$ for any $\delta > 0$. Further, in dimension two, they establish an analogous result with respect to the 2-norm. The proof uses estimates for *Generalized GCD-sums* which they develop in this paper.

Let $\mathcal{M}_n$ denote the set of monic polynomials of degree n over a finite field $\mathbb{F}_q$ of q elements. For multiplicative functions ψ_1, ψ_2, the authors establish in [**Mu2**], a "local-global" principle for correlation functions of the form

$$\sum_{f \in \mathcal{M}_n} \psi_1(f + h_1)\psi_2(f + h_2)$$

as n goes to infinity and q remains fixed, where $h_1, h_2 \in \mathbb{F}_q[x]$ are fixed polynomials. As a consequence, they give a new proof of a function field analog of Kátai's conjecture which states that if the average of the first divided difference of a completely multiplicative function whose values lie on the unit circle is zero then it must be a Hayes character. They further extend this result to pairs and triplets of completely multiplicative functions.

In [**Mu3**], the authors obtain an upper bound for the discrepancy of the sequence $([p\alpha]\beta)$ generated by the generalized monomial $[x\alpha]\beta$, where p runs through the set of all primes and α, β are irrational numbers satisfying natural diophantine conditions.

In [**B**], authors, assuming Dickson's conjecture, show that the set of values of the iterated Euler's φ function $\underbrace{\varphi \circ \cdots \circ \varphi}_{a times}$ contains arbitrarily large arithmetic progressions with common difference $2^{2a}P_{2a+1}Q$. Here Q is the product of distinct primes dividing $2^i - 1$ for $1 \leq i \leq a$ and P_{2a+1} is the product of primes between 5 and $2a + 1$.

In a recent work of Gun, Kohnen and Soundararajan, it was shown that L-functions associated with arbitrary non-zero cusp forms, not necessarily Hecke eigen forms, take large values at the central critical point. In [**Gun2**], authors prove analogous results for L-functions associated with twists of Dirichlet-type functions.

Let X be a smooth projective variety defined over the field K which is finitely generated over its prime field, and if $M \supseteq K$ is a finite extension of K, then the L-function $L_{2j}(X_{/M}, s)$ associated to $H_\ell^{2j}(\overline{X_{/M}}, s)$ is known to be analytic for $\Re(s) > j+1$ and is conjectured to have a meromorphic continuation to the line $\Re(s) = j+1$ with the only possible pole occurring at $s = j+1$. Moreover, J. Tate conjectures that the order of pole at $s = j+1$ is equal to the dimension of the space of codimension j cycles on X (modulo homological equivalence) which have a representative defined over M. Since the dimension of this space of cycles is bounded over an algebraic closure $\overline{K}$ of K, a consequence of Tate's conjecture is that the order of pole of $L_{2j}(X_{/M}, s)$ is bounded as M ranges over fields $K \subseteq M \subseteq \overline{K}$. In [**D3**], assuming the meromorphic continuation, Anup Dixit and Kumar Murty prove this consequence.

For any algebraic number α, let $h(\alpha)$ denote the logarithmic Weil height of α. A famous conjecture of Lehmer asserts that if α is non-zero and not a root of unity, then $h(\alpha) > \frac{c}{[\mathbb{Q}(\alpha):\mathbb{Q}]}$ for an absolute constant $c > 0$. In [**D2**], Anup Dixit and Sushant Kala connect this conjecture to the study of low-lying zeros of Dedekind zeta-function. As a consequence, they prove the conjecture for certain infinite non-Galois extensions over $\mathbb{Q}$.

The unbounded rank conjecture for elliptic curves asserts that the existence of elliptic curves over Q with arbitrarily large rank. Denote by the function $f(n)$ which enumerates the number of factorizations $ab = n$ with $a + b$ a perfect square. The descent theory of elliptic curves would show that if $f(n)$ is unbounded over squarefree n, then there are elliptic curves over Q of arbitrary large rank. In [**D5**], Anup Dixit, Ram Murty and Siddhi Pathak prove that the unboundedness of the cognate function $f_p(n)$, which enumerates the number of factorizations $ab = n$ with $a + b$ a perfect square (mod p).

Combinatorics

Given a vector space W and a linear operator $T : W \to W$, a subspace V of W is called a T-splitting subspace if $V \oplus TV = W$. When W is a finite dimensional vector space over a finite field, a simple formula was found to enumerate the number of T-splitting subspaces in terms of the number of T-invariant subspaces [**Pr6**]. Upon comparing with a previously known case of a diagonal matrix with distinct diagonal entries, a new, enumerative proof of an old formula of Touchard and Riordan on the moments of the q-Hermite orthogonal polynomial sequence (that arose in the context of the stamp-folding problem) was obtained. In [**Pr7**] the enumerative result for subspaces was generalized to a more general class of subspaces called *anti-invariant subspaces*, namely subspaces V such that $V \cap TV$ is trivial, thereby obtaining a combinatorial interpretation of all the entries of the Catalan triangle of q-Hermite orthogonal polynomials. This generalization was achieved by the use of Heine's identities on basic hypergometric series.

Modular forms

Soundararajan showed that there exists a normalized Hecke eigenform f of weight k and level one such that $L(1/2, f)$ takes extreme values for sufficiently large $k \equiv 0 \pmod 4$. In [**Gun1**], authors show that for any $\epsilon > 0$ and for all sufficiently large $k \equiv 0 \pmod 4$, the number of normalized Hecke eigenforms of weight k and level one for which $L(1/2, f)$ takes extreme values is $\gg_\epsilon k^{1-\epsilon}$. Authors also prove similar results for L-values associated with

quadratic twists of f. These questions are intricately liked to the non-existence of Siegel zeros via the works of Iwaniec and Sarnak.

In [**Gu3**], authors investigate large prime factors of Fourier coefficients of non-CM normalized cuspidal Hecke eigenforms in short intervals, i.e. in an interval of length strictly smaller than x. Techniques require to address a question in short interval is very different than those employed to solve the same question for an interval of length x. For instance, the existence of a prime p in short intervals with $a_f(p) \neq 0$ in itself a very difficult question and very little is known about it.

One of the new ingredients in [**Gu3**] involves deriving an explicit version of Chebotarev density theorem in an interval of length $\frac{x}{(\log x)^A}$ for any $A > 0$. Furthermore, authors managed to obtain results for the largest prime factor of Fourier coefficients in an interval ofmlength $x^{1/2+\epsilon}$ for any $\epsilon > 0$.

The authors in [**Gu1**] investigate a non-Archimedean analogue of a question of Atkin and Serre. More precisely, they derive lower bounds for the largest prime factor of non-zero Fourier coefficients of non-CM normalized Hecke eigen cusp forms of weight k, level N with integer Fourier coefficients. In particular, the authors show that for such a form f and for any real number $r > 0$, the largest prime factor of the p-th Fourier coefficient $a_f(p)$ of f, denoted by $P(a_f(p))$, satisfies

$$P(a_f(p)) > (\log p)^{1/8}(\log\log p)^{3/8-r}$$

for almost all primes p. This is the best known result in this direction. The authors also investigate a number field analogue of a recent result of Bennett, Gherga, Patel and Siksek about the largest prime factor of $a_f(p^m)$ for $m \geq 2$.

In a recent work, Diamantis, Lee, Raji, and Rolen defined L-series associated with weakly holomorphic modular forms and studied functional equations. They also gave a converse theorem for weakly holomorphic modular forms. In [**Ch1**], inspired by the idea of Diamantis, Lee, Raji, and Rolen, the author define L-series associated with weakly holomorphic quasimodular forms and studied functional equations. The author also prove a converse theorem for weakly holomorphic quasimodular forms.

In 2014, Oberdieck constructed the Jacobi-Serre derivative on the space of Jacobi forms, which is an obvious generalization of Serre derivative on the space of modular forms. Analogous to Ramanujan derivative equation associated to classical Eisenstien series, he gave Ramanujan equation for Jacobi forms of index 1 using Jacobi-Serre derivative. In [**Ch2**], the authors compute the adjoint of Jacobi-Serre derivative map with respect to Petersson scalar product defined on the space of Jacobi forms. As an application, they obtain certain relations among the Fourier coefficients of Jacobi forms.

Representation Theory

Given a finite group G, an irreducible representation V of G and an element $g \in G$, one may ask when V admits a non-zero vector that is invariant under the action of g. It was a surprising discovery that this happens in the vast majority of cases for symmetric groups and alternating groups, with only a few, easily enumerated exceptions [**Pr4**] abd [**Pr5**].

The question is closely related to understanding cyclic characters of G, namely characters that are induced from cyclic subgroups.

The symmetric group S_n is a subgroup of the general linear group $GL_n(\mathbb{C})$. Given an irreducible polynomial representation W of S_n and an irreducible complex representation V of S_n, one may ask for the multiplicity of V in the restriction of W to S_n. A formula for these multiplicities using the theory of symmetric functions was discovered by D. E. Littlewood in 1958. To this day, a combinatorial interpretation of these coefficients remains elusive. This problem was solved in several interesting special cases in [**Pr2**]

Given a finite group G and irreducible representations U, V, and W of G, the multiplicity of W in $U \otimes V$ is known as a Kronecker coefficient. A new class of algebras called *Kronecker Hecke algebras* were introduced to study these numbers. Through Kronecker Hecke algebras, it is shown that the sum of squares of all possible Kronecker coefficients for a given finite group is equal to the number of simultaneous conjugacy classes of pairs. A sum of Kronecker coefficients, weighted by Frobenius-Schur indices is shown to equal the number of conjugacy classes of pairs that contain their inverses.

The Knutson-Tao saturation theorem was generalised to the setting of analogs of Littlewood-Richardson coefficients arising from flagged skew-Schur functions [**Ku1**].

Various monomial expansions of the q-Whittaker functions were considered and reconciled bijectively [**Bha**]. Applications to the representations of affine Lie algebra of type A were obtained.

The unique factorization theorem for tensor products of highest-weight representations of Kac-Moody algebras was generalized to the setting of parabolic Verma modules [**Ra**]

Transcendental number theory

The authors in [**Lu1**] introduce some generalisations of the Euler-Kronecker constant of a number field and study their arithmetic nature.

The values of L-functions inside the critical strip encode a lot of arithmetic data. In 2011, Gun, Murty and Rath studied non-vanishing and transcendental nature of special values of a varying class of L-functions and their derivatives. Their work was generalized by several authors in different set-ups including studying higher derivatives. However, all these works were focused around the central point of the critical strip. In [**Lu3**], the author extends the study to arbitrary points in the critical strip.

2.2.2 List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript *; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.

[**A**]
Anbu Arjunan, Sruthymurali ., and Sundar S.
KMS states on $c_c^*(\mathbb{N}^2)$.
Glasgow Mathematical Journal, **65(3)**, 501 – 528, 2023.
https://doi.org/10.1017/S0017089523000071

[**As1**]
Abhijeet Ghanwat*, Suhas Pandit*, and Selvakumar A.
Lefschetz open book decompositions of 4−manifolds.
Journal of Knot Theory and Its Ramifications, **32(04)**, 2350026, 2023.
https://doi.org/10.1142/S0218216523500268

[**As2**]
Abhijeet Ghanwat*, Suhas Pandit*, and Selvakumar A.
Murasugi sum of k -open books.
Indian Journal of Pure and Applied Mathematics, 2023.
https://doi.org/10.1007/s13226-023-00477-0 (Submitted).

[**B**]
R. Balasubramanian, Jean-Marc Deshouillers*, and Sanoli Gun.
The set of values of any finite iteration of Eulers ϕ function contains long arithmetic progressions.
Acta Arithmetica, 2024.
https://doi.org/10.4064/aa230601-7-9 (To be published).

[**Ba1**]
Ramachandran Balasubramanian, Olivier Ramaré*, and Priyamvad Srivastav*.
Product of three primes in large arithmetic progressions.
International Journal of Number Theory, **19(04)**, 843–857, 2023.
https://doi.org/10.1142/S1793042123500422

[**Ba2**]
Ramachandran Balasubramanian, Gautham Sekar*, and Mabin Joseph*.
Revisiting the software-efficient stream ciphers RCR-64 and RCR-32.
The Computer Journal, 2023.
https://doi.org/10.1093/comjnl/bxad084 (Submitted).

[Be]
Tanmoy Bera, Mithun Kumar Das*, and Anirban Mukhopadhyay.
On higher dimensional poissonian pair correlation.
Journal of Mathematical Analysis and Applications, **530(1)**, 127686, 2024.
https://doi.org/10.1016/j.jmaa.2023.127686

[Bh]
Jagannath Bhanja and Raj Kumar Mistri*.
The sizes of restricted sums of multisets.
Proceedings - Mathematical Sciences, **133(2)**, 40, 2023.
https://doi.org/10.1007/s12044-023-00763-1

[Bha]
Aritra Bhattacharya, T. V. Ratheesh, and Sankaran Viswanath.
Monomial expansions for q-whittaker and modified hall-littlewood polynomials.
2023.
(Preprint: arXiv:2311.07904)

[C]
Sachin S. Sharma*, Priyanshu Chakraborty, Ritesh K. Pandey*, and Eswara S. Rao*.
Representations of map extended Witt algebras.
Journal of Algebra, **639**, 327–353, 2024.
https://doi.org/10.1016/j.jalgebra.2023.10.013

[Ch1]
Mrityunjoy Charan.
L-series of weakly holomorphic quasimodular forms and a converse theorem.
Forum Mathematicum, 2024.
https://doi.org/10.1515/forum-2023-0194 (To be published).

[Ch2]
Mrityunjoy Charan and Lalit Vaishya.
Construction of Jacobi forms using adjoint of Jacobi-Serre derivative.
2024.
https://doi.org/10.48550/arXiv.2401.02182 (Submitted).

[Cha]
Indranil Biswas*, Pralay Chatterjee, and Chandan Maity*.
Homotopy type of the nilpotent orbits in classical lie algebras.
Kyoto Journal of Mathematics, **63(4)**, 851–891, 2023.
https://doi.org/10.1215/21562261-2023-0009

[**D1**]
Saunak Bhattacharjee*, **Anup Dixit, and Dishant Saikia***.
An effective bound on generalized diophantine m-tuples.
Bulletin of the Australian Mathematical Society, **109(2)**, 242–253, 2023.
https://doi.org/10.1017/S0004972723001077

[**D2**]
Anup Dixit and Sushant Kala.
Lower bound heights of algebraic numbers and low lying zeros of dedekind zeta function.
2023.
arXiv:2309.15872 (Submitted).

[**D3**]
Anup Dixit and Kumar Murty*.
A consequence of tate's conjecture on the order of pole of certain L-functions.
2023.
(Submitted).

[**D4**]
Anup Dixit and Ram Murty*.
On ihara's conjectures for euler-kronecker constants.
Acta Arithmetica, **210**, 95–123, 2023.
https://doi.org/10.4064/aa220729-19-3

[**D5**]
Anup Dixit, Ram Murty*, and Siddhi Pathak*.
A function related to the mordell-weil rank of elliptic curves.
International Journal of number theory, 2024.
https://doi.org/10.1142/S1793042124501094 (To be published).

[**D6**]
Anup Dixit, Siddhi Pathak*, and Veekesh Kumar*.
Linear independence of values of the q-exponential and related functions.
Bulletin of the Australian Mathematical Society, 2023.
https://doi.org/10.1017/S0004972723001028 (Submitted).

[**D7**]
Anup B. Dixit and Saunak Bhattacharjee*.
On the distribution of phi(sigma(n)).
2024.
(Submitted).

[**G**]
Sayan Goswami.
Product of difference sets of the set of primes.
Proceedings of the American Mathematical Society, **151(12)**, 5081–5086, 2023.
https://doi.org/10.1090/proc/16478

[**Gu1**]
Y. F. Bilu[*], **S. Gun, and S. L. Naik**.
On a non-archimedean analogue of a question of Atkin and Serre.
Mathematische Annalen, 2023.
https://doi.org/10.1007/s00208-023-02686-8 (To be published).

[**Gu2**]
J. M. Deshouillers[*], **S. Gun, O. Ramare**[*], **and J. Sivaraman**[*].
Representing ideal classes of ray class groups by products of prime ideals of small size.
2023.
(Submitted).

[**Gu3**]
S. Gun and S. L. Naik[*].
A note on Fourier coefficients of Hecke eigen forms in short intervals.
2023.
(Submitted).

[**Gu4**]
S. Gun and S. L. Naik[*].
On the largest prime factor of non-zero Fourier coefficients of Hecke eigenforms.
Forum Mathematicum, **36(1)**, 173–192, 2024.
https://doi.org/10.1515/forum-2023-0050

[**Gun1**]
Sanoli Gun and Rashi Lunia.
Extreme values of L-functions of newforms.
Bulletin of the London Mathematical Society, **56(4)**, 1570–1586, 2024.
https://doi.org/10.1112/blms.13012

[**Gun2**]
Sanoli Gun and Rashi Lunia.
On extreme values of quadratic twists of dirichlet-type L-functions.
2024.
(Submitted).

[**K1**]
Futoshi Hayasaka[*] **and Vijay Kodiyalam**.
Note on indecomposable integrally closed modules of rank 2 over two-dimensional regular local rings.
Journal of Commutative Algebra, **15(4)**, 513–518, 2023.
https://doi.org/10.1216/jca.2023.15.513

[**K2**]
Futoshi Hayasaka* **and Vijay Kodiyalam**.
Indecomposable integrally closed modules of rank 3 over two-dimensional regular local rings.
Journal of Pure and Applied Algebra, **228(6)**, 107612, 2024.
https://doi.org/10.1016/j.jpaa.2024.107612

[**K3**]
Suhail A. Rather*, **N. Ramadas***, **Vijay Kodiyalam, and Arul Lakshminarayan***.
Absolutely maximally entangled state equivalence and the construction of infinite quantum solutions to the problem of 36 officers of euler.
Physical Review A, **108(3)**, 032412, 2023.
https://doi.org/10.1103/PhysRevA.108.032412

[**Ko1**]
Anuj Jakhar*, **Ravi Kalwaniya***, **and Srinivas Kotyada**.
Explicit discriminant, monogenity and galois group of a class of polynomials.
2024.
hal-04492809 (Submitted).

[**Ko2**]
Anuj Jakhar*, **Srinivas Kotyada, and Arunabha Mukhopadhyay**.
On the irreducibility of extended laguerre polynomials.
2023.
arXiv:2306.06890 (Submitted).

[**Ko3**]
Anuj Jakhar*, **Shanta Laishram***, **Srinivas Kotyada, and Prabhakar Yadav***.
A study of newton polygon of composition of two polynomials and its applications.
2024.
(Submitted).

[**Ks**]
Kathiravan T*, **Srinivas K, and Usha K Sangale***.
Some infinite families of congruences for 5- elongated plane partition diamonds.
2024.
(Submitted).

[**Ku1**]
Siddheswar Kundu, K.N. Raghavan, V. Sathish Kumar, and Sankaran Viswanath.
Saturation for flagged skew littlewood-richardson coefficients.
Algebraic Combinatorics, 2023.
arXiv:2305.05195 (To be published).

[**L1**]
Lalit Vaishya and Manish Kumar Pandey*.
Counting square-free integers represented by binary quadratic forms of a fixed discriminant
Archiv der Mathematik, **121(4)**, 385-395, 2023.
https://doi.org/10.1007/s00013-023-01915-5

[**L2**]
Lalit Vaishya.
Identities among some combinatorial objects involving special values of multiple zeta functions
Hardy-Ramanujan Journal, **46**, 42-50, 2024.
https://doi.org/10.46298/hrj.2024.13032

[**L3**]
Lalit Vaishya.
Oscillations and first-ever negative fourier coefficients of symmetric square l-functions
2024.
(Preprint: hal-04447538).

[**Lu1**]
Neelam Kandhil* and Rashi Lunia.
Transcendence of generalized Euler–Kronecker constants.
Bulletin of the Australian Mathematical Society, pages 1–7, 2023.
https://doi.org/10.1017/S0004972723000631 (To be published).

[**Lu2**]
Neelam Kandhil*, Rashi Lunia, and Jyothsnaa Sivaraman*.
Explicit upper bounds on the average of Euler–Kronecker constants of narrow ray class fields.
Research in Number Theory, **9(4)**, 69, 2023.
https://doi.org/10.1007/s40993-023-00472-8

[**Lu3**]
Rashi Lunia.
On quotients of derivatives of L-functions inside the critical strip.
Journal of Number Theory, **259**, 16–37, 2024.
https://doi.org/10.1016/j.jnt.2023.12.001

[**M**]
S. Murugan*, S. Manikandan, and A. Selvakumar.
The automorphism group of nonzero component graph of vector space.
Bulletin of the Malaysian Mathematical Sciences Society, **47(2)**, 56, 2024.
https://doi.org/10.1007/s40840-024-01651-1

[**Mu1**]
Karthick Babu*, **Anirban Mukhopadhyay, and A. Sankaranarayanan***.
Residue pattern for infinitely many primes.
International Journal of Number Theory, **19(03)**, 511–529, 2023.
https://doi.org/10.1142/S1793042123500240

[**Mu2**]
Pranendu Darbar* **and Anirban Mukhopadhyay**.
Correlation of multiplicative functions over finite fields: A pretentious approach.
Mathematika, **70(1)**, 1–51, 2024.
https://doi.org/10.1112/mtk.12227

[**Mu3**]
Karthick Babu C. G.*, **Anirban Mukhopadhyay, and Viswanadham G. K.***.
Discrepancy estimates for some linear generalized monomials at prime arguments.
The Ramanujan Journal, **63(2)**, 431–449, 2024.
https://doi.org/10.1007/s11139-023-00767-5

[**P**]
Shripad Garge*, **Arghya Pramanik, and Aditya Subramaniam***.
Seshadri constants of $\overline{M}_{0,n}$.
2024.
(Submitted).

[**Pr1**]
Dilpreet Kaur*, **Sunil Prajapati***, **and Amritanshu Prasad**.
Simultaneous conjugacy classes for finite p-groups of rank ≤ 5.
Journal of the Ramanujan Mathematical Society, **38(3)**, 275–293, 2023.

[**Pr2**]
Sridhar P. Narayanan*, **Digjoy Paul***, **Amritanshu Prasad, and Shraddha Srivastava***.
Some restriction coefficients for the trivial and sign representations.
Algebraic Combinatorics, 2024.
arXiv:2211.15252 (To be published).

[**Pr3**]
Uri Onn*, **Amritanshu Prasad, and Pooja Singla***.
Representation zeta functions of arithmetic groups of type A2 in positive characteristic.
2023.
(Preprint: arXiv:2308.07073).

[**Pr4**]
Amrutha P*, **Amritanshu Prasad, and Velmurugan S**.
On the existence of elementwise invariant vectors in representations of symmetric groups.
Algebraic Combinatorics, 2024.
arXiv:2308.08146 (To be published).

[**Pr5**]
Amrutha P*, **Amritanshu Prasad, and Velmurugan S**.
Cyclic characters of alternating groups.
2024.
arXiv:2403.05109 (Submitted).

[**Pr6**]
Amritanshu Prasad and Samrith Ram*.
Splitting subspaces and a finite field interpretation of the touchard–riordan formula.
European Journal of Combinatorics, **110**, 103705, 2023.
https://doi.org/10.1016/j.ejc.2023.103705

[**Pr7**]
Amritanshu Prasad and Samrith Ram*.
Enumeration of anti-invariant subspaces and touchard's formula for the entries of the q-hermite catalan matrix.
Advances in Applied Mathematics, **154**, 102654, 2024.
https://doi.org/10.1016/j.aam.2023.102654

[**Ra**]
K. N. Raghavan, V. Sathish Kumar, R. Venkatesh*, **and Sankaran Viswanath**.
Unique factorization for tensor products of parabolic verma modules.
Algebras and Representation Theory, 2023.
https://doi.org/10.1007/s10468-024-10254-0 (To be published).

[**Rag**]
Mrigendra S. Kushwaha*, **KN Raghavan, and Sankaran Viswanath**.
Simple procedures for left and right keys of semi-standard young tableaux.
2023.
arXiv:2302.08279 (Submitted).

[**Ram**]
Shyamala Sakthivel*, **Pankaj Shukla***, **and Selvi Ramasamy**.
Creeping flow of couple stress fluid over a spherical field on a saturated biporous medium.
Journal of Porous Media, **27**, 85–100, 2024.
https://doi.org/10.1615/JPorMedia.2024050262

[**S**]
Dhananjaya Sahu.
On values of dedekind zeta function.
Proceedings - Mathematical Sciences, **133(2)**, 48, 2023.
https://doi.org/10.1007/s12044-023-00767-x

[Se]
Suhas Pandit* **and A. Selvakumar**.
Relative trisection embeddings of 4–manifolds.
Topology and its Applications, **334**, 108550, 2023.
https://doi.org/10.1016/j.topol.2023.108550

[Sel1]
R. Selvi.
Drag on a semipermeable spherical particle covered by a couple stress fluid.
Mathematical Methods in the Applied Sciences, 2023.
https://doi.org/10.1002/Mma.9277 (Submitted).

[Sel2]
R. Selvi and Osman Anwar Bég*.
Mathematical modelling of couple stress fluid flow around a semi-permeable sphere enclosing a solid core.
ZAMM - Journal of Applied Mathematics and Mechanics, **104(4)**, e202300225, 2024.
https://doi.org/10.1002/zamm.202300225

[Sel3]
R. Selvi, Deepak Kumar Maurya*, and Pankaj Shukla*.
Analytical solution of a couple stress fluid saturated in a porous medium through a Reiner–Rivlin liquid sphere.
Physics of Fluids, **35(7)**, 073106, 2023.
https://doi.org/10.1063/5.0149507

[Sel4]
R. Selvi, Deepak Kumar Maurya*, Pankaj Shukla*, and Ali J. Chamkha*.
Analysis of a Reiner–Rivlin liquid sphere enveloped by a permeable layer.
Physics of Fluids, **36(2)**, 023303, 2024.
https://doi.org/10.1063/5.0182706

2.3 Physics

2.3.1 Research Summary

Astrophysics and Cosmology

The on-going Pulsar Timing Array (PTA) efforts have inaugurated the era of nano-Hertz gravitational waves (GW) astronomy by seeing the early signature of the stochastic gravitational waves background in June 2023. Nano-Hertz GW is beyond the sensitivity of ground based GW detectors

A PTA experiment employs an ensemble of pulsar clocks to detect GW from either a stochastic background or from an isolated individual binary supermassive black hole source. There

are four well established PTAs - Parkes Pulsar Timing Array (PPTA), North American Nano-hertz Observatory for Gravitational Waves (NANOGrav), and European Pulsar Timing Array (EPTA), and the Indian Pulsar Timing Array (InPTA).

All PTAs pool their data to create the International Pulsar Timing Array (IPTA) data releases. This is useful as it (a) allows cross comparison and calibration of different PTAs, and (b) increases the number of pulsars and the cadence of observations, thus improving the sensitivity of PTAs collectively.

InPTA data has been already pooled with the EPTA data. Presently efforts are going on to join the data of all four PTAs and to find the signature of the nano-HZ gravitational waves with improved confidence level.

In 2015, an Indian PTA experiment (InPTA) has started by a few of them, using the upgraded Giant Metrewave Radio Telescope (uGMRT) and the Ooty Radio Telescope (ORT). InPTA become an associate member of IPTA in 2018 and a full member of IPTA in 2021. It is actually an India-Japan collaborative effort.

The simultaneous, multiband observational facility of uGMRT and data in low radio frequency make InPTA unique. Because of the above reason, InPTA can measure the values of dispersion measure of the pulsars most accurately.

InPTA experiment is ongoing.

Earlier data of InPTA experiment helped (a) debug instrumentation and commission new modes at uGMRT, such as validating time and frequency standards at the observatory, determining fixed pipeline delays and routine use of multi-band coherent dedispersion systems, (b) tune analysis techniques, (c) train students and (d) uncover systematics in residuals and (e) provide data for validating GW analysis procedures resulting in preliminary limits, and (f) auxiliary science on individual pulsars.

Nearly ten percent of the presently known radio pulsars are part of binary systems. Binaries for which the companion of the pulsar is also a compact star, e.g., either a white dwarf or another neutron star or a stellar mass black hole, can be used to test theories of gravity, e.g., general relativity, scalar-tensor theory, tensor-vector-scalar theory, etc. Additionally, it is expected that pulsar-black hole (stellar mass) binaries would be useful to test the black-hole 'no-hair theorem', 'Cosmic Censorship Conjecture', to detect dipolar gravitational waves (allowed by some gravity theories) if those exist, to test the validity of non-conservative theories of gravity that predict a self acceleration of the centre of mass of the binary, etc. Although no pulsar-black hole binaries have been discovered yet, various theoretical studies demand that such pulsar-black hole binaries must exist in the Galaxy. The LIGO detection of gravitational waves emitted by the merger of a neutron star and a black hole in a binary supported this claim. As radio telescopes like MeerKAT and FAST are discovering many pulsars presently and more discoveries are expected by them as well as by the upcoming telescopes like SKA, it is possible that the discovery of a pulsar-black hole binary will happen anytime soon. Hence, it is a good time to understand how different aspects of the strong field gravity would manifest in the data of the pulsar in such a binary.

Manjari Bagchi and Jyotijwal Debnath studied the light bending phenomenon in the signal of a radio pulsar in a binary with a stellar mass black hole as a companion within a full general relativistic framework considering the Schwarzchid spacetime near the companion.

The values of the bending delays obtained in their formalism match with the pre-existing approximate analytical expressions unless both of the orbital inclination angle and the orbital phase are close to ninte degrees. For such a case, the approximate analytical expressions underestimate the value of the bending delay. On the other hand, for systems like the double pulsar, those expressions are valid throughout the orbital phase, unless its inclination angle is very close to 90 degrees. For a pulsar-black hole binary, the bending phenomenon also increases the strength of the pulse profile and sometimes can lead to a small low intensity tail.

While the simplest inflationary models predict the primordial perturbations to be near scale-invariant, the primordial power spectrum (PPS) can exhibit oscillatory features in many physically well-motivated models. The authors search for hints of such features via free-form reconstructions of the PPS based on Planck 2018 CMB temperature and polarization anisotropies. In order to robustly invert the oscillatory integrals and handle noisy unbinned data, they draw inspiration from image analysis techniques. In previous works, the Richardson-Lucy deconvolution algorithm for deblurring images has been modified for reconstructing PPS from the CMB temperature angular power spectrum. They extensively develop the methodology by including CMB polarization and introducing two new regularization techniques, also inspired by image analysis and adapted for their cosmological context [**Ha**]. Regularization is essential for improving the fit to the temperature and polarization channels (TT, TE and EE) simultaneously without sacrificing one for another. The reconstructions obtain are consistent with previous findings from temperature-only analyses. They evaluate the statistical significance of the oscillatory features in their reconstructions using mock data and find the observations to be consistent with having a featureless PPS. The machinery developed here will be a complimentary tool in the search for features with upcoming CMB surveys. The methodology also shows competitive performance in image deconvolution tasks, which have various applications from microscopy to medical imaging.

Primordial features, in particular oscillatory signals, imprinted in the primordial power spectrum of density perturbations represent a clear window of opportunity for detecting new physics at high-energy scales. Future spectroscopic and photometric measurements from the Euclid space mission will provide unique constraints on the primordial power spectrum, thanks to the redshift coverage and high-accuracy measurement of nonlinear scales, thus allowing the authors to investigate deviations from the standard power-law primordial power spectrum. They consider two models with primordial undamped oscillations superimposed on the matter power spectrum described by $1 + \mathcal{A}_{\rm X} \sin\left(\omega_{\rm X} \Xi_{\rm X} + 2\pi\phi_{\rm X}\right)$, one linearly spaced in k space with $\Xi_{\rm lin} \equiv k/k_*$ where $k_* = 0.05\,{\rm Mpc}^{-1}$ and the other logarithmically spaced in k space with $\Xi_{\rm log} \equiv \ln(k/k_*)$. They note that $\mathcal{A}_{\rm X}$ is the amplitude of the primordial feature, $\omega_{\rm X}$ is the dimensionless frequency, and $\phi_{\rm X}$ is the normalised phase, where $X = \{{\rm lin}, {\rm log}\}$. They provide forecasts from spectroscopic and photometric primary Euclid probes on the standard cosmological parameters $\Omega_{\rm m,0}$, $\Omega_{\rm b,0}$, h, $n_{\rm s}$, and σ_8, and the primordial feature parameters $\mathcal{A}_X$, ω_X, and ϕ_X. They focus on the uncertainties of the primordial feature amplitude $\mathcal{A}_X$ and on the capability of to detect primordial features at a given frequency. They also study a nonlinear density reconstruction method in order to retrieve the oscillatory signals in the primordial power spectrum, which are damped on small scales in the late-time Universe due to cosmic structure formation. Finally, they also include the expected measurements from Euclid's galaxy-clustering bispectrum and from observations of the cosmic microwave background (CMB). In [**H**], they forecast uncertainties in estimated values of the cosmological parameters with a Fisher matrix method applied to spectroscopic galaxy clustering (GCsp), weak

lensing (WL), photometric galaxy clustering (GCph), the cross correlation (XC) between GCph and WL, the spectroscopic galaxy clustering bispectrum, the CMB temperature and E-mode polarisation, the temperature-polarisation cross correlation, and CMB weak lensing. They consider two sets of specifications for the Euclid probes (pessimistic and optimistic) and three different CMB experiment configurations, that is, *Planck*, Simons Observatory (SO), and CMB Stage-4 (CMB-S4). They find the following percentage relative errors in the feature amplitude with primary probes: for the linear (logarithmic) feature model, with a fiducial value of $\mathcal{A}_X = 0.01$, $\omega_X = 10$, and $\phi_X = 0$: 21% (22%) in the pessimistic settings and 18% (18%) in the optimistic settings at a 68.3% confidence level (CL) using +WL++XC. While the uncertainties on the feature amplitude are strongly dependent on the frequency value when single probes are considered, they find robust constraints on $\mathcal{A}_{\rm X}$ from the combination of spectroscopic and photometric measurements over the frequency range of $(1,\, 10^{2.1})$. Due to the inclusion of numerical reconstruction, the bispectrum, SO-like CMB reduces the uncertainty on the primordial feature amplitude by 32%–48%, 50%–65%, and 15%–50%, respectively. Combining all the sources of information explored expected from in combination with the future SO-like CMB experiment, they forecast $\mathcal{A}_{\rm lin} \simeq 0.010 \pm 0.001$ at a 68.3% CL and $\mathcal{A}_{\rm log} \simeq 0.010 \pm 0.001$ for (PS rec + BS)+WL++XC+SO-like for both the optimistic and pessimistic settings over the frequency range $(1,\, 10^{2.1})$.

Classical and Quantum Optics

Collisional models are a category of microscopic framework designed to study open quantum systems. The framework involves a system sequentially interacting with a bath comprised of identically prepared units. In this regard, quantum homogenization is a process where the system state approaches the identically prepared state of bath unit in the asymptotic limit. Here [**Sa**], the authors study the homogenization process for non-Markovian collisional model generated via additional bath-bath interaction. With partial swap operation as both system-bath and bath-bath unitary, they show that homogenization is achieved irrespective of the initial states of the system or bath units. This is reminiscent of the Markovian scenario, where partial swap is the unique operation for a universal quantum homogenizer. On the other hand, they observe that the rate of homogenization is slower than its Markovian counter part. Interestingly, a different choice of bath-bath unitary speeds up the homogenization process but loses the universality being dependent on the initial states of the bath units.

Linear optics-based schemes to implement various quantum information processing tasks are of paramount importance due to ease of implementation and low noise. Many information-theoretic tasks depend on the successful discrimination of Bell states. A no-go theorem has been proved in literature which tells that it is not possible to perfectly discriminate among the four Bell states by restricting measurement apparatus to linear optical elements. The success probability is only 50% in this case for unambiguous discrimination. Using extra resources such as hyper entanglement, ancillary entanglement, and even a minimum amount of non-linearity, complete Bell-state discrimination (unambiguous) can be achieved. The success probability for Bell-like state discrimination is only 25% – without any extra resource. The authors find [**G1**] that this can be boosted up to 50% using hyperentanglement in polarization, momentum, or OAM degrees of freedom of the photons, which, is in contrast with the Bell-state discrimination scenario, where 100% can be achieved. Although, by using correlation in time of the photons, all four Bell states can be distinguished with 100% success probability, nevertheless, they show that for the Bell-like state discrimination, it strictly lies

between 25% and 50% depending on the state parameter, with only three Bell-like states being distinguishable. They also observe a similar contrast when they use ancillary entangled photons. While the success probability for all four Bell-state discrimination increases as $1 - 1/2^N$, where N is the number of ancillary photons for Bell-like states it depends again on the state parameters, and can even be less than 25% in some cases. Also, adding further ancillary photons seems to decrease the success probability. they then show that using non-linear gadgets namely, sum-frequency generation, 100% success probability can be achieved even for Bell-like state discrimination.

Classical and Quantum Gravity, Black Holes, Cosmology

The authors have established the Generalized Second Law (GSL) within the framework of higher curvature gravity theories, considering non-minimal couplings in the matter sector. Their proof pertains to the regime of linearized fluctuations around equilibrium black holes. Notably, while prior proofs addressed various gravity theories, they uniformly assumed minimally coupled matter sectors. In this work, the authors extended the proof of the linearized semi-classical GSL to encompass scenarios involving non-minimal couplings in the matter sector [**Dhi**].

Condensed Matter Physics

Using large-scale molecular dynamics simulations, the authors observe the melting of a topological glass of stiff ring polymers by incorporating flexible ring polymers, along an isobaric path [**Ro1**]. As more flexible ring polymers are introduced, cluster glass-like structures emerge in the stiffer ring polymers with reduced orthogonal threading. This eventually evolves to a stacked columnar structure at an increased fraction of flexible ring polymers. Depletion interactions between the stiff and flexible rings drive the stacking, contingent on the disparity in flexibility in the ring polymer mixture.

They have presented universal characterization of stress correlations in athermal systems, across crystalline to amorphous packings [**Cha**]. Via numerical analysis of static configurations of particles interacting through harmonic as well as Lennard-Jones potentials, for a variety of preparation protocols and ranges of microscopic disorder, they show that the properties of the stress correlations at large lengthscales are surprisingly universal across all situations, independent of structural correlations, or the correlations in orientational order. In the near-crystalline limit, they present exact results for the stress correlations for both models, which work surprisingly well at large lengthscales, even in the amorphous phase. Finally, they study the differences in stress fluctuations across the amorphization transition, where stress correlations reveal the loss of periodicity in the structure at short lengthscales with increasing disorder.

The effect of ring stiffness and pressure on the glassy dynamics of a thermal assembly of two-dimensional ring polymers is investigated using extensive coarse-grained molecular dynamics simulations [**Ghos1**]. In all cases, dynamical slowing down is observed with increasing pressure, and thereby, a phase space for equilibrium dynamics is identified in the plane of the obtained monomer density and ring stiffness. When the rings are highly flexible, i.e., have low ring stiffness, glassiness sets in via the crowding of crumpled polymers, which take on a globular form. In contrast, at large ring stiffness, when the rings tend to have large asphericity under compaction, they observe the emergence of local domains having

orientational ordering at high pressures. Therefore, their simulations highlight how varying the deformability of rings leads to contrasting mechanisms in driving the system toward the glassy regime.

Amorphous solids are known to fail catastrophically via fracture, and cavitation at nanometric scales is known to play a significant role in such a failure process. Micro-alloying via inclusions is often used as a means to increase the fracture toughness of amorphous solids. Modeling such inclusions as randomly pinned particles that only move affinely and do not participate in plastic relaxations, they study how the pinning influences the process of cavitation-driven fracture in an amorphous solid [**Da**]. Using extensive numerical simulations and probing in the athermal quasistatic limit, they show that just by pinning a very small fraction of particles, the tensile strength is increased, and also the cavitation is delayed. Furthermore, the cavitation that is expected to be spatially heterogeneous becomes spatially homogeneous by forming a large number of small cavities instead of a dominant cavity. The observed behavior is rationalized in terms of screening of plastic activity via the pinning centers, characterized by a screening length extracted from the plastic-eigenmodes.

In glasses under mechanical load, intrinsic spatial inhomogeneities at specific locations in the sample may cause shear banding. This allows us to initiate mechanical failure in a controlled manner. We perform molecular dynamics simulations to investigate inhomogeneous glass states under shear, using two different protocols to obtain these spatial inhomogeneities, viz., (i) by applying a temperature pulse, and (ii) by generating regions with a different degree of annealing via the swap Monte Carlo technique. In both cases, they find that shear banding is associated with a subtle interplay between stochasticity and local potential energy [**V**].

In Ref. [**Mo**], the authors showed that pronounced quantum many-body scars, which is a new paradigm for weak-ergodicity breaking, are hosted in certain sectors of the spin-1 Kitaev model.

The authors also looked at the nature of a particular ground state, namely the one that arises at even denominators [**C3**], in particular in the presence of Landau level mixing [**C4**]. They settled a long-standing debate on the nature of the ground state at half-filling in wide quantum wells showing that it is a single-component one (and not two-component as was widely believed). Along the same lines they also study the competition between FQH liquids and charge-density waves in Landau levels of multilayer graphene [**Do**].

In collaboration with Zlatko Papic, Ajit C. Balram wrote a review on FQH in semiconductor systems [**C1**].

In many-particle systems, certain exotic symmetries that are absent in the original Hamiltonian can emerge at low energies. One example, originally proposed in high-energy physics, is supersymmetry (SUSY) – an elusive symmetry relating bosons and fermions. The authors show that SUSY can arise in a fractional quantum Hall state at filling factor 5/2, a well-known topological phase of matter. They construct wave functions for the collective excitations of this state based on SUSY and demonstrate that they are degenerate in energy for realistic models of the 5/2 state. Their work opens the door to the experimental exploration of SUSY in quantum materials [**C2**]. In FQH systems, they looked at neutral excitations of the Moore-Read state and showed that the fermionic and bosonic versions of the neutral excitations can potentially be superpartners of each other. This intriguing

connection potentially provides a manifestation of SUSY in a solid state system (SUSY has long been thought of as occuring in high-energy physics but has remained elusive to date). They also showed that excitations of another state, known as the Haldane-Rezayi state, can possibly be connected to models of supergravity.

Non-Abelian fractional quantum Hall states are of interest because they harbor quasiparticles with exotic non-Abelian statistics, which may be of use for fault-tolerant quantum computation. In [**C3**] the authors propose a new mechanism for realizing non-Abelian fractional quantum Hall states via the hitherto unexplored route of Landau-level mixing. In particular, their calculations show that the composite-fermion Fermi seas at the half and quarter-filled Landau levels are unstable to paired fractional quantum Hall states with sufficient Landau level mixing. This potentially opens a new avenue for creating and studying non-Abelian states.

Foundations of Quantum Mechanics

Measurement incompatibility and the negativity of quasiprobability distribution functions are well-known non-classical aspects of quantum systems. Both of them are widely accepted resources in quantum information processing. The authors acquaint an approach [**G2**] to establish a connection between the negativity of the Wigner function, a well-known phase-space quasiprobability distribution, of finite-dimensional Hermitian operators and incompatibility among them. They calculate the negativity of the Wigner distribution function for noisy eigenprojectors of qubit Pauli operators as a function of the noise and observe that the amount of negativity increases with the decrease in noise vis-à-vis the increase in the incompatibility. It becomes maximum for the set of maximally unbiased operators. Their results, although qualitatively, provide a direct comparison between relative degrees of incompatibility among a set of operators for different amounts of noise. They generalize their treatment for higher dimensional qudits for specific finite-dimensional Gell-Mann operators to observe that with an increase in the dimension of the operators, the negativity of their Wigner distribution, and hence incompatibility, decreases.

High Energy Physics Phenomenology

The Baryon Asymmetry of the Universe:

The standard model (SM) of particle physics fails to adequately explain the observed baryon asymmetry of the Universe (BAU). It is commonly believed that physics beyond the standard model (BSM) is required to generate the BAU. Any such BSM model must satisfy the three Shakarov conditions, namely, violate C and CP symmetries, violate baryon number, and depart from thermal equilibrium.

In Ref. [**Gop**] an effective theory with a Majorana fermion pair coupled to quark-like fermions was constructed, and the physical phases were identified. The theory was shown to have C and CP violation, and baryon number violation. The departure from thermal equilibrium is provided by the Hubble expansion of the Universe. Majorana fermion decays and scattering processes were included and the resulting BAU was estimated.

Non-perturbative QCD, Lattice Gauge Theory, QGP

The authors have identified and proposed the relevant set of interactions among hadrons within an augmented version of the famous nuclear model proposed by Walecka,which has been successfully used earlier to understand the liquid-gas phase transition in a cold and dense nuclear matter. With their new proposal they are, for the first time, able to augment the applicability of such models to understand nuclear matter at finite temperatures and moderately large baryon densities, where no first-principles calculation exist so far. They can now study various aspects of the QCD phase diagram for a wide range of temperatures and nuclear densities. Their studies also provide bounds on the location of the widely studied critical end-point of the phase diagram of QCD, which is being investigated at the just concluded BES-II experiments at the Relativistic Heavy Ion collider in Brookhaven National Lab. This work with Aman Abhishek was published on January 1, in Physical Review D, 109,014007 (2024).

One of the themes of research my group is involved in the last year, is about understanding the details of chiral phase transition in strongly interacting matter described by Quantum Chromodynamics (QCD). This problem is very involved and essentially intractable analytically, thus the authors use ab-initio lattice field theory techniques to study this problem. Their work, [**Sha**] with my student Ravi Shanker and collaborator Olaf Kaczmarek, have shown for the first time that the singlet and non-singlet parts of the chiral symmetry in QCD with physical quarks get effectively restored at different temperatures. This has been an important and unresolved problem for many years, with conflicting earlier results from different research groups. They performed a state-of-the-art calculation using fermions with good chirality property in lattice gauge theory and carefully considered all the systematic effects in their calculations. They have also discussed the possible physical origin of this phenomena in terms of the microscopic degrees of freedom. They observe that the effective restoration of the anomalous singlet part of chiral symmetry in QCD is related to an Anderson-Mott like localization-delocalization transition. Their study thus has important connections to strongly-correlated electron systems in presence of a disordered lattice potential. Another direction which they explored last year was to understand the details of chiral phase transition considering different hadronic models. They proposed different ways to introduce interactions among different hadron species, see [**Shar1**], [**A**] thereby increasing the range of applicability of such hadronic models for a large range of temperatures and nuclear densities, where no predictions exist so far.

Exotic hadrons are of significant topical interest to physicists. In a recent work [**P4**], we present the first lattice calculation that unambiguously predicts the existence of a bound exotic tetraquark (Tbc) with a bottom and a charm quark. Our finding is particularly important given the recent discovery of its lighter cousin, Tcc. Recent experimental progress in doubly heavy quark production promises the discovery of Tbc in near future. Previous phenomenological and lattice predictions for Tbc are scattered or inconclusive, whereas our conclusive findings proliferate the interest in Tbc and similar hadrons that await discovery.

A plasma far from equilibrium, containing gauge field coupled to fermionic matter fields with an initial handedness or chirality is known to be an unstable system. From a first principles study, using classical-statistical lattice techniques, the authors systematically track the dynamics of the chirality in a system of fermions coupled to non-Abelian SU(2) gauge

fields. They reconfirm that the initial transfer of chirality from the fermions to gauge fields occur through the onset of instabilities i.e. exponential growth of certain momentum modes of the gauge fields. More interestingly the chirality in the fermion sector gets absorbed by gauge fields via non-trivial topological transitions. This has interesting consequences, like the saturation of momentum distribution of the low energy modes of gauge fields unlike the onset of turbulence observed in an Abelian electromagnetic plasma by us in an earlier work. Their findings have consequences for the ongoing experimental searches at Brookhaven National Laboratory and at CERN on the signatures of Chiral Magnetic effect [**Shar2**].

Recently discovered T_{cc} tetraquark is the longest-lived explicitly exotic $cc\bar{u}\bar{d}$ hadron ever discovered. Experimental progress in double heavy quark production indicates T_{cc}'s heavy cousin Tbc tetraquark with flavor $bc\bar{u}\bar{d}$, would be the most sought-after candidate in the next decade. Phenomenological and lattice predictions for T_{bc} are quite scattered or inconclusive. In this recent investigation with Dr. Archana Radhakrishnan and Prof. Nilmani Mathur from TIFR Mumbai, Dr. M. Padmanath reported a lattice QCD study of the heavy-light meson-meson interactions with an explicitly exotic flavor content $bc\bar{u}\bar{d}$, isospin $I = 0$, and axialvector $J^P = 1^+$ quantum numbers in search of possible tetraquark bound states. The continuum extrapolated estimates for $D\bar{B}^*$ elastic S-wave scattering amplitude extracted from the lattice data are analysed using amplitude parametrizations supplemented by a lattice spacing dependence. Light quark mass $m_{u/d}$ dependence of the $D\bar{B}^*$ scattering length (a_0) suggests that at the physical pion mass $a_0^{phys} = +0.57(^{+4}_{-5})(17)$ fm, which clearly points to an attractive interaction between the D and $\bar{B}^*$ mesons that is strong enough to host a real bound state T_{bc}, with a binding energy of $-43(^{+6}_{-7})(^{+14}_{-24})$ MeV with respect to the $D\bar{B}^*$ threshold.

In a recent lattice investigation with Dr. Sara Collins from University of Regensburg, and Dr. Alexey Nefediev and Prof. Sasa Prelovsek from Josef Stefan Institute, Ljubljana, Dr. M. Padmanath has investigated the heavy quark mass dependence of the T_{cc} tetraquark system. To this end, the DD^* scattering phase shifts in the $T_{cc}^+ = cc\bar{u}\bar{d}$ channel are extracted from lattice QCD for five different charm quark masses and a fixed light-quark mass corresponding to $m_\pi \simeq 280$ MeV. The phase shifts are analysed employing two approaches: effective range expansion and Lippmann–Schwinger equation derived in the effective field theory. In the latter case, the results imply an attraction at short range parametrised by contact terms and a slight repulsion at long range mediated by one-pion exchange with $m_\pi > m_{D^*} - m_D$. The poles in the amplitude across the complex energy plane are extracted and their trajectories are discussed as the charm quark mass is varied. Two complex conjugate poles corresponding to a resonance below threshold are found for m_c close to the physical value. They turn into a pair of virtual states at the largest m_c studied. With further increasing m_c, one virtual pole representing T_{cc}^+ is expected to move towards the two-body threshold and turn into a bound state. The article was reported with arXiv [**P3**]preprint number 2402.14715 and has been accepted for publication in Physical Review D.

Nonlinear Dynamics, Solitons and Chaos

The authors find exact static soliton solutions for the unit spin vector field of an inhomogeneous, anisotropic 3D Heisenberg ferromagnet. Each soliton is labeled by two integers n and m. It is a (modified) skyrmion in the $z = 0$ plane with winding number n, which twists out of the plane m times in the z-direction to become a 3D soliton. Here m arises

due to the periodic boundary condition in z. They use Whitehead's integral expression to find that the Hopf invariant of the soliton is an integer $H = nm$. Thus the soliton describes a closed hopfion vortex. Plots of the preimages of this topological soliton show that they are either unknots or nontrivial knots, depending on n and m. Any pair of preimage curves links H times, corroborating the interpretation of H as a linking number. They also calculate the exact energy of the hopfion vortex, and show that its topological lower bound has a sublinear dependence on H. Using Derrick's scaling analysis, they demonstrate that the presence of a spatial inhomogeneity in the anisotropic interaction, which in turn introduces a characteristic length scale in the system, leads to the stability of the hopfion vortex. [**Ba1**]

Topological invariants such as winding numbers and linking numbers appear as charges of topological solitons in diverse nonlinear physical systems described by a unit vector field defined on two and three dimensional manifolds. While the Gauss-Bonnet theorem shows that the Euler characteristic (a topological invariant) can be written as the integral of the Gaussian curvature (an intrinsic geometric quantity), the intriguing question of whether winding and linking numbers can also be expressed as integrals of some other kinds of intrinsic geometric quantities has not been addressed in the literature. In this paper the authors provide the answer by showing that for the winding number in two dimensions, these geometric quantities involve torsions of the two evolving space curves describing the manifold. On the other hand, in three dimensions they find that in addition to torsions, intrinsic twists of the space curves are necessary to obtain a nontrivial winding number and linking number.

They arise from the hitherto unknown connections that they establish between these topological invariants and the corresponding appropriately normalized global space curve anholonomies (i.e., geometric phases) that can be associated with the unit vector fields on the respective manifolds. An application of their results to a 3D Heisenberg ferromagnetic model supporting a topological soliton is also presented. [**Ba2**]

Perturbative QCD

The form factors for various local composite operators between massless physical states have been computed up to the fourth order in perturbative quantum chromodynamics (QCD) and have played a key role in precision studies of the Standard Model (SM) param- eters. The heavy quark form factors (HQFF) are the cases when the physical states are massive (such as a pair of top quarks), and are of critical importance in the study of physi- cal observables - such as the forward-backward asymmetry of heavy quark pair production at lepton colliders, the study of anomalous magnetic moment of a heavy quark, and more importantly, the study of top-quark properties at the High-Luminosity Large Hadron Col- lider (HL-LHC). The current state-of-the-art computations in this frontier involve third order QCD to the HQFF.

Recently the authors presented the analytic expressions for the color-planar contributions to the heavy- light form factors at three loops in perturbative QCD. These form factors play an important role in the precision predictions of various observables in top quark and flavour physics. They compute the master integrals using the method of differential equations. They perform the ultraviolet renormalization for all the appearing fields and parameters. The analytic results for the renormalized form factors are expressed in terms of generalized harmonic polylogarithms. They also study the Sudakov behaviour of these form factors in

the asymptotic limit, which enables them to obtain the complete logarithmic three-loop and partial four-loop contributions.

The resummed predictions played a crucial role to understand the experimental data in the threshold regions. Besides the threshold enhanced logarithms which are also called as the soft virtual (SV) logarithms, the subleading logarithms, called the next-to-soft vir- tual (NSV) logarithms, are also present in the partonic channels beyond leading order in perturbation theory. There have been a surge of interests in the community of theoret- ical physicists to understand the nature of these subleading logarithms by using various methods. Recently, the well-established ideas of collinear factorisation and renormalisation group invariance have been implemented to understand the perturbative structure of NSV logarithms for inclusive processes. Following the same formalism of, in a series of articles, the authors studied variety of inclusive reactions to understand the impact of NSV logarithms and found a systematic way to sum them up to all orders in z as well as in the Mellin N spaces. The authors have also studied the perturbative structure of the NSV logarithms in the context of rapidity distributions of DY and Higgs productions. In addition, for the first time, a pro- cedure to resum them in a systematic manner in the double Mellin space beyond the SV accuracy has also been developed. Further, they have studied the phenomenological rele- vance of the NSV resummation in the context of both DY and Higgs rapidity distributions respectively. For the pseudo-scalar Higgs, the resummed predictions including both SV and NSV are recently available to NNLO+NNLL accuracy for the inclusive cross section case. However, similar predictions for the differential case is not available in the literature.

The authors present the differential predictions for the rapidity distribution of pseudo- scalar Higgs boson through gluon fusion at the LHC. These results are obtained taking into account the soft-virtual (SV) as well as the next-to-soft virtual (NSV) resummation effects to next-to-next-to-leading- logarithmic (NNLL) accuracy and matching them to the approximate fixed order next-to-next-to-leading- order (NNLOA) computation. We perform the resummation in two dimensional Mellin space using our recent formalism by limiting ourselves to the contributions only from gluon- gluon (gg) initiated channels. The NNLOA rapidity distribution of pseudo-scalar Higgs is obtained by applying a ratio method on the NNLO rapidity distribution of the scalar Higgs boson. They also present the first analytical results of N3LO rapidity distribution of pseudo-scalar Higgs at SV+NSV accuracy. The phenomenological impacts of NNLOA + NNLL predictions for 13 TeV LHC are studied. They observe that, for mA =125(700) GeV, the SV+NSV resummation at NNLL level brings about 14.76% (11.48%) corrections to the NNLOA results at the central scale value mA. Further, they find that the sensitivity to the renormalisation scale gets improved substantially by the inclusion of NSV resummed predictions at NNLL accuracy.

Landmark inclusive measurements of structure functions (SF) in deep-inelastic scat- tering (DIS) experiments provide a wealth of information on the internal struc- ture of hadrons at high energies in terms of quarks and gluons and give valuable insights into the underlying strong interaction dynamics. Collinear factorization in quantum chromo- dynamics (QCD) with the systematic separation of short- and long-distance phenomena provides the theoretical foundations for the use of SF data in the extraction of the process- independent parton distribution functions (PDFs), which describe the parton dynamics within the colliding hadrons. Semi-inclusive DIS (SIDIS) measurements with an observed hadron in the final state allows, in addition, for the study of the parton (quark/gluon) to hadron fragmentation, encoded in universal fragmentation functions (FFs). This makes SIDIS the most promising and valuable probe of PDFs and FFs at the upcoming Electron- Ion collider (EIC) at the

Brookhaven National Laboratory in the USA. The EIC opens up unique opportunities to explore the nucleon structure as well as the underlying dynamics of hadrons in various environments. This includes a thorough un- derstanding of the light- quark flavor PDFs and also the spin structure of the nucleon, using polarized beams, to measure the polarized PDFs.

The authors present the first results for the next-to-next-to leading order (NNLO) corrections to the semi- inclusive deep-inelastic scattering process in perturbative quantum chromodynamics [**Ra3**]. They consider the quark initiated flavor non-singlet process and obtain the complete contributions analytically at leading color. All relevant virtual and real emission Feynman diagrams have been computed using integration-by-parts reduction to master integrals and two approaches for their subsequent evaluation (parametric phase-space integration and method of differential equations). The numerical analysis demonstrates the significance of the NNLO corrections and their great impact on the reduction of the residual scale dependence.

Quantum Computations

Weak values of product observables or higher moments of an observable are informationally significant because of their ability to solve some paradoxes, realise strange quantum effects, reconstruct density matrices, etc. In the present work [**Md2**], the authors demonstrate that pairwise orthogonal post-selections can be used to obtain higher moment weak values. By measuring only local weak values (defined as single system weak values in a multipartite scenario), product weak values can be obtained. As applications, they use product and higher moment weak values to reconstruct quantum states showing advantages over previous works in terms of number of required measurement operators and experimental feasibility. Additionally, a necessary separability criteria is given using product weak values to detect entanglement. For some classes of entangled states, positive partial transpose (PPT) criteria is achieved by cleverly choosing product observables and post selections. Robustness of their method against inappropriate choices of observables and noisy post-selections is also discussed.

Quantum Teleportation is a very useful scheme for transferring quantum information. Given that the quantum information is encoded in a state of a system of distinguishable particles, and given that the shared bi-partite entangled state is also that of a system of distinguishable particles, the optimal teleportation fidelity of the shared state is known to be $(F_{max}d + 1)/(d + 1)$ with F_{max} being the 'maximal singlet fraction' of the shared state. In the present work [sibasish-2023.6], they address the question of optimal teleportation fidelity given that the quantum information to be teleported is encoded in Fermionic modes while a $2N$-mode state of a system of Fermions (with maximum $2N$ no. of Fermions – in the second quantization language) is shared between the sender and receiver with each party possessing N modes of the $2N$-mode state. Parity Superselection Rule (PSSR) in Fermionic Quantum Theory (FQT) puts constraint on the allowed set of physical states and operations, and thereby, leads to a different notion of Quantum Teleportation. Due to PSSR, the authors introduce restricted Clifford twirl operations that constitute the Unitary 2-design in case of FQT, and show that the structure of the canonical form of Fermionic invariant shared state differs from that of the isotropic state – the corresponding canonical invariant form for teleportation in Standard Quantum Theory (SQT). They provide a lower bound on the optimal teleportation fidelity in FQT and compare the result with teleportation in SQT. Surprisingly, They find that, under separable measurements on a bipartite Fermionic state,

input and output states of the Fermionic teleportation channel cannot be distinguished operationally, even if a particular kind of resource state with 'maximal singlet fraction' being less than unity is used.

Quantum teleportation is a task in which one sends quantum information of an unknown quantum state to a distant receiver using shared entanglement together with Local Operations and Classical Communication (LOCC). The authors consider [sibasish-2024.1] a network of three spatially separated labs of Alice, Bob, and Charlie, with a two-qubit state shared between Alice-Bob and another two-qubit state shared between Bob-Charlie, and all of them can collaborate through LOCC. They focus on the problem of optimal and deterministic distribution of a quantum teleportation channel (QTC) between Alice and Charlie. This involves distributing a two-qubit entangled state between Alice and Charlie with an optimized fully entangled fraction (FEF) over all three-party trace-preserving (TP) LOCC, exceeding the classical bound. However, they find that the optimal distribution of QTC generally has no one-to-one correspondence with the optimal distribution of entanglement. For some specific class of pre-shared two-qubit states, they identify the set of sufficient TP LOCC strategies that optimally distribute QTC. In this context, the mentioned set is restricted, with Bob initiating operations and subsequently sharing the outcomes with Alice and Charlie. Following Bob's contribution and after it is discarded, Alice and Charlie have the freedom of local post-processing. It seems that if one of the pre-shared entangled states is noisy, the optimal distribution may not necessarily require the other one to be most resourceful, i.e., a maximally entangled state (MES). Furthermore, when both of the pre-shared entangled states are noisy, there are instances where an efficient Bob-assisted protocol (generally a suboptimal protocol distributing a channel with FEF larger than the classical bound) necessarily requires Bob's joint measurement to be either performing projective measurement (PVM) in partially entangled pure states or performing POVM. In this regard, their study also reveals that the RPBES protocol introduced in [G. Gour and B. C. Sanders, *Phys. Rev. Lett.* **93**, 260501 (2004)] for efficient entanglement distribution (even optimally for some cases), is not an efficient protocol in general.

The authors study [**Ghosh2**] an analogous Bloch sphere representation of higher-level quantum systems using the Heisenberg-Weyl operator basis. They introduce a parametrization method that will allow us to identify a real-valued Bloch vector for an arbitrary density operator. Before going into arbitrary d-level ($d \geq 3$) quantum systems (qudits), they start their analysis with three-level ones (qutrits). It is well known that they need at least eight real parameters in the Bloch vector to describe arbitrary three-level quantum systems (qutrits). However, using their method they can divide these parameters into four weight, and four angular parameters, and find that the weight parameters are inducing a unit sphere in four-dimension. And, the four angular parameters determine whether a Bloch vector is physical. Therefore, unlike its qubit counterpart, the qutrit Bloch sphere does not exhibit a solid structure. Importantly, this construction allows us to define different properties of qutrits in terms of Bloch vector components. They also examine the two and three-dimensional sections of the sphere, which reveal a non-convex yet closed structure for physical qutrit states. Further, they apply their representation to derive mutually unbiased bases (MUBs), characterize unital maps for qutrits, and assess ensembles using the Hilbert-Schmidt and Bures metrics. Moreover, they extend this construction to qudits, showcasing its potential applicability beyond the qutrit scenario.

Statistical Mechanics

Models with only hard interactions have been studied for a long time as the simplest models to show phase transitions. In these models, the phases and phase transitions are determined by only the shape and density of the particles. Here, a review of known results and open problems are addressed. In addition, an approach to determine the equation of state for hard sphere gas is determined [**R1**].

The Mpemba effect refers to the counterintuitive result that, when quenched to a low temperature, a system at a higher temperature may equilibrate faster than one at intermediate temperatures. The closeness to the final state is defined in terms of a distance measure. For driven granular systems, the Mpemba effect has been illustrated in terms of an ad-hoc measure of mean kinetic energy as the distance function. Here, by studying four different distance measures based on the mean kinetic energies as well as velocity distribution, it is shown that the Mpemba effect depends on the definition of the measures [**Bi1**]. Mpemba effect is further explored for a single colloidal particle relaxing in a simple potential that is either single well or double welled. Surprisingly, it is shown that metastability is not a requirement for Mpemba effect, contrary to current proposals [**Bi3**, **Bi2**]

Polymers are usually expected to be in an extended conformation in the presence of attractive crowders/solvents. Here the counterintuitive phenomena of a charged polymer collapsing due to attraction with crowders is studied. It is shown that for low crowder densities, the polymer predominantly shows three phases as a function of both intra-polymer and polymer–crowder interactions: (1) extended or coil polymer conformations (2) globular conformations due to counterion-induced attraction, and (3) globular conformation due to polymer-crowder attraction. The detailed phase diagram giving the phase boundaries delineating the different phases is obtained. The dependence of the phase diagram on strength of crowder–crowder attractive interactions and crowder density is clarified [**Tr1**].

Collagen fibrils, when subjected to cyclic loading, are known to exhibit hysteretic behaviour with energy dissipation that is partially recovered on relaxation. A molecular dynamics model for a collagen fibril incorporating the presence of hidden loops and stochastic fragmentation as well as the reformation of sacrificial bonds is developed. It is shown that the model reproduces well the characteristic features of reported experimental data on the cyclic response of collagen fibrils, such as moving hysteresis loops, the time evolution of residual strains and energy dissipation, recovery on relaxation, etc. It is also shown that the approach to the steady state is controlled by a characteristic cycle number for both residual strains as well as energy dissipation and is in good agreement with reported existing experimental data [**Suh**].

The deformation and mixed-mode fracture of a single phase and two-phase system is studied. A square domain with an edge crack is discretized using a square lattice to develop a random spring network model. The model is based on each lattice point interacting with nearest and next nearest neighbours using extensional and torsional springs. From the mixed-mode fracture simulations, it is shown that the lattice architecture results in anisotropic fracture behaviour locally which is resolved by incorporating disorder in the failure strain threshold of the springs. It is further shown that for a crack propagating in a two-phase solid, the inherent differences in the two phases result in an inclined crack path in mixed mode loading and additional disorder in the individual phases are not vital for realistic simulations of the fracture process [**R5**]

Ballistic aggregation on a two dimensional square lattice, where particles move ballistically in between momentum and mass conserving coalescing collisions is studied. Three models are studied based on the shapes of the aggregates: in the first the aggregates remain point particles, in the second they retain the fractal shape at the time of collision, and in the third they assume a spherical shape. The exponents describing the power law temporal decay of number of particles and energy as well as dependence of velocity correlations on mass are determined using large scale Monte Carlo simulations. It is shown that the exponents are universal only for the point particle model. In the other two cases, the exponents are dependent on the initial number density and correlations vanish at high number densities. The fractal dimension for the second model is close to 1.49 [**F**]

The role of record statistics of damage avalanches in predicting the fracture of a heterogeneous material under tensile loading is studied. The material is modeled using a two-dimensional random spring network where disorder is introduced through randomness in the breakage threshold strains of the springs. It is shown that the waiting time between successive records of avalanches has a maximum for moderate disorder, thus showing an acceleration of records with impending fracture. Such a signature is absent for low disorder strength when the fracture is nucleation-dominated, and high disorder strength when the fracture is percolation type. The authors examine the correlation between the record with the maximum waiting time and the crossover record at which the avalanche statistics change from off-critical to critical. It is also shown that in the avalanche-dominated regime, the failure strain is shown to have a linear relation with the strain at the maximum waiting time, making possible a quantitative prediction. A similar study is performed experimentally using acoustic emission data from glassy polymers [**R6**, **R4**]

Arrhenius law for interacting diffusive systems: Finding the mean time it takes for a particle to escape from a metastable state due to thermal fluctuations is a fundamental problem in physics, chemistry, and biology. Here, the authors consider the escape rate of interacting diffusive particles, from a deep potential trap within the framework of the macroscopic fluctuation theory—a nonequilibrium hydrodynamic theory [**Ku**]. For systems without excluded volume, their investigation reveals adherence to the well-established Arrhenius law. However, in the presence of excluded volume, a universality class emerges, fundamentally altering the escape rate. Remarkably, the modified escape rate within this universality class is independent of the interactions at play. The universality class, demonstrating the importance of excluded volume effects, may bring insights to the interpretation of escape processes in the realm of chemical physics.

Directional synchrony among self-propelled particles under spatial influence: Synchronization is one of the emerging collective phenomena in interacting particle systems. Its ubiquitous presence in nature, science, and technology has fascinated the scientific community over the decades. Moreover, a great deal of research has been, and is still being, devoted to understand various physical aspects of the subject. In particular, the study of interacting active particles has led to exotic phase transitions in such systems which have opened up a new research front-line. Motivated by this line of work, in this paper [**Pa6**], the authors study the directional synchrony among self-propelled particles. These particles move inside a bounded region, and crucially their directions are also coupled with spatial degrees of freedom. They assume that the directional coupling between two particles is influenced by the relative spatial distance which changes over time. Furthermore, the nature of the influence is

considered to be both short and long-ranged. They explore the phase transition scenario in both the cases and propose an approximation technique which enables us to analytically find the critical transition point. The results are further supported with numerical simulations. Our results have potential importance in the study of active systems like bird flocks, fish schools, and swarming robots where spatial influence plays a pertinent role.

Thermodynamic Trade-off Relation for First Passage Time in Resetting Process: Resetting is a strategy for boosting the speed of a target-searching process. Since its introduction over a decade ago, most studies have been carried out under the assumption that resetting takes place instantaneously. However, due to its irreversible nature, resetting processes incur a thermodynamic cost, which becomes infinite in the case of instantaneous resetting. Here [**Pa5**], the authors take into consideration both the cost and the first passage time (FPT) required for a resetting process, in which the reset or return to the initial location is implemented using a trapping potential over a finite but random time period. An iterative generating function and a counting functional method à la Feynman and Kac are employed to calculate the FPT and the average work for this process. From these results, they obtain an explicit form of the time-cost trade-off relation, which provides the lower bound of the mean FPT for a given work input when the trapping potential is linear. This trade-off relation clearly shows that instantaneous resetting is achievable only when an infinite amount of work is provided. More surprisingly, the trade-off relation derived from the linear potential seems to be valid for a wide range of trapping potentials. In addition, they have also shown that the fixed-time or sharp resetting can further enhance the trade-off relation compared to that of the stochastic resetting.

First-passage functionals for Ornstein Uhlenbeck process with stochastic resetting: The authors study the statistical properties of first-passage Brownian functionals (FPBFs) of an Ornstein-Uhlenbeck (OU) process in the presence of stochastic resetting [**Du**]. They consider a one dimensional set-up where the diffusing particle sets off from x_0 and resets to x_R at a certain rate r. The particle diffuses in a harmonic potential (with strength k) which is centered around the origin. The center also serves as an absorbing boundary for the particle and they denote the first passage time of the particle to the center as t_f. In this set-up, they investigate the following functionals: (i) local time $T_{loc} = \int_0^{t_f} d\tau\ \delta(x - x_R)$ i.e., the time a particle spends around x_R until the first passage, (ii) occupation or residence time $T_{res} = \int_0^{t_f} d\tau\ \theta(x - x_R)$ i.e., the time a particle typically spends above x_R until the first passage and (iii) the first passage time t_f to the origin. They employ the Feynman-Kac formalism for renewal process to derive the analytical expression for the first moment of all the three FPBFs mentioned above. In particular, they find that resetting can either prolong or shorten the mean residence and first passage time depending on the system parameters. The transition between these two behaviors or phases can be characterized precisely in terms of optimal resetting rates, which interestingly undergo a continuous transition as they vary the trap stiffness k. They characterize this transition and identify the critical -parameter & -coefficient for both the cases. They also showcase other interesting interplay between the resetting rate and potential strength on the statistics of these observables. Our analytical results are in excellent agreement with the numerical simulations.

A first passage under resetting approach to income dynamics: Detailed knowledge of individual income dynamics is one essential ingredient for investigating the existence of the

American dream, pertinent to the question Are we able to improve our income status during our working life? This key question simply boils down to observing individual status and how it moves between two thresholds: the current income and the desired income. Yet, our knowledge of these temporal properties of income remains limited since we rely on estimates coming from transition matrices which simplify income dynamics by aggregating the individual changes into quantiles and thus overlooking significant microscopic variations. Here [**Pa1**], the authors bridge this gap by employing First Passage Time concepts in a baseline stochastic process with resetting used for modeling income dynamics and developing a framework that is able to crucially disaggregate the temporal properties of income to the level of an individual worker. They find analytically and illustrate numerically that our framework is orthogonal to the transition matrix approach and leads to improved and more granular estimates. Moreover, to facilitate potential empirical applications of the framework, they introduce a statistical methodology, and showcase the application using the USA income dynamics data. These results help to improve our understanding on the temporal properties of income in real economies and could potentially provide a set of tools for designing policy interventions.

Rate enhancement of gated drift-diffusion process by optimal resetting:
"Gating" is a widely observed phenomenon in biochemistry that describes the transition between the activated (or open) and deactivated (or closed) states of an ion-channel, which makes transport through that channel highly selective. In general, gating is a mechanism that imposes an additional restriction on a transport, as the process ends only when the "gate" is open and continues otherwise. When diffusion occurs in the presence of a constant bias to a gated target, i.e., to a target that switches between an open and a closed state, the dynamics essentially slow down compared to ungated drift-diffusion, resulting in an increase in the mean completion time. In this work [**Bis**], the authors utilize stochastic resetting as an external protocol to counterbalance the delay due to gating. They consider a particle in the positive semi-infinite space that undergoes drift-diffusion in the presence of a stochastically gated target at the origin and is moreover subjected to rate-limiting resetting dynamics. Calculating the minimal mean completion time rendered by an optimal resetting rate for this exactly solvable system, they construct a phase diagram that owns three distinct phases: (i) where resetting can make gated drift-diffusion faster even compared to the original ungated process, (ii) where resetting still expedites gated drift-diffusion but not beyond the original ungated process, and (iii) where resetting fails to expedite gated drift-diffusion. They also highlight various non-trivial behaviors of the completion time as the resetting rate, gating parameters, and geometry of the set-up are carefully ramified. Gated drift-diffusion aptly models various stochastic processes such as chemical reactions that exclusively take place in certain activated states of the reactants. Our work predicts the conditions under which stochastic resetting can act as a useful strategy to enhance the rate of such processes without compromising their selectivity.

Resetting-mediated navigation of an active Brownian searcher in a homogeneous topography:
Designing navigation strategies for search-time optimization remains of interest in various interdisciplinary branches in science. Herein [**Pa7**], the authors focus on active Brownian walkers in noisy and confined environments, which are mediated by one such autonomous strategy, namely stochastic resetting. As such, resetting stops the motion and compels

the walkers to restart from the initial configuration intermittently. The resetting clock is operated externally without any influence from the searchers. In particular, the resetting coordinates are either quenched (fixed) or annealed (fluctuating) over the entire topography. Although the strategy relies upon simple governing laws of motion, it shows a significant ramification for the search-time statistics, in contrast to the search process conducted by the underlying reset-free dynamics. Using extensive numerical simulations, they show that the resetting-driven protocols enhance the performance of these active searchers. This, however, depends robustly on the inherent search-time fluctuations, measured by the coefficient of variation of the underlying reset-free process. They also explore the effects of different boundaries and rotational diffusion constants on the search-time fluctuations in the presence of resetting. Notably, for the annealed condition, resetting is always found to expedite the search process. These features, as well as their applicability to more general optimization problems from queuing systems, computer science and randomized numerical algorithms, to active living systems such as enzyme turnover and backtracking recovery of RNA polymerases in gene expression, make resetting-based strategies universally promising.

Chiral run-and-tumble walker: Transport and optimizing search: The authors study the statistical properties of a non-Markovian chiral run-and-tumble particle (CRTP) in two dimensions in continuous space and time. In their model [M], the possible orientations of the particle correspond to the four cardinal directions. The particle can reorient by turning left, right or reversing its direction of motion at different rates. They show how chirality manifests itself in the transport properties like the spatial moments of the marginal position distribution and the first-passage properties of a CRTP. Interestingly, they find that the chirality leads to enhanced diffusion and a looping tendency in the trajectory space. Their results show that chirality plays a pivotal role in the improvement of the search strategy — notably, there exists an optimal bias in tumbling that minimizes the mean search time. They determine an analytical expression for this optimal bias. Furthermore, they find that there exists a critical rate for the reversal of direction beyond which the optimal bias becomes constant. This behavioural drift is in stark contrast to that of the simple non-chiral particle. They believe that these key observations can play a crucial role in determining how living systems efficiently search under non-equilibrium conditions.

Universal Framework for Record Ages under Restart: The authors propose a universal framework to compute record age statistics of a stochastic time series that undergoes random restarts [Pa2]. The proposed framework makes minimal assumptions on the underlying process and is furthermore suited to treat generic restart protocols going beyond the Markovian setting. After benchmarking the framework for classical random walks on the 1D lattice, they derive a universal criterion underpinning the impact of restart on the age of the n-th record for generic time series with nearest-neighbor transitions. Crucially, the criterion contains a penalty of order n that puts strong constraints on restart expediting the creation of records, as compared to the simple first-passage completion. The applicability of their approach is further demonstrated on an aggregation-shattering process where they compute the typical growth rates of aggregate sizes. This unified framework paves the way to explore record statistics of time series under restart in a wide range of complex systems.

The authors investigate [I] the performance of a Brownian thermal machine working in a heterogeneous heat bath. The mobility of the heat bath fluctuates and it is modelled

as an Ornstein Uhlenbeck process. They trap the Brownian particle with time-dependent harmonic potential and by changing the stiffness coefficient and bath temperatures, they perform a Stirling cycle. They numerically calculate the average absorbed work, the average ejected heat and the performance of the heat pump. For shorter cycle times, they find that the performance of a Brownian yet non-Gaussian heat pump is significantly higher than the normal (Gaussian) heat pump. They numerically find the coefficient of performance at maximum heating power.

String Theory

In [**Mu**], symmetry analysis of covariant classical closed string bits is presented. The theory is obtained by latticizing the two dimensional non-linear sigma model with an arbitrary spacetime as target space. Both the spacetime isometries and the local (Diff $\times$ Weyl) symmetries are preserved by working with the logarithmic discrete derivative (LDD). The latter is given by an infinite series involving arbitrary higher powers of the forward and backward difference operators. It has been argued with preliminary evidences that such a derivative satisfies both the Liebniz product rule and partial integration law. Given these properties, the work proves Noether's theorems for both global and local symmetries and derives the corresponding classical Poisson bracket algebras (spacetime isometry and Virasoro algebras respectively) for the symmetry generators on the lattice. More detailed analysis on how to work with LDD including the complete proof of the above properties will appear in follow-up papers.

The holographic dual of string theory on anti de Sitter space with Neveu-Schwarz flux is studied in detail, especially focusing on the operator product expansion of protected (supersymmetric) operators in the dual non-gravitational theory. The dual model of interest is a two dimensional conformal field theory that is a symmetric orbifold. In a first work [**As2**], the basic methods are elucidated in a simple toy model that is the Nth symmetric orbifold of $\mathbb{C}^2$, where the focus is on the large-N limit. In a second work [**As1**], the authors generalize these results to all symmetric orbifolds and obtain operator product coefficients, up to third order in the $1/N$ expansion. These explicit operator product coefficients should serve as an important guide and motivation in the formulation, and even a derivation of a topological version of the AdS/CFT correspondence, for this protected subsector of the full theory.

During this period, the author explored various aspects of the recent progresses towards a resolution of Hawking's black hole information paradox such as the island paradigm. The island paradigm suggested that the black hole evaporation is a unitary evolution, and it is possible to reconstruct all the information went into the black hole from the Hawking radiation collected at the future null infinity of the spacetime. With Manish Ramchander, Roji Pius found that the complete reconstruction of the black hole interior [**K1**], especially the singularity, from the Hawking radiation requires a complete knowledge of quantum gravity.

The author work on the most recent developments in holography that attempt to understand the holographic emergence of gravitational physics from the dual conformal field theory using the ideas in the theory of operator algebras, such as the modular inclusions and the half-sided inclusions. Due to the work of Hong Liu and Sam Leutheusser, it is now understood that the half-sided inclusions, operations in the operator algebra that form a group, can be used to describe the time evolution of operators, both in the exterior and in the interior of a black

hole. Moreover, it can be interpreted as a procedure for the reconstruction of operators in the interior of a black hole using the operators outside the black hole horizon. Based on these developments, with PhD students Krishna Jalan and Manish Ramchander, the author derived the island paradigm using the half-sided translations in a two dimensional toy model for evaporating black hole constructed using the Jackiw-Teitelboim gravity [**J2**].

2.3.2 List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript *; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.

[**A**]
Aman Abhishek and Sayantan Sharma.
Toward a universal description of hadronic phase of QCD.
Physical Review D, **109(1)**, 014007, 2024.
https://doi.org/10.1103/PhysRevD.109.014007

[**Ad**]
Aparajita Sen*, **Soumen Basak***, **Tuhin Ghosh***, **Debabrata Adak, and Srijita Sinha***.
Importance of high-frequency bands for removal of thermal dust in ECHO.
Physical Review D, **108(8)**, 083529, 2023.
https://doi.org/10.1103/PhysRevD.108.083529

[**Ag**]
G. Agazie*, **J. Antoniadis*** **and A. Anumarlapudi*** **(includes Manjari Bagchi, Debabrata Deb, Pratik Tarafdar)**.
Comparing recent PTA results on the nanohertz stochastic gravitational wave background.
2023.
(Preprint: arXiv:2309.00693).

[**An**]
Akhil Antony, Fabio Finelli*, **Dhiraj Kumar Hazra, Daniela Paoletti***, **and Arman Shafieloo***.
A search for super–imposed oscillations to the primordial power spectrum in planck and SPT-3G 2018 data.
2024.
(Preprint: arXiv:2403.19575).

[**Ant1**]
J. Antoniadis*, P. Arumugam* and S. Arumugam* (includes Manjari Bagchi, Debabrata Deb, Pratik Tarafdar).
The second data release from the European Pulsar Timing Array: V. Implications for massive black holes, dark matter and the early Universe.
2023.
(Preprint: arXiv:2306.16227).

[**Ant2**]
J. Antoniadis*, P. Arumugam* and S. Arumugam* (includes Manjari Bagchi, Debabrata Deb, Pratik Tarafdar).
The second data release from the European Pulsar Timing Array: IV. Search for continuous gravitational wave signals.
2023.
(Preprint: arXiv:2306.16226).

[**Ant3**]
J. Antoniadis*, P. Arumugam* and S. Arumugam* (includes Manjari Bagchi, Debabrata Deb, Pratik Tarafdar).
The second data release from the European Pulsar Timing Array: III. Search for gravitational wave signals.
Astronomy and Astrophysics, **678**, A50, 2023.
https://doi.org/10.1051/0004-6361/202346844

[**Ant4**]
J. Antoniadis*, P. Arumugam* and S. Arumugam* (includes Manjari Bagchi, Debabrata Deb, Pratik Tarafdar).
The second data release from the European Pulsar Timing Array: II. Customised pulsar noise models for spatially correlated gravitational waves.
Astronomy and Astrophysics, **678**, A49, 2023.
https://doi.org/10.1051/0004-6361/202346842

[**As1**]
Sujay K. Ashok, Renjan R. John*, Sujoy Mahato*, Madhusudhan Raman*, and T. Layon *.
Effective gravitational couplings of Kaluza-Klein gauge theories.
Journal of High Energy Physics, **2023(9)**, 137, 2023.
https://doi.org/10.1007/JHEP09(2023)137

[**As2**]
Sujay K. Ashok and Jan Troost*.
The chiral ring of a symmetric orbifold and its large N limit.
Journal of High Energy Physics, **2023(08)**, 004, 2023.
https://doi.org/10.1007/JHEP08(2023)004

[**As3**]
Sujay K. Ashok and Jan Troost*.
The operator rings of topological symmetric orbifolds and their large N limit.
Journal of High Energy Physics, **2024(4)**, 039, 2024.
https://doi.org/10.1007/JHEP04(2024)039

[**B1**]
J. S. Deneva*, **M. McLaughlin***, **T. E. E. Olszanski***, **E. F. Lewis***, **D. Pang***, **P. C. C. Freire***, **Manjari Bagchi, and K. Stovall***.
The AO327 drift survey catalog and data release of pulsar detections.
The Astrophysical Journal Supplement Series, **271(1)**, 23, 2024.
https://doi.org/10.3847/1538-4365/ad19da

[**B2**]
Evan F. Lewis*, **Timothy E. E. Olszanski***, **Julia S. Deneva***, **Paulo C. C. Freire***, **Maura A. McLaughlin***, **Kevin Stovall***, **Manjari Bagchi, Jose G. Martinez***, **and Benetge B. P. Perera***.
Discovery and timing of millisecond pulsars with the arecibo 327 MHz drift-scan survey.
The Astrophysical Journal, **956(2)**, 132, 2023.
https://doi.org/10.3847/1538-4357/acf99d

[**B3**]
Avinash Kumar Paladi*, **Churchil Dwivedi*** **and Prerna Rana*** **(includes Manjari Bagchi, Debabrata Deb, Pratik Tarafdar, Jyotijwal Debnath)**.
Multiband extension of the wideband timing technique
Monthly Notices of the Royal Astronomical Society, **527(1)**, 213–231, 2023.
https://doi.org/10.1093/mnras/stad3122

[**Ba1**]
Radha Balakrishnan, Rossen Dandoloff*, **and Avadh Saxena***.
Exact hopfion vortices in a 3D Heisenberg ferromagnet.
Physics Letters A, **480**, 128975, 2023.
https://doi.org/10.1016/j.physleta.2023.128975

[**Ba2**]
Radha Balakrishnan, Rossen Dandoloff*, **and Avadh Saxena***.
Twisted curve geometry underlying topological invariants.
Physics Letters A, **493**, 129261, 2024.
https://doi.org/10.1016/j.physleta.2023.129261

[**Bas**]
K. Yogendra*, **Tanmoy Das***, **and G. Baskaran**.
Emergent glassiness in the disorder-free Kitaev model: Density matrix renormalization group study on a one-dimensional ladder setting.
Physical Review B, **108(16)**, 165118, 2023.
https://doi.org/10.1103/PhysRevB.108.165118

[**Bi1**]
Apurba Biswas, V. V. Prasad*, **and R. Rajesh**.
Mpemba effect in driven granular gases: Role of distance measures.
Physical Review E, **108(2)**, 024902, 2023.
https://doi.org/10.1103/PhysRevE.108.024902

[**Bi2**]
Apurba Biswas and R. Rajesh.
Mpemba effect for a brownian particle trapped in a single well potential.
Physical Review E, **108(2)**, 024131, 2023.
https://doi.org/10.1103/PhysRevE.108.024131

[**Bi3**]
Apurba Biswas, R. Rajesh, and Arnab Pal.
Mpemba effect in a langevin system: Population statistics, metastability, and other exact results.
The Journal of Chemical Physics, **159(4)**, 044120, 2023.
https://doi.org/10.1063/5.0155855

[**Bis**]
Arup Biswas, Arnab Pal, Debasish Mondal*, **and Somrita Ray***.
Rate enhancement of gated drift-diffusion process by optimal resetting.
The Journal of Chemical Physics, **159(5)**, 054111, 2023.
https://doi.org/10.1063/5.0154210

[**Bisw**]
Changfeng Li*, **Deeptak Biswas, and Nihar Ranjan Sahoo***.
Cumulants of net-strangeness multiplicity distributions at energies available at the BNL relativistic heavy ion collider.
Physical Review C, **107(6)**, 064905, 2023.
https://doi.org/10.1103/PhysRevC.107.064905

[**Bo**]
Koyena Bose and Ajit C. Balram.
Prediction of non-abelian fractional quantum hall effect at $\nu = 2 + \frac{4}{11}$.
Physical Review B, **107(23)**, 235111, 2023.
https://doi.org/10.1103/PhysRevB.107.235111

[**C1**]
Zlatko Papic* **and Ajit C. Balram**.
Fractional quantum hall effect in semiconductor systems.
In Tapash Chakraborty, editor, *Encyclopedia of Condensed Matter Physics (Second Edition)*, pages 285–307. Elsevier, 2024.
https://doi.org/10.1016/B978-0-323-90800-9.00007-X

[**C2**]
Songyang Pu*, Ajit C. Balram, Mikael Fremling*, Andrey Gromov*, and Zlatko Papi263;*.
Signatures of supersymmetry in the $\nu = 5/2$ fractional quantum hall effect.
Physical Review Letter, **130(17)**, 176501, 2023.
https://doi.org/10.1103/PhysRevLett.130.176501

[**C3**]
Anirban Sharma*, Ajit C. Balram, and Jainendra Jain*.
Composite-fermion pairing at half-filled and quarter-filled lowest landau level.
Physical Review B, **109(3)**, 035306, 2024.
https://doi.org/10.1103/PhysRevB.109.035306

[**C4**]
Tongzhou Zhao*, Ajit C. Balram, and Jainendra Jain*.
Composite fermion pairing induced by landau level mixing.
Physical Review Letter, **130(18)**, 186302, 2023.
https://doi.org/10.1103/PhysRevLett.130.186302

[**Ch**]
Kunal Shukla* and C. Chandrashekar.
Quantum magnetometry using discrete-time quantum walk.
Physical Review A, **109(3)**, 032608, 2024.
https://doi.org/10.1103/PhysRevA.109.032608

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Universal stress correlations in crystalline and amorphous packings.
Physical Review E, 2024.
arXiv:2402.08738 (To be published).

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[**Chaw3**]
K. Muhammed Shafi*, Prateek Chawla, Abhaya S. Hegde*, R. Gayatri*, A. Padhye*, and C. Chandrashekar.
Multi-bit quantum random number generator from path-entangled single photons.
EPJ Quantum Technology, **10(1)**, 43, 2023.
https://doi.org/10.1038/s41598-019-48844-4

[**D**]
Biswajit Das D. Das and Pankaj P. Agrawal*.
Effect of anomalous HHH and $ZZHH$ couplings on the decay width of $H \to ZZ \to 4l$
Ref.: Ms. No. MPLA-D-22-00341R2 (To be published).

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Athermal quasistatic cavitation in amorphous solids: Effect of random pinning.
The Journal of Chemical Physics, **159**, 204501, 2023.
https://doi.org/10.1063/5.0171905

[**De1**]
Jyotijwal Debnath, Manjari Bagchi, and Avishek Basu*.
A study of the light bending phenomenon under full general relativity for a pulsar in a binary with a schwarzschild black hole.
Monthly Notices of the Royal Astronomical Society, **524(4)**, 5411–5431, 2023.
https://doi.org/10.1093/mnras/stad2147

[**De2**]
Aman Srivastava*, Shantanu Desai*, Neel Kolhe* (includes Manjari Bagchi).
Noise analysis of the Indian Pulsar Timing Array data release I.
Physical Review D, **108(2)**, 023008, 2023.
https://doi.org/10.1103/PhysRevD.108.023008

[**Dh**]
Navdeep Singh Dhindsa, Raghav G. Jha*, Anosh Joseph*, and David Schaich*.
Phase diagram of two-dimensional SU(N) super–Yang–Mills theory with four supercharges.
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arXiv:2312.04980 (Submitted).

[**Dhi**]
Prateksh Dhivakar* and Krishna Jalan.
Generalized Second Law for Non–minimally Coupled Matter Theories.
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Sanatan Digal, Vinod Mamale, and Sabiar Shaikh.
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Physical Review D, **108(5)**, 054503, 2023.
https://doi.org/10.1103/PhysRevD.108.054503

[**Do**]
Ashutosh Dubey and Arnab Pal.
Competition between fractional quantum Hall liquid and electron solid phases in the Landau levels of multilayer graphene.
Physical Review D, **108(23)**, 235153, 2023.
https://doi.org/10.1103/PhysRevB.108.235153

[**Du**]
Rakesh K. Dora and Ajit C. Balram.
First-passage functionals for Ornstein–Uhlenbeck process with stochastic resetting.
Journal of Physics A: Mathematical and Theoretical, **56(43)**, 435002, 2023.
https://doi.org/10.1088/1751-8121/acf748

[**F**]
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Lattice models for ballistic aggregation: Cluster-shape-dependent exponents.
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https://doi.org/10.1103/PhysRevE.108.044127

[**G1**]
Jatin Ghai and Sibasish Ghosh.
Linear optics and the problem of bell-like state discrimination.
2024.
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[**G2**]
Jatin Ghai, Gautam Sharma*, and Sibasish Ghosh.
Negativity of wigner distribution function as a measure of incompatibility.
2023.
(Preprint: arXiv:2306.07917).

[**Gh**]
Arkaprabha Ghosal, Jain Ghai, Tanmay Saha, Mir Alimuddin*, and Sibasish Ghosh.
Optimal quantum teleportation of collaboration.
2024.
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2.4 Theoretical Computer Science

2.4.1 Research Summary

Algorithms and Data Structures

Graph-deletion problems involve deleting a small number of vertices so that the resulting graph belong to a given hereditary graph class. A study of a natural variation of the problem of deletion to scattered graph classes is initiate. Here, the goal is to delete at most k vertices so that each connected component of the resulting graph belongs to one of the constant number of graph classes. As a main result, it is shown in [**R2**] that this problem is non-uniformly fixed-parameter tractable (FPT) when the deletion problem corresponding to each of the constant number of graph classes is known to be FPT and the properties that a graph belongs to these classes are expressible in Counting Monodic Second Order (CMSO) logic. While this is shown using some black box theorems in parameterized complexity, a faster FPT algorithm is given when each of the graph classes has a finite forbidden set.

In [**R3**] much improved fixed parameter tractable algorithms are given for deletion to *pairs of graph classes* for some specific pairs of graph classes.

Two popular variants of graph coloring – *dominator coloring* and *class dominating coloring* are studied under structural parameterizations. In both problems, the authors are given a graph G and a as input and the goal is to properly color the vertices with at most colors with specific constraints. In dominator coloring, they require for each, a color c such that v dominates all vertices colored c. In class domination coloring, they require for each color c, a which dominates all vertices colored c.

It was already known that both problems are fixed-parameter tractable (FPT) when parameterized by the treewidth of the graph. In [**R1**], it is shown that dominator coloring is FPT when parameterized by the size of a graph's cluster vertex deletion (CVD) set and that class domination coloring is FPT parameterized by CVD set size plus the number of remaining cliques. En route, simpler and faster FPT algorithms are developed, when the problems are parameterized by the size of a graph's twin cover, a special CVD set. When the parameter is the size of a graph's clique modulator, randomized single-exponential time algorithm for the problems are developed using an inclusion–exclusion based polynomial sieving technique. These add to the growing number of applications using this powerful algebraic technique.

In parameterized complexity, each problem instance comes with a parameter k. A central notion in parameterized complexity is *fixed parameter tractability (FPT)*, which means, for a given instance (x, k), solvability in time $f(k) \cdot p(|x|)$, where f is an arbitrary function of k and p is a polynomial in input size. Further, a parameterized problem is said to admit a *polynomial kernel* if there is a polynomial time algorithm (the degree of polynomial is independent of k), called a *kernelization* algorithm, that reduces the input instance down to an instance with size bounded by a polynomial $p(k)$ in k, while preserving the answer. This reduced instance is called a $p(k)$ *kernel* for the problem. If $p(k) = O(k)$, then it is called a *linear kernel*. Polynomial dependency on the input size n is hidden in $\mathcal{O}^\star$ notation.

In [**Sau**] the authors studied the Feedback Vertex Set problem, undoubtedly one of

the most well-studied problems in Parameterized Complexity. In this problem, given an undirected graph G and a non-negative integer k, the objective is to test whether there exists a subset $S \subseteq V(G)$ of size at most k such that $G - S$ is a forest. After a long line of improvement, recently, Li and Nederlof [TALG, 2022] designed a randomized algorithm for the problem running in time $\mathcal{O}^\star(2.7^k)$. In the Parameterized Complexity literature, several problems around Feedback Vertex Set have been studied. Some of these include Independent Feedback Vertex Set (where the set S should be an independent set in G), Almost Forest Deletion and Pseudoforest Deletion. In Pseudoforest Deletion, each connected component in $G - S$ has at most one cycle in it. However, in Almost Forest Deletion, the input is a graph G and non-negative integers $k, \ell \in \mathbb{N}$, and the objective is to test whether there exists a vertex subset S of size at most k, such that $G - S$ is ℓ edges away from a forest. In this paper, using the methodology of Li and Nederlof [TALG, 2022], the authors obtained the current fastest algorithms for all these problems. In particular they obtained the following randomized algorithms.

1. Independent Feedback Vertex Set can be solved in time $\mathcal{O}^\star(2.7^k)$.
2. Pseudo Forest Deletion can be solved in time $\mathcal{O}^\star(2.85^k)$.
3. Almost Forest Deletion can be solved in time $\mathcal{O}^\star(\min\{2.85^k \cdot 8.54^\ell, 2.7^k \cdot 36.61^\ell, 3^k \cdot 1.78^\ell\})$.

In [**B4**], the authors study Dominating Set, a well-studied combinatorial problem. Given a graph G, a dominating function f is a labeling of vertices $V(G)$ from $\{0, 1\}$ such that $\sum_{w \in N[v]} f(w) \geq 1$ for each vertex $v \in V(G)$, where $N[v] = \{v\} \cup \{u \mid uv \in E(G)\}$. Let $f(V) = \sum_{u \in V(G)} f(u)$ be the weight of f. Dominating Set asks to find a dominating function of minimum weight. They studied a generalization of Dominating Set called Minus Domination (in short MD) where $f : V(G) \to \{-1, 0, 1\}$. Such a function is said to be a *minus dominating function* if for each vertex $v \in V(G)$, they have $\sum_{w \in N[v]} f(w) \geq 1$. The objective is to minimize the weight of a minus domination function. The problem is NP-hard even on bipartite, planar, and chordal graphs.

In this paper, the authors studied Minus Domination from the perspective of parameterized complexity. After observing the complexity of the problem with the natural parameters such as the number of vertices labelled 1, -1 and 0, they proceed to the structural parameters. They show that Minus Domination is fixed-parameter tractable when parameterized by twin-cover number, neighborhood diversity or the combined parameters component vertex deletion set and size of the largest component. In addition, they gave an XP-algorithm when parameterized by distance to cluster number.

The streaming model was introduced to parameterized complexity independently by Fafianie and Kratsch [MFCS14] and by Chitnis, Cormode, Hajiaghayi and Monemizadeh [SODA15]. Subsequently, it was broadened by Chitnis, Cormode, Esfandiari, Hajiaghayi and Monemizadeh [SPAA15] and by Chitnis, Cormode, Esfandiari, Hajiaghayi, McGregor, Monemizadeh and Vorotnikova [SODA16]. Despite its strong motivation, the applicability of the streaming model to central problems in parameterized complexity has remained, for almost a decade, quite limited. Indeed, due to simple $\Omega(n)$-space lower bounds for many of these problems, the $k^{(1)} \cdot \mathsf{polylog}(n)$-space requirement in the model is too strict.

Thus, in [Saur15] the authors explored *semi-streaming* algorithms for parameterized graph problems, and presented the first systematic study of this topic. Crucially, they aim to construct succinct representations of the input on which optimal post-processing time complexity can be achieved.

- They devise meta-theorems specifically designed for parameterized streaming and demonstrate their applicability by obtaining the first $k^{\mathcal{O}(1)} \cdot n \cdot \mathsf{polylog}(n)$-space streaming algorithms for well-studied problems such as Feedback Vertex Set on Tournaments, Cluster Vertex Deletion, Proper Interval Vertex Deletion and Block Vertex Deletion. In the process, they demonstrate a fundamental connection between semi-streaming algorithms for recognizing graphs in a graph class $\mathcal{H}$ and semi-streaming algorithms for the problem of vertex deletion into $\mathcal{H}$.
- they present an algorithmic machinery for obtaining streaming algorithms for cut problems and exemplify this by giving the first $k^{\mathcal{O}(1)} \cdot n \cdot \mathsf{polylog}(n)$-space streaming algorithms for Graph Bipartitization, Multiway Cut and Subset Feedback Vertex Set.

In the Euclidean Bottleneck Steiner Tree problem, the input consists of a set of n points in $\mathbb{R}^2$ called terminals and a parameter k, and the goal is to compute a Steiner tree that spans all the terminals and contains at most k points of $\mathbb{R}^2$ as Steiner points such that the maximum edge-length of the Steiner tree is minimized, where the length of a tree edge is the Euclidean distance between its two endpoints. The problem is well-studied and is known to be NP-hard.

In [Saur14], the authors gave a $k^{O(k)}n^{O(1)}$-time algorithm for Euclidean Bottleneck Steiner Tree, which implies that the problem is fixed-parameter tractable (FPT). This settled an open question explicitly asked by Bae et al. [Algorithmica, 2011], who showed that the ℓ_1 and ℓ_∞ variants of the problem are FPT. Their approach can be generalized to the problem with ℓ_p metric for any $1 \leq p \leq \infty$, or even other metrics on $\mathbb{R}^2$.

An *independent set* in a graph G is a set of pairwise non-adjacent vertices. A graph G is *bipartite* if its vertex set can be partitioned into two independent sets. In the Odd Cycle Transversal problem, the input is a graph G along with a weight function associating a real weight with each vertex, and the task is to find a smallest weight vertex subset S in G such that $G - S$ is bipartite; the weight of S, $(S) = \sum_{v \in S}(v)$. they show that Odd Cycle Transversal admits an algorithm with running time $n^{O(\log^2 n)}$ on graphs excluding P_5 (a path on five vertices) as an induced subgraph. The problem was previously known to be polynomial time solvable on P_4-free graphs and NP-hard on P_6-free graphs [Dabrowski, Feghali, Johnson, Paesani, Paulusma and Rzażewski, Algorithmica 2020]. Bonamy, Dabrowski, Feghali, Johnson and Paulusma [Algorithmica 2019] posed the existence of a polynomial time algorithm on P_5-free graphs as an open problem, this was later re-stated by Rzażewski [Dagstuhl Reports, 9(6): 2019] and by Chudnovsky, King, Pilipczuk, Rzażewski, and Spirkl [SIDMA 2021], who gave an algorithm with running time $n^{O(\sqrt{n})}$. While their $n^{O(\log^2 n)}$ time algorithm in [Saur13] falls short of completely resolving the complexity status of Odd Cycle Transversal on P_5-free graphs it shows that the problem is not NP-hard unless every problem in NP is solvable in quasi-polynomial time.

Clustering with outliers is one of the most fundamental problems in Computer Science. Given a set X of n points and two numbers k, m, the clustering with outliers aims to

exclude m points from X and partition the remaining points into k clusters that minimizes a certain cost function. In [Saur16], they gave a general approach for solving clustering with outliers, which results in a fixed-parameter tractable (FPT) algorithm in k and m, that almost matches the approximation ratio for its outlier-free counterpart.

As a corollary, they obtained FPT approximation algorithms with optimal approximation ratios for k-MEDIAN and k-MEANS with outliers in general and Euclidean metrics. They also exhibited more applications of their approach to other variants of the problem that impose additional constraints on the clustering, such as fairness or matroid constraints.

In [Saur12] the authors revisited a natural variant of the geometric set cover problem, called *minimum-membership geometric set cover* (MMGSC). In this problem, the input consists of a set S of points and a set $\mathcal{R}$ of geometric objects, and the goal is to find a subset $\mathcal{R}^* \subseteq \mathcal{R}$ to cover all points in S such that the *membership* of S with respect to $\mathcal{R}^*$, denoted by $\mathsf{memb}(S, \mathcal{R}^*)$, is minimized, where $\mathsf{memb}(S, \mathcal{R}^*) = \max_{p \in S} |\{R \in \mathcal{R}^* : p \in R\}|$. they gave the first polynomial-time approximation algorithms for MMGSC in $\mathbb{R}^2$. Specifically, they achieved the following two main results.

- They gave the first polynomial-time constant-approximation algorithm for MMGSC with unit squares. This answers a question left open since the work of Erlebach and Leeuwen [SODA'08], who gave a constant-approximation algorithm with running time $n^{O(\mathsf{opt})}$ where opt is the optimum of the problem (i.e., the minimum membership).
- They gave the first polynomial-time approximation scheme (PTAS) for MMGSC with halfplanes. Prior to this work, it was even unknown whether the problem can be approximated with a factor of $o(\log n)$ in polynomial time, while it is well-known that the minimum-size set cover problem with halfplanes can be solved in polynomial time.

They also considerd a problem closely related to MMGSC, called *minimum-ply geometric set cover* (MPGSC), in which the goal is to find $\mathcal{R}^* \subseteq \mathcal{R}$ to cover S such that the *ply* of $\mathcal{R}^*$ is minimized, where the ply is defined as the maximum number of objects in $\mathcal{R}^*$ which have a nonempty common intersection. Very recently, Durocher et al. gave the first constant-approximation algorithm for MPGSC with unit squares which runs in $O(n^{12})$ time. They gave a significantly simpler constant-approximation algorithm with near-linear running time.

Clustering with capacity constraints is a fundamental problem that attracted significant attention throughout the years.

In [Saur11], the authors gave the first FPT constant-factor approximation algorithm for the problem of clustering points in a general metric into k clusters to minimize the sum of cluster radii, subject to non-uniform hard capacity constraints (Capacitated Sum of Radii). In particular, they gave a $(15+\epsilon)$-approximation algorithm that runs in $2^{\mathcal{O}(k^2 \log k)} \cdot n^3$ time.

When capacities are uniform, they obtained the following improved approximation bounds.

- A $(4+\epsilon)$-approximation with running time $2^{\mathcal{O}(k \log(k/\epsilon))} n^3$, which significantly improves over the FPT 28-approximation of Inamdar and Varadarajan [ESA 2020].
- A $(2+\epsilon)$-approximation with running time $2^{\mathcal{O}(k/\epsilon^2 \cdot \log(k/\epsilon))} dn^3$ and a $(1+\epsilon)$-approximation with running time $2^{\mathcal{O}(kd \log((k/\epsilon)))} n^3$ in the Euclidean space. Here d is the dimension.

- A $(1+\epsilon)$-approximation in the Euclidean space with running time $2^{\mathcal{O}(k/\epsilon^2 \cdot \log(k/\epsilon))} dn^3$ if they are allowed to violate the capacities by $(1+\epsilon)$-factor. They complemented this result by showing that there is no $(1+\epsilon)$-approximation algorithm running in time $f(k) \cdot n^{\mathcal{O}(1)}$, if any capacity violation is not allowed.

In the Vertex Connectivity Survivable Network Design (VC-SNDP) problem, the input is a graph G and a function $d : V(G) \times V(G) \to \mathbb{N}$ that encodes the vertex-connectivity demands between pairs of vertices. The objective is to find the smallest subgraph H of G that satisfies all these demands. It is a well-studied NP-complete problem that generalizes several network design problems.

They considered the case of *uniform demands*, where for every vertex pair (u, v) the connectivity demand $d(u, v)$ is a fixed integer κ. It is an important problem with wide applications.

They studied this problem in the realm of Parameterized Complexity. In this setting, in addition to G and d they are given an integer ℓ as the *parameter* and the objective is to determine if they can remove at least ℓ edges from G without violating any connectivity constraints. This was posed as an open problem by Bang-Jansen et.al. [SODA 2018], who studied the edge-connectivity variant of the problem under the same settings. Using a powerful classification result of Lokshtanov et al. [ICALP 2018], Gutin et al. [JCSS 2019] recently showed that this problem admits a (non-uniform) FPT algorithm where the running time was unspecified. Further they also gave an (uniform) FPT algorithm for the case of $\kappa = 2$. In [**Saur10**] the authors presented a (uniform) FPT algorithm any κ that runs in time $2^{O(\kappa^2 \ell^4 \log \ell)} \cdot |V(G)|^{O(1)}$.

Their algorithm is built upon new insights on vertex connectivity in graphs. Their main conceptual contribution is a novel graph decomposition called the *Wheel decomposition*. Informally, it is a partition of the edge set of a graph G, $E(G) = X_1 \cup X_2 \ldots \cup X_r$, with the parts arranged in a cyclic order, such that each vertex $v \in V(G)$ either has edges in at most two consecutive parts, or has edges in every part of this partition. The first kind of vertices can be thought of as the rim of the wheel, while the second kind form the hub. Additionally, the vertex cuts induced by these edge-sets in G have highly symmetric properties. Their main technical result, informally speaking, establishes that "nearly edge-minimal" κ-vertex connected graphs admit a wheel decomposition – a fact that can be exploited for designing algorithms. They believe that this decomposition is of independent interest and it could be a useful tool in resolving other open problems.

In [**Saur9**] the authors considered the following problem about dispersing points. Given a set of points in the plane, the task is to identify whether by moving a small number of points by small distance, they can obtain an arrangement of points such that no pair of points is "close" to each other. More precisely, for a family of n points, an integer k, and a real number $d > 0$, they ask whether at most k points could be relocated, each point at distance at most d from its original location, such that the distance between each pair of points is at least a fixed constant, say 1. A number of approximation algorithms for variants of this problem, under different names like distant representatives, disk dispersing, or point spreading, are known in the literature. However, to the best of their knowledge, the parameterized complexity of this problem remained widely unexplored. They made the first step in this direction by providing a kernelization algorithm that, in polynomial time, produces an equivalent instance with $\mathcal{O}(d^2k^3)$ points. As a byproduct of this result, they also designed a non-trivial fixed-parameter tractable (FPT) algorithm for the problem, parameterized by k and d. Finally,

they complemented the result on polynomial kernelization by showing a lower bound that rules out the existence of a kernel whose size is polynomial in k alone, unless some complexity collapse occurs.

In [**Saur8**] the authors re-visited the complexity of polynomial time pre-processing (kernelization) for the d-Hitting Set problem. This is one of the most classic problems in Parameterized Complexity by itself, and, furthermore, it encompasses several other of the most well-studied problems in this field, such as Vertex Cover, Feedback Vertex Set in Tournaments (FVST) and Cluster Vertex Deletion (CVD). In fact, d-Hitting Set encompasses any deletion problem to a hereditary property that can be characterized by a finite set of forbidden induced subgraphs. With respect to bit size, the kernelization complexity of d-Hitting Set is essentially settled: there exists a kernel with (k^d) bits ((k^d) sets and (k^{d-1}) elements) and this it tight by the result of Dell and van Melkebeek [STOC 2010, JACM 2014]. Still, the question of whether there exists a kernel for d-Hitting Set with *fewer elements* has remained one of the most major open problems in Kernelization.

In this paper, the authors first showed that if they allow the kernelization to be *lossy* with a qualitatively better loss than the best possible approximation ratio of polynomial time approximation algorithms, then one can obtain kernels where the number of elements is linear for every fixed d. Further, based on this, they presented their main result: they show that there exist approximate Turing kernelizations for d-Hitting Set that even beat the established bit-size lower bounds for exact kernelizations—in fact, they use a *constant* number of oracle calls, each with *"near linear"* $((k^{1+\epsilon}))$ bit size, that is, almost the best one could hope for. Lastly, for two special cases of implicit 3-Hitting set, namely, FVST and CVD, they obtain the "best of both worlds" type of results—$(1+\epsilon)$-approximate kernelizations with a linear number of vertices. In terms of size, this substantially improved the exact kernels of Fomin et al. [SODA 2018, TALG 2019], with simpler arguments.

In the Minimum Bisection problem input is a graph G and the goal is to partition the vertex set into two parts A and B, such that $||A| - |B|| \leq 1$ and the number k of edges between A and B is minimized. The problem is known to be -hard, and assuming the Unique Games Conjecture even -hard to approximate within a constant factor [Khot and Vishnoi, J.ACM'15]. On the other hand, a $\mathcal{O}(\log n)$-approximation algorithm [Räcke, STOC'08] and a parameterized algorithm [Cygan et al., ACM Transactions on Algorithms'20] running in time $k^{\mathcal{O}(k)}n^{\mathcal{O}(1)}$ is known.

The Minimum Bisection problem can be viewed as a clustering problem where edges represent similarity and the task is to partition the vertices into two equally sized clusters while minimizing the number of pairs of similar objects that end up in different clusters. Motivated by a number of egregious examples of unfair bias in AI systems, many fundamental clustering problems have been revisited and re-formulated to incorporate fairness constraints. In [**Saur7**] the authors initiated the study of the Minimum Bisection problem with fairness constraints. Here the input is a graph G, positive integers c and k, a function $\chi : V(G) \to \{1, \ldots, c\}$ that assigns a color $\chi(v)$ to each vertex v in G, and c integers $r_1, r_2, \cdots, r_c$. The goal is to partition the vertex set of G into two almost-equal sized parts A and B with at most k edges between them, such that for each color $i \in \{1, \ldots, c\}$, A has exactly r_i vertices of color i. Each color class corresponds to a group which they require the partition (A, B) to treat fairly, and the constraints that A has exactly r_i vertices of color i can be used to encode that no group is over- or under-represented in either of the two clusters.

They first showed that introducing fairness constraints appears to make the Minimum Bisection problem qualitatively harder. Specifically they show that unless FPT=W[1] the problem admits no $f(c)n^{\mathcal{O}(1)}$ time algorithm even when $k = 0$. On the other hand, their main technical contribution showed that is that this hardness result is simply a consequence of the very strict requirement that each color class i has *exactly* r_i vertices in A. In particular they gave an $f(k, c, \epsilon)n^{\mathcal{O}(1)}$ time algorithm that finds a balanced partition (A, B) with at most k edges between them, such that for each color $i \in [c]$, there are at most $(1 \pm \epsilon)r_i$ vertices of color i in A.

Their approximation algorithm is best viewed as a proof of concept that the technique introduced by [Lampis, ICALP'18] for obtaining -approximation algorithms for problems of bounded tree-width or clique-width can be efficiently exploited even on graphs of unbounded width. The key insight is that the technique of Lampis is applicable on tree decompositions with unbreakable bags (as introduced in [Cygan et al., SIAM Journal on Computing'14]). An important ingredient of their approximation scheme was a combinatorial result that may be of independent interest, namely that for every k, every graph G admits a tree decomposition with adhesions of size at most $\mathcal{O}(k)$, unbreakable bags, and logarithmic depth.

For numerous graph problems in the realm of parameterized algorithms, using the size of a smallest deletion set (called a modulator) into well-understood graph families as parameterization has led to a long and successful line of research. Recently, however, there has been an extensive study of structural parameters that are potentially much smaller than the modulator size. In particular, recent papers [Jansen et al. STOC 2021; Agrawal et al. SODA 2022] have studied parameterization by the size of the modulator to a graph family ((·)), elimination distance to ((·)), and -treewidth ((·)). These parameters are related by the fact that lower bounds , which in turn lower bounds . While these new parameters have been successfully exploited to design fast exact algorithms their utility (especially that of and) in the context of approximation algorithms is mostly unexplored.

The conceptual contribution of [**Saur6**] was to present novel algorithmic meta-theorems that expand the impact of these structural parameters to the area of FPT Approximation, mirroring their utility in the design of exact FPT algorithms. As concrete exemplifications of their meta-theorems, the authors obtain FPTASes for well-studied graph problems such as Vertex Cover, Feedback Vertex Set, Cycle Packing and Dominating Set, parameterized by modulators.

In the Min k-Cut problem, the input is a graph G and an integer k. The task is to find a partition of the vertex set of G into k parts, while minimizing the number of edges that go between different parts of the partition. The problem is -complete, and admits a simple $3^n \cdot n^{\mathcal{O}(1)}$ time dynamic programming algorithm, which can be improved to a $2^n \cdot n^{\mathcal{O}(1)}$ time algorithm using the fast subset convolution framework by Björklund et al. [STOC'07]. In [**Saur5**] the authors gave an algorithm for Min k-Cut with running time $\mathcal{O}((2 - \varepsilon)^n)$, for $\varepsilon > 10^{-50}$. This is the first algorithm for Min k-Cut with running time $\mathcal{O}(c^n)$ for $c < 2$.

For any fixed positive integer r and a given budget k, the r-Eigenvalue Vertex Deletion (r-EVD) problem asks if a graph G admits a subset S of at most k vertices such that the adjacency matrix of $G \setminus S$ has at most r distinct eigenvalues. The edge deletion, edge addition, and edge editing variants are defined analogously. For $r = 1$, r-EVD is equivalent to the Vertex Cover problem. For $r = 2$, it turns out that r-EVD amounts removing a subset S of at most k vertices so that $G \setminus S$ is a cluster graph where all connected components have the same size.

In [Saur4] the authors showed that r-EVD is NP-complete even on bipartite graphs with maximum degree four for every fixed $r > 2$, and FPT when parameterized by the solution size and the maximum degree of the graph.

They also established several results for the special case when $r = 2$. For the vertex deletion variant, they showed that 2-EVD is NP-complete even on triangle-free and $3d$-regular graphs for any $d \geq 2$, and also NP-complete on d-regular graphs for any $d \geq 8$. The edge deletion, addition, and editing variants are all NP-complete for $r = 2$. The edge deletion problem admits a polynomial time algorithm if the input is a cluster graph, while — in contrast — the edge addition variant is hard even when the input is a cluster graph. They show that the edge addition variant has a quadratic kernel. The edge deletion and vertex deletion variants admit a single-exponential FPT algorithm when parameterized by the solution size alone.

Their main contribution was to develop the complexity landscape for the problem of modifying a graph with the aim of reducing the number of distinct eigenvalues in the spectrum of its adjacency matrix. It turns out that this captures, apart from Vertex Cover, also a natural variation of the problem of modifying to a cluster graph as a special case, which they believe may be of independent interest.

Given an undirected graph $G = (V, E)$ and an integer ℓ, the Eccentricity Shortest Path (ESP) problem asks to check if there exists a shortest path P such that for every vertex $v \in V(G)$, there is a vertex $w \in P$ such that $d_G(v, w) \leq \ell$, where $d_G(v, w)$ represents the distance between v and w in G. Dragan and Leitert [Theor. Comput. Sci. 2017] studied the optimization version of this problem which asks to find the minimum ℓ for ESP and showed that it is NP-hard even on planar bipartite graphs with maximum degree 3. They also showed that ESP is W[2]-hard when parameterized by ℓ. On the positive side, Kučera and Suchý [IWOCA 2021] showed that ESP is fixed-parameter tractable (FPT) when parameterized by modular width, cluster vertex deletion set, maximum leaf number, or the combined parameters disjoint paths deletion set and ℓ. It was asked as an open question in the same paper, if ESP is FPT parameterized by disjoint paths deletion set or feedback vertex set. They answered these questions in [B3] and obtained the following results:

1. ESP is FPT when parameterized by disjoint paths deletion set, split vertex deletion set, or the combined parameters feedback vertex set and ℓ.
2. They design a $(1+\epsilon)$-factor FPT approximation algorithm when parameterized by the feedback vertex set number.
3. ESP is W[2]-hard parameterized by the chordal vertex deletion set.

In [B2] the authors considered the question of polynomial kernelization of a generalization of the classical Vertex Cover problem parameterized by a parameter that is provably smaller than the solution size. In particular, they focused on the c-Component Order Connectivity problem (c-COC) where given an undirected graph G and a non-negative integer t, the objective is to test whether there exists a set S of size at most t such that every component of $G - S$ contains at most c vertices. Such a set S is called a c-coc set. It is known that c-COC admits a kernel with (ct) vertices. Observe that for $c = 1$, this corresponds to the Vertex Cover problem.

They studied the c-Component Order Connectivity problem parameterized by the size of a d-coc set (c-COC/d-COC), where $c, d \in \mathbb{N}$ with $c \leq d$. In particular, the input

is an undirected graph G, a positive integer t and a set M of at most k vertices of G, such that the size of each connected component in $G - M$ is at most d. The question is to find a set S of vertices of size at most t, such that the size of each connected component in $G - S$ is at most c. In this paper, the authors give a kernel for c-COC/d-COC with (k^{d-c+1}) vertices and (k^{d-c+2}) edges. Their result exhibited that the difference in d and c, and not their absolute values, determines the exact degree of the polynomial in the kernel size.

When $c = d = 1$, the c-COC/d-COC problem is exactly the Vertex Cover problem parameterized by the solution size, which has a kernel with $O(k)$ vertices and $O(k^2)$ edges, and this is asymptotically tight [Dell & Melkebeek, JACM 2014]. They also show that the dependence of $d - c$ in the exponent of the kernel size cannot be avoided under reasonable complexity assumptions.

Selection of a group of representatives satisfying certain fairness constraints, is a commonly occurring scenario. Motivated by this, they initiate a systematic algorithmic study of a *fair* version of Hitting Set. In the classical Hitting Set problem, the input is a universe , a family of subsets of , and a non-negative integer k. The goal is to determine whether there exists a subset $S \subseteq$ of size k that *hits* (i.e., intersects) every set in . Inspired by several recent works, they formulated a fair version of this problem, as follows. The input additionally contains a family of subsets of $\mathcal{U}$, where each subset in $\mathcal{B}$ can be thought of as the group of elements of the same *type*. They want to find a set $S \subseteq \mathcal{U}$ of size k that (i) hits all sets of $\mathcal{F}$, and (ii) does not contain *too many* elements of each type. They call this problem Fair Hitting Set, and chart out its tractability boundary from both classical as well as multivariate perspective in [**Saur3**]. Their results used a multitude of techniques from parameterized complexity including classical to advanced tools, such as, methods of representative sets for matroids, FO model checking, and a generalization of best known kernels for Hitting Set.

Feedback Vertex Set (FVS) is one of the most studied vertex deletion problems in the field of graph algorithms. In the decision version of the problem, given a graph G and an integer k, the question is whether there exists a set S of at most k vertices in G such that $G - S$ is acyclic. It is one of the first few problems which were shown to be , and has been extensively studied from the viewpoint of approximation and parameterized algorithms. The best-known polynomial time approximation algorithm for FVS is a 2-factor approximation, while the best known deterministic and randomized algorithms run in time $\mathcal{O}^*(3.460^k)$ and $\mathcal{O}^*(2.7^k)$ respectively.

In [**Sak**], the authors contribute to the newly established area of parameterized approximation, by studying FVS in this paradigm. In particular, they combine the approaches of parameterized and approximation algorithms for the study of FVS, and achieve an approximation guarantee with a factor better than 2 in randomized FPT running time, that improves over the best known parameterized algorithm for FVS. They give three simple randomized $(1+\epsilon)$ approximation algorithms for FVS, running in times $\mathcal{O}^*(2^{\epsilon k} \cdot 2.7^{(1-\epsilon)k})$, $\mathcal{O}^*\left(\left(\left(\frac{4}{1+\epsilon}\right)^{(1+\epsilon)} \cdot \left(\frac{\epsilon}{3}\right)^{\epsilon}\right)^k\right)$, and $\mathcal{O}^*(4^{(1-\epsilon)k})$ respectively for every $\epsilon \in (0,1)$. Combining these three algorithms, they obtain a factor $(1+\epsilon)$ approximation algorithm for FVS, which has better running time than the best-known (randomized) FPT algorithm for every $\epsilon \in (0,1)$. This is the first attempt to look at a parameterized approximation of FVS to the best of their knowledge. Their algorithms are very simple, and they rely on some well-known reduction rules used for arriving at FPT algorithms for FVS.

In the Strongly Connected Steiner Subgraph problem, the authors are given an n-vertex digraph D, a weight function $w\colon A(D) \mapsto \mathbb{R}^+$ on the arc set of D, and a set of k terminals $Q \subseteq V(D)$, and their objective is to find a strongly connected subgraph of D containing Q with minimum total weight. The problem is known to be W[1]-hard on general digraphs. However on bi-directed graphs (digraphs where, if uv is an arc then so is vu) with symmetric weight function $w\colon A(D) \mapsto \mathbb{R}^+$ (i.e., $w(uv) = w(vu)$ for any $uv \in A(D)$), Chitnis, Feldmann and Manurangsi [ESA 2018, TALG 2021] showed that the problem is fixed parameter tractable (FPT) with running time $2^{(k^2)}n^{(1)}$, where n is the input length. They also showed that, unless the Exponential Time Hypothesis (ETH) fails, there is no algorithm for the problem on bi-directed graphs with running time $2^{o(k)}n^{(1)}$. They left the existence of a single-exponential in k time algorithm as an open problem. They resolved this question in [**Saur2**], by designing an algorithm for the problem running in time $2^{(k)}n^{(1)}$ that is asymptotically tight under ETH, thereby closing the gap between the upper and lower-bounds for this problem.

Computational Complexity

Conflict-driven clause learning (CDCL) is the dominating algorithmic paradigm for SAT solving and hugely successful in practice. In its lifted version QCDCL, it is one of the main approaches for solving quantified Boolean formulas (QBF). In both SAT and QBF, proofs can be efficiently extracted from runs of (Q)CDCL solvers. While for CDCL, it is known that the proof size in the underlying proof system propositional resolution matches the CDCL runtime up to a polynomial factor, the work reported in [**M1**] shows that in QBF there is an exponential gap between QCDCL runtime and the size of the extracted proofs in QBF resolution systems. It demonstrates that this is not just a gap between QCDCL runtime and the size of any QBF resolution proof, but even the extracted proofs are exponentially smaller for some instances. Hence searching for a small proof via QCDCL (even with non-deterministic decision policies) will provably incur an exponential overhead for some instances.

In the work reported in [**D2**], it shown that polynomial-size constant-rank linear decision trees (LDTs) can be converted to polynomial-size depth-2 threshold circuits LTF∘LTF. An intermediate construct is polynomial-size decision lists that query a conjunction of a constant number of linear threshold functions (LTFs); it is shown that these are equivalent to polynomial-size exact linear decision lists (ELDLs) i.e. decision lists querying exact threshold functions (ELTFs).

The work reported in [**M2**] demonstrates the limitations of the proof system Merge Resolution (MRes), a refutational proof system for prenex quantified Boolean formulas (QBF) with a CNF matrix first defined by Beyersdorff,Blinkhorn,Mahajan in 2019. Unlike most QBF resolution systems in the literature, proofs in MRes consist of resolution steps *together* with information on countermodels, which are syntactically stored in the proofs as merge maps. This makes MRes quite powerful: it has strategy extraction by design and allows short proofs for formulas which are hard for classical QBF resolution systems. In [**M2**], the first proof size *exponential lower bounds for MRes* were established, thereby uncovering limitations of MRes. Technically, the results are either transferred from bounds from circuit complexity (for restricted versions of MRes) or directly obtained by combinatorial arguments (for full MRes). These results imply that the MRes approach is *largely orthogonal to other QBF resolution models* such as the QCDCL resolution systems QRes and QURes and the

expansion systems ∀Exp+Res and IR.

In Quantified Boolean Formulas QBFs, dependency schemes help to detect spurious or superfluous dependencies that are implied by the variable ordering in the quantifier prefix but are not essential for constructing countermodels. This detection can provably shorten refutations in specific proof systems, and is expected to speed up runs of QBF solvers. The proof system QCDCL recently defined by Beyersdorff and Boehm (LMCS 2023) abstracts the reasoning employed by QBF solvers based on conflict-driven clause-learning (CDCL) techniques. In [**C**] it is shown how the use of dependency schemes can be incorporated into this proof system, either in a preprocessing phase, or in the propagations and clause learning, or both. It is then shown that when the reflexive resolution path dependency scheme D^{rrs} is used, a mixed picture emerges: the proof systems that add D^{rrs} to QCDCL in these three ways are not only incomparable with each other, but are also incomparable with the basic QCDCL proof system that does not use ^{rrs} at all, as well as with several other resolution-based QBF proof systems. A notable fact is that all these separations are achieved through QBFs with bounded quantifier alternation.

In the decision tree computation model for Boolean functions, the depth corresponds to query complexity, and the size corresponds to storage space. The depth measure is the most well-studied one, and is known to be polynomially related to several non- computational complexity measures of functions such as certificate complexity. The size measure is also studied, but to a lesser extent. Another decision tree measure that has received very little attention is the minimal rank of the decision tree, first introduced by Ehrenfeucht and Haussler in 1989. This measure is closely related to the logarithm of the size, but is not polynomially related to depth, and hence it can reveal additional information about the complexity of a function. It is characterised by the value of a Prover-Delayer game first proposed by Pudlák and Impagliazzo in the context of tree-like resolution proofs. In the paper [**D3**] this measure is studied further. An upper bound on depth in terms of rank and Fourier sparsity is obtained. Upper and lower bounds on rank in terms of (variants of) certificate complexity are obtained. Upper and lower bounds on the rank for composed functions are also obtained in terms of the depth of the outer function and the rank of the inner function. This allows one to easily recover known asympotical lower bounds on logarithm of the size for Iterated AND-OR and Iterated 3-bit Majority. Further, in [**D3**], the rank is computed exactly for several natural functions and used to show that all the obtained bounds are tight. It is also shown that rank in the simple decision tree model can be used to bound query complexity, or depth, in the more general conjunctive decision tree model. Finally, the known size lower bound for the Tribes function is improved upon, to conclude that in the size-rank relationship for decision trees, obtained by Ehrenfeucht and Haussler, the upper bound for Tribes is asymptotically tight.

In [**D1**], various complexity measures like sensitivity, block sensitivity, certificate complexity for multi-output functions are related to the query complexities of such functions. Using these relations, it is shown that the deterministic query complexity of total search problems is at most the third power of its pseudo-deterministic query complexity. Previously, a fourth-power relation was shown by Goldreich, Goldwasser and Ron (ITCS'13). Furthermore, the known separation between pseudo-deterministic and randomized decision tree size for total search problems is improved in two ways: (1) an $\exp(\widetilde{\Omega}(n^{1/4}))$ separation for the SearchCNF relation for random k-CNFs is exhibited. This seems to be the first exponential lower bound on the pseudo-deterministic size complexity of SearchCNF associated with random k-CNFs. (2) an $\exp(\Omega(n))$ separation for the ApproxHamWt relation is

exhibited. The previous best known separation for any relation was $\exp(\Omega(n^{1/2}))$. Further, in [**D1**], pseudo-determinism is separated from randomness in AND and (AND,OR) decision trees, and determinism from pseudo-determinism in PARITY decision trees. For a hypercube colouring problem, that was introduced by Goldwasswer, Impagliazzo, Pitassi and Santhanam (CCC'21) to analyze the pseudo-deterministic complexity of a complete problem in TFNP^{dt}, it is proved that either the *monotone* block-sensitivity or the *anti-monotone* block sensitivity is $\Omega(n^{1/3})$; Goldwasser et al. had showed an $\Omega(n^{1/2})$ bound for *general* block-sensitivity.

Arithmetic circuits are a natural well-studied model for computing multivariate polynomials over a field. In [**Ra**], the authors study planar arithmetic circuits. These are circuits whose underlying graph is planar. In particular, an $\Omega(n \log n)$ lower bound is proved on the size of planar arithmetic circuits computing explicit bilinear forms on $2n$ variables. As a consequence, they get an $\Omega(n \log n)$ lower bound on the size of arithmetic formulas and planar algebraic branching programs computing explicit bilinear forms. This is the first such lower bound on the formula complexity of an explicit bilinear form. In the case of read-once planar circuits, an $\Omega(n^2)$ size lower bounds is proved for computing explicit bilinear forms. Furthermore, fine separations between the various planar models of computations mentioned above are also obtained.

In addition to this, multi-output planar circuits are considered and $\Omega(n^{4/3})$ size lower bounds are proved for computing an explicit linear transformation on n-variables. For a suitable definition of multi-output formulas, the above result is extended to get an $\Omega(n^2/logn)$ size lower bound. As a consequence, this demonstrate that there exists an n-variate polynomial computable by $n^{1+o(1)}$-sized formulas such that any multi-output planar circuit (resp., multi-output formula) simultaneously computing all its first-order partial derivatives requires size $\Omega(n^{4/3})$ (resp., $\Omega(n^2/\log n)$). This shows that a statement analogous to that of Baur, Strassen[Walter Baur and Volker Strassen, 1983] does not hold in the case of planar circuits and formulas.

2.4.2 List of Publications

The list of publications follows the following conventions: firstly, names of (co)authors who are not IMSc members are marked with a superscript *; secondly, the citation labels used for cross-referencing with the research summary are constructed from the last name of the first IMSc author and finally the list is ordered alphabetically according to the labels.

[**B1**]
Sriram Bhyravarapu, Swati Kumari*, and Vinod I. Reddy*.
Dynamic coloring on restricted graph classes.
In *International Conference on Algorithms and Complexity*, page 112–126. Springer, Cham, Apr 2023.
https://doi.org/10.1007/978-3-031-30448-4_9

[**B2**]
Sriram Bhyravarapu, Satyabrata Jana, Saket Saurabh, and Roohani Sharma*.
Difference determines the degree: Structural kernelizations of componentorder connectivity.
In Neeldhara Misra and Magnus Wahlström, editors, *18th International Symposium on Parameterized and Exact Computation,IPEC 2023,*, pages 5:1–5:14. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, Aug 2023.
https://doi.org/10.4230/LIPIcs.IPEC.2023.5

[**B3**]
Sriram Bhyravarapu, Satyabrata Jana, Lawqueen Kanesh*, Saket Saurabh, and Shaily Verma.
Parameterized algorithms for eccentricity shortest path problem.
In Chia-Wei Lee Sun-Yuan Hsieh, Ling-Ju Hung, editor, *34th International Workshop on Combinatorial Algorithms, IWOCA 2023*, pages 74–86. Springer, Jun 2023.
https://doi.org/10.1007/978-3-031-34347-6_7

[**B4**]
Sriram Bhyravarapu, Lawqueen Kanesh*, A. Mohanapriya*, Nidhi Purohit*, N. Sadagopan*, and Saket Saurabh.
On the parameterized complexity of minus domination.
In Ralf Klasing Henning Fernau, Serge Gaspers, editor, *SOFSEM 2024: Theory and Practice of Computer Science. Lecture Notes in Computer Science, vol 14519*, pages 96–110. Springer, Feb 2024.
https://doi.org/10.1007/978-3-031-52113-3_7

[C]
Abhimanyu Choudhury and Meena Mahajan.
Dependency schemes in CDCL-based QBF solving: a proof-theoretic study.
In *Proceedings of 43rd conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS); LIPIcs vol 284.*, pages 38:1–38:18. Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dec 2023.
https://doi.org/10.4230/LIPIcs.FSTTCS.2023.38

[D1]
Arkadev Chattopadhyay*, **Yogesh Dahiya, and Meena Mahajan**.
Query complexity of search problems.
In *48th International Symposium on Mathematical Foundations of Computer Science MFCS; LIPIcs vol 272*, pages 34:1–34:15. Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Aug 2023.
https://doi.org/10.4230/LIPIcs.MFCS.2023.34

[D2]
Yogesh Dahiya, Vignesh K*, **Meena Mahajan, and Karteek Sreenivasaiah***.
Linear threshold functions in decision lists, decision trees, and depth-2 circuits.
Information Processing Letters, **183**, 106418, 2024.
https://doi.org/10.1016/j.ipl.2023.106418

[D3]
Yogesh Dahiya and Meena Mahajan.
On (simple) decision tree rank.
Theoretical Computer Science, **978**, 114177, 2023.
https://doi.org/10.1016/j.tcs.2023.114177

[Da1]
Ramit Das, R. Ramanujam*, **and Sunil Simon***.
A logical description of priority separable games.
In Andreas; Liang Fei Alechina, Natasha; Herzig, editor, *Logic, Rationality, and Interaction. LORI 2023. Lecture Notes in Computer Science, vol 14329*, pages 31–46. Springer Cham, Oct 2023.
https://doi.org/10.1007/978-3-031-45558-2_3

[Da2]
Ramit Das, Anantha Padmanabha*, **and R. Ramanujam***.
Implicit quantification for modal reasoning in large games.
Synthese, **201(5)**, 163, 2023.
https://doi.org/10.1007/s11229-023-04156-9

[**Das**]
Pradeesha Ashok*, Sayani Das, Lawqueen Kanesh*, Saket Saurabh, Avi Tomar*, and Shaily Verma.
Burn and win.
In Chia-Wei Lee Sun-Yuan Hsieh, Ling-Ju Hung, editor, *Combinatorial Algorithms. IWOCA 2023. Lecture Notes in Computer Science, vol 13889.*, pages 36–48. Springer Cham, Jun 2023.
https://doi.org/10.1007/978-3-031-34347-6_4

[**G1**]
Sushmita Gupta, Ramanujan Sridharan*, and Peter Strulo*.
An exercise in tournament design: When some matches must be scheduled.
In *Proceedings of the AAAI Conference on Artificial Intelligence, 38(9).*, page 9749. Association for the Advancement of Artificial Intelligence, Mar 2024.
https://doi.org/10.1609/aaai.v38i9.28833

[**G2**]
Sushmita Gupta, Sounak Modak, Saket Saurabh, and Sanjay Seetharaman.
Quick-sort style approximation algorithms for generalizations of feedback vertex set in tournaments.
In *LATIN 2024: Theoretical Informatics. LATIN 2024. Lecture Notes in Computer Science, vol 14578.*, pages 225–240. Springer Nature Switzerland, Mar 2024.
https://doi.org/10.1007/978-3-031-55598-5_15

[**G3**]
Sushmita Gupta, Pallavi Jain*, Mohanapriya Ashokan*, and Vikash Tripathi.
Budget-feasible egalitarian allocation of conflicting jobs.
In *Proceedings of the 23rd International Conference on Autonomous Agents and Multi-Agent Systems (AAMAS)*, pages 2659–2667. May 2024.
(To be published).

[**G4**]
Sushmita Gupta, Pallavi Jain*, Saket Saurabh, and Nimord Talmon*.
Even more effort towards improved bounds and fixed-parameter tractability for multiwinner rules.
Algorithmica, **85(12)**, 3717–3740, 2023.
https://doi.org/10.1007/s00453-023-01155-7

[**J1**]
Satyabrata Jana, Souvik Saha, Abhishek Sahu*, Saket Saurabh, and Shaily Verma.
Partitioning subclasses of chordal graphs with few deletions.
In Marios Mavronicolas, editor, *13th International Conference on Algorithms and Complexit, (CIAC)*, pages 293–307. Lecture Notes in Computer Science, May 2023.
https://doi.org/10.1007/978-3-031-30448-4_21

[**J2**]
Satyabrata Jana, Anil Maheshwari*, Saeed Mehrabi*, and Sasanka Roy*.
Maximum bipartite subgraphs of geometric intersection graphs.
International Journal of Computational Geometry and Applications, **33(03n04)**, 133–157, 2023.
https://doi.org/10.1142/S021819592350005X

[**M1**]
Olaf Beyersdorff*, Benjamin Böhm*, and Meena Mahajan.
Runtime vs. extracted proof size: an exponential gap for CDCL on QBFs.
In *Proceedings, Thirty-Eighth AAAI Conference on Artificial Intelligence, 38(8)*, pages 7943–7951. AAAI Press, Feb 2024.
https://doi.org/10.1609/aaai.v38i8.28631

[**M2**]
Olaf Beyersdorff*, Joshua Blinkhorn*, Meena Mahajan, Tomas Peitl*, and Gaurav Sood.
Hard QBFs for merge resolution.
ACM Transactions on Computation Theory, **16(2)**, 1–24, 2024.
https://doi.org/10.1145/3638263

[**P**]
Kalpana Mahalingam*, Anuran Maity*, and Palak Pandoh.
Rich words in the block reversal of a word.
Discrete Applied Mathematics, **334**, 127–138, 2023.
https://doi.org/10.1016/j.dam.2023.03.013

[**R1**]
Aritra Banik*, Prahlad N. Kasturirangan*, and Venkatesh Raman.
Dominator coloring and CD coloring in almost cluster graphs.
In Pat Morin and Subash Suri, editors, *Algorithms and Data Structures Symposium (WADS)*, pages 106–119. Springer Verlag, Jul 2023.
https://doi.org/10.1007/978-3-031-38906-1_8

[**R2**]
Ashwin Jacob*, Jari J. de Kroon*, Diptapriyo Majumdar*, and Venkatesh Raman.
Deletion to scattered graph classes I case of finite number of graph classes.
Journal of Computer and System Sciences, **138**, 103460, 2023.
https://doi.org/10.1016/j.jcss.2023.05.005

[**R3**]
Ashwin Jacob*, Diptapriyo Majumdar*, and Venkatesh Raman.
Deletions to scattered graph classes II improved FPT algorithms for deletion to pairs of graph classes.
Journal of Computer and System Sciences, **136**, 280–301, 2023.
https://doi.org/10.1016/j.jcss.2023.03.004

[**Ra**]
C. Ramya and Pratik Shastri.
Lower bounds for planar arithmetic circuits.
In Venkatesan Guruswami, editor, *15th Innovations in Theoretical Computer Science Conference (ITCS 2024). Leibniz International Proceedings in Informatics (LIPIcs), Volume 287*, pages 91:1–91:22. Schloss Dagstuhl Leibniz-Zentrum für Informatik, Jan 2024.
https://doi.org/10.4230/LIPIcs.ITCS.2024.91

[**S1**]
Pallavi D. Jain*, Lawqueen D. Kanesh*, Fahad D. Panolan*, Souvik M. Saha, Abhishek D. Sahu*, Saket P. Saurabh, and Anannya M. Upasana.
Max-sat with cardinality constraint parameterized by the number of clauses.
In José A. Soto Andreas Wiese, editor, *LATIN 2024: Theoretical Informatics 16th Latin American Symposium Puerto Varas, Chile, March 18–22, 2024 Proceedings, Part II*, page 223. Lecture Notes in Computer Science (LNCS), Jan 2024.
https://doi.org/10.1007/978-3-031-55601-2_15

[**Sa**]
Abhishek Sahu and Saket Sauarabh.
Kernelization of arc disjoint cycle packing in α-bounded digraphs.
Theory Comput. Syst., **67(2)**, 221–233, 2023.
https://doi.org/10.1007/978-3-030-50026-9_27

[**Sai1**]
Prince Mathew*, Vincent Panelle*, Prakash Saivasan, and Sreejith A. V.*.
Weighted one-deterministic-counter automata.
In Srikanth Srinivasan Patricia Bouyer, editor, *43rd IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2023). Leibniz International Proceedings in Informatics (LIPIcs), Volume 284*, pages 39:1–39:23. Schloss Dagstuhl Leibniz-Zentrum für Informatik, Dec 2023.
https://doi.org/10.4230/LIPIcs.FSTTCS.2023.39

[**Sai2**]
C. Aiswarya*, Soumodev Mal*, and Prakash Saivasan.
Satisfiability of context-free string constraints with subword-ordering and transducers.
In Orna Kupferman Olaf Beyersdorff, Mamadou Moustapha Kanté and Daniel Lokshtanov, editors, *41st International Symposium on Theoretical Aspects of Computer Science (STACS 2024). Leibniz International Proceedings in Informatics (LIPIcs), Volume 289*, pages 5:1–5:20. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, Mar 2024.
https://doi.org/10.1145/3531130.3533329

[**Sak**]
Satyabrata Jana, Daniel Lokshtanov*, Soumen Mandal*, Ashutosh Rai*, and Saket Saurabh.
Parameterized approximation scheme for feedback vertex set.
In Jérôme Leroux, Sylvain Lombardy, and David Peleg, editors, *48th International Symposium on Mathematical Foundations of Computer Science, MFCS 2023,*, pages 56:1–56:15, Aug 2023.
https://doi.org/10.4230/LIPIcs.MFCS.2023.56

[**Sau**]
Kishen N. Gowda*, Aditya LonkaR*, Fahad Panolan*, Vraj Patel*, and Saket Saurabh.
Improved FPT algorithms for deletion to forest-like structures.
Algorithmica, 2024.
https://doi.org/10.1007/s00453-023-01206-z (Submitted).

[**Saur1**]
Lawqueen Kanesh *, Jayakrishnan Madathil*, Sanjukta Roy*, Abhishek Sahu*, and Saket Saurabh.
Further exploiting c-closure for FPT algorithms and kernels for domination problems.
SIAM Journal on Discrete Mathematics, **37(4)**, 2626–2669, 2023.
https://doi.org/10.1137/22M1491721

[**Saur2**]
Daniel Lokshtanov*, Pranabendu Misra*, Fahad Panolan*, Saket Saurabh, and Meirav Zehavi*.
An ETH-tight algorithm for bidirected steiner connectivity.
In Subhash Morin, Pat; Suri, editor, *Algorithms and Data Structures. WADS 2023.*, pages 588–604. Springer, Aug 2023.
https://doi.org/10.1007/978-3-031-38906-1_39

[**Saur3**]
Tanmay Inamdar*, Lawqueen Kanesh*, Madhumita Kundu*, Nidhi Purohit*, and Saket Saurabh.
Fixed-parameter algorithms for fair hitting set problems.
In Sylvain Lombardy, Jérôme Leroux and David Peleg, editors, *48th International Symposium on Mathematical Foundations of Computer Science, MFCS 2023,*, pages 55:1–55:14. LIPIcs, Aug 2023.
https://doi.org/10.4230/LIPIcs.MFCS.2023.55

[**Saur4**]
Neeldhara Misra*, Harshil Mittal*, Saket Saurabh, and Dhara Thakkar*.
On the complexity of the eigenvalue deletion problem.
In Satoru Iwata and Naonori Kakimura, editors, *34th International Symposium on Algorithms and Computation, ISAAC 2023*, pages 53:1–53:17. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, Dec 2023.
https://doi.org/10.4230/LIPIcs.ISAAC.2023.53

[**Saur5**]
Daniel Lokshtanov*, Saket Saurabh, and Vaishali Vaishali Surianarayanan*.
Breaking the all subsets barrier for min k-cut.
In Uriel Feige Kousha Etessami and Gabriele Puppis, editors, *50th International Colloquium on Automata, Languages, and Programming,ICALP 2023*, pages 90:1–90:19. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, Jul 2023.
https://doi.org/10.4230/LIPIcs.ICALP.2023.90

[**Saur6**]
Tanmay Inamdar*, Lawqueen Kanesh*, Madhumita Kundu*, Ramanujan M. S.*, and Saket Saurabh.
FPT approximations for packing and covering problems parameterized by elimination distance and even less.
In Patricia Bouyer and Srikanth Srinivasan, editors, *43rd IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science, FSTTCS 2023*, pages 28:1–28:16. LIPICS, Dec 2023.
https://doi.org/10.4230/LIPIcs.FSTTCS.2023.28

[**Saur7**]
Tanmay Inamdar*, Daniel Lokshtanov*, Saket Saurabh, and Vaishali Surianarayanan*.
Parameterized complexity of fair bisection: (FPT-approximation meets unbreakability).
In *31st Annual European Symposium on Algorithms, ESA 2023*, pages 63:1–63:17. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, Aug 2023.
https://doi.org/10.4230/LIPIcs.ESA.2023.63

[**Saur8**]
Fedor V. Fomin*, Tien-Nam Le*, Daniel Lokshtanov*, Saket Saurabh, Stéphan Thomassé*, and Meirav Zehavi.
Lossy kernelization for (implicit) hitting set problems.
In *31st Annual European Symposium on Algorithms, ESA*, pages 49:1–49:14. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, Aug 2023.
https://doi.org/10.4230/LIPIcs.ESA.2023.49

[**Saur9**]
Fedor V. Fomin*, Petr A. Golovach*, Tanmay Inamdar*, Saket Saurabh, and Meirav Zehavi*.
Kernelization for spreading points.
In *31st Annual European Symposium on Algorithms, ESA*, pages 48:1–48:16. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, Aug 2023.
https://doi.org/10.4230/LIPIcs.ESA.2023.48

[**Saur10**]
Jørgen Bang-Jensen*, **Kristine Vitting Klinkby***, **Pranabendu Misra***, **and Saket Saurabh**.
A parameterized algorithm for vertex connectivity survivable network design problem with uniform demands.
In *31st Annual European Symposium on Algorithms, ESA*, pages 13:1–13:15. Schloss Dagstuhl - Leibniz-Zentrum für Informatik, Aug 2023.
https://doi.org/10.4230/LIPIcs.ESA.2023.13

[**Saur11**]
Sayan Bandyapadhyay*, **William Lochet***, **and Saket Saurabh**.
FPT constant-approximations for capacitated clustering to minimize the sum of cluster radii.
In *39th International Symposium on Computational Geometry (SoCG 2023). Leibniz International Proceedings in Informatics (LIPIcs), Volume 258*, pages 12:1–12:14. Schloss Dagstuhl Leibniz-Zentrum für Informatik, Jun 2023.
https://doi.org/10.4230/LIPIcs.SoCG.2023.12

[**Saur12**]
Sayan Bandyapadhyay*, **William Lochet***, **Saket Saurabh, and Jie Xue***.
Minimum-membership geometric set cover, revisited.
In *39th International Symposium on Computational Geometry (SoCG 2023). Leibniz International Proceedings in Informatics (LIPIcs), Volume 258*, pages 11:1–11:14. Schloss Dagstuhl Leibniz-Zentrum für Informatik, Jun 2023.
https://doi.org/10.4230/LIPIcs.SoCG.2023.11

[**Saur13**]
Akanksha Agrawal*, **Paloma T. Lima***, **Daniel Lokshtanov***, **Saket Saurabh, and Roohani Sharma***.
Odd cycle transversal on p_5-free graphs in quasi-polynomial time.
In *Proceedings of the 2024 Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 5276–5290. Society for Industrial and Applied Mathematics, Jan 2024.
https://doi.org/10.1137/1.9781611977912.189

[**Saur14**]
Sayan Bandyapadhyay*, **William Lochet***, **Daniel Lokshtanov***, **Saket Saurabh, and Jie Xue***.
Euclidean bottleneck steiner tree is fixed-parameter tractable.
In *Proceedings of the 2024 Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 699–711. Society for Industrial and Applied Mathematics, Jan 2024.
https://doi.org/10.1137/1.9781611977912.27

[**Saur15**]
Daniel Lokshtanov*, Pranabendu Misra*, Fahad Panolan*, Ramanujan M. S.*, Saket Saurabh, and Meirav Zehavi*.
Meta-theorems for parameterized streaming algorithms.
In David P. Woodruff, editor, *Proceedings of the 2024 Annual ACM-SIAM Symposium on Discrete Algorithms (SODA)*, pages 712–739. Society for Industrial and Applied Mathematics, Jan 2024.
https://doi.org/10.1137/1.9781611977912.28

[**Saur16**]
Akanksha Agrawal*, Tanmay Inamdar*, Saket Saurabh, and Jie Xue*.
Clustering what matters: Optimal approximation for clustering with outliers.
Journal of Artificial Intelligence Research, **78**, 143–166, 2023.
https://doi.org/10.1613/jair.1.14883

[**Saur17**]
Akanksha Agrawal*, Daniel Lokshtanov*, Pranabendu Misra*, Saket Saurabh, and Meirav Zehavi*.
Erdös–Pósa property of obstructions to interval graphs.
Journal of Graph Theory, **102(4)**, 702–727, 2023.
https://doi.org/10.1002/jgt.22895

[**Saur18**]
Akanksha Agrawal*, Daniel Lokshtanov*, Pranabendu Misra*, Saket Saurabh, and Meirav Zehavi*.
Polynomial kernel for interval vertex deletion.
ACM Trans. Algorithms, **19(2)**, 11:1–11:68, 2023.
https://doi.org/10.1145/3571075

[**Saur19**]
Arijit Bishnu*, Arijit Ghosh*, Sudeshna Kolay*, Gopinath Mishra*, and Saket Saurabh.
Small vertex cover helps in fixed-parameter tractability of graph deletion problems over data streams.
Theory of Computing Systems, **67(6)**, 1241–1267, 2023.
https://doi.org/10.1007/s00224-023-10136-w

[**Saur20**]
Arijit Bishnu*, Arijit Ghosh*, Sudeshna Kolay*, Gopinath Mishra*, and Saket Saurabh.
Almost optimal query algorithm for hitting set using a subset query.
Journal of Computer and System Sciences, **137**, 50–65, 2023.
https://doi.org/10.1016/j.jcss.2023.02.002

[**Saur21**]
Fedor V. Fomin*, **Petr A. Golovach***, **William Lochet***, **Danil Sagunov***, **Saket Saurabh, and Kirill Simonov***.
Detours in directed graphs.
Journal of Computer and System Sciences, **137**, 66–86, 2023.
https://doi.org/10.1016/j.jcss.2023.05.001

[**Saur22**]
Fahad Panolan*, **Saket Saurabh, and Meirav Zehavi***.
Contraction decomposition in unit disk graphs and algorithmic applications in parameterized complexity.
ACM Transactions on Algorithms, 2024.
https://doi.org/10.1145/3648594 (Submitted).

[**Sh**]
Prashant Batra* **and Vikram Sharma**.
Complexity of a root clustering algorithm for holomorphic functions.
Theoretical Computer Science, **999**, 114504, 2024.
https://doi.org/10.1016/j.tcs.2024.114504

[**Su**]
C. Subramanian.
On approximating stochastic independent sets.
The Journal of Analysis, 2023.
https://doi.org/10.1007/s41478-023-00603-5 (Submitted).

Books/Monographs Authored/Edited

The list below follows the same conventions as those followed for the list of publications.

[**M**]
Meena Mahajan and Friedrich Slivovsky*, editors.
Proceedings of the 26th International Conference on Theory and Applications of Satisfiability Testing (SAT 2023), volume 271 of *LIPIcs: Leibniz International Proceedings in Informatics*.
Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl, Germany, 2023.

2.5 Student Programmes

2.5.1 Degrees Awarded

Doctoral Degrees Awarded during 2023 – 2024

Mathematics

Name: **Naik, Sunil L.**
Thesis Title: Prime divisors of non-zero Fourier coefficients of Hecke eigenforms
Thesis Advisor: Gun, S.
University: HBNI

Physics

Name: **Antony, Akhil**
Thesis Title: A Primordial Solution to Tensions in Cosmology
Thesis Advisor: HAZRA, Dhiraj Kumar
University: HBNI

Name: **Suhail, Amir**
Thesis Title: Dissipation and recovery in collagen fibrils: modelling and simulations
Thesis Advisor: Rajesh, R.
University: HBNI

Name: **Biswas, Apurba**
Thesis Title: Mpemba effect in granular and Langevin systems
Thesis Advisor: Rajesh, R.
University: HBNI

Name: **Mitra, Arindam**
Thesis Title: Aspects of compatibility of quantum devices and quantum communication using quantum switch
Thesis Advisor: Ghosh, Sibasish
University: HBNI

Name: **Shabbir, Mohammad**
Thesis Title: Lie Algebraic Decomposition of Black Hole Partition Functions
Thesis Advisor: Nemani, Venkata Suryanarayana
University: HBNI

Name: **Chawla, Prateek**
Thesis Title: Quantum walks on networks – A paradigm for quantum simulation and computation
Thesis Advisor: Chandrashekar, C.
University: HBNI

Name: **Singh, Raghvendra**
Thesis Title: The Role of Spacetime Curvature in Quantum Phenomena at Various Length Scales
Thesis Advisor: Ashok, Sujay K.
University: HBNI

Name: **Shaikh, Sabiar**
Thesis Title: Study of ZN symmetry in SU(N) gauge theories in the presence of matter fields
Thesis Advisor: Digal, Sanatan
University: HBNI

Name: **Sur, Soumya**
Thesis Title: Investigations into Quantum Compass Models in Two Dimensions
Thesis Advisor: Laad, Mukul S.
University: HBNI

Name: **Mitra, Toshali**
Thesis Title: Studies of ultra-relativistic macroscopic phenomena including real time correlations
Thesis Advisor: Ravindran, V.
University: HBNI

Name: **Dattani, Umang A.**
Thesis Title: Cavitation instabilities in amorphous solid: an athermal study
Thesis Advisor: Chaudhuri, Pinaki P.
University: HBNI

Name: **Thiru Senthil, R**
Thesis Title: Tau Neutrino Studies at the ICAL detector in INO
Thesis Advisor: Indumathi, D
University: HBNI

Name: **Khindri, Honey**
Thesis Title: Magnetic Field Studies and Physics Implications for ICAL at INO
Thesis Advisor: Indumathi, D
University: HBNI

Theoretical Computer Science

Name: **Das, Ramit**
Thesis Title: Logical Study of Improvement Graphs formed from Games
Thesis Advisor: Saivasan, Prakash
University: HBNI

Computational Biology

Name: **Netha, Vadnala Rakesh**
Thesis Title: Investigating how chromatin regulates gene expression and cellular processes
Thesis Advisor: Siddharthan, Rahul
University: HBNI

Doctoral Theses Submitted during 2023 – 2024

Mathematics

Name: **Bhattacharya, Aritra**
Thesis Title: Haglund's conjecture and Clebsch-Gordan rule for Macdonald polynomials
Thesis Advisor: Viswanath, Sankaran
University: HBNI

Name: **Lunia, Rashi S.**
Thesis Title: Arithmetic and Analytic aspects of values of L-functions
Thesis Advisor: Gun, S.
University: HBNI

Name: **Kumar, Sathish**
Thesis Title: On factorisation results for tensor products and twisted characters
Thesis Advisor: Viswanath, Sankaran
University: HBNI

Name: **Kundu, Siddheswar**
Thesis Title: Demazure crystal structure for flagged skew tableaux and flagged reverse plane partitions
Thesis Advisor: Viswanath, Sankaran
University: HBNI

Physics

Name: **Kundu, Arpan**
Thesis Title: On the Asymptotic Symmetry Algebra of Classical and Quantum Gravity
Thesis Advisor: Ravindran, V.
University: HBNI

Name: **Gola, Shivam**
Thesis Title: A Phenomenological Study of WIMP Models
Thesis Advisor: Ravindran, V.
University: HBNI

Name: **Gupta, Nishant**
Thesis Title: Aspects of chiral symmetries in holography
Thesis Advisor: Nemani, Venkata Suryanarayana
University: HBNI

Theoretical Computer Science

Name: **Dahiya, Yogesh**
Thesis Title: Exploring Size Complexity and Randomness in the Query Model
Thesis Advisor: Mahajan, Meena B.
University: HBNI

Computational Biology

Name: **Reshma, M.**
Thesis Title: Modeling active transport in axons
Thesis Advisor: Menon, Gautam I.
University: HBNI

Name: **Kumari, Chandrani**
Thesis Title: Machine Learning and Predicting Clinical Outcomes
Thesis Advisor: Siddharthan, Rahul
University: HBNI

Name: **Mozaffer, Farhina**
Thesis Title: Studies in disease dynamics
Thesis Advisor: Menon, Gautam I.
University: HBNI

Name: **T S, Sreevidya**
Thesis Title: Effects of charged mutations and phosphorylation on binding pocket dynamics in proteins
Thesis Advisor: Vemparala, Satyavani
University: HBNI

Name: **Selvakumar, Pavitra**
Thesis Title: Evolution and its role in DNA, centromeres and speciation
Thesis Advisor: Siddharthan, Rahul
University: HBNI

Name: **Ajay, Subbaroyan**
Thesis Title: Elucidating and leveraging design principles towards realistic Boolean models of gene regulatory networks
Thesis Advisor: Samal, Areejit
University: HBNI

Masters Theses awarded during 2023 – 2024

Mathematics

Name: **Devraj, Rao Suhas**
Thesis Title: Surface Profiles
Thesis Advisor: Prasad, Amritanshu
University: HBNI

Physics

Name: **Negi, Manoj**
Thesis Title: Statistics of dwell time in chemical reactions
Thesis Advisor: Pal, Arnab
University: HBNI

Name: **Murali, Praveen**
Thesis Title: Applications of Machine Learning in Detecting Phase Transitions
Thesis Advisor: Sharma, Sayantan
University: IISER Trivandrum

Theoretical Computer Science

Name: **Choudhury, Abhimanyu**
Thesis Title: Topics in Proof Complexity
Thesis Advisor: Mahajan, Meena B.
University: HBNI

Name: **Choudary, Koduri Siddharth**
Thesis Title: Verification of concurrent systems
Thesis Advisor: Saivasan, Prakash
University: HBNI

Name: **Saha, Souvik**
Thesis Title: Multivariate Analysis of Graph Problems and Beyond
Thesis Advisor: Saurabh, Saket
University: HBNI

Masters Theses submitted during 2023 – 2024

Mathematics

Name: **Chatterjee, Abhirup**
Thesis Title: On the Marcus-Spielman-Srivastava solution to the Kadison-Singer problem
Thesis Advisor: Kodiyalam, Vijay
University: HBNI

Name: **Basu, Tirtharaj**
Thesis Title: Characters of the Symmetric group and the Alternating group
Thesis Advisor: Prasad, Amritanshu
University: HBNI

Name: **Sarkar, Soumyadip**
Thesis Title: Classification of Real Simple Lie Algebras using Satake Diagrams
Thesis Advisor: Chatterjee, Pralay
University: HBNI

Physics

Name: **Singh, Saurav**
Thesis Title: Investigating Eclipsing Properties of Eclipsing Pulsars
Thesis Advisor: Bagchi, Manjari
University: Maharashtra Institute of Technology

Name: **Guin, Sayak**
Thesis Title: Properties of Z_2 scalar field theory both in and out-of-equilibrium conditions
Thesis Advisor: Sharma, Sayantan
University: HBNI

Name: **Tah, Swagatam**
Thesis Title: SU(2) Lattice Gauge Theory
Thesis Advisor: Sharma, Sayantan
University: HBNI

Name: **Shrimal, Tanishk**
Thesis Title: Excited State Spectroscopy using variational methods
Thesis Advisor: Madanagopalan, Padmanath
University: HBNI

Theoretical Computer Science

Name: **Nair, Abhijith R.**
Thesis Title: Decidable Aspects Of Parity Games Over Pushdown Systems
Thesis Advisor: Saivasan, Prakash
University: HBNI

Name: **Seetharaman, Sanjay**
Thesis Title: Small Space Subset Sum Solutions
Thesis Advisor: Gupta, Sushmita
University: HBNI

Name: **Modak, Sounak**
Thesis Title: A Survey on Flow Augmentation
Thesis Advisor: Saurabh, Saket
University: HBNI

2.5.2 Lecture Courses During 2023 – 2024.

The following **lecture courses** were offered during 2023 – 2024.

Course Title	Period	Lecturer
Computational Biology		
Biological sequence analysis	Jan-May 2023	Siddharthan, Rahul
Machine learning for biosciences	Aug-Dec 2023	Siddharthan, Rahul
Biological sequence analysis	Jan-May 2024	Siddharthan, Rahul
Mathematics		
Algebraic Combinatorics (online course on NPTEL)	Jan-Apr 2023	Prasad, Amritanshu
Introduction to Diophantine geometry	Jan-May 2023	Dixit, Anup B.
Algebra 1	Aug-Dec 2023	Dixit, Anup B.
Mathematical Thinking (IIT Madras online data science program)	Aug-Dec 2023	Prasad, Amritanshu
Measure Theory	Aug-Nov 2023	Mukhopadhyay, Anirban
Complex Analysis	Sep-Dec 2023	Srinivas, K.
Algebra II	Jan-May 2024	Gupta, Rahul
Number Theory	Jan-Apr 2024	Gun, S.
Probabilistic number theory	Jan-May 2024	Dixit, Anup B.

Physics

Classical Mechanics	Aug-Nov 2023	Ashok, Sujay K.
Quantum Mechanics I	Aug-Nov 2023	Digal, Sanatan
Electromagnetic Theory	Aug-Nov 2023	Bagchi, Manjari
Mathematical Methods I	Aug-Nov 2023	Madanagopalan, Padmanath
Quantum Field Theory I	Aug-Nov 2023	Ravindran, V
Statistical Mechanics II	Aug-Nov 2023	Chaudhuri, Pinaki P.
Particle Physics I	Aug-Nov 2023	Gopalakrishna, Shrihari
Mathematical Methods II	Aug-Nov 2023	Suryanarayana, Nemani V.
Gravitation and Cosmology	Jan-May 2024	HAZRA, Dhiraj Kumar
Quantum Field Theory II	Jan-Apr 2024	Mukhopadhyay, Partha
Quantum Information and Computation	Jan-Apr 2024	Ghosh, Sibasish
Quantum mechanics 2	Jan-Apr 2024	Pius, Roji
Statistical Mechanics I	Jan-Apr 2024	Rajesh, R.
Stochastic process (Non-equilibrium physics)	Jan-May 2024	Pal, Arnab
Condensed Matter Physics I	Jan-Apr 2024	Chakraborty, Debayan

Theoretical Computer Science

Approximation Algorithms	Jan-Apr 2023	Saurabh, Saket
Complexity Theory	Jan-May 2023	Ramya, C.
Parameterized Algorithms	Jan-Apr 2023	Raman, Venkatesh
Randomized Algorithms	Jan-Apr 2023	Saurabh, Saket
Discrete Mathematics	Jul-Dec 2023	Ramya, C.
Mathematical Logic	Jul-Dec 2023	Saivasan, Prakash
Design and analysis Algorithms	Aug-Dec 2023	Raman, Venkatesh
Discrete Maths (jointly with C. Ramya)	Aug-Dec 2023	Sharma, Vikram
Mathematical Logic	Aug-Nov 2023	Saivasan, Prakash
Theory of Computation	Aug-Dec 2023	Mahajan, Meena B.
Advanced Parameterized Complexity	Jan-Apr 2024	Saurabh, Saket
Approximation Algorithms in Algorithmic Game Theory	Jan-May 2024	Gupta, Sushmita
Computational Complexity	Jan-May 2024	Ramya, C.
Linear Programming and Combinatorial Optimization	Jan-May 2024	Sharma, Vikram
Parameterized Algorithms	Jan-Apr 2024	Raman, Venkatesh
Randomized Algorithms	Jan-Apr 2024	Saurabh, Saket

In addition, the following **lecture courses** were offered during 2023 – 2024 by IMSC faculty in the National Undergraduate programme of the Chennai Mathematical Institute.

Course Title	Period	Lecturer
Theoretical Computer Science		
Infinite State Verification	Jan-Apr 2024	Saivasan, Prakash

2.6 Honours and Awards

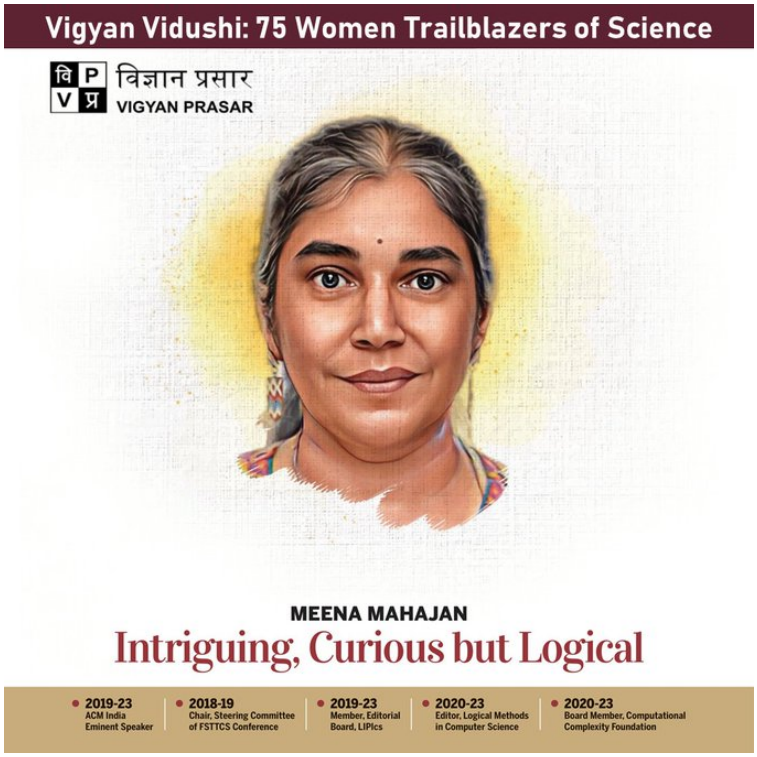
Baskaran, Shanmuga Priya was awarded Best Poster Award, for 2024, by the Pondicherry University at the International Conference on Bioinformatics in Health and Food Security 2024.

Chivukula, Nikhil was awarded Best Poster Award, for 2024, by the 17th Annual International Biocuration Conference (AIBC-2024), held at Indian Biological Data Centre, Regional Centre for Biotechnology, Faridabad, Haryana, India.

Madanagopalan, Padmanath was awarded Startup Research Grant for the proposal titled "Hadron Physics using lattice QCD", for 2024, by the SERB India.

Mahajan, Meena B. was awarded Recipient of J. C. Bose Fellowship, for 2024, by the SERB-DST, Govt of India.

Mahajan, Meena B. faculty in Theoretical Computer Science (TCS) group featured in the **"Vigyan Vidushi: 75 Women Trailblazers of Science"** - a book portraying the valuable contributions of 75 Indian women scientists, published by Vigyan Prasar.
Source : https://vigyanprasar.gov.in/product/vigyan-vidushi/



Chapter 3

Other Professional Activities

This chapter lists the activities carried out by the individual members of the institute in their professional capacity.

Bagchi, Manjari

Reviewer of GMRT observation proposals during Aug 2019 – Feb 2024.

Lecturer at Online on Jun 30, 2023. 'Neutron stars: the undead stars that help to study gravity and particle physics' – A lecture on 30-June-2023 to college teachers in an online faculty development program (FDP) on theoretical and experimental physics organised by Vellore Institute of Tec

Lecturer at Online on Jul 29, 2023. An online talk titled "Hunting low-frequency gravitational waves through Pulsar Timing Arrays: The role of InPTA" to National Institute of Science Education and Research astronomy club (run by the students of NISER).

Lecturer at IMSc on Jul 22, 2023. A lecture on "Hunting low-frequency gravitational waves through Pulsar Timing Arrays: The role of InPTA" in the populsar science lecture series of the Tamil Nadu Science Forum.

Lecturer at IMSc on Jul 13, 2023. A lecture on "Hunting low-frequency gravitational waves through Pulsar Timing Arrays: The role of InPTA" in the Vigyan Pratibha Teachers Workshop.

M.Sc thesis examiner of University of Manchester during Aug 2023 – Mar 2024.

Member of Local Organising Committee for Remembering Amal Kumar Raychaudhuri (AKR): the celebration of the centenary year held at IMSc during Oct 5 – Oct 7, 2023.

Lecturer at Department of Materials Science, University of Madras on Nov 30, 2023. A lecture on "Physics of the Stars, alive and dead" to college teachers for the UGC-HRDC refresher course in physics.

Member of National Organising Committee for New Horizons and Singularities in Gravity (10th International Conference on Gravitation and Cosmology) held at IIT-Guwahati during Dec 6 – Dec 9, 2023.

Convener of Local Organising Committee for A Conference on Pulsar Timing Array Experiments: Present and Future of Indian Contribution held at IMSc during Feb 5 – Feb 9, 2024.

Chakraborty, Debayan

Guest Associate Editor of the journal Biophysical Chemistry .

Member of the Topical Advisory Panel of the journal Symmetry.

Convener of Local Organising Committee for FRACMEET 2024, held at IMSc during Mar 5 – Mar 8, 2024.

Chaudhuri, Pinaki P.

Convener of Local Organising Committee for Chennai Soft Matter Days held at IMSc during Feb 23 – Feb 24, 2024.

Coimbatore Balram, Ajit

Associate of Indian Academy of Sciences during Aug 2022 – Dec 2023.

Ghosh, Sibasish

External Member of Doctoral Committee of two Ph.D. students in the Physics Department of IIITDM-Kancheepuram

Invited Speaker at RV College of Engineering, Bengaluru on Dec 21, 2023. Gave (on 21st Dec., 2023) a popular-level talk on fundamentals of quantum key distribution at the Six-day ATAL Faculty Development Programme on "Quantum Photonics, Computing and Communications", held at the College from 18th to 23rd Dec 2023.

Gun, S.

Reviewer of Mathematical Reviews during Jul 2008 – Mar 2024.

Managing Editor of IMSc monograph series during Apr 2015 – Mar 2024.

Editor of JRMS during Mar 2017 – Mar 2024.

Editorial Board Member of Proceedings of the Indian Academy of Sciences - Mathematical Sciences during Jan 2018 – Mar 2024.

Editor of RMS newsletter during Jul 2019 – Mar 2024.

Editor of International Journal of Pure and Applied Mathematics during Jan 2020 – Mar 2024.

Member of Sectional Committee of Indian Academy of Sciences during Jan 2022 – Mar 2024.

Member of Academic Senate of IISER, Trivandrum during Jul 2022 – Mar 2024.

Member of Indian women in Mathematics Executive committee during Aug 2022 – Mar 2024.

President of Asia-Oceania Women in Mathematics (AOWM)

https://www.mathunion.org/cwm/news-and-events/2022-08-01/establishement-aowm

See also : https://www.ams.org/news?news_id=7062 during Aug 2022 – Mar 2024.

Associate Editor of Research in Number Theory during Sep 2022 – Mar 2024.

Member of NCM committee for Advanced Instructional Schools /Advanced Instructional Course (AIC) during Oct 2022 – Mar 2024.

Convener of International Organising Committee for inaugural meeting of Asian-Oceanian Women in Mathematics held at ICTS, Bangalore during Apr 24 – Apr 28, 2023.

Convener of International Organising Committee for a course in PARI-GP held at IMSc during Feb 19 – Feb 23, 2024.

Convener of Local Organising Committee for one day conference in number theory held at IMSc on Mar 15, 2024.

Gupta, Sushmita

Convener of Local Organising Committee for Winter School on AI and TCS: Computation in Social Choice and Economics (COSCOE) held at IIT Jodhpur during Dec 8 – Dec 12, 2023.

HAZRA, Dhiraj Kumar

Convener of Local Organising Committee for Remembering Amal Kumar Raychaudhuri (AKR): the celebration of the centenary year held at IMSc during Oct 5 – Oct 7, 2023.

Kodiyalam, Vijay

Convener of National Organising Committee for Symposium on Commutative Algebra of the 89th Annual Conference of the Indian Mathematical Society held at BITS Pilani, Hyderabad during Dec 22 – Dec 25, 2023.

Madanagopalan, Padmanath

PhD thesis external examiner of PhD thesis evaluation committee IIT Kanpur during Jun 2023 – Feb 2024.

Career guidance interactive program at Palakkad [ONLINE] on Jan 23, 2024. An interactive program with 10th standard girl students in JNV Palakkad in connection to the Vigyan Jyoti program by DST, GoI.

Mahajan, Meena B.

Member of Editorial Board of the journal Logical Methods in Computer Science during Jun 2020 – Dec 2023.

Member of Council of IARCS: Indian Association for Research in Computing Science during Jan 2021 – Dec 2023.

Co-Chair of Programme Committee, 26th International Conference on Theory and Applications of Satisfiability Testing SAT 2023 during Aug 2022 – Jul 2023.

co-Chair of Programme Committee, 26th International Conference on Theory and Applications of Satisfiability Testing SAT 2023 during Oct 2022 – Aug 2023.

Member of School Research Board of Vignan's Foundation for Science, Technology and Research (Deemed to be University), A.P during Nov 2022 – Dec 2023.

Member of ICM Structure Committe for ICM (International Congress of Mathematicians) 2026, during Jan – Dec, 2023.

Member of Programme Committee of 43rd conference on Foundations of Software Technology and Theoretical Computer Science Conference (FSTTCS) during Apr – Dec, 2023.

Member of Jury for 2023 Infosys Prize in Mathematical Sciences during Jun – Nov, 2023.

Speaker at Chennai Mathematical Institute on Jun 12, 2023. Gave a talk titled SAT Solvers in the post-IOITC (International Olympiad in Informatics Training Camp) series of lectures on topics in theoretical computer science. The attendees were mostly high-school students.

Member of Review Committee, Dept of Computer Science and Engineering, IIT Bombay during Oct – Oct, 2023.

Mukhopadhyay, Anirban

Member of National Organising Committee for Words and Transcendence held at Kerala School of Mathematics, Kozhikode, Kerala during Aug 7 – Aug 12, 2023.

Member of National Organising Committee for Words and Transcendence II held at HRI, Allahabad during Feb 6 – Feb 15, 2024.

Member of National Organising Committee for Analytic and combinatorial number theory held at HRI, Allahabad during Mar 20 – Mar 30, 2024.

Pal, Arnab

Convener of National Organising Committee for Meeting On Statistical Physics and Complex Systems held at IIT Kharagpur during Jun 5 – Jun 7, 2023.

Convener of National Organising Committee for School on Nonlinear Physics and Statistical Physics held at IIT Kharagpur during Jun 8 – Jun 10, 2023.

Member of Local Organising Committee for AKR centenary program held at IMSc during Oct 5 – Oct 7, 2023.

Member of Local Organising Committee for CHENNAI SOFT MATTER DAYS 2024 held at IMSc during Feb 23 – Feb 24, 2024.

Organizer at ANNA CENTENARY LIBRARY AUDITORIUM KOTTURPURAM on Feb 18, 2024. SCIENCE AT THE SABHA 2024 – This program of four talks aimed at the general public is part of the Triveni Outreach Series of IMSc.

Pius, Roji

Member of National Organising Committee for Indian strings meeting 2023 held at IIT Mumbai during Dec 10 – Dec 16, 2023.

Invited talk during the National Science Day celebration at Marian College, Kuttikkanam, Kerala on Feb 26, 2024. Gave an online seminar as a part of the National Science Day celebration: Emergence of classical spacetime form quantum entanglement

Prasad, Amritanshu

Member of National Organising Committee for First Meru Annual Combinatorics Conference held at Pondicherry University during May 29 – May 31, 2023.

Convener of National Organising Committee for Advanced Topics in Finite Fields held at IMSc during Jul 10 – Jul 29, 2023.

Convener of Local Organising Committee for Teachers Enrichment Workshop: A Panorama of Geometry held at IMSc during Nov 20 – Nov 25, 2023.

Raghavan, K. N.

External Member of Board of the School of Mathematics and Statistics of University of Hyderabad

Member of Board of Studies (Mathematical Sciences) of HBNI

Member of Research Council of the Kerala School of Mathematics

Member of Science Education Panel of the Indian Academy of Sciences

Member of Programme Committee for AIS (Annual Instructional Schools) of the NCM (National Centre for Mathematics)

Convener of CMI-NASI Chennai Chapter

Editorial Board Member of Indian Journal of Pure and Applied Mathematics

Associate Editor of Journal of the Ramanujan Mathematical Society

Chair of Examinations Committee of the NBHM (National Board for Higher Mathematics)

Chair of National Library Committee of NBHM (National Board for Higher Mathematics)

Board Member of National Board for Higher Mathematics (NBHM)

IMU appointed member of Commission for Developing Countries (CDC) of the International Mathematical Union (IMU)

Member of Board of the School of Physical Sciences, Central University of Karnataka

Member of Advisory Committee for CMI-NASI Third Winter Training Programme in Mathematics held at Ramanujan Institute for Advanced Study in Mathematics during Dec 7 – Dec 20, 2023.

Invited Lecture at Vellore Institute of Technology, Chennai Campus on Mar 14, 2024. Delivered a lecture to second year Engineering undergraduates

Raman, Venkatesh

Instructor for a module of CSEDU Module on Data Structures and Algorithms during Apr 2022 – Dec 2023.

Convener for Advanced Graph Algorithms held at SRM Institute of Science and Technology, Kattankulathur, Chennai during May 22 – May 26, 2023.

Speaker at TKM College of Engineering, Kollam on Oct 14, 2023. Gave a talk on "Research Career, What, Why and How" in the ACM ROCS series

Ramya, C.

Invited Speaker at Chennai Mathematical Institute on Apr 7, 2023. Gave an invited talk titled "The Art and Science of Computing: A Mathematical Perspective" at STEMS (Scholastic Test of Excellence in Mathematical Sciences) Final Camp.

Panel member at ICTS Bengaluru (attended online) on Apr 28, 2023. Invited to be a Panel member for the panel discussion on "Opportunities and possible future course of actions", at the Inaugural meeting of Asian-Oceanian Women in Mathematics (AOWM).

Invited Speaker at Chennai Mathematical Institute, on Jun 13, 2023. Gave an invited talk "A panorama of computational problems" at the International Olympiad in Informatics Training Camp, 2023 (IOITC-2023).

Invited Speaker at Dept. of Computer Science and Engineering, IIT Madras on Sep 21, 2023. Gave a talk titled "Exploring multiple facets of algebraic computation" at the IITM-CSE Alumni Talk Series "Alum@Alma".

Ravindran, V.

Member of Recruitment and promotion committees of Physical Research Laboratory, Ahmedabad. Physical Research Laboratory, Ahmedabad. Mar 2023

Member of Recruitment and promotion committees of IISER, Pune Mar 2023

Member of Member of Council of Management of Homi Bhabha National Institute, Mumbai

Member of Member of Board of Governors National Institute of Science Educaton and Research Apr 2023

Member of Member of Advisory Committee for Jawaharlal Nehru National Science, Mathematics and Environment Exhibition (JNNSMEE) Jawaharlal Nehru National Science, Mathematics and Environment Exhibition (JNNSMEE) Mar 2022

Samal, Areejit

PhD Thesis Examiner of Central University of Gujrat

PhD Thesis Examiner of IIT Madras

PhD Thesis Examiner of IISc Bengaluru

Associate Editor of Cell Press journal Heliyon

Associate Editor of journal Frontiers in Fungal Physiology and Metabolism

Editorial Board member of Springer Nature journal Scientific Reports

Associate Editor of the Springer journal Theory in Biosciences

Member of AYUSH Informatics sub-committee of the Health Informatics committee (MHD-17:1) of the Bureau of Indian Standards (BIS), Government of India

Convener of Local Organising Committee for Network Biology Day held at IMSc on Jul 20, 2023.

Convener of Local Organising Committee for Modelling and Tackling Complex Biological Systems held at IMSc during Oct 13 – Oct 14, 2023.

Convener of Local Organising Committee for Contemporary Perspectives in Computational Biology held at IMSc during Feb 19 – Feb 20, 2024.

Saurabh, Saket

Associate Editor of Journal of Computer and System Sciences

Editor of Theory of Computing Systems

One of the Editor in Chief of Indian Journal of Discrete Mathematics

Associate Editor of Algorithmica

Associate Editor of Theoretical Computer Science

Associate Editor of Siam Journal on Computing

Convener of International Organising Committee for FPT Fest in the Honour of Mike Fellows held at Grand Hotel Terminus, Bergen, Norway, during Jun 12 – Jun 16, 2023.

Program Committee Member of SIAM Symposium on Discrete Algorithms (SODA 2024) during Jul 2023 – Jan 2024.

Program Committee Member of LATIN (Latin American Theoretical Informatics) 2024. during Sep 2023 – Mar 2024.

Program Committee Member of International Conference and Workshop on Algorithms and Computation (WALCOM 2024) during Sep 2023 – Mar 2024.

Program Committee Member of International Symposium on Theoretical Aspects of Com-

puter Science (STCAS 2024) during Sep 2023 – Mar 2024.

Invited Speaker at Science at the Sabha at Chennai on Feb 18, 2024. This program of four talks aimed at the general public is part of the Triveni Outreach Series of IMSc.

Invited Speaker at STEMS 2024 at Chennai Mathematical Institute on Feb 17, 2024. STEMS (Scholastic Test of Excellence in Mathematical Sciences) is an annual first-of-its-kind open resource examination conducted for students from 8th grade to undergraduates across India conduced by CMI.

Sharma, Sayantan

Convener of Local Organising Committee for Institute Seminar Days held at IMSc during Jan 23 – Jan 31, 2024.

Sharma, Vikram

Convener of National Organising Committee for Recent Trends in Algorithms held at Online during Jul 26 – Jul 28, 2023.

Siddharthan, Rahul

Convener of National Organising Committee for Machine learning for health and diseasee held at ICTS, TIFR, Bengaluru during Jul 24 – Aug 4, 2023.

Convener of Local Organising Committee for Clinical data, machine learning and modelling held at IMSc during Dec 1 – Dec 2, 2023.

Srinivas, K.

TEW Convener of National Center for Mathematics

Managing Editor of Hardy Ramanujan Journal

Member of Project Advisory Committee, DST

Managing Editor of Journal of Ramanujan Mathematical Society during Dec 2023 – Mar 2024.

Viswanath, Sankaran

Member of NCERT Mathematics Curricular Area Group (CAG) during Sep 2023 – Jan 2024.

Convener of Local Organising Committee for Alladi Ramakrishnan Centenary conference held at IMSc during Dec 16 – Dec 18, 2023.

Chapter 4

Colloquia

4.1 Conferences/Workshops Held at IMSc

4.1.1 Advanced Topics in Finite Fields during Jul 10 – Jul 29, 2023.

The theory of finite fields lies at the crossroads of algebra, combinatorics, and number theory. Finite fields play an important role in many application areas, such as coding theory and cryptography. The topics covered in this workshop included the following: the structure of finite fields, matrices and linear operators over finite fields, polynomials over finite fields, sequences over finite fields, exponential sums over finite fields, and equations and varieties over finite fields. This workshop was intended for graduate students with a potential interest in finite fields and their applications. Organized jointly by Amritanshu Prasad with Sartaj Ul Hasan, IIT Jammu.

4.1.2 Network Biology Day on Jul 20, 2023.

This conference in the area of network science was held at IMSc Chennai on 20 July 2023. This conference included high-level research talks by 10 invited speakers and poster presentations by more than 15 researchers. The conference was attended by 90 participants. Detailed information on this conference supported by Apex project from DAE to IMSc is available at: https://www.imsc.res.in/~asamal/netbioday23/

4.1.3 Modelling and Tackling Complex Biological Systems during Oct 13 – Oct 14, 2023.

This conference included high-level research talks by 15 invited speakers, 5 Oral presentations and poster presentations by more than 40 researchers. The conference was attended by 140 participants. Detailed information on this conference supported by Apex project from DAE to IMSc is available at: https://www.imsc.res.in/~asamal/modtackbio23/

4.1.4 Remembering Amal Kumar Raychaudhuri (AKR): the celebration of the centenary year during Oct 5 – Oct 7, 2023.

AKR centenary program is a mini-conference during October 5-7, 2023 organized by and to be held at the Institute of Mathematical Sciences, Chennai. In this 3 day long program we will discuss the works of Professor Amal Kumar Raychaudhuri. We will remember the scientist, the teacher, the visionary and the man from the memories of his students and eminent scientists working in the areas of gravitation and related subjects. In the first 2 days we will have seminars at the technical level followed by discussions. October 7 is dedicated for students' outreach.
Organisers : Dhiraj Kumar Hazra, Arnab Pal and Manjari Bagchi
https://sites.google.com/imsc.res.in/imsc-akr-centenary-program/home

4.1.5 Teachers Enrichment Workshop: A Panorama of Geometry during Nov 20 – Nov 25, 2023.

A gentle introduction to different ways of studying geometric spaces. Sponsored by National Centre for Mathematics.

4.1.6 Clinical data, machine learning and modelling during Dec 1 – Dec 2, 2023.

An informal meeting of minds from clinical medicine and computational and data science. Schedule in progress. We plan to have short talks and plenty of time for discussion and brainstorming aimed at possible collaborations.

The program is funded by the IMSc Centre for Disease Modelling, an apex project at IMSc funded by the Department of Atomic Energy, Government of India. The program is partly a followup on the recent workshop on Machine Learning for Health and Disease at ICTS, Bengaluru.

4.1.7 Alladi Ramakrishnan Centenary conference during Dec 16 – Dec 18, 2023.

A conference to celebrate the birth centenary of the Institute's founder-director Prof Alladi Ramakrishnan was organised during December 16-18, 2023.

The inaugural event featured a speech by chief guest Mr N R Narayanamurthy (Founder, Infosys). He also unveiled a bust of Prof Ramakrishnan on the institute campus. The first day of the conference featured talks by leaders of science policy and institutions in India. The remaining days featured talks on physics and mathematics by eminent senior scientists, who also reminisced about their association with Prof Ramakrishnan and the institute.

Figure 4.1: L-R Professor Krishnaswamy Alladi, Mr N R Narayanamurthy (Founder, Infosys) and Professor V. Ravindran during the unveiling ceremony of a bust of Prof. Alladi Ramakrishnan.

The details are archived on the conference webpage: https://www.imsc.res.in/ar100/

4.1.8 Institute Seminar Days during Jan 23 – Jan 31, 2024.

The Institute Seminar Days was held on two days 23/1/2024 and 31/1/2024 where institute members discuss about their research work to their peers and colleagues from the institute in 10 mins colloquium like talks accessible to a scientific audience.

4.1.9 A course in PARI-GP during Feb 19 – Feb 23, 2024.

In this workshop, Prof. Marine Rougnant from Besancon Mathematics Laboratory delivered a set of lectures introducing Pari-GP to students and faculty. There were around 30/35 participants for this program. Details of the program can be found;

Details of the program can be found; https://sites.google.com/view/imscparigp/home

4.1.10 A Conference on Pulsar Timing Array Experiments: Present and Future of Indian Contribution during Feb 5 – Feb 9, 2024.

The conference was held on 5 days and had several high-level talks on Ultra-Long Gravitational Waves Astronomy, new detection methods with pulsar timing array, BH kicks and mass spectrum etc.

Figure 4.2: Participants in the meeting "Pulsar Timing Array Experiments: Present and Future of Indian Contribution

4.1.11 Contemporary Perspectives in Computational Biology during Feb 19 – Feb 20, 2024.

This conference included high-level research talks by 16 invited speakers, 5 oral presentations and poster presentations by more than 25 researchers. The conference was attended by 110 participants. Detailed information on this conference supported by Apex project from the Department of Atomic Energy (DAE) to IMSc is available at: https://www.imsc.res.in/~asamal/copecompbio24/

4.1.12 Chennai Soft Matter Days during Feb 23 – Feb 24, 2024.

This neighbourhood meeting, held annually, is intended to bring together researchers carrying out theoretical and experimental studies on diverse aspects of soft matter.

https://che.iitm.ac.in/chennaisoft/

4.1.13 FRACMEET during Mar 05 – Mar 08, 2024.

Fracmeet 2024 was organized at IMSc from 5th to 8th March, 2024. The focus of this 4-day conference was to discuss the recent developments and future challenges in the upscaling process from a point of view of Statistical Mechanics and Non-linear Physics. We had about 22 invited speakers, and student participants.

Organisers : Debayan Chakraborty, Subhadeep Roy, Purusattam Ray, Viswajeet Kumar, Subashri V., Reshmi Roy and Mohd Taher

4.1.14 One day conference in number theory on Mar 15, 2024.

One day number theory conference was organized on 15th March, 2024 to celebrate recent contributions in number theory from Chennai. There were eight lectures by Students/PDFs and three lectures by senior mathematicians. Around 30 mathematicians participated in this program.

Figure 4.3: Participants during the One day number theory conference

4.2 Other Conferences/Workshops Organized by IMSc

4.2.1 Inaugural meeting of Asian-Oceanian Women in Mathematics during Apr 24 – Apr 28, 2023.

This was the first meeting of recently formed AOWM under the auspices of CWM of IMU. The meeting was funded by ICTS, IMSc and CWM.

In addition to the lectures and the panel discussions, we also had the first hybrid meeting of EC members of AOWM.

Deatils of the meeting can be found at https://www.icts.res.in/discussion-meeting/AOWM

4.2.2 Advanced Graph Algorithms during May 22 – May 26, 2023.

This is a faculty development program, part of the CSEDU program of IIIT Delhi.

Venkatesh Raman organised the academic program, and gave several lectures on topics in algorithms.

4.2.3 First Meru Annual Combinatorics Conference during May 29 – May 31, 2023.

This is the first of a series of annual conferences on combinatorics in India: the Meru Annual Combinatorics Conference. The format of the series will be two mini-courses in combinatorics (interpreted broadly) as well as contributed talks and posters.

Meru stands for the mountain in Indian mythology and was used as a metaphor for the triangle of binomial coefficients studied by classical Indian prosodists.

4.2.4 FPT Fest in the Honour of Mike Fellows during Jun 12 – Jun 16, 2023.

The symposium consisted of a number of invited talks, minisymposia, and one full day (Wednesday) devoted to Mike Fellows and his contributions to computer science and Parameterized Complexity in particular.

4.2.5 Meeting On Statistical Physics and Complex Systems during Jun 5 – Jun 7, 2023.

The MeetStatPhysics is an initiative by me and three other colleagues across India.

The scope of the meeting is broad and interdisciplinary. The meeting will focus on equilibrium and non-equilibrium statistical physics (classical and quantum) and its applications

to condensed matter systems; quantum field theories; active matter, soft matter, biological systems; nonlinear physics, fluids (strong and weak turbulence), dynamo, geophysical flows, astrophysical flows, etc.

This was the second edition of the meeting.

4.2.6 School on Nonlinear Physics and Statistical Physics during Jun 8 – Jun 10, 2023.

The school consists of a series of pedagogical lectures and expository research seminars for the advanced level undergraduates, postgraduates and research fellows.

4.2.7 Machine learning for health and diseases during Jul 24 – Aug 4, 2023.

The program brought together machine learning experts, statisticians, clinicians, and public health experts to discuss how to harness modern mathematical and computational techniques to better understand health-related data across multiple domains. Basics of various machine learning techniques, including logistic regression, tree-based methods, support vector machines, Bayesian methods, and deep networks were covered with examples of their applicability in biomedicine and health. Applications includes predicting outcomes for individual patients from clinical and lifestyle parameters, analysing patient data such as X-rays, ultrasound images and ECG measurements, genomic variant analysis, and inferring patterns in heterogeneous large-scale data. Speakers from both computational/statistical and clinical backgrounds were invited.

While the overarching goal is to bridge the gap between mathematical modelling and clinical problems in general, the program had these specific aims:

- To introduce people who are trained in machine learning (both theory and practice) to data-based problems in health care.
- To introduce clinical practitioners with little ML background to tools that can be easily adapted to analyse their own data.
- To have an open discussion between clinicians and mathematical modellers about the problems faced in bridging the gap between the communities.
- To discuss the possibility of building public health databases as resources.
- To generate reference material, tutorials, videos and other resources to help clinicians understand and apply ML techniques in their work.

The event was partly supported by the IMSc Centre for Disease Modelling, The Institute of Mathematical Sciences, Chennai.

4.2.8 Recent Trends in Algorithms during Jul 26 – Jul 28, 2023.

This meeting aims to provide a broad picture of the latest research in algorithms through a series of invited talks.

4.2.9 Words and Transcendence during Aug 7 – Aug 12, 2023.

This is the first in a series of workshops in the interphase of word combinatorics and transcendental number theory.

4.2.10 Symposium on Commutative Algebra of the 89th Annual Conference of the Indian Mathematical Society during Dec 22 – Dec 25, 2023.

The Indian Mathematical Society organizes its annual conference at different locations of the country. The 89th Annual Conference of The Indian Mathematical Society was organized during 22-25 December, 2023 at Birla Institute of Technology Science (BITS) Pilani, Hyderabad Campus. The conference was intended to keep abreast of the latest developments in the field of Mathematics.
Vijay Kodiyalam was the convenor of the symposium on Commutative Algebra

4.2.11 CMI-NASI Third Winter Training Programme in Mathematics during Dec 7 – Dec 20, 2023.

This Winter Training Programme (WTP) was aimed at motivating younger minds in Mathematics to understand the fundamentals in Mathematics at their U.G (III - Year only) level and encourage them to take up research. Also it exposed students to the recent research areas alongside strengthening their understanding in fundamental concepts.

K. N. Raghavan helped organise this event which was co-sponsored by IMSc.

4.2.12 New Horizons and Singularities in Gravity (10th International Conference on Gravitation and Cosmology) during Dec 6 – Dec 9, 2023.

The 10th International Conference on Gravitation and Cosmology (ICGC) was hosted by the Indian Institute of Technology (IIT) Guwahati, India during December 6 - 9, 2023. The aims of the conference is to bring together experts working in the area of Gravitation and Cosmology to discuss the recent developments, present status and exchange ideas while providing young researchers from India an opportunity for interaction with experts. The programme had a series of plenary lectures, with parallel and poster sessions.

4.2.13 Winter School on AI and TCS: Computation in Social Choice and Economics (COSCOE) during Dec 8 – Dec 12, 2023.

The school was focused on Matching under Preferences. This school introduced the fascinating world of matching problems with preferences from different perspectives, such as algorithms and complexity, discrete mathematics, and combinatorial optimization. The participants learnt about the main concepts, methods, and challenges in this field, and explore various types of problems and applications in this domain.

4.2.14 Indian strings meeting 2023 during Dec 10 – Dec 16, 2023.

ISM is a series of conferences organised by the String Theory community in India every alternate year. Besides the invited speakers from abroad and India, all active string theorists from India (including postdocs and students) were invited to participate in this meeting.

4.2.15 Words and Transcendence II during Feb 6 – Feb 15, 2024.

This is the second part in a series of workshops in the interphase of word combinatorics and transcendental number theory.

4.2.16 Analytic and combinatorial number theory during Mar 20 – Mar 30, 2024.

The workshop aimed to illustrate how the method of analysis, combinatorics and probability theory has helped answer deep questions in Number theory.

4.3 Outreach Activities

Vigyan Pratibha Regional Workshop (KVS / JNV / AECS): (10-14 July,2023)

IMSc organized a 5-day regional teachers workshop for the Vigyan Pratibha program, a Government of India program to nurture of talent in Science and Mathematics among VIII - X students. The workshop was attended by 43 teachers from central government schools (KVs and JNVs) from the southern region. The program included a trip to IITM labs.

Speakers: Arun Kumar (IITM), Disha Kuzhively (IMSc), Madhusree Basu, Manikandan Sambasivam (IMSc), Manjari Bagchi (IMSc), Sarang Sane (IITM), Sivashankara Sastry, Thiru Senthil (IMSc), Uthra Dorairajan (D G Vaishnav College), Sujatha Ramdorai (University of British Columbia), Varuni P (IMSc)

Figure 4.4: Participants during the Vigyan Pratibha Regional Workshop, 10-14 July, 2023

Organisers: Manikandan Sambasivam, Varuni P, S. Viswanath
Details: https://www.imsc.res.in/outreach/vpchennai/TWChEng2023July.html

Chandrayaan-3 Soft-landing telecast: (23 August, 2023)

IMSc hosted a live stream of Chandrayaan-3 soft-landing in Ramanujam Auditorium. Chandrayaan-3 is India's third lunar exploration mission.

Details: https://www.imsc.res.in/outreach/lectures/chandrayaan3telecast.pdf

Amal Kumar Raychaudhuri (AKR) centenary program: (7 October, 2023)
Physics outreach lectures for invited college students as part of the Amal Kumar Raychaudhuri (AKR) centenary program

Organisers: Manjari Bagchi, Dhiraj Hazra, Arnab Pal, V. Ravindran
Details: https://sites.google.com/imsc.res.in/imsc-akr-centenary-program/home

Facets: (9 October, 2023)

Facets is the Institutes's outreach program for advanced undergraduate and postgraduate students of mathematics. This one day program is intended for mathematics students to interact with professional mathematicians working in research. This year, over 120 students attended this program.

Speakers: Prakash Saivasan (IMSc), Sushmita Venugopalan (IMSc), S Viswanath (IMSc)
Organisers: Sushmita Venugopalan, Disha Kuzhively, Varuni P, S. Viswanath
Details: https://www.imsc.res.in/outreach/facets2023/

kaNita-kAnakam: (12 October, 2023)

The workshop was aimed at students of class X - XII of corporation schools and conducted in Tamil. The program included Mathematics activities conducted by IMSc members for students to engage with topics more interactively. About 120 students from various government and corporation schools from the area attended the program.

Speakers: Amritanshu Prasad (IMSc), Disha Kuzhively (IMSc), Shri Hari Gopalakrishnan (IMSc), Viswanath (IMSc), VSS Sastry

Figure 4.5: V Sivashankara Sastry, during Kanita-Kanakam workshop, 12 October, 2023

Organisers: Amritanshu Prasad, Disha Kuzhively, Manikandan Sambasivam, Varuni P, S. Viswanath
Details: https://www.imsc.res.in/outreach/KK2023/

Mathematics Toy Development workshop: (13 October, 2023)

VSS Sastry, a Maths and science communicator, explained various ways in which math education could be done using toys. He also exhibited some of his own works.
Speaker: VSS Sastry

Organisers: Viswanath S, Varuni P

Vigyan Pratibha Teachers Workshop (TN govt schools Chennai region): (17-20 October, 2023)

Regional workshop for teachers in the Vigyan Pratibha program in Tamil.
IMSc organized a 4-day teachers workshop for the Vigyan Pratibha program, a Government of India program to nurture talent in Science and Mathematics among VIII - X students. The workshop was attended by 50 teachers from state government schools (GCCs) from the chennai region.

Speakers: Amritanshu Prasad (IMSc), Arun Kumar (IITM), Disha Kuzhively (IMSc), Maruthu Pandiyan B (IMSc), Manikandan Sambasivam (IMSc), Thiru Senthil (IMSc), Sathish Kumar (IMSc), Sitabara Sinha (IMSc), Sushmita Venugopalan (IMSc), TR Govindarajan, Retd. (IMSc), Varuni P (IMSc), Srinivasan G (IMSc), Yuvan Aves (Palluyir Trust)

Organisers: Manikandan Sambasivam, Varuni P, S. Viswanath
Details: https://www.imsc.res.in/outreach/vpchennai/TWChTam2023.html

TNSF Lecture series: Nobel Prize in Physics: (4 November, 2023)

Conceiving and developing Attosecond optical pulses, Sivarama Krishnan, IITM

Speaker: Sivarama Krishnan

Organisers: TNSF
Details: https://tnsfchennai.github.io/indexpsl65opticalpulses.html

Women, Science and Media: (6-8 November, 2023)

A series of sessions highlighting Women in Science and Science Journalism. A one-off event with lecture about the state of women in Science and a workshop on how to effectively communicate science. There was also a talk about the year's Nobel prizes.

Speakers: Nandita Jayaraj, Ashima Dogra, Indumathi D

Details: https://www.imsc.res.in/outreach/WomenScienceMedia2023/

Vigyan Pratibha Regional Workshop (KVS & JNV): (20-23 November, 2023)

Teacher workshop for Kendriya Vidyalaya and Jawahar Navodaya Vidyalaya teachers from the southern region. IMSc organized a 4-day follow-up regional teachers workshop for the Vigyan Pratibha program, a Government of India program to nurture talent in Science and Mathematics among VIII - X students. The workshop was attended by 39 teachers from central government schools (KVs and JNVs) from the southern region.

Speakers: Areejit Samal (IMSc), Arun Kumar (IITM), Disha Kuzhively (IMSc), Indumathi D. (IMSc), Manikandan Sambasivam (IMSc), Thiru Senthil (IMSc), Sitabara Sinha (IMSc), Subramanya Hegde (IMSc), Sulochana R (HBCSE), Uthra Dorairajan (D G Vaishnav College), Varuni P (IMSc)

Organisers: Manikandan Sambasivam, Varuni P, S. Viswanath
Details: https://www.imsc.res.in/outreach/vpchennai/TWChEng2023Nov.html

Public lecture by Kalaiyarasan A (MIDS) on the Nobel Prize in Economics 2023: (25 November, 2023)

(Part of Nobel Prize series, coorganized by TNSF popular lecture series)

Details: https://www.imsc.res.in/outreach/lectures/TNSF_2023.11.25_NobelPhys.jpg

IMSc Conversation Series — Living in Science - Scholar or Scribe: (5 January, 2024)

Shubashree Desikan, Science Journalist, Shaastra IITM (In conversation with: Varuni P). This is a monthly series which aims to invite speakers from outside the academic community but are involved in and related to science.

Speaker: Shubashree Desikan

Organisers: Sitabara Sinha, Varuni P, Manikandan Sambasivam, Viswanath P
Details: https://www.imsc.res.in/outreach/ConvoSeries/images/Shuba_5Jan2024.png

State level Youth Astronomy and Space Science Congress: (27-28 January, 2024)

Inauguration of Planet Festival 2024, which aims to take astronomy outreach to schools in Tamil Nadu.

Speakers: TASS Committee Members, Sudhan IAS (retd.)

Organisers: TASS Co-organized by Tamilnadu Astronomy & Science Society (TASS)
Details: https://www.imsc.res.in/outreach/programs/2024.01.27-28_TASS_AstroConf.pdf

Science at the Sabha (18 February, 2024)

"Science at the Sabha 2024" was conducted on Sunday, 18 February, 4:00-7:30 pm at the Anna Centenary Library Auditorium. "Science at the Sabha" is a set of four public talks on different aspects of science and is part of the Institute of Mathematical Sciences, ongoing program of outreach to the general public. This was the 7th edition of this flagship event conducted in February of each year. The event was attended by 500-700 people. The talks were aimed at anyone with an interest in science, irrespective of age or background. This year the talks were:

- **Astronomy from Ground and Space** by **Annapurni Subramaniam**, Indian Institute of Astrophysics, Bengaluru.

- **Plastics – the good, the bad and the ugly** by **S. Ramakrishnan**, Indian Institute of Science, Bengaluru.

- **Evolution of our understanding of the dynamics of the North Indian Ocean** by **D. Shankar**, CSIR-National Institute of Oceanography, Goa.

- **The Art and Math of Puzzle Solving** by **Saket Saurabh**, The Institute of Mathematical Sciences, Chennai.

This year there was also a poster series on Climate Change in India: What do we know and how?

Figure 4.6: Speakers : Science at the Sabha, 18 February, 2024

Figure 4.7: Annapurni Subramaniam, during her talk at the Science at the Sabha, 18 February, 2024

Organisers: Viswanath S, Varuni P, Manikandan Sambasivam
Details: https://www.imsc.res.in/triveni/

IMSc Conversation Series — Photography - A language of perspective, process and purpose: (23 February, 2024)

Speakers:Shuchi Kapoor, Co-Founder of the Chennai Photo Biennale Foundation

Organisers: Sitabara Sinha, Varuni P
Details: https://www.imsc.res.in/outreach/ConvoSeries/

Understanding the UNFCCC Process – Decoding COP28: (23 March, 2024)

Public lecture by T Jayaraman, Senior Fellow, M. S. Swaminathan Research Foundation (MSSRF). As part of the poster series, Part of Climate Change in India: What do we know and how?, the contributor T Jayaraman talked about the international scenario driving climate change discussions.

Speakers: T Jayaraman

Organisers: Varuni P, Viswanath S
Details: https://www.imsc.res.in/outreach/ClimateChange2024/

IMSc Conversation Series — Ways of the Virus: (29 March, 2024)

Speaker : Chitra Pattabiraman
Organisers: Sitabara Sinha, Varuni P
Details: https://www.imsc.res.in/outreach/ConvoSeries/

4.4 Seminars

Date	Speaker Affiliation	Title
3-4-2023	A. P. Balachandran Syracuse University	Lectures on Algebraic Quantum Theory
5-4-2023	Rakesh Netha Vadnala IMSc (presently NCBS Bangalore)	Investigating how chromatin regulates gene expression and cellular processes
5-4-2023	A. P. Balachandran Syracuse University	Lectures on Algebraic Quantum Theory
5-4-2023	Rakesh Mishra Tata Institute for Genetics and Society, Bengaluru	Nuclear architecture and the structural basis of cellular memory
10-4-2023	A. P. Balachandran Syracuse University	Lectures on Algebraic Quantum Theory
10-4-2023	Suman Kumbhakar University of Montreal	A U-spin puzzle in B decays
12-4-2023	A. P. Balachandran Syracuse University	Lectures on Algebraic Quantum Theory
12-4-2023	Pratik Tarafdar IMSc	The Indian Pulsar Timing Array (InPTA): Joining the global hunt for nanohertz gravitational waves and related sciences
17-4-2023	A. P. Balachandran Syracuse University	Lectures on Algebraic Quantum Theory
17-4-2023	Sabiar Shaikh IMSC	Study of ZN symmetry in SU(N) gauge theories in the presence of matter fields
18-4-2023	Kushal Chakraborty IISER Bhopal	Fermions and higher spin
19-4-2023	A. P. Balachandran Syracuse University	Lectures on Algebraic Quantum Theory
19-4-2023	Ram Murty Queen's University	HASSE'S INEQUALITY

20-4-2023	Prosenjit Roy IIT Kanpur	Some functional Inequalities on Sobolev Spaces
20-4-2023	Sujoy Mahato HRI	Effective Gravitational Couplings of Higher-Rank Supersymmetric Gauge Theories
20-4-2023	Sangram Bagh Biophysics and Structural Genomics Division, Saha Institute of Nuclear Physics, Kolkata	Building computers and artificial neural networks with engineered bacteria that can compute, solve mazes and add and subtract numbers
21-4-2023	Sreetosh Goswami Centre for Nano Science and Engineering, Indian Institute of Science, Bengaluru	Molecular hardware for Artificial Intelligence
24-4-2023	A. P. Balachandran Syracuse University	Lectures on Algebraic Quantum Theory
26-4-2023	A. P. Balachandran Syracuse University	Lectures on Algebraic Quantum Theory
26-4-2023	T. R. Govindarajan Retired Professor, IMSc	RRR
27-4-2023	R Venkatesh IISc	Bases for partially commutative free Lie algebras
28-4-2023	Mr Soumya Sur IMSc	Investigations into Quantum Compass Models in Two Dimensions.
28-4-2023	Sven-Olaf Moch Hamburg University	The deep structure of the proton in the LHC era
3-5-2023	Sumithra Surendralal Symbiosis International (Deemed University), Pune	Inference of Syntax from Songbird Songs and Implications for Neural Mechanisms
5-5-2023	Chandrani Kumari IMSc, Chennai	Machine learning and predicting clinical outcomes (Pre-synopsis talk)
8-5-2023	Karthik Raman Department of Biotechnology, IIT Madras	Computational approaches to decoding microbial interactions microbiomes
10-5-2023	Chirag Jain Computational and Data Sciences, IISc Bangalore	Graph-theoretic models for de novo genome assembly using third-generation sequencing technologies

11-5-2023	R Thiru Senthil HBNI/IMSc	Tau Neutrino Studies at the Proposed ICAL De- tector in INO
11-5-2023	Aritra Bhattacharya IMSc	Clebsch Gordon coefficients for Macdonald polynomials
12-5-2023	Rukmini Kumar Chief Scientist and Co-Founder, Vantage Research	Impacting drug development through BioSimulation, Case Studies & Career Opportunities for Computational Biologists
12-5-2023	Pranav Thekke Madathil Princeton University	Correlated states in ultra-high-quality two-dimensional electron systems
15-5-2023	Ashutosh Dubey IMSc	First-passage functionals for Ornstein Uhlenbeck process with stochastic resetting and Non-uniqueness of quantum first detection time
16-5-2023	Nirav P Bhatt Department of Biotechnology, IIT Madras	Developing Integrated Biological Models from Data for Understanding Diseases
18-5-2023	Kishore Hari Centre for BioSystems Science and Engineering, IISc, Bengaluru	Design principles of phenotypic plasticity and robustness in gene regulatory networks underlying cancer metastasis
23-5-2023	M. Michael Gromiha Department of Biotechnology, IIT Madras	Bioinformatics approaches for understanding mutational effects on protein structure and function: implications to diseases
24-5-2023	Raj Kumar Manna Department of Physics, Syracuse University	Shape morphing of chemically active elastic sheets, and tissues
25-5-2023	Prof. Bindusar Sahoo IISER Thiruvananthapuram	Relating maximal conformal supergravities in 6d and 4d
29-5-2023	Yasharth Yadav Division of Mathematical Sciences, Nanyang Technological University, Singapore	Analyzing human brain functional connectivity networks using discrete Ricci curvatures
2-6-2023	Sunil L Naik IMSc	Prime divisors of non-zero Fourier coefficients of Hecke eigenforms
7-6-2023	Gargi Lather IIT Madras	Skeleton ideals of graphs

9-6-2023	Yogesh Dahiya IMSc	Randomness Gives Little Advantage for Decision Tree Size
9-6-2023	Ankur Sarkar IMSc	Smooth Structures on the product of a manifold with a standard sphere
14-6-2023	Madhulika Dixit Department of Biotechnology, IIT Madras	Insulin and impaired glucose metabolism: the atypical determinants of lymphocyte adherence
14-6-2023	Aninda Sinha IISc, Bengaluru	Bootstrap using the crossing symmetric dispersion relation
14-6-2023	Amritanshu Prasad IMSc	Counting anti-invariant subspaces in terms of invariant ones
15-6-2023	Pinaki Swain IMSc	A model chromatin with differential binding affinity for interacting proteins leads to condensate with layered organization
16-6-2023	Sagar Pandit IISER Pune	Molecular and chemical ecology of the plant-insect herbivore-natural enemy interactions in the omics era: An agricultural perspective
21-6-2023	A. Sankaranarayanan University of Hyderabad	On the Rankin-Selberg L-function related to the Godement-Jacquet L-function
21-6-2023	Amritanshu Prasad IMSc	Central Limit Theorem: Independent and Free
22-6-2023	Tanmoy Bera IMSc	Metric theory of minimal gaps
22-6-2023	Subramanya Hegde IMSc	Loops and Bridges on the Coulomb branch
23-6-2023	Manu Mathur Retired Professor, SN Bose National Center for Basic Sciences	Duality made Simple: From Ising model to SU(N) lattice gauge theory
23-6-2023	Debodirna Ghosh IMSc	Chaos and Krylov Complexity in Bose-Hubbard Model
26-6-2023	P Amrutha Chennai Mathematical Institute	Cyclic Characters of the Alternating Group
27-6-2023	Sumanta Ghosh California Institute of Technology	A deterministic parallel reduction from the weighted linear matroid intersection search to decision

4-7-2023	Ramya Nair IISER Pune	Seifert fiber spaces with singular surfaces
4-7-2023	Vinodchandran Variyam University of Nebraska-Lincoln, USA	Geometric Partitions and Replicable Computations
5-7-2023	Vinodchandran Variyam University of Nebraska-Lincoln, USA	Distinct Elements in Streams: An Algorithm for the (Text) Book
6-7-2023	Rhine Samajdar Princeton University	Quantum algorithms for combinatorial optimization with neutral atom arrays
7-7-2023	Amit Adhikary University of Warsaw	Higgs boson(s) at the LHC
7-7-2023	Srivatsav Kunnawalkam Elayavalli, UCLA	Free entropy theory and applications
10-7-2023	Sashikanta Mohaptra IMSc	Pronounced quantum many-body scars in the one-dimensional spin-1 Kitaev model
10-7-2023	Arpan Kundu IMSc	Synopsis Submission Seminar
11-7-2023	Ganesh Ramachandran Brock University	Berry phase in the rigid rotor
13-7-2023	Apurba Biswas The Institute of Mathematical Sciences	Mpemba effect in granular and Langevin systems (thesis talk)
13-7-2023	Honey Khindri IMSc/INO/HBNI	Magnetic field studies and physics implications for ICAL at INO
17-7-2023	Deeksha Adil ETH	Fast Algorithms for Regression Problems
19-7-2023	Akhil Antony IMSc, Chennai	A primordial solution to tensions in cosmology
19-7-2023	Dhananjaya Sahu IMSc	Special values of Dedekind zeta function for abelian number fields
21-7-2023	Koyena Bose IMSc	Prediction of non-Abelian fractional quantum Hall effect at v=2+4/11
21-7-2023	Manikandan Narayanan Department of Computer Science and Engineering, IIT Madras	Distinguishing causation from correlation among noisily-measured and non-linearly coupled genes

21-7-2023	V Sathish Kumar IMSc	Saturation for flagged skew Littlewood-Richardson coefficients
24-7-2023	Surabhi Tiwari Institut für Theoretische Teilchenphysik, Karlsruhe Institute of Technology (KIT)	Next-to-Soft Virtual resummed corrections to processes at the LHC
24-7-2023	Tejbir Lohan IISER Mohali	Reversibility of Linear and Affine Transformations
25-7-2023	Raghuveer Garani INFN Firenze (Florence divison)	The quest for the nature of dark matter: Astrophysical and cosmological probes of weakly interacting particles
26-7-2023	Rashi Lunia IMSc	On quotients of derivatives of Modular L functions
26-7-2023	Raghuveer Garani INFN Firenze (Florence divison)	Condensed dark matter with a Yukawa interaction
26-7-2023	Tejbir Lohan IISER Mohali	Reversibility of Linear and Affine Transformations
27-7-2023	A. J. Parameswaran TIFR	ULRICH BUNDLES ON DOUBLE COVERS OF PROJECTIVE SPACES
28-7-2023	Soling Zimik IMSc Chennai	Effects of curvature on activation dynamics in excitable media
2-8-2023	Prateek Chawla Institute of Mathematical Sciences	Quantum walks on networks - A paradigm for quantum simulation and computation
4-8-2023	Balachandran Sathiapalan IMSc	Holographic RG from ERG: Locality and General Coordinate Invariance in the Bulk
7-8-2023	Sasank Mouli IDSIA	Lower bounds for Polynomial Calculus with extension variables over finite fields.
8-8-2023	Sarthak Chandra Massachusetts Institute of Technology, USA	Emergence of structure in cortical circuits through bottom-up dynamical principles
8-8-2023	Anup Dixit IMSc	Bogomolov property for infinite Galois extensions

9-8-2023	Surag Nair Stanford University	Decoding fibroblast reprogramming through the lens of transcription factor stoichiometry and motif syntax at single cell resolution
10-8-2023	Parameswaran Sankaran CMI	The BNS-invariant and the twisted conjugacy.
10-8-2023	Yogesh Dahiya IMSc	Pseudo-Deterministic Query Algorithms: Complexity Separations and Improved Bounds
11-8-2023	Ipsita Mandal Shiv Nadar Institute of Eminence	Anatomy of Some Unconventional Phases
14-8-2023	Yash Deshmukh Columbia University	An Introduction to Flow Categories
14-8-2023	Krishnaswamy Alladi University of Florida	Parity results involving the generalized divisor function involving small prime factors of integers
14-8-2023	Mohan Ravichandran Bogazici University	Correlation inequalities beyond Rayleigh's theorem
17-8-2023	Kshitij Gajjar Indian Institute of Technology, Jodhpur	How to store a graph?
17-8-2023	Shubham R. Bais IMSc	$\mathbb{C}^*$-algebras of integral operators on Fock space
18-8-2023	Shrobona Bagchi Center for Quantum Information, Korea Institute of Science and Technology, Seoul, South Korea	IID and problem-specific samples of quantum states from Wishart distributions
22-8-2023	Chandan Kumar IISER–Mohali	Advantage of probabilistic non-Gaussian operations in phase estimation
23-8-2023	Harvendra Singh SINP, Kolkata	Entanglement Entropy and geometric Islands
23-8-2023	Athulya K. P. IISER–Thiruvananthapuram	Open quantum dynamics and steering of a finite-dimensional system coupled to a controllable, infinite-dimensional environment

24-8-2023	Prosenjit Roy IIT Kanpur	Nonlocal Boundary Hardy Inequality: The critical case
28-8-2023	Sibaram Ruidas TIFR-ICTS, Bangalore	Classical limit of measurement-induced transition in many-body chaos in integrable and non-integrable oscillator chains
29-8-2023	Aditya Karnataki CMI	Sums of rational cubes, Selmer groups, and cubic forms
31-8-2023	Rijubrata Kundu IMSc	Products of conjugacy classes in finite groups
4-9-2023	P Rakesh Kumar Dora IMSc	Competition between fractional quantum Hall liquid and electron solid phases in the Landau levels of multilayer graphene
4-9-2023	Abhijith R Nair IMSc	Decidable Aspects Of Parity Games Over Pushdown Systems
7-9-2023	Soumya Adhikari IISER Thiruvananthapuram	N=2 Dilaton Weyl Multiplet in 5D Supergravity
7-9-2023	Sanjay Seetharaman IMSc	Small Space Subset Sum Solutions
7-9-2023	Namrata Aravind IMSc	On Hopf-Galois structures
8-9-2023	Sanhita Parihar IMSc	TsT vs. LCR and gravity dual of non-relativistic fluids
8-9-2023	Ajjath A H Paris, LPTHE	di-Higgs production at N3LO+N3LL
11-9-2023	Sagar Sawant IIT Madras	On distinguishing proper q-caterpillars by their chromatic symmetric functions
12-9-2023	Sayan Goswami IMSc	Exponential patterns in arithmetic Ramsey theory
13-9-2023	Sucheta Majumdar ENS, Lyon	Residual gauge symmetries in Dirac's front form
14-9-2023	Sounak Modak IMSc	A survey on Flow Augmentation
14-9-2023	Rahul Gupta IMSc	Tame class field theory

15-9-2023	Digjoy Paul IISc	On the column sums and total sum of a character table
15-9-2023	Prasanna K. Dhani INFN, Genoa	Collinear contributions to QCD resummations for the LHC observables
15-9-2023	Anurag Pandey Saarbrucken, Germany	Complexity of Polynomial Division and Power Series Truncation
18-9-2023	Anand Pathak Department of Psychological and Brain Sciences, Dartmouth College, Hanover, NH, USA	New Learning Principles Emerge From Novel Biomimetic Computational Primitives
21-9-2023	S Sundar IMSc	Banach limits and Dilation theory
22-9-2023	Prof. Tarun Souradeep Raman Research Institute	Validating the Cosmological principle
27-9-2023	Prahladh Harsha TIFR	Fast Numerical Multivariate Multipoint Evaluation
27-9-2023	G Baskaran IMSc Chennai and IIT Madras	Doing Research, Anderson Style
29-9-2023	M. V. N. Murthy Retired Professor, IMSc	On the concept of Raga Parentage in Indian Music
3-10-2023	Siddhi Pathak CMI	Eichler integrals, Ramanujan-type identities and period polynomials
4-10-2023	Umang Dattani IMSc	Cavitation instabilities in amorphous solid: an athermal study
4-10-2023	Surajit Biswas IISER Bhopal	W(0,b) algebra and the dual theory of 3D asymptotically flat higher spin gravity
4-10-2023	Roni Saiba IMSc Chennai	A bioelectrical phase transition patterns the first vertebrate heartbeat
5-10-2023	Amritanshu Prasad IMSc	Counting Subspaces in Relation to a Linear Operator
9-10-2023	Anirban Das SNU, South Korea	Neutrinos: The Key to the Dark Sector?
10-10-2023	Anirban Das SNU, South Korea	Mesoscopic quantum systems to detect light dark matter
11-10-2023	Dr Mohd Taher IMSc	Design and development of artifical metalloenzymes

11-10-2023	Bidisha Roy SNS, Pisa , Italy	Frobenius constants for families of elliptic curves
12-10-2023	Mrityunjoy Charan IMSc	Converse theorem for quasimodular forms
12-10-2023	Abhimanyu Choudhury IMSc	IMSc Dependency schemes in CDCL-based QBF solving: a proof-theoretic study
13-10-2023	Rahul Kashyap Pennsylvania State University	Neutron Stars and White Dwarf Mergers: An Emerging Multimessenger View
16-10-2023	Amritanshu Prasad IMSc	What is Koszul Duality?
18-10-2023	Anuran Pal IMSc Chennai	Can assembly theory explain and quantify selection and evolution?
19-10-2023	Lakshmi Priya M. E. Tel Aviv University	Almost sharp lower bound for the nodal volume of harmonic functions
19-10-2023	Prakash Saivasan IMSc	Satisfiability of String Constraints with Sub-word Ordering and Transducers
20-10-2023	Steven Spallone IISER Pune and Sai University	Characteristic Classes of Representations of Lie Groups
20-10-2023	Ramit Das IMSc,TIFR	A logical Study of Improvement Graphs formed from Games
24-10-2023	Loic Merel IMJ-PRG, Université Paris Cité	On the conjecture of Harris and Venkatesh
26-10-2023	Kalyan B Sinha JNCASR	The BCL theorem and factorization of the right-shift semigroup
26-10-2023	Ramya C IMSc	Uncertainty, thy name is Entropy
26-10-2023	Aritra Bhattacharya IMSc	The Clebsch-Gordan rule for Macdonald polynomials
27-10-2023	Varun Gupta IMSc	Holograpghic M5 branes
1-11-2023	Arghya Das TIFR Hyderabad	Dynamic condensates and giant fluctuations in mass aggregation processes

2-11-2023	Ruchika INFN, Rome	Reconciling JWST and HST with Planck
2-11-2023	Sanjay S. IMSc	Determinantal Sieving
2-11-2023	S Viswanath IMSc	q-Whittaker polynomials: a view from many sides
3-11-2023	Vishnu Jejjala University of Witswatersrand	New Calabi-Yau manifolds from genetic algorithms
3-11-2023	Sounak Modak	Two set Cut-Uncut on Planar Graphs
6-11-2023	R Venkatesh IISc	On symmetric regular subalgebras of Kac-Moody algebras
6-11-2023	Nandita Jayaraj and Ashima Dogra Nil	The Gender Gap in Indian STEM & the Questions that Remain
7-11-2023	Tanushree Shah Alfred Renyi Institute	Tight contact structures on Seifert fibered 3-manifolds.
7-11-2023	Shubham Dwivedi Humboldt University	Geometric flows of G_2- structures
7-11-2023	Pratiksha Shingavekar IIT Madras	3-Selmer groups, ideal class groups and the rational cube sum problem
7-11-2023	Nandita Jayaraj Nil	Sneak-peeks into Lives of Real Scientists
7-11-2023	Nandita Jayaraj Nil	Storytell Your Science
8-11-2023	Ratna Pal IISER Mohali	Henon maps, Short $\mathbb{C}^2$ and beyond
8-11-2023	Haripada Sau IISER Pune	Certain affine varieties as a spectral set
8-11-2023	Avijit Misra Weizmann Institute, Israel	Work extraction in quantum optical setups
8-11-2023	Shubashree Desikan, IIT Madras Nil	Let's talk about Science Journalism
8-11-2023	Ragini Singhal Université Libre de Bruxelles	Nearly half-flat $SU(3)$ structures on $S^3 \times S^3$
9-11-2023	Nishant Chandgotia TIFR-CAM	The Dimer Model in 3 dimensions

9-11-2023	Avijit Misra Weizmann Institute, Israel	Work extraction by homodyne measurement and cross-Kerr nonlinearity in quantum optical setups
9-11-2023	Pritesh Kumar IMSc	Fast 2-approximation algorithm for unweighted All Pair Shortest Path.
10-11-2023	Dave Thirumalai The University of Texas at Austin	Theory of Catch Bonds
10-11-2023	Vincent Vennin LPENS, Paris	Can we prove that cosmic structures are of quantum mechanical origin?
16-11-2023	Saurav Holme Choudhury IMSc	Stratified bundles on Hilbert schemes of n points on a surface
16-11-2023	Ajay Subbaroyan IMSc Chennai	Elucidating and leveraging design principles towards realistic Boolean models of gene regulatory networks
16-11-2023	Arkaprabha Ghosal IMSc	Quantum teleportation of collaboration
17-11-2023	Darshan Joshi TIFR-Hyderabad	Superconductivity of non-Fermi liquids described by Sachdev-Ye-Kitaev models
17-11-2023	Deepti Sharma HRI-Allahabad	Dynamics of Spin Squeezing in Quantum Optical systems
23-11-2023	Neeldhara Misra IIT Gandhinagar	Two Tricks
24-11-2023	Dibyendu Bala Bielefeld University	Quarkonia spectral functions and thermal static quark-antiquark potential from Lattice QCD
24-11-2023	Vikram Gota Professor, ACTREC, Tata Memorial Centre, Mumbai	Clinical Pharmacology Approaches to Improvement of Outcomes in Oncology in Low and Middle Income Countries
24-11-2023	Sobyasachi Chatterjee IMSc	Improved Roundtrip Spanners, Emulators, and Directed Girth Approximation
27-11-2023	Goutam Das RWTH, Aachen	Precision Frontiers through Perturbative Quantum Chromodynamics
29-11-2023	Dr. Ankit Rai CMI	Geometric realization of perverse filtration

29-11-2023	Goutam Das RWTH, Aachen	Automated Resummation - aiming at percent accuracies at colliders
29-11-2023	Saptarshi Chakraborthy IMSc Chennai	Resolving the iterated prisoner's dilemma: theory and reality
30-11-2023	Satyanarayan Mukhopadhyay IACS Kolkata	Some applications of S-matrix Unitarity in Particle Cosmology
30-11-2023	Tattwamasi Amrutam Ben Gurion University	On the Existence, or lack, of non-commutative factors of a dynamical system
30-11-2023	Pratik Shastri IMSc	Lower bounds for Planar Arithmetic Circuits
4-12-2023	Debayan Chakraborty IMSc	Exploring biomolecular energy landscapes with different flavors of coarse-graining
5-12-2023	Naveen S. Prabhakar ICTS, Bangalore	Chern-Simons matter theories, Bose-Fermi duality and anyonic statistics
11-12-2023	T S Sreevidya IMSc, Chennai	Effects of charge mutations and phosphorylation on binding pocket dynamics in proteins
13-12-2023	Pavithran Iyer Xanadu Quantum Technologies Inc,, Toronto, Canada	Quantum error correction: verifying theoretical guarantees on experimental hardware
13-12-2023	Yogesh Dahiya IMSc, HBNI	Exploring Size Complexity and Randomness in the Query Model
14-12-2023	Pavithran Iyer Xanadu Quantum Technologies Inc,, Toronto, Canada	Analyzing quantum error correction on realistic hardware
15-12-2023	Soumyadip Banerjee IMSc Chennai	Signalling Networks: Uncovering the Cellular Digital Computer
15-12-2023	Abhishek Mohapatra Technical University of Munich	Nonrelativistic Effective Field Theory for XYZ Exotic Mesons
18-12-2023	Chandan Datta Institute for Theoretical Physics III, Heinrich Heine University Düsseldorf, Germany	Role of catalysts in quantum state transformation

19-12-2023	Chandrashekar Radhakrishnan New York University, Shanghai, China	Measures of Quantum correlations and coherence
20-12-2023	Chandan Datta Institute for Theoretical Physics III, Heinrich Heine University Düsseldorf, Germany	Catalysis in quantum resource theories
21-12-2023	Ankit Singh BHU, Varanasi	Cooperativity and dynamics of glass-forming liquids
21-12-2023	Matteo Braglia NYU, USA	Tests of inflation from the largest to the smallest scales
22-12-2023	Chandrashekar Radhakrishnan New York University, Shanghai, China	Resource theory of quantum coherence and its applications
26-12-2023	Pratik Ghosal Bose Institute (Kolkata) & IMSc	Distribution of Quantum Gravity induced Entanglement in Many-body systems
27-12-2023	Venkatesan Guruswami UC Berkeley	Parameterized Inapproximability of the Minimum Distance Problem over all Fields (as well as the Shortest Vector Problem in all l_p Norms
27-12-2023	Amir Suhail The Institute of Mathematical Sciences (IMSc)	Dissipation and recovery in collagen fibrils: modelling and simulations
29-12-2023	Venkatesan Guruswami UC Berkeley	Parameterized Inapproximability Hypothesis under ETH
1-1-2024	Rashi Lunia IMSc	Some Arithmetic and Analytic aspects of L-functions
1-1-2024	Pranendu Darbar NTNU, Norway	Extreme values of the Dirichlet L-functions on the critical line.
1-1-2024	Deep Maity IMSc	Studying dark matter with binary pulsars
2-1-2024	I. Iyyappan IMSc	Performance of a nonlinear refrigerator with finite-sized cold sink
2-1-2024	Dr Manoj Kumar Gurukul Kangri Univeristy, Haridwar	Elliptic curves and their applications to cryptography

3-1-2024	Some Sankar Bhattacharya ICTQT, University of Gdansk, Poland	Information Processing with Finite Resources: Quantum Advantage and Near-term Applications
3-1-2024	GV Ravindra University of Missouri, St. Loius, USA	Lefschetz theorems for higher rank bundles.
4-1-2024	Vivek Vyas IIIT Vadodara	Is geometric phase unique?
5-1-2024	Some Sankar Bhattacharya ICTQT, University of Gdansk, Poland	Randomness-free Tests of Non-classicality
5-1-2024	Mithun Das NISER, Bhubaneswar	Distribution of zeros of higher derivatives of the Riemann zeta function.
5-1-2024	Dr. Shubashree Desikan IIT Madras, Shaastra	Living in Science - Scholar or Scribe
5-1-2024	Nishant Gupta IMSc	Aspects of chiral symmetries in holography
8-1-2024	Sonali Verma ULB, Brussels	Dark Sectors from strongly coupled theories
10-1-2024	Abhijit Chakraborty Graduate School of Advanced Integrated Studies in Human Survivability (GSAIS), Kyoto University, Kyoto, Japan	Unraveling economic and financial networks: exploring insights through statistical physics and random matrix theory
10-1-2024	Moritz Kerz University of Regensburg	Semi-stable Lefschetz pencils
11-1-2024	Namit Anand NASA Ames Research Centre, USA	Information-theoretic aspects of scrambling and chaos
11-1-2024	Meena Mahajan IMSc	Runtime vs. extracted proof size: an exponential gap for CDCL on QBFs
11-1-2024	Nitin Williams Department of Neuroscience & Biomedical Engineering, Aalto University, Helsinki, Finland	Brain Computational Models of Human Electrophysiological Data
12-1-2024	Aswin Parayil Mana tony Brook University	CSS codes and dualities via cluster state measurements

12-1-2024	L Mahadevan Harvard University	Kirigami
17-1-2024	Sachin Grover HRI	Duality defects in D-type Niemeier lattice CFTs
17-1-2024	Tim Browning IST Austria	Polynomials over Q : counting and freeness
17-1-2024	Rakesh Pawar UMPA, ENS de Lyon	Milnor-Witt cycle modules over excellent DVR
18-1-2024	Debraj Das ICTP, Trieste	Quantifying animal encounter and interactions: Lattice random walk approach
18-1-2024	Abhay Srivastav HRI-Allahabad	Limitation of independent and identical distribution (iid) to capture the hierarchy of nonlocality
19-1-2024	Roopayan Ghosh University College London (UCL)	Growth of number entropy and dephasing induced relaxation in strongly disordered systems
22-1-2024	Naveen S. Prabhakar ICTS, Bangalore	Chern-Simons matter theories, Bose-Fermi duality and anyonic statistics
22-1-2024	T Geetha IISER Thiruvananthapuram	q-partition algebras
22-1-2024	Murugappan Muthukumar University of Masschusetts, Amherst	Dipole-driven Self-assembly and Dynamics in Solutions of Charged Macromolecules
22-1-2024	V Sathish Kumar IMSc	Unique factorization for tensor products of parabolic Verma modules (presynopsis seminar)
24-1-2024	Naveen S. Prabhakar ICTS, Bangalore	Two dimensional QCD with quarks in large gauge representations
24-1-2024	Jacky Kumar LANL	Exploration of Physics at Different Scales
24-1-2024	Sarang Sane IIT Madras	Derived categories supported on certain ideals
24-1-2024	Florent Foucaud Université Clermont Auvergne (Clermont-Ferrand, France)	Covering a graph using shortest paths

25-1-2024	Ajay C Ramadoss Indiana University, Bloomington	Representation homology of spaces and the strong Macdonald conjectures
25-1-2024	Jacky Kumar LANL	EFTs: Recent Developments and Applications
25-1-2024	Raghvendra Singh IMSc	The Role of Spacetime Curvature in Quantum Phenomena at Various Length Scales
25-1-2024	Abbas Ali AMU, Aligarh	Moduli Space of ADHM Sigma Models and AdS_3 Superstrings
26-1-2024	Marisa Geyer University of Cape Town	A pulsar with a mass-gap object as its companion
29-1-2024	Kaustuv Sanyal JNCASR Bengaluru	The Centromere Code Hypothesis
29-1-2024	Siddheswar Kundu IMSc	Demazure crystal structure for flagged skew tableaux and flagged reverse plane partitions (presynopsis seminar)
30-1-2024	Anantha Padmanabha IIT Dharwad	Consistent Query Answering for Inconsistent Databases
30-1-2024	R. Balasubramanian IMSc	Product of three primes in arithmetic progression
31-1-2024	Prateksh Dhivakar IIT Kanpur	AdS Witten Diagrams to Carrollian Correlators
31-1-2024	Siddharth Mathur Universidad Católica de Chile	Formal GAGA for Brauer classes
5-2-2024	Bhal Chandra Joshi NCRA-TIFR, Pune	The Era of Ultra-long Wavelength Gravitational Astronomy
5-2-2024	Rajagopalan Balaji Department of Civil, Environmental and Architectural Engineering (CEAE), University of Colorado, Boulder, USA	Holocene Climate Variability and Their Potential Signatures on the Raise, Fall and Migration of Ancient Societies
6-2-2024	R. Balasubramanian IMSc	Product of three primes in arithmetic progression
6-2-2024	Arpan Kundu IMSc	On the Asymptotic Symmetry Algebra of Classical and Quantum Gravity

7-2-2024	Shuvayu Roy NISER, Bhubanewshwar	Local Entropy Current on a Black-Hole Horizon and its Reparametrizations
7-2-2024	Devarshi Mukherjee University of Buenos Aires	p-adic noncommutative geometry
8-2-2024	Amudhan Krishnaswamy Usha National Institute of Standards and Technology, USA	Spectral decompositions of operators in tracial von Neumann algebras
9-2-2024	Shivam Gola IMSc	A Phenomenological Study of WIMP models
13-2-2024	Gniewomir Sarbicki Nicolaus Copernicus University, Torun; (Poland)	Optimal positive maps without spanning property
14-2-2024	Pavan Dharanipragada IMSc	Applications of renormalisation group in holography
14-2-2024	Prajakta Purushottam Bedekar Department of Applied Mathematics, Johns Hopkins University and National Institute of Standards and Technology, Maryland, USA	Prevalence estimation to account for time-dependent antibody kinetics for previously infected and vaccinated individuals
14-2-2024	Neeraj Deshmukh IMPAN	Cohomology theories for algebraic stacks
15-2-2024	Dr Shaon Chakrabarti National Centre for Biological Sciences, Bengaluru	Establishing the fundamental limits of spatially resolved cellular-time decoding from single-cell gene expression
15-2-2024	Mohanapriya IMSc	On the Parameterized Complexity of Minus Domination
15-2-2024	S. Sundar IMSc	An Invitation to Product Systems
19-2-2024	Juergen Horbach University of Duesseldorf	Yielding in crystals towards the quasistatic limit: A slip-plane condensation transition
20-2-2024	Hitesh Garg IMSc, Chennai	Bridging induced coil-to-globule transitions in polymers
20-2-2024	Jyothsnaa Sivaraman ISI Bangalore	On analogues of the Brun-Titchmarsh theorem and some applications

20-2-2024	Jitendra Rathore HRI	Brauer group and Chow group of 0-cycles for curves over local fields
21-2-2024	Syed Yunus Ali IIT Tirupati	Modeling of Stochasticity on Geometric Brownian Information
21-2-2024	Vivek Shenoy University of Pennsylvania	How do forces transmitted from a cell's environment affect DNA organization?
21-2-2024	Jayanth Guhan CMI	Local-global principle for hermitian spaces over semi-global fields
22-2-2024	Tanmoy Bera IMSc	Poissonian pair correlation in higher dimensions
22-2-2024	Gurmeet Singh IISER Bhopal	Logarithmic correction to black hole entropy in universal low-energy string theory models
22-2-2024	Piyasa Sarkar The institute of mathematical Sciences	On Multiparameter CCR flows
23-2-2024	Peter Petreczky BNL	Exploring strongly interacting matter at high temperatures using lattice QCD
23-2-2024	Shuchi Kapoor Chennai Photo Biennale Foundation	IMSc Conversation Series
26-2-2024	Rajath Radhakrishnan ICTP, Trieste	Lectures on non-invertible symmetries
26-2-2024	Satadru Bag Garching, Max Planck Inst.	Harnessing the Unresolved Lenses: Detecting Strong Lenses and Measuring Time-Delays from Unresolved Light Curves
27-2-2024	Dwaipayan Mazumder CMI	Diophantine Approximation with prime restriction
28-2-2024	Rajath Radhakrishnan ICTP, Trieste	Constraints on non-invertible symmetries in 2+1D QFTs
28-2-2024	Anish Ghoshal University of Warsaw	Hearing the Universe Hum with Gravitational Waves at Pulsar Timing Array: astrophysical, cosmological and particle physics interpretations

28-2-2024	Vivek Sadhu IISER Bhopal	Algebraic K-theory and Binary Complexes
29-2-2024	Hridis Pal IIT Bombay	Magic beyond magic angle in twisted bilayer graphene
29-2-2024	Rajath Radhakrishnan ICTP, Trieste	Non-invertible Symmetries
5-3-2024	Mrityunjoy Charan IMSc	Zeros of period polynomials of Hecke eigenforms
6-3-2024	Nairita Pal Centre for Ocean, River, Atmosphere and Land Sciences (CORAL), Indian Institute of Technology (IIT) Kharagpur	Fluid mixing in ideal systems and large-scale oceans
7-3-2024	Koel Das Department of Mathematics and Statistics IISER Kolkata	Neural Correlates of Food Craving
8-3-2024	Supratim Sengupta Department of Physical Sciences, IISER Kolkata	Origin of life: Perspectives from the RNA world and beyond
8-3-2024	A P Balachandran Syracuse & IMSc	A Non-Abelian Gauge Theory for Surface Excitations of 3He-B
11-3-2024	Sudipto Singha Roy IIT–Dhanbad	Entanglement and its role in efficient representation of quantum states
12-3-2024	Sivabal Sivaloganathan University of Toronto	Medical Challenges: Exploring High Intensity Focused Ultrasound through Mathematical & Computational Modelling
13-3-2024	Sudipto Singha Roy IIT–Dhanbad	Link representation of entanglement in quantum states
14-3-2024	Abhishek Sahu NISER	Tractability of Packing Vertex-Disjoint A-Paths under Length Constraints
14-3-2024	P Vanchinathan VIT Chennai	Roots of Irreducible Polynomials and their Clusters
14-3-2024	Hemant Rathi IIT Roorkee	Carrollian Born-Infeld Electrodynamics
15-3-2024	E. V. Sampathkumaran HBCSE, TIFR, Mumbai.	Exotic Physics of 4f electrons

15-3-2024	Kajal Singh University of Liverpool	On Cosmological Correlators in Momentum Space
18-3-2024	Manish Jaiswal TIFR Hyderabad	Genetic screens: targeting mitochondrial shape size and numbers
19-3-2024	Saunak Bhattacharjee IISER Tirupati	An effective lower bound for the integer cube sum
19-3-2024	Sinnou David Sorbonne University	Irrationality of integer values of the zeta function
20-3-2024	Suman Saurabh IIT Kanpur	Molecular dynamics simulations of biomolecules and biologics
20-3-2024	Ann Mary Mathew Assumption College, Changanassery, Kerala	Emergent spatial coordination among a group of adaptively crowd-avoiding agents
23-3-2024	Dr. T. Jayaraman MSSRF	Climate Change in India: What do we know and how?

Chapter 5

External Interactions

5.1 Collaborative Projects with Other Institutions

Advantage in two-way robust communication using non-classical states of light

Sibasish Ghosh, Ms. Bohnishikha Ghosh (a Ph.D. student in the Division of Optics, University of Warsaw, Poland), Dr. S. Aravinda (a faculty member in the Physics Department of IIT-Tirupati), and Dr. Amit Mukherjee (a CSIR Pool Officer at S. N. Bose National Centre for Basic Sciences, Kolkata)] are observing at the issue of robustness [under noisy state preparation, noisy linear optical gadgets (e.g., beam splitter, phase shifter, etc.), noisy photo-detectors] of the scheme of advantage (over the corresponding classical scenario) in two-way communication using initial states having low average photon number.

Arecibo 327 MHz Drift Pulsar Survey (AO327)

** ongoing project **

AO327 has been running using the Arecibo radio telescope (USA) since 2010. To date, the survey has discovered 87 pulsars and transients. Papers have been published reporting results of this survey.

This collaboration has members from different institutes across the world, e.g., Naval Research Laboratory USA, University of New Mexico USA, West Virginia University USA, IMSc India (Manjari Bagchi), Max-Planck-Institut fur Radioastronomie Bonn Germany, etc.

Brauer group of Algebraic stacks–part I,II

This work introduces and investigates Brauer groups of algebraic stacks and moduli spaces over any field and over DVR. Jaya N Iyer collaborates with R. Joshua and A. Dhillon on this project. Part I is currently under review, while Part II is being prepared.

Charm meson exotics

Study of doubly charm exotic tetraquarks using lattice QCD methodologies, Padmanath Madanagopalan in collaboration with Prof. Sasa Prelovsek, University of Ljubljana, Slovenia and Dr. Sara Collins, University of Regensburg, Germany.

Chemical kinetics and stochastic thermodynamics

Arnab Pal's ongoing collaboration with Prof. Saar Rahav, Technion, Israel

Chow Lefschetz Conjectures on ample smooth divisors

Jaya N. Iyer collaborates with K.Banerjee, to investigate Chow version of Lefschetz theorems for certain ample divisors on moduli spaces. This is work under progress.

Dibaryons and Tetraquarks involving bottom quarks

Study of heavy dibaryons and heavy tetraquarks involving valence bottom quarks using lattice QCD techniques, Padmanath Madanagopalan in collaboration with Prof. Nilmani Mathur, Tata Institute of Fundamental Research, Mumbai.

Dibaryons, dihyperons and tetraquarks from lattice QCD

Study of exotic hadron systems using lattice QCD methods on state-of-the-art CLS gauge configurations, Padmanath Madanagopalan in collaboration with Prof. Hartmut Wittig, Johannes Gutenberg-Universitat Mainz, MITP Mainz, Helmholtz Institute Mainz, Germany, and Prof. Jeremy Green, ZPPT, DESY Zeuthen.

DST SERB Start-up Research Grant

A project of Arnab Pal titled First passage of intermittent random walk searchers applications to statistical physics, biological and chemical processes.

Dynamics of strongly-entangled topological quantum matter

Royal Society Exchange grant with Zlatko Papic, University of Leeds IES\R2\202052
- International Exchanges 2020 Round 2 Award Value: GBP 11,990.00. The initial award was for two years but owing to COVID they got a year's extension.

Efficient Quantum Repeater-Based Teleportation: Minimizing Entanglement Consumption in the Presence of Fixed Noise

In this project, Sibasish Ghosh along with a few members (Dr. Arkaprabha Ghosal (a post-doc), Mr. Jatin Ghai (a Ph.D. student), and Mr. Tanmay Saha (a Ph.D. student)), in IMSc, Dr. Mir Alimuddin (a post-doc at S. N. Bose National Centre for Basic Sciences, Kolkata) is also involved. The work is ongoing, and the draft will be ready soon.

A brief summary of the work:- Traditionally, entanglement swapping protocols necessitate maximally shared ebits between the consecutive nodes and maximal entangled basis measurement. The present project aims to propose an optimal strategy for some practical noisy scenarios. In this case, one can achieve equal teleportation fidelity with less than one ebit of shared entanglement, and measurement in non-maximally entangled basis, resulting in reduced entanglement consumption at each node. This approach showcases promising advancements in quantum communication technology.

Extreme events in dynamical and stochastic systems

This is an ongoing collaboration of Arnab Pal with Prof. Dibakar Ghosh, ISI Kolkata

First passage processes of many body systems

This is an ongoing collaboration of Arnab Pal with Dr. Ohad Shpielberg, University of Haifa, Israel.

Harnessing stochastic motion using automated robots

This is a theory-experiment collaboration of Arnab Pal with Dr Nitin Kumar, IIT Mumbai. They study Active dynamics of a self-propelled programmable robot.

Home-range search processes

Ongoing collaboration of Arnab Pal with Prof. Shlomi Reuveni, Tel Aviv University, Israel

Indian Pulsar Timing Array (InPTA) experiment

Pulsar Timing Array (PTA) uses an ensemble of pulsar clocks in an attempt to detect Gravitational Waves (GW) from a stochastic background resulting from a superposition of an ensemble of super-massive black hole binary systems (BSMBH). The Indian PTA (InPTA) experiment is going on since 2015 using the upgraded Giant Metrewave Radio Telescope (uGMRT). Observations and data analysis is going on. The preliminary results were presented in various national and international meetings and some papers have been published. This collaboration has become a full member of the International Pulsar Timing Array (IPTA) consortium in February 2021.

InPTA experiment is a joint venture among various Indian institutes (IMSc, TIFR, NCRA-TIFR, IIT-Hyderabad, RRI, etc) as well as Kumamoto University of Japan. Four IMSc members (one faculty, one postdoc, one research associate, and one student) are part of this experiment.

Recently InPTA and EPTA combined data revealed the evidence of nanoHertz gravitational waves. Presently, InPTA data is being added to IPTA data

Modelling of amorphous solids for large scale simulations

DST/NSM/R& D HPC Applications/2021/29, Pinaki Chaudhuri in collaboration with Smarajit Karmakar, Physics (Tata Institute of Fundamental Research, Hyderabad), Shi- laditya Sengupta (Indian Institute of Technology, Roorkee), Vishwas V, (Indian Institute of Technology, Palakkad). The project proposes to develop a computational modeling methodology and tools that will enable faithful modeling of a diverse range of amorphous solids and allow such solids to be simulated for a variety of mechanical deformation protocols, on large length scales that are not possible with atomistic simulation methods.

Mpemba effect in non-equilibrium systems

Inhouse collaboration of Arnab Pal with Prof. R Rajesh, IMSc

Period Index problems oncurves over number fields

Jaya N Iyer continue to study period index questions on hyperelliptic curves over number fields. Genus two case is under review. Higher genus curves case is in discussion with R.Parimala.

Stochastic resetting and ergodic theory

Ongoing collaborations of Arnab Pal with Prof. Trifce Sandev (Macedonia Academy), Prof. Ljupco Kocarev (Macedonia Academy), Prof. Ralf Metzler (University of Potsdam, Germany), and Dr. Viktor Stojkoski (Macedonia Academy)

Stochastic resetting experiments using optical traps

Ongoing theory-experiment collaboration of Arnab Pal with Prof. Basudev Roy, IIT Chennai

Stochastic thermodynamics in viscoelastic systems

This is a theory-experiment collaborative project of Arnab Pal with Prof. Ayan Banerjee, IISER Kolkata

Tautological algebra of moduli space of vector bundles on curve

This work is under review, Jaya N Iyer jointly work with A.Mukherjee and C.Gangapadhyay.

5.2 Conference Participation and Visits to Other Institutions

Ashok, Sujay K.

Visited University of Torino during Apr 23 – Jul 17, 2023. Collaboration on string amplitudes and AdS/CFT

Participated in *String Theory as a bridge between Gauge Theories and Quantum Gravity* held at SISSA, Italy during Jun 22 – Jun 23, 2023.

Participated in *Indian Strings Meeting* held at IIT, Mumbai during Dec 10 – Dec 16, 2023.

Participated in *Workshop on Aspects of CFT* held at IIT Kanpur during Jan 8 – Jan 11, 2024. Invited speaker

Participated in *Non-perturbative methods in Quantum Field Theory and String Theory* held at HRI during Jan 29 – Feb 2, 2024. Invited speaker

Visited TIFR, Mumbai during Feb 4 – Feb 11, 2024. Invited speaker

Bagchi, Manjari

Visited Indian Institute of Astrophysics during Apr 26 – Apr 28, 2023. Interacted with faculty and students, delivered a seminar on "Studying gravitational physics using rotation-powered radio pulsars" on 27 April, 2023

Visited Chennai Mathematical Institute on 26 July, 2023. Interacted with faculty and students. Delivered a seminar on "Hunting low-frequency gravitational waves through Pulsar Timing Arrays: The role of InPTA".

"Hunting low-frequency gravitational waves through Pulsar Timing Arrays: The role of InPTA" - an online seminar on 01-August-2023 to researchers of Aryabhatta Research Institute of Observational Sciences: ARIES, Nainital, India.

Visited Ewha Womans University, Seoul, South Korea during Oct 23 – 25 October, 2023. Interacted with faculty and students. Delivered a seminar on "Studying gravitational physics using rotation-powered radio pulsars" on 24 October, 2023

Participated in *Pioneer Symposium "Gravitational Wave Background and Pulsar Timing Array Observation" of the fall meeting of Korean Physics Soceity* held at Changwon, South Korea on 26 October, 2023. Invited oral presentation

Balakrishnan, Radha

Visited (online) The International Institute for Sustainable Knotted Chiral matter, Hiroshima University, Japan on Jun 29, 2023. Gave a seminar titled 'Exact knotted hopfion vortices in a 3D Heisenberg frromagnet' (via zoom).

Baskaran, Shanmuga Priya

Participated in *Big Data Algorithms for Biology* held at Indian Institute of Science, Bengaluru during Jun 2 – Jun 3, 2023. Presented poster titled "Identification of activity cliffs in structure-activity landscape of androgen receptor binding chemicals"

Participated in *Network Biology Day* held at The Institute of Mathematical Sciences, Chennai on Jul 20, 2023. Presented a poster titled "Identification of activity cliffs in structure-activity landscape of androgen receptor binding chemicals"

Participated in *Integrating Traditional Knowledge in Evidence Based Medicine Symposium* held at Advanced Centre for Treatment, Research and Education in Cancer (ACTREC) during Sep 21 – Sep 22, 2023. Presented a poster titled "Compilation, curation and diversity analysis of secondary metabolite space of medicinal fungi"

Participated in *Modelling and Tackling Complex Biological Systems* held at The Institute of Mathematical Sciences, Chennai during Oct 13 – Oct 14, 2023. Presented a poster titled "Identification of activity cliffs in structure-activity landscape of chemicals binding to endocrine receptors"

Participated in *Contemporary Perspectives in Computational Biology* held at The Institute of Mathematical Sciences, Chennai during Feb 19 – Feb 20, 2024. Presented a poster titled "Identification of activity cliffs in structure-activity landscape of chemicals binding to endocrine receptors"

Participated in *17th Annual International Biocuration Conference* held at Regional Centre for Biotechnology (RCB), Faridabad during Mar 5 – Mar 8, 2024. Presented a poster titled "Identification of activity cliffs in structure-activity landscape of chemicals binding to endocrine receptors"

Participated in *International Conference on Bioinformatics in Health and Food Security* held at Pondicherry University, Puducherry during Mar 14 – Mar 16, 2024. Presented a poster titled "Identification of activity cliffs in structure-activity landscape of chemicals binding to endocrine receptors"

Charan, Mrityunjoy

Participated in *Hida Theory and Iwasawa Main Conjecture over Q* held at CMI, Siruseri during Dec 4 – Dec 9, 2023.

Visited NISER, Bhubaneswar during Dec 11 – Dec 18, 2023.

Participated in *BIRS-CMI Workshop on New Directions in Rational Points* held at CMI, Siruseri during Jan 8 – Jan 12, 2024.

Chaudhuri, Pinaki P.

Participated in *Frontiers in Physics of Soft and Biological Matter* held at Raman Research Institute, Bangalore during Sep 25 – Sep 30, 2023. Talk on "Ring polymers: glassines & de-mixing"

Participated in *Compflu 2023* held at IIT, Madras during Dec 18 – Dec 20, 2023. co-organiser of sessions on "Gels and Glasses"

Participated in *Physics of life: Active and living matter (PoL24)* held at Toshali Sands, Puri (organised by IOP, Bhubaneshwar) during Feb 8 – Feb 10, 2024. Talk on "Active breathing: a micro-meso analysis"

Chivukula, Nikhil

Participated in *Symposium on Big Data Algorithms for Biology (BDBio) 2023* held at Indian Institute of Science (IISc), Bengaluru during Jun 2 – Jun 3, 2023. Presented poster titled 'T9GPred: A Predictor for Bacterial Type 9 Secretion System, Associated Gliding Motility and Secreted Proteins'

Participated in *Network Biology Day* held at The Institute of Mathematical Sciences (IMSc), Chennai on Jul 20, 2023. Presented poster titled 'EPEK: creation and analysis of an Ectopic Pregnancy Expression Knowledgebase'

Participated in *Machine Learning for Health and Disease (MLHD 2023)* held at International Centre for Theoretical Sciences (ICTS-TIFR), Bengaluru during Jul 24 – Aug 4, 2023. Presented poster titled 'T9GPred: A Predictor for Bacterial Type 9 Secretion System, Associated Gliding Motility and Secreted Proteins'

Participated in *First National Symposium on "Integrating Traditional Knowledge in Evidence based medicine" (ITKEBM Symposium 2023)* held at Advanced Centre for Treatment, Research and Education in Cancer (ACTREC), Tata Memorial Hospital, Navi Mumbai during Sep 21 – Sep 22, 2023.

Participated in *Modelling and Tackling Complex Biological Systems* held at The Institute of Mathematical Sciences (IMSc), Chennai during Oct 13 – Oct 14, 2023. Presented 2 posters titled 'EPEK: creation and analysis of an Ectopic Pregnancy Expression Knowledgebase' and 'ViCEKb: Creation and analysis of a curated knowledgebase on vitiligo-triggering chemicals to link exposome and health'

Participated in *Contemporary Perspectives in Computational Biology* held at The Institute of Mathematical Sciences (IMSc), Chennai during Feb 19 – Feb 20, 2024. Presented poster titled 'ViCEKb: Creation and analysis of a curated knowledgebase on vitiligo-triggering chemical' and gave a talk titled 'Beyond observations, Towards Solutions: Computational Biology as a key to unraveling environmental health impacts'

Participated in *17th Annual International Biocuration Conference (AIBC-2024), India* held at Indian Biological Data Center, Regional Centre for Biotechnology, Faridabad, India. during Mar 5 – Mar 8, 2024. Won the 'Best Poster Award' for presenting the poster titled 'ViCEKb: Creation and analysis of a curated knowledgebase on vitiligo-triggering chemicals to link exposome and health'

Participated in *International Conference on Bioinformatics in Health and Food Security 2024 (ICB-HFS 2024)* held at Pondicherry University, Puducherry during Mar 14 – Mar 16, 2024. Presented poster titled 'ViCEKb: Creation and analysis of a curated knowledgebase on vitiligo-triggering chemicals to link exposome and health'

Coimbatore Balram, Ajit

Visited International Centre for Theoretical Sciences (ICTS) during Dec 24, 2022 – Dec 1, 2023. Attended the lectures of Ganpathy Murthy and had discussions.

Visited Indian Institute of Science (IISc), Bengaluru during Apr 17 – Apr 18, 2023. Invited seminar

Visited Raman Research Institute (RRI), Bengaluru during Apr 20 – Apr 21, 2023. Invited seminar

Participated in *Quantum Information, Quantum Matter, and Quantum Gravity* held at Center for Quantum and Topological Systems (CQTS), New York University, Abu Dhabi (NYU-AD) during May 22 – May 26, 2023. Invited talk

Visited IISER Kolkata during Jun 21 – Jun 22, 2023. Invited seminar

Participated in *Discussion Meeting on Non-Equilibrium Correlated Systems* held at Harish-Chandra Research Institute, Prayagraj during Jul 24 – Jul 26, 2023. Invited talk

Visited Harish-Chandra Research Institute, Prayagraj during Jul 24 – Jul 28, 2023. Invited seminar

Participated in *MRSI-Kalpakkam Chapter theme meeting on "Recent Advances in Low-dimensional Quantum Systems"* held at Materials Science Group, IGCAR, Kalpakkam on Oct 6, 2023. Invited speaker

Participated in *Indian Academy of Sciences (IASc) annual meeting* held at BITS Pilani Goa campus during Nov 3 – Nov 5, 2023. attending as an associate of IASc

Visited Raman Research Institute (RRI), Bengaluru during Nov 19 – Nov 23, 2023. Invited seminar

Participated in *Fractionalization and Emergent Gauge Fields in Quantum Matter* held at International Centre for Theoretical Physics (ICTP), Trieste, Italy during Dec 4 – Dec 8, 2023. Invited talk

Participated in *Young Investigators Meet on Quantum Condensed Matter Theory 2023* held at IISER Bhopal during Dec 14 – Dec 17, 2023. Invited speaker

Participated in *Emergent phenomena in Quantum Hall systems (EPQHS) 9th edition* held at NTU Singapore during Jan 3 – Jan 5, 2024. Invited speaker

Participated in *Stability of Quantum Matter in and out of Equilibrium at Various Scales* held at International Centre for Theoretical Sciences (ICTS), TIFR, Bengalur during Jan 22 – Jan 24, 2024.

Participated in *Fractional Quantum Anomalous Hall Effect and Fractional Chern Insulators* held at Max Planck Institute for the Physics of Complex Systems, Dresden during Feb 5 – Feb 8, 2024.

Participated in *APS March meeting 2024* held at Minneapolis Convention Center during Mar 3 – Mar 8, 2024. Presented a talk in a focus session

Visited Tata Institute of Fundamental Research (TIFR), Mumbai during Mar 18 – Mar 19, 2024. discussions and speaker at the Infosys condensed matter seminar

Das, Biswajit

Visited Institute of Physics, Bhubaneswar, Odisha, India during Nov 20 – Dec 12, 2023. Academic visit regarding ongoing project with Dr. Debottam Das's group at IOP.

Participated in *Advanced School & Workshop on Multiloop Scattering Amplitudes* held at National Institute of Science Education and Research (NISER), Odisha during Jan 15 – Jan 19, 2024.

Dhindsa, Navdeep Singh

Visited The Mandelstam Institute for Theoretical Physics, University of the Witwatersrand, Johannesburg, South Africa during Oct 21 – Oct 31, 2023. Attended the 13th Joburg School on Theoretical Physics (http://neo.phys.wits.ac.za/w23/) and gave a department talk on "Holography from large matrices on lattice and beyond"

Dixit, Anup B.

Visited IISER Tirupati during Sep 21 – Sep 23, 2023. Invited Colloquium speaker

Visited Northwestern University, USA during Oct 12 – Oct 29, 2023. Collaboration

Visited IIT Dharwad during Dec 2 – Dec 6, 2023. Collaboration and Colloquium speaker

Ghosh, Sibasish

Visited Indian Statistical Institute, Kolkata during May 8 – May 12, 2023.

Visited the Physics and Applied Mathematics Unit (PAMU), interacted with the members in the group of Prof. Guruprasad Kar of PAMU, and gave a talk there on 11th May, 2023 on linear optics based local discrimination of quantum states.

Participated in *Quantum Information and Quantum Technology (QIQT-2023) [online mode]* held at IISER-Kolkata during May 8 – Jun 15, 2023. Gave an invited (online) talk entitled, "Quantum homogenization in Marovian and non-Markovian collisional models" (on 2nd June, 2023).

Participated in *3rd QuEST Workshop* held at IISER-Kolkata during Sep 23 – Sep 24, 2023. Gave an invited talk entitled, "Entanglement or Complexity? The Chauffeur of Faster Battery" in the Workshop (via online mode).

Participated in *MATHEMATICAL FOUNDATIONS OF QUANTUM INFORMATION THEORY* held at IIT-Tirupati and IISER-Tirupati on Oct 7, 2023. This Meeting was jointly organized by IIT-Tirupati and IISER-Tirupati in memory of Prof. K. R. Parthasarathy. Gave an invited talk (entitled, "A glimpse of Gaussian quantum information theory") in the meeting.

Participated in *Meeting on Quantum Information Processing and Applications (QIPA-2023) Harish-Chandra Research Institute, Prayagraj 04 - 10 December, 2023* held at Harish-Chandra Research Institute, Prayagraj during Dec 4 – Dec 10, 2023. Gave an invited talk there in QIPA-2023

Participated in *International Conference on Photonics, Quantum Information, and Quantum Communication* held at Biswa Bangla Convention Centre during Jan 29 – Feb 2, 2024. This Conference was organized by S. N. Bose National Centre for Basic Sciences as a part of it's year long programme on 100 years of S. N. Bose's paper on 'Bose Statistics'. Gave an invited talk at the Conference.

Visited IISER–Kolkata during Feb 5 – Feb 6, 2024. Visited the Physics Department of IISER-Kolkata, interacted with the members in the group of Prof. Sourin Das, visited the labs of Profs. Nirmalya Ghosh and Chiranjib Mitra, and gave a talk there at IISER-Kolkata.

Visited the Physics and Applied Math. Unit of I.S.I.-Kolkata, interacted with a few researchers there in the group of Prof. G. Kar, and gave a talk. during Feb 7 – Feb 8, 2024.

Participated in *National Workshop on Quantum Technologies, 2024* held at Department of Physics, Banaras Hindu University during Mar 1 – Mar 2, 2024. Gave a plenary talk at the Workshop. Member of the National Advisory Committee for the Workshop.

Participated in *4th Workshop on QuEST Theme-1* held at Punjabi University, Patiala during Mar 16 – Mar 17, 2024. Attended the Workshop and delivered an Invited talk.

Gun, S.

Visited KSOM during Aug 7 – Aug 12, 2023. Academic Collaboration

Participated in *Automorphic forms and L-functions of higher rank* held at QMUL, London, UK during Sep 11 – Sep 15, 2023. Invited speaker

Participated in *Women in Science Lecture Series on Frontiers in Science and Engineering* held at Online mode on Oct 31, 2023. Invited speaker

Participated in *WoNiMS Conference* held at Kirtipur Hillside Hotel and Resort, Seminar Hall during Nov 3 – Nov 5, 2023. Invited speaker

Participated in *AIS school on Analytic Methods in Algebraic Number Theory* held at IIT Delhi during Dec 4 – Dec 16, 2023. Invited speaker

Participated in *Women in Pure and Applied Mathematics* held at SRM University AP during Jan 3 – Jan 4, 2024. Invited speaker

Visited HRI during Feb 9 – Feb 16, 2024. Academic Collaboration

Gupta, Rahul

Visited Indian institute of Technology, Delhi during Sep 28 – Oct 1, 2023. Gave an invited talk on "Introduction to $K_0(R)$".

Participated in *Workshop on Representation theory of real Lie groups and Automorphic forms* held at Harish-Chandra Research Institute (HRI), Prayagraj, India. during Oct 2 – Oct 7, 2023.

Participated in *Conference on Harish-Chandra's work on Representation theory and Harmonic Analysis* held at Harish-Chandra Research Institute (HRI), Prayagraj, India. during Oct 9 – Oct 14, 2023.

Participated in *38th Annual Conference of the Ramanujan Mathematical Society* held at IIT

Guwahati, India during Dec 22 – Dec 24, 2023. I gave a Invited talk on "Kernel of the cycle class map".

Gupta, Sushmita

Participated in *Distinguished Visitor Fellow (DVF) at University of Glasgow and University of Edinburgh* held at University of Edinburgh and University of Glasgow during Jun 19 – Jun 30, 2023. Funded by Scottish Informatics and Computer Science Alliance (SICSA)

Participated in *Winter School on AI and TCS (Computation in Social Choice and Economics (COSCOE))* held at IIT Jodhpur, Department of Computer Science and Engineering during Dec 8 – Dec 12, 2023. Gave a series of talks on computational social choice and game theory, focused on the topic of matchings under preferences.

Participated in *The Thirty-Eighth AAAI Conference on Artificial Intelligence (AAAI-24)* held at Vancouver, Canada during Feb 20 – Feb 27, 2024.

HAZRA, Dhiraj Kumar

Visited Ecole normale superieure, Paris, France during May 1 – May 31, 2023. Part of Indo-French CEFIPRA visit. Delivered Seminar – "One Spectrum to cure them all"

Visited Institut d'Astrophysique de Paris, Paris, France during May 1 – May 31, 2023. CEFIPRA Indo-French visit. Delivered Seminar 'One Spectrum to cure them all'

Visited Astroparticule et Cosmologie, Paris, France during May 1 – May 31, 2023. Part of CEFIPRA Indo-French visit. Presented seminar – 'One Spectrum to cure them all'

Visited INAF and University of Bologna, Bologna, Italy during May 31 – Jun 9, 2023. Part of Indo-Italy RELIC project. Delivered a seminar –'One Spectrum to cure them all'– in the physics department of the University of Bologna

Participated in *Cosmological Tensions and its implication to Concordance Cosmology* held at Institute for Fundamental Physics of the Universe (IFPU), in Trieste, Italy during Jun 12 – Jun 23, 2023. Invited speaker

Participated in *Remembering Amal Kumar Raychaudhuri (AKR): the celebration of the centenary year* held at The Institute of Mathematical Sciences, Chennai, India during Oct 5 – Oct 7, 2023. Organizer: 5-6 October was for conference and 7 October was the outreach day

Iyer, Jaya N.

Participated in *Gave talk at Asian Women Conference at ICTS,Bengaluru* held at ICTS Bengaluru during Apr 19 – Apr 23, 2023.

Participated in *INdian Mathematical Sciences Society* held at BITS Pilani Campus,Hyderabad during Dec 23 – Dec 25, 2023. Gave Ramaswami Aiyer Memorial talk

Visited Gave talks at ST Hindu College,Nagercoil, CUTN,Thiruvarur and Stella Maris College,Chennai during Jan 19 – Feb 28, 2024. Visitor programme of Indian Women and Mathematics, an initiative of NBHM-India.

Kodiyalam, Vijay

Participated in *89th Annual Meeting of the Indian Academy of Sciences* held at BITS Pilani, Goa Campus during Nov 3 – Nov 5, 2023. Gave a talk on "Infinitely many quantum solutions to Euler's 36 officers problem"

Participated in *Refresher course on mathematics* held at RIASM, Chennai on Nov 29, 2023. Gave a talk on "Grobner Bases"

Participated in *38th Annual Conference of the Ramanujan Mathematical Society* held at IIT, Guwahati during Dec 22 – Dec 24, 2023. Gave a talk on "Unitary invariants and an application to quantum solutions of Euler's 36 officers problem"

Participated in *89th Annual Conference of the Indian Mathematical Society* held at BITS Pilani, Hyderabad during Dec 22 – Dec 25, 2023. Gave a talk on "Indecomposable integrally closed modules over two-dimensional regular local rings"

Madanagopalan, Padmanath

Participated in *Physics of Heavy Baryon workshop* held at Munich Institute for Astro-, Particle, and bio Physics, Munich during Jun 1 – Jun 2, 2023. Gave an online talk on "Heavy baryon spectroscopy and interactions using lattice QCD". Link to the workshop: https://indico.ph.tum.de/event/7286/

Participated in *40th International Symposium on Lattice Field Theory* held at Fermilab, Batavia, Illinois, USA during Jul 31 – Aug 4, 2023. Presented (Online) our recent work on Tbc tetraquark, arXiv:2307.14128.

Participated in *Hunting for the charming beauty tetraquark Tbc: LHCb meets theory* held at CERN, Switzerland on Oct 5, 2023. Gave an online talk on "Search for isoscalar $bc\bar{u}\bar{d}$ tetraquarks using lattice QCD". Link to the workshop: https://indico.cern.ch/event/1324964/overview

Participated in *The 2024 International Workshop on Future Tau Charm Facilities* held at University of Science and Technology of China (USTC), Hefei, China during Jan 14 – Jan 18, 2024. ONLINE participation. Gave a talk on 'Lattice simulations for charm'. Link to the workshop: https://indico.pnp.ustc.edu.cn/event/91/

Participated in *INTERNATIONAL SCHOOL AND WORKSHOP ON PROBING HADRON STRUCTURE AT THE ELECTRON-ION COLLIDER* held at ICTS-TIFR Bangalore during Feb 5 – Feb 9, 2024. Gave a talk on "XYZTP spectroscopy using lattice QCD". Link to the workshop: https://www.icts.res.in/event/page/27443

Participated in *The 16th International Workshop on Heavy Quarkonium* held at IISER Mohali during Feb 26 – Mar 1, 2024. Gave a talk on "Quark mass dependence of Tcc using lattice QCD and lhc". Link to the workshop: https://indico.cern.ch/event/1226860/overview

Madgaonkar, Shreyes Rajan

Participated in *Modelling and Tackling Complex Biological Systems* held at The Institute of Mathematical Sciences (IMSc), Chennai during Oct 13 – Oct 14, 2023.

Participated in *Contemporary Perspectives in Computational Biology* held at The Institute of Mathematical Sciences (IMSc), Chennai during Feb 19 – Feb 20, 2024.

Participated in *17th Annual International Biocuration Conference (AIBC 2024)* held at Indian Biological Data Centre, Regional Centre for Biotechnology, Faridabad, India during Mar 6 – Mar 8, 2024.

Participated in *International Conference on Bioinformatics in Health and Food Security 2024 (ICB-HFS 2024)* held at Pondicherry University, Puducherry, India during Mar 14 – Mar 16, 2024.

Mahajan, Meena B.

Visited Simons Institute for the Theory of Computing during Mar 18 – May 12, 2023.

Participant, Extended Reunion on Satisfiability 13 March - 12 May, 2023. Participant: Workshop on Proof Complexity and Meta-Mathematics 20-24 March, 2023, Workshop TonICS 27-29 March, 2024

Participated in *Workshop on "Satisfiability: Theory, Practice, and Beyond"* held at Simons Institute for the Theory of Computing, Berkeley, USA. during Apr 17 – Apr 21, 2023. Gave an Invited talk titled "Beyond SAT - Proofs for QBF, and more"

Participated in *The 26th International Conference on Theory and Applications of Satisfiability Testing SAT.* held at Alghero, Italy during Jul 4 – Jul 8, 2023. co-Chair, Program Committee.

Participated in *Highlights of Logic, Games and Automata* held at Kassel, Germany during Jul 24 – Jul 28, 2023. Keynote speaker. Gave a talk titled "Quantified Boolean Formulas and Proof Complexity"

Participated in *Workshop on Algebra and Computation* held at Chalmers University of Technology, Gothenburg, Sweden during Aug 14 – Aug 16, 2023.

Participated in *Foundations of Software Technology and Theoretical Computer Science* held at IIIT Hyderabad during Dec 18 – Dec 20, 2023.

Participated in *ACM India Annual Event, including ARCS and ACMI-W Annual Summit* held at NISER Bhubaneshwar during Feb 8 – Feb 10, 2024.

Participated in *VerTECSS Symposium* held at CSE Department, IIT Delhi on Mar 9, 2024.

Visited MNM Jain Engineering College on Mar 12, 2024. Gave a talk titled "The Fascinating World of Computational Complexity" at the invitation of the ACM Student Chapter.

Participated in *Workshop on "Proof Complexity and Beyond"* held at MFO Oberwolfach Research Institute for Mathematics, Germany. during Mar 24 – Mar 29, 2024. One of the four scientific co-organisers of the research workshop.

Mondal, Madhumita

Participated in *Network Biology Day* held at The Institute of Mathematical Sciences (IMSc), Chennai, India on Jul 20, 2023.

Visited Max Planck Institute for Mathematics in the Sciences during Aug 11, 2023 – Feb 10, 2024. Visited MPI MiS for joint research under the framework of the Max Planck India Partner Group.

Participated in *Contemporary Perspectives in Computational Biology* held at The Institute of Mathematical Sciences (IMSc), Chennai, India during Feb 19 – Feb 20, 2024.

Mukhopadhyay, Anirban

Participated in *Words and transcendence* held at Kerala School of Mathematics during Aug 7 – Aug 12, 2023. Gave two talks.

Participated in *RMS Annual conference* held at IIT Guwahati during Dec 22 – Dec 24, 2023. Gave an invited talk.

Participated in *Discussion meeting in Analytic number theory* held at ISI Kolkata on Jan 8, 2024. Gave a talk.

Participated in *Words and Transcendence II* held at HRI during Feb 6 – Feb 15, 2024. Gave two talks.

Mukhopadhyay, Partha

Visited Department of Physics and Astronomy, University of Kentucky during Oct 23 – Dec 22, 2023. Academic exchange. Research seminar: *Construction of Poincaré invariant theories on a lattice*

Pal, Arnab

Participated in *Edinburgh Statistical Physics and Complexity Webinar Series* held at Webinar on May 16, 2023. https://www.ph.ed.ac.uk/events/2023/83090-resetting-state-of-the-art-and-new-developments

Participated in *YITP-YSF Symposium Perspectives on Non-Equilibrium Statistical Mechanics: The 45th Anniversary Symposium of Yamada Science Foundation* held at Yukawa Institute for Theoretical Physics, Kyoto University during Aug 3 – Aug 5, 2023. The main purpose of this symposium was to review the academic development of the field of nonequilibrium statistical mechanics and to discuss its future prospects.

Participated in *SOFT AND LIVING MATTER: FROM FUNDAMENTAL CONCEPTS TO NEW MATERIAL DESIGN* held at ICTS, Bangalore during Aug 7 – Aug 25, 2023. The SLM2023 School and Workshop on Soft and Living Matter was to attract global experts who provided pedagogical lectures and seminars on a subset of this broad field to students and young researchers.

Participated in *STATPHYS 28, Tokyo* held at The University of Tokyo, Japan during Aug 7 – Aug 11, 2023. The conference covered a wide range of topics, including traditional aspects of statistical mechanics, non-equilibrium physics, turbulence and nonlinear dynamics, disordered systems and phase transitions, hard and soft condensed matter, as well as mode

Participated in *Frontiers in Statistical Physics* held at Raman Research Institute, Bangalore during Dec 4 – Dec 8, 2023. The "Frontiers in Statistical Physics" conference aims to discuss exciting recent developments in statistical physics. It is part of a series of meetings to celebrate the 75th year of the founding of Raman Research Institute by Nobel Laureate Sir C V Raman.

Participated in *7th International Conference on Complex Dynamical Systems & Applications* held at Digha Science Centre & National Science Camp during Jan 25 – Jan 27, 2024. Organized by Physics & Applied Mathematics Unit, Indian Statistical Institute, Kolkata.

Participated in *Physics of life: Active and living matter* held at Toshali Sands, Puri during Feb 8 – Feb 10, 2024. The workshop on 'Physics of life: Active and living matter (PoL24)' is a part of the Golden Jubilee celebration of the Institute of Physics, Bhubaneswar. The conference is co-organized by the Indian Institute of Science Education and Research, Mohali

Pius, Roji

Participated in *Observable algebras in field theory and gravity* held at IIT Mandi during Jul 20 – Jul 23, 2023. Two lectures : Entanglement wedge islands and half-sided modular translations

Visited ICTS Bangalore during Aug 12 – Aug 15, 2023. String Seminar: Theory dependence of black hole interior reconstruction and the extended strong subadditivity

Participated in *Chennai Strings Meeting 2023* held at IMSc during Nov 28 – Dec 1, 2023. Reconstruction and half-sided translations

Participated in *Pre-ISM 2023* held at TIFR Mumbai during Dec 3 – Dec 8, 2023. Talk: Islands and half-sided translations

Prasad, Amritanshu

Participated in *Inter IISER-NISER Math Meet* held at NISER Bhubaneswar during Sep 29 – Oct 1, 2023. Plenary speaker

Raghavan, K. N.

Visited Kerala School of Mathematics during Jun 2 – Jun 6, 2023. Convened the NBHM Scholarship Interview Panel hosted by KSoM

Participated in *NCM Annual Foundation School (AFS)-II* held at MEPCO Schlenk Engineering College, Sivakasi during Jun 12 – Jun 16, 2023. Gave four lectures in algebra and conducted the corresponding tutorials

Participated in *Groups and Representations* held at Indian Institute of Technology, Bombay during Jul 3 – Jul 5, 2023. Invited speaker

Participated in *Science Education Panel Symposium* held at Indian Academy of Sciences, Bengaluru on Jul 6, 2023. Invited speaker

Participated in *Workshop on Linear Algebra and Real Analysis* held at Vellore Institute of Technology, Vellore during Jul 7 – Jul 8, 2023. Facilitated the organisation of the event (which was held under the auspices of the CMI-NASI Chennai Chapter). Was one of three resource persons.

Visited Indian Institute of Technology, Bombay during Aug 4 – Aug 5, 2023. Meetings of the NBHM Board and the National Library Committee

Visited Central University of Tamil Nadu, Tiruvarur on Aug 18, 2023. Attended a meeting; delivered a seminar talk

Visited University of Hyderabad, School of Mathematics and Statistics on Sep 5, 2023. Meeting

Visited Krea University on Sep 25, 2023. Collquium Talk

Participated in *Refresher Course in Mathematics* held at UGC-HRDC Pondicherry University on Oct 17, 2023. Resource person

Participated in *89th Annual Meeting of the Indian Academy of Sciences* held at BITS-Pilani, K K Birla Goa Campus, Goa during Nov 2 – Nov 5, 2023. Attended especially the meeting of the Science Education Panel

Visited IISER Tirupati on Nov 15, 2023. Colloquium Talk

Participated in *Refresher Course in Mathematics* held at UGC-HRDC University of Madras during Nov 28 – Nov 29, 2023. Resource person

Participated in *93rd Annual Session of the National Academy of Sciences (NASI)* held at Bhabha Atomic Research Centre during Dec 3 – Dec 5, 2023. Participated as convener of the CMI-NASI Chennai Chapter

Participated in *International Conference on Algebraic Geometry, Coding Theory and Combinatorics* held at Indian Institute of Technology, Hyderabad during Dec 6 – Dec 7, 2023. Invited speaker

Visited Institute of Mathematics and Applications on Dec 8, 2023. Attended the Governing Council Meeting as the NBHM Representative

Participated in *Workshop on Algebra, Topology, and Differential Equations* held at Vellore Institute of Technology, Vellore on Dec 16, 2023. Facilitated the organisation of this event which was co-sponsored by IMSc and the CMI-NASI Chennai Chapter. Was one of four resource persons.

Visited Institute of Mathematics and Applications on Jan 8, 2024. Attended the Governing Council meeting as the NBHM representative

Participated in *State Level Seminar (on Mathematics)* held at B.J.B.(A) College, Bhubaneswar on Jan 9, 2024. Delivered a talk; interacted with students and faculty

Visited Indian Academy of Sciences, Bengaluru during Jan 18 – Jan 19, 2024. Chaired the meeting for selection of the Joint Academies' Summer Research Fellowships (Mathematics)

Participated in *Workshop on Real Analysis, Complex Analysis, and Linear Algebra* held at Department of Mathematics, The Gandhigram Rural Institute during Jan 26 – Jan 27, 2024. Facilitated the organisation of this event which was co-sponsored by CMI and IMSc. Was one of four resource persons. Visited the library which receives grants from NBHM.

Participated in *IISER TVM Frontier Symposium–Mathematics 2024* held at IISER, Thiruvananthapuram during Feb 2 – Feb 4, 2024. Invited speaker

Visited Ambedkar University, Delhi on Feb 15, 2024. Delivered a seminar talk; visited the library as Chair of the NBHM National Library Committee

Visited Indian Statistical Institute, Delhi during Feb 16 – Feb 17, 2024. NBHM Board Meeting; NBHM National Library Committee Meeting

Visited Kerala School of Mathematics, Kozhikode during Feb 26 – Mar 1, 2024. Convened the NBHM Scholarship Interview Panel that was hosted at KSoM

Visited Indian Institute of Science, Department of Mathematics on Mar 4, 2024. Collaboration

Visited University of Hyderabad, School of Mathematics and Statistics on Mar 11, 2024. Participated in the School Board Meeting as an external member; Delivered a seminar talk

Participated in *Summer Training Programme in Mathematics 2024* held at Kongunadu Arts and Science College (Autonomous), Coimbatore on Mar 18, 2024. Was the resource person for the first day of the event

Ramya, C.

Participated in *Foundations of Software Technology and Theoretical Computer Science* held at IIIT Hyderabad during Dec 18 – Dec 20, 2023.

Participated in *Quantum Computing Semester* held at Dr. F.C. Kohli Centre of Excellence during Jan 22 – Jan 26, 2024. Quantum Computing Semester Bootcamp

Ravindran, V.

Visited DESY, Hamburg,Germany, during Feb 11 – Feb 26, 2024. Collaboration under Indo German joint project.

Participated in *University of Tubingen* held at Tuebingen Castle during Feb 27 – Feb 29, 2024. Workshop

Saha, Souvik M.

Participated in *13th International Conference on Algorithms and Complexity (CIAC 2023)* held at Larnaca, Cyprus during Jun 14 – Jun 16, 2023.

Participated in *Recent Trends in Algorithms* held at NISER,Bhubaneswar during Jul 26 – Jul 28, 2023.

Sahoo, Ajaya Kumar

Participated in *Network Biology Day* held at The Institute of Mathematical Sciences (IMSc), Chennai on Jul 20, 2023. Presented poster on 'T9GPred: A Predictor for Bacterial Type 9 Secretion System, Associated Gliding Motility and Secreted Proteins'

Participated in *First National Symposium on Integrating Traditional Knowledge in Evidence Based Medicine* held at Advanced Centre for Treatment, Research and Education in Cancer (ACTREC), Tata Memorial Centre, Kharghar, Navi Mumbai during Sep 21 – Sep 22, 2023. Presented poster on 'IMPPAT: An extensive resource on the phytochemical space of Indian medicinal plants and its potential applications in natural product based drug discovery'

Participated in *Modelling and Tackling Complex Biological Systems* held at The Institute of Mathematical Sciences (IMSc), Chennai during Oct 13 – Oct 14, 2023. Gave talk on 'Unravelling activity cliffs in structure-activity landscape' and presented poster on 'T9GPred: A Predictor for Bacterial Type 9 Secretion System, Associated Gliding Motility and Secreted Proteins'

Participated in *Contemporary Perspectives in Computational Biology* held at The Institute of Mathematical Sciences (IMSc), Chennai during Feb 19 – Feb 20, 2024. Gave talk on 'From Bench to Bytes: Prediction of Bacterial Type 9 Secretion System and Associated Functionalities' and presented poster on 'T9GPred: A Predictor for Bacterial Type 9 Secretion System, Associated Gliding Motility and Secreted Proteins'

Participated in *17th Annual International Biocuration Conference (AIBC-2024)* held at Indian Biological Data Centre (IBDC), Regional centre for biotechnology, Faridabad, Haryana during Mar 5 – Mar 8, 2024. Presented poster on 'An integrative data-centric approach to derivation and characterization of an adverse outcome pathway network for cadmium-induced toxicity'

Samal, Areejit

Visited Biochemical Sciences Division, NCL, Pune, India on Apr 6, 2023. Invited talk

Participated in *Discussion meeting on Redox Chemical Biology of Health and Disease* held at IISER Pune, India. during Apr 7 – Apr 8, 2023. Invited talk

Visited KREA University, Sricity, India on May 3, 2023. Invited talk

Participated in *Faculty Development Program* held at VIT, Vellore, India. on Aug 1, 2023. Invited talk

Participated in *First National Symposium on Integrating Traditional Knowledge in Evidence Based Medicine* held at ACTREC, Mumbai, India during Sep 21 – Sep 22, 2023. Invited talk

Participated in *National workshop on Plant Bioinformatics* held at Bose Institute, Kolkata, India on Nov 7, 2023. Invited talk

Participated in *AISMBR Seminar Series* held at Amrita Vishwa Vidyapeetham, Coimbatore, India on Nov 25, 2023. Invited talk (online)

Participated in *Clinical data, Machine learning and Modelling* held at IMSc, Chennai, India during Dec 1 – Dec 2, 2023. Invited talk

Participated in *International Conference on Emerging Trends in Mathematical Sciences & Computing (IEMSC-24)* held at Kolkata, India during Feb 2 – Feb 4, 2024. Invited talk

Visited Institute of Life Sciences, Bhubaneswar, India on Feb 6, 2024. Invited talk

Participated in *International Conference on Bioinformatics in Health and Food Security* held at Pondicherry University, India during Feb 14 – Feb 16, 2024. Invited talk

Visited National Institute of Science Education and Research (NISER), Bhubaneswar, India on Feb 27, 2024. Invited talk

Sarkar, Ratan

Visited INFN Turin during Oct 16 – Oct 20, 2023. Academic visit and discussion on research works with Dr. Simon Badger.

Visited Technical University of Munich during Oct 21 – Nov 3, 2023. Academic visit and discussion on research works with Prof. Martin Beneke

Visited University of Edinburgh during Nov 4 – Nov 10, 2023. Academic visit and discussion on research works with Prof. Einan Gardi

Participated in *Workshop in High Energy Physics Phenomenology (WHEPP XVII)* held at IIT Gandhinagar during Jan 2 – Jan 11, 2024. HEP

Participated in *Advanced School Workshop on Multiloop Scattering Amplitudes* held at NISER Bhubaneshwar during Jan 15 – Jan 19, 2024. On pQCD and loop calculations.

Saurabh, Saket

Participated in *New Frontiers of Parameterized Complexity in Graph Drawing* held at Dagstuhl during Apr 16 – Apr 21, 2023. Gave an Invited talk.

Participated in *Parameterized Approximation: Algorithms and Hardness* held at Dagstuhl during Jul 16 – Jul 21, 2023. Participated in the panel discussion.

Participated in *Pingala Interactions In Computing* held at Mysore campus of Infosys during Feb 3 – Feb 6, 2024. One of the laureates of the event.

Participated in *10th International Conference on Algorithms and Discrete Applied Mathematics (CALDAM).* held at IIT Bhilai, Chhattisgarh, India during Feb 15 – Feb 17, 2024. One of the Invited speakers.

Seetharaman, Sanjay

Participated in *Recent Trends in Algorithms* held at NISER Bhubaneswar during Jul 26 – Jul 28, 2023.

Participated in *Winter School on AI and TCS* held at IIT Jodhpur during Dec 8 – Dec 10, 2023.

Participated in *Foundations of Software Technology and Theoretical Computer Science* held at IIIT Hyderabad during Dec 18 – Dec 20, 2023.

Sharma, Sayantan

Visited IIT Bombay during May 16 – May 19, 2023. Collaborative Research

Visited IISER Pune during May 20 – May 24, 2023. Collaborative research and delivered a colloquium in the Physics Department.

Participated in *Statistical Physics and Complex systems* held at IIT Kharagpur during Jun 5 – Jun 7, 2023. Gave an Invited talk titled "Chiral instabilities and the fate of chirality imbalance in gauge theories".

Participated in *INT workshop on Chirality and Criticality in Heavy-Ion Collisions* held at Online, organized by the Institute of Nuclear Theory, University of Washington, Seattle, US during Aug 21 – Aug 25, 2023. Delivered a seminar titled "Chiral Plasma Instabilities in non-Abelian Gauge Theories"

Participated in *4th Heavy Flavour Meet 2023* held at National Institute of Oceanography, Goa during Nov 2 – Nov 4, 2023. Was a part of the National Organizing committee and also one of the instructors for the one-day school held at Goa University on 1 November, 2023 aimed at training the Ph. D. students working on the topic of heavy quarks.

Visited IIT Bombay for furthering research collaboration. during Nov 5 – Nov 7, 2023.

Visited IISER Bhopal during Nov 15 – Nov 17, 2023. Research collaboration

Participated in *Aspects of QCD Phase Diagram* held at IISER Bhopal during Nov 18 – Nov 20, 2023. Was a part of the organizing committee of the workshop and also gave an talk on "Chiral Plasma Instabilities in Gauge Theories".

Participated in *Workshop in High Energy Physics Phenomenology XVII (WHEPP XVII)* held at IIT Gandhinagar during Jan 2 – Jan 11, 2024. Coordinator of the Working Group on Heavy Ions and QCD and gave the concluding summary talk of the working group.

Participated in *Meeting on the physics of ALICE, CBM and STAR* held at VECC, Kolkata during Jan 29 – Jan 30, 2024. Gave an invited talk on "Anomalous chiral symmetry in finite temperature QCD and its implications "

Participated in *International Workshop on Probing Hadron Structure at the Electron-Ion Collider* held at ICTS-TIFR, Bengaluru during Feb 4 – Feb 9, 2024. Gave an Invited talk on "Chiral anomaly and its implications for hadron physics"

Sharma, Vikram

Participated in *ICIAM* held at Tokyo during Aug 20 – Aug 25, 2023. Gave an Invited talk in the session on Recent Advances on Polynomial System Solving

Shrimal, Tanishk

Visited International Centre for Theoretical Sciences during Feb 29 – Mar 3, 2024. School on Probing the Hadron Structure at EIC

Sil, Priyotosh

Participated in *Big Data Algorithms for Biology (BDBio) 2023* held at Indian Institute of Science (IISc), Bengaluru, India during Jun 2 – Jun 3, 2023. Presented a poster titled 'Leveraging Developmental Landscapes for Model Selection in Boolean Gene Regulatory Networks'

Participated in *Network Biology Day* held at The Institute of Mathematical Sciences (IMSc), Chennai, India on Jul 20, 2023. Presented a poster titled 'Leveraging Developmental Landscapes for Model Selection in Boolean Gene Regulatory Networks'

Participated in *Perspectives in Nonlinear Dynamics (PNLD) 2023* held at Indian Institute of Technology (IIT) Madras, India during Aug 1 – Aug 4, 2023. Presented a poster titled 'Biologically Meaningful Regulatory Logic Enhances the Convergence Rate in Boolean Networks and Bushiness of their State Transition Graph'

Participated in *Modelling and Tackling Complex Biological Systems* held at The Institute of Mathematical Sciences (IMSc), Chennai, India during Oct 13 – Oct 14, 2023. Presented a poster and gave a talk titled 'Adapting concepts from cellular automata to explore 'bushiness'

and 'convergence' in Boolean network dynamics'

Participated in *Stochasticity and Plasticity in living Systems* held at Sakleshpur, Karnataka, India (organised by National Centre for Biological Sciences (NCBS) & Simons Foundation). during Nov 14 – Nov 18, 2023. Presented a poster titled 'Biologically Meaningful Regulatory Logic Enhances the Convergence Rate in Boolean Networks and Bushiness of Their State Transition Graph'

Participated in *Contemporary Perspectives in computational Biology* held at The Institute of Mathematical Sciences (IMSc), Chennai, India during Feb 19 – Feb 20, 2024. Presented a poster titled 'Biologically Meaningful Regulatory Logic Enhances the Convergence Rate in Boolean Networks and Bushiness of Their State Transition Graph' and volunteered in this conference

Participated in *Theoretical Approaches in Cancer Progression and Treatment* held at International Centre for Theoretical Sciences (ICTS), Bengaluru, India during Mar 11 – Mar 22, 2024. Presented a poster and gave a talk titled 'Adapting concepts from cellular automata to explore bushiness and convergence in Boolean network dynamics'

Srinivas, K.

Participated in *Workshop in number theory* held at SRTM University, Nanded. during Apr 10 – Apr 13, 2023. Delivered couple of talks in analytic number theory in the workshop.

Participated in *Workshop for School Teachers of Odisha* held at IMA, Bhubaneswar during May 30 – May 31, 2023. Delivered 2 talks for school teachers in the workshop.

Visited NIT, Rourkela during Aug 18 – Aug 21, 2023. Delivered 2 talks in the department of mathematics.

Visited IMA, Bhubaneswar during Aug 22 – Aug 24, 2023. Delivered a talk with the title Ramanujan sums.

Participated in *Refresher course in Mathematics* held at Pondicherry University on Oct 5, 2023. Conducted a session with the title Euler's theorem and its applications.

Participated in *Workshop in algebra and number theory* held at SRTM University, Nanded. during Oct 9 – Oct 13, 2023. Delivered a 4 talks in analytic number theory in the workshop.

Subbaroyan, Ajay

Participated in *Network Biology Day* held at The Institute of Mathematical Sciences (IMSc), Chennai on Jul 20, 2023. Oral presentation titled 'Elucidating and leveraging design principles towards realistic reconstruction of Boolean gene regulatory networks'.

Participated in *Perspectives in Nonlinear Dynamics (PNLD)* held at Indian Institute of Technology (IITM), Chennai during Aug 1 – Aug 4, 2023. Poster presentation titled 'Leveraging developmental landscapes for model selection in Boolean gene regulatory networks'.

Participated in *Modeling and Tackling Complex Biological Systems* held at The Institute of Mathematical Sciences (IMSc), Chennai during Oct 13 – Oct 14, 2023. Poster presentations titled (1) 'Minimum complexity drives regulatory logic in Boolean models of living systems'; (2) 'Leveraging developmental landscapes for model selection in Boolean gene regulatory networks'.

Participated in *Contemporary Perspectives in Computational Biology* held at The Institute of Mathematical Sciences (IMSc), Chennai during Feb 19 – Feb 20, 2024. Poster presentations titled (1) 'Minimum complexity drives regulatory logic in Boolean models of living systems'; (2) 'Leveraging developmental landscapes for model selection in Boolean gene regulatory networks'.

Participated in *Theoretical approaches in cancer progression and treatment* held at The International Center for Theoretical Sciences (ICTS), Bengaluru during Mar 11 – Mar 22, 2024. Poster presentation titled 'Leveraging developmental landscapes for model selection in Boolean gene regulatory networks'.

Upasana, Anannya

Participated in *ACM ARCS* held at NISER Bhubaneswar during Feb 8 – Feb 10, 2024. Invited for a poster presentation

5.3 Visitors from Other Institutions

Research is often a collaborative activity and is boosted by a vibrant visitor program. The Institute hosts a large number of short term and long term visitors.
During the year 2023-24, 253 scientists have visited the Institute. The list of visitors to the Institute during this period is listed below:

Faculty Visitors

Prosenjit Roy	15.3.23 - 12.5.23	IIT Kanpur
Sangram Bagh	20.4.23 - 22.4.23	SINP Kolkata
Narayan Rana	19.4.23 - 23.4.23	NISER BBSR
Sreetosh Goswami	19.4.23 - 22.4.23	IISc Bangalore
Sumitra Surendralal	1.5.23 - 7.5.23	Symbiosis Pune
Kasi Viswanadhan	15.5.23 - 27.5.23	IISER Berhampur
Mubeena T.	8.5.23 - 12.5.23	University, Of Calicut
S.P. Murugan	30.5.23 - 9.6.23	Shiv Nadar University, Noida
Bindusar Sahoo	21.5.23 - 28.5.23	IISER Trivandrum
Asweel Ahmed A Jaleel	12.6.23 - 18.6.23	S.A.C.Tirunelveli
R. Venkatesh	23.4.23 - 22.5.23	IISc Bangalore
Sagar Pandit	15.6.23 - 17.6.23	IISER Pune
Sachin Subash Sharma	6.6.23 - 21.6.23	IIT Kanpur
Vinodchandran Variyam	3.7.23 - 5.7.23	Nebraska University, USA
Manu Mathur	11.6.23 - 13.7.23	SN Bose Kolkata
Sumithra Surendralal	25.6.23 - 8.7.23	Symbiosis, Pune
Azizul Haque	4.7.23 - 14.7.23	Gauhati University, Assam
Sujatha Ramdorai	10.7.23 - 11.7.23	U.B.C., Canada
Subasish Banerjee	31.7.23 - 5.8.23	IIT Jodhpur
V.K. Adersh	15.7.23 - 18.7.23	TKM Kollam
B. Ravinder	29.6.23 - 4.7.23	IIT Tirupati
Pradeesha Ashok	23.7.23 - 5.8.23	IIIT Bangalore
Vipin Singh	19.7.23 - 23.7.23	Chandigarh University
Kalyan Banerjee	17.7.23 - 21.7.23	VIT Chennai
Anshu Bhardwaj	19.7.23 - 23.7.23	IMTECH Chandigarh
Krishanu Roy	13.6.23 - 30.6.23	IIIT Delhi
Kshijit Gajjar	16.8.23 - 18.8.23	IIT Jodhpur
Mrigendra Singh Kushwala	29.7.23 - 14.8.23	Delhi University
Kshitij Gajjar	16.8.23 - 18.8.23	IIT Jodhpur
Pradeesha Ashok	24.7.23 - 4.8.23	IIIT Bangalore
K. Srilakshmi	5.10.23 - 8.10.23	IISER Trivandrum
Nihar Ranjan Sahoo	13.10.23 - 16.10.23	Texas A& M University, U.S.A.
Chetan Gadgil	13.10.23 - 15.10.23	CSIR, Pune
Abhishek Subramanian	13.10.23 - 15.10.23	IIT Hyderabad
Anu Raghunathan	13.10.23 - 15.10.23	NCL, Pune
Mohit Kumar Jolly	12.10.23 - 17.10.23	IISc Bengaluru
Amit Ghosh	13.10.23 - 15.10.23	IIT Kharagpur

Amit Ghosh	13.10.23 - 15.10.23	IIT Kharagpur
Haripada Sau	6.11.23 - 8.11.23	IISER Pune
Ratna Pal	6.11.23 - 8.11.23	IISER Mohali
Indira Singh	22.11.23 - 22.11.23	IIHS
Seabeeha Hasnain	9.11.23 - 11.11.23	Mahindra U, Hyderabad
Akhilesh P.	28.12.23 - 31.12.23	KSoM
Nirupama Malli	1.12.23 - 31.3.24	SRM, Chennai
Satyanarayan Mukhopadhyay	22.11.23 - 1.12.23	IACS Kolkata
R. Venkatesh	5.11.23 - 8.11.23	IISc Bangalore
Manish Kumar Pandey	26.12.23 - 29.12.23	SRM, Chennai
Vivek M. Vyas	2.1.24 - 5.1.24	IIIT Vadodara
Akhilesh P.	10.1.24 - 14.1.24	KSoM Calicut
Mithun Kumar Das	29.12.23 - 8.1.24	NISER Odisha
Nitin Williams	11.1.24 - 12.1.24	Aalto University, Finland
K.V.S. Shiv Chaitanya	24.1.24 - 26.1.24	BITS Pilani
Abhijit Chakraborty	9.1.24 - 10.1.24	Kyoto University, Japan
Geetha Thangavelu	19.1.24 - 27.1.24	IISER TVM
T. Bakkyaraj	20.1.24 - 26.1.24	IIIT Kottayam
J. Ayyappan	20.1.24 - 18.2.24	Govt. College, Tanjavur
Rakesh Tibrewala	4.3.24 - 8.3.24	LNMIIT, Jaipur
Soumya Adhikari	1.9.23 - 10.9.23	IISER, TVM
Ashish Srivastava	22.11.23 - 22.11.23	BARC Mumbai
Goutam Das	27.11.23 - 1.12.23	RWTH, Germany
Sabarinathan Radhakrishnan	13.10.23 - 15.10.23	NCBS, Bangalore
Guruprasad Kar	30.3.23 - 3.4.23	ISI Kolkata
Ram Murty	16.4.23 - 20.4.23	Queens University, CA
Sven Olaf Moch	18.4.23 - 29.4.23	ITP, Hamburg
Brijesh Kumar	27.4.23 - 28.4.23	JNU, Delhi
Johannes Keeblar	17.3.23 - 11.5.23	Humbolot University, Berlin
Naveen Garg	22.5.23 - 23.5.23	IIT Delhi
M.Manickam	1.6.23 - 30.7.23	IISER Bhopal
David Sinnou	24.5.23 - 9.6.23	Sorbonne University, Fr
A. Sankaranarayanan	12.6.23 - 24.6.23	Hyderabad University
B. Ramakrishnan	19.6.23 - 30.6.23	ISI, Tezpur
S.D. Adhikari	13.8.23 - 17.8.23	RKMV, WB
Parthanil Roy	20.8.23 - 22.8.23	ISI Bangalore
Harvendra Singh	19.8.23 - 25.8.23	SINP Kolkata
Ajit Srivastava	29.8.23 - 30.8.23	IOP BBSR
Ganapathy Murthy	4.9.23 - 8.9.23	Kentucky University, USA
S. Krishnaswamy	5.9.23 - 19.9.23	MKU, Madurai
Prahladh Harsha	27.9.23 - 28.9.23	TIFR, Mumbai
Prosenjit Roy	7.8.23 - 1.9.23	IIT Kanpur
Loic Merel	15.10.23 - 31.10.23	University, Paris Cite
Rajiv V. Gavai	12.9.23 - 16.9.23	IISER Bhopal
Ganesh Bagler	13.10.23 - 16.10.23	IIIT Delhi
Dhiraj Kumar	13.10.23 - 15.10.23	ICGEB Delhi
Jyotirmoy Sengupta	17.10.23 - 27.10.23	IACS Kolkata

Kalyan Bidhan Sinha	25.10.23 - 29.10.23	ISI, Bengaluru
Swarup Poria	21.10.23 - 2.11.23	University, Calcutta
Sowdhabini	13.10.23 - 15.10.23	NCBS, Bangalore
S. Krishnaswamy	30.10.23 - 3.11.23	MKU, Madurai
Prasun Mukherjee	22.11.23 - 27.11.23	HBNI, BARC
Vikram Gota	24.11.23 - 24.11.23	ACTREC, TMC
Philippon Patrice	17.12.23 - 15.1.23	CNAS
Soumen Sarkar	17.11.23 - 3.12.23	IIT Madras
Deshouillers Jean Marc	7.12.23 - 20.12.23	Bordeaux University, France
Sinnou David	28.12.23 - 29.12.23	Sorbonne University
Manoj Kumar	31.12.23 - 3.1.24	GKU, Haridwar
Ravindra Girivaru Venkata	30.12.23 - 4.1.24	Missouri University, USA
Shanta Laishram	8.12.23 - 15.12.23	ISI, Delhi
Luca Barbieri Viale	21.12.23 - 20.1.24	Milan University
Ipsita Mandal	9.8.23 - 12.8.23	Shiv Nadar University, Noida
Keitaro Takahashi	4.2.24 - 6.2.24	KU, Japan
Anjan Kumar Giri	5.2.24 - 8.2.24	IIT Hyderabad
Sven Olaf Moch	20.1.24 - 26.1.24	ITP , Hamburg
Kaustuv Sanyal	28.1.24 - 30.1.24	JNCASR, Bangalore
Vivek Sadhu	27.2.24 - 3.3.24	IISER Bhopal
M. Sivakumar	2.1.24 - 1.3.24	Hyderabad University
Hridas Kumar Pal	28.2.24 - 2.3.24	IIT Bombay
A.P. Balachandran	14.1.24 - 14.1.24	Syracuse University, USA

Post Doctoral Visitors

Roshani Sharma	13.3.23 - 5.4.23	Max Planck, Germany
Suman Kumbhakar	9.4.23 - 12.4.23	Montreal University.
Vadnala Rakesh	4.4.23 - 7.4.23	NCBC, Bengaluru
Sujay Mahato	17.4.23 - 22.4.23	HRI, Allahabad
Purbita Jana	1.4.23 - 30.4.23	IIT Kanpur
Sabiar Shaikh	7.4.23 - 29.4.23	NISER
Kishore Hari	18.5.23 - 19.5.23	IISc, Bangalore
Arkabrata Ghosh	10.4.23 - 1.6.23	Central U, Michigan
Lakshmi S. Mohan	9.5.23 - 7.7.23	Warsaw University, Poland
Amit Adhikary	6.7.23 - 9.7.23	University. Warsaw, Poland
Arijit Dutta	9.7.23 - 31.8.23	Texas University,
Sanjay Moudgalya	16.7.23 - 19.7.23	Caltech USA
Raghuveer Garani	24.7.23 - 28.7.23	INFN Fienze
Apurba Biswas	1.8.23 - 31.10.23	IMSc
Amir Suhail	1.8.23 - 31.10.23	IMSc
Sitender Pratap	29.7.23 - 28.10.23	IMSc
Toshali Mitra	31.7.23 - 30.8.23	IMSc
Deeksha Adil	16.7.23 - 19.7.23	ITS, Switzerland
Sasank Mouli	7.8.23 - 26.8.23	IDSIA, Switzerland
Neelam Kandhil	14.8.23 - 20.8.23	Max Planck, Germany
Yash Deshmukh	7.8.23 - 14.8.23	Max Planck, Germany

C.G. Karthick Babu	21.8.23 - 22.8.23	ISI Bengaluru
Shrobona Bagchi	15.8.23 - 20.8.23	CQIKI, Seoul
Sitender Pratap Kashyap	29.7.23 - 31.8.23	IMSc
Amir Suhail	1.8.23 - 3.1.24	IMSc
Sibaram Ruidas	19.8.23 - 31.8.23	ICTS Bangalore
Digjoy Paul	11.9.23 - 15.9.23	IISc Bangalore
Arkajyoti Manna	2.8.24 - 3.9.24	IISc Bangalore
Mohd Taher	11.9.23 - 11.12.23	TIFR, Mumbai
Apurba Biswas	1.8.23 - 30.9.23	IMSc
Suraj Hegde	19.10.23 - 20.10.23	Technische U. Germany
Lakshmi Priya M.E.	18.10.23 - 21.10.23	Tel Aviv University
Mohd. Taher	11.9.23 - 11.12.23	TIFR, Mumbai
Chandan Kumar	29.10.23 - 31.10.23	IISER Mohali
Ramit Das	1.10.23 - 30.10.23	Ericson, Bengaluru
Varun Gupta	1.8.23 - 31.10.23	CMI, Chennai
Ruchika	1.11.23 - 4.11.23	INFN, Rome
Shivam Gola	18.9.23 - 17.10.23	IMSc
Ragini Singhal	6.11.23 - 9.11.23	ULB, Brussels
Shubham Dwivedi	6.11.23 - 9.11.23	University Humboldt, Berlin
Avijit Misra	6.11.23 - 11.11.23	Weizman Ins., Israel
Tejbir	25.10.23 - 24.12.23	IISER Mohali
Pratik Ghosal	3.11.23 - 2.2.24	Bose Ins., Kolkara
Bagavathy S. Karthikeyan	15.12.23 - 31.3.24	Orcbro University, Sweden
Tanushree Shah	5.11.23 - 7.11.23	ARI, Hungary
Abhishek Mohapatra	15.12.23 - 15.12.23	TUM, Mumbai
Pranendu Darbar	27.12.23 - 1.1.24	NTNU Norway
Some Sankar Bhattacharya	21.24 - 12.1.24	Gdansk University, Poland
R. Thiru Senthil	9.11.23 - 8.1.24	IMSc
Richa Tripathi	30.11.23 - 6.12.24	Washington University, USA
Kajal Samanta	1.12.23 - 31.1.24	Fudan University
Raghvendra Singh	1.8.23 - 31.1.24	IMSc
Saikat Panja	13.1.24 - 10.2.24	HCRI Allahabad
Honey Khindri	1.11.23 - 29.2.24	IMSc
Rajath Krishna Radhakrishnan	26.2.24 - 1.3.24	ICTP, Italy
Ryo Kato	4.2.24 - 10.2.24	KU, Japan
Shinnosuke Hisano	4.2.24 - 10.2.24	KU, Japan
Anshul Mishra	1.2.24 - 30.4.24	IIT Madras
Jitendra Rathore	13.2.24 - 23.2.24	HCRI Allahabad
Prasanna Kumar Dhani	15.9.23 - 17.9.23	University of Valencia, Spain
Bidisha Roy	8.10.23 - 15.10.23	Superiore di Pisa, Italy
Subrata Dev	4.10.23 - 15.10.24	Emory University, USA
Chandan Datta	18.12.23 - 20.12.23	HHU, Germany

Doctoral Visitors

Madhumita Kundu	10.12.22 - 6.5.23	Bergen University, Norway
Biswajit Das	5.4.23 - 4.5.23	I.O.P., Bhubaneswar
Sreejata Dey	25.3.23 - 9.4.23	University of Hyderabad
Sreenanda SB	25.3.23 - 9.4.23	Hyderabad University
Pankaj Kumar	10.3.23 - 1.5.23	Charles University, CZ
Kushal Chakraborty	30.3.23 - 8.5.23	IISER Bhopal
Zakhiya	30.4.23 - 3.5.23	NIAS, Bengaluru
Shingavekar P Satish	1.6.23 - 30.7.23	IIT Madras
Yasharth Yadav	28.5.23 - 31.5.23	NTU Singapore
Sachin Grover	24.5.23 - 3.6.23	HRI Allahabad
P. Gangaeswari	6.10.23 - 9.9.23	MSU Tirunelveli
Md. Irfan Habib	9.5.23 - 17.5.23	IISc Bengaluru
Siddharth Jain	25.6.23 - 30.6.23	IIT Kolkata
Ramya Nair	2.7.23 - 6.7.23	IISER Pune
Suvam Pal	17.7.23 - 31.7.23	ISI Kolkata
Surag Nair	9.8.23 - 9.8.23	Stanford University, US
Sreenanda S.B.	2.8.23 - 23.8.23	University of Hyderabad
Ms.Honey	1.8.23 - 1.10.23	TIFR/ INO
Shruli Hegde	13.8.23 - 26.8.23	RKMVERI, Belur
Athulya K.P.	20.8.23 - 24.8.23	IISER TVM
Lalitharashmi Y	23.8.23 - 10.9.23	BARC Mumbai
Chaitanya Yogesh Bhatt	18.9.23 - 29.9.23	IISc Bangalore
Honey Khindri	1.8.23 - 31.10.23	IMSc
P. Gangaeswari	9.10.23 - 8.1.24	M.S.U. Tirunelveli
Antra Thada	26.10.23 - 7.11.23	BARC Mumbai
Debattam Das	1.12.23 - 13.12.23	IISER, Mohali
Amitava Ghosh	1.1.24 - 5.1.24	Purdue University
Pavan	31.12.23 - 2.1.24	Bielefeld University, Germany
Prabhakar Ratipal Yadav	6.12.23 - 13.12.23	ISI Delhi
Madhumita Kundu	23.12.23 - 25.5.24	Bergen University, Norway
Prateksh Dhivakar	28.1.24 - 3.2.24	IIT Kanpur
Sachin Grover	14.1.24 - 21.1.24	HCRI Allahabad
Jacky Kumar	22.1.24 - 26.1.24	LANL USA

Non-Doctoral Student Visitors

Sathish Kumar G	12.12.22 - 30.6.23	Anna University, Chennai
Lakshmi Priya	6.1.12 - 30.6.23	SASTRA
Sudharsan V	20.2.23 - 30.9.23	PSG Tech
Aathif M	9.4.23 - 22.4.23	Khajamian C, Trichy
Sobhit Singh	1.1.23 - 30.6.23	Azim Premji University
Aniruddha Datta	5.1.23 - 1.5.23	IISER Kolkata
Suchetana Mitra	9.5.23 - 31.12.23	IISER Mohali
Kundanathan R	20.5.23 - 31.8.23	NIT Rourkela
Ashwin K.R.	1.6.23 - 30.9.23	PSG Tech

Varun Shah	1.6.23 - 31.5.24	IISER Pune
Rishi Dinesh	3.6.23 - 2.9.23	Shiv Nadar University
J. Jayasri	15.6.23 - 15.7.23	NCUP, Madras University
Prabhoda C.S.	4.6.23 - 4.7.23	Azim Premji University
Keertana Kartik	1.6.23 - 30.6.23	Krea University
Ashwath Kumaran C.	6.7.23 - 6.10.23	LPU, Punjab
Gauranga Kumar Baishya	7.7.23 - 7.10.23	CMI
Purna Dutta	2.8.23 - 30.4.23	IISER Berhampur
Saunak Bhattacharjee	1.8.23 - 31.3.24	IISER Tirupathi
Anushree A	9.8.23 - 8.9.23	Azim Premji University
Venkatavaradhan Sundararajan	6.8.23 - 30.4.23	IISER Mohali
Praveen Murali	28.8.23 - 27.11.23	IISER Trivandrum
Prabhoda C.S.	4.6.23 - 28.7.23	Aziz Premji University, KA
Ashwathkumaran C	8.7.23 - 6.10.23	LPU, Punjab
Suchetana Mitra	9.5.23 - 31.12.23	IISER Mohali
Varun Shah	1.6.23 - 31.5.24	IISER Pune
Sudharsan V	20.2.23 - 30.9.23	PSG Tech, Coimbatore
Ashwin K R	1.6.23 - 30.9.23	PSG Tech, Coimbatore
Vighnesh Iyer	7.8.23 - 31.1.24	Aziz Premji University, KA
Abhipsa Bhattacharjee	2.10.23 - 6.10.23	IISER, TVM
Surajit Biswas	26.9.23 - 8.10.23	IISER Bhopal
Venkatavaradhan Sundararajan	1.8.23 - 4.10.23	IISER Mohali
Abir Utthasani	25.8.23 - 19.10.23	IISER, Kolkata
Praveen Murali	28.8.23 - 28.11.23	IISER, TVM
Saunak Bhattacharjee	1.8.23 - 31.3.24	IISER Tirupati
Purna Dutta	2.8.23 - 30.4.23	IISER Berhampur
Gauranga Kr. Baishya	2.8.23 - 7.10.23	CMI, Chennai
Mohan Kumar C	3.11.23 - 3.2.24	Anna University
Srikar PB	4.12.23 - 3.1.24	Sastra University
A.P. Balachandran	15.12.23 - 23.12.23	Syracuse University, USA
Naveen Kumar	30.10.23 - 15.12.23	Madras University, TN
Sayan Dutta	15.12.23 - 31.12.23	IISER Kolkata
Apratim Rastogi	5.1.24 - 20.5.24	Thapar Inst., Punjab
Suchetana Mitra	1.1.24 - 31.3.24	IISER Mohali
Mohan Kumar C	3.11.23 - 3.2.24	Anna University
Tomonosuke Kikunaga	4.2.24 - 10.2.24	KU, Japan
Toki Ogi	4.2.24 - 10.2.24	KU, Japan
Shubhra Verma	24.1.24 - 28.6.24	Central University, Bihar
Gurmeet Singh	15.2.24 - 29.2.24	IISER Bhopal
Pradhyumna Parthasarathy	4.1.24 - 3.3.24	Stonybrook University, USA

Chapter 6

Infrastructure

6.1 Computer Facilities

Enhancement of Computer Facility during 2023-24

- The Laptops/ipads are issued to newly joined faculty and 4+ years old laptops are replaced with new one on demand received from the faculty. About 10 nos of different model laptops are purchased and issued to faculty.
- IMSc HPC facility is augmented with a Cluster solution to the tune of 300TF (Tera FLOPS) of theoretical compute power on HPL (turbo off) which can be scaled up further in future. The Cluster is equipped with 56 compute nodes, 112 CPUs (3584 Cores). Each compute node has dual Intel Xeon Platinum 8358 2.6G, 32C, 11.2GT/s CPU with 256 GB (4GB/core) DDR4/RDIMM, 3200MT/s, Dual Rank, Fully Balanced ECC (16 x 16GB) RAM, dual 10/100/1000 Gig Ethernet ports , Mellanox ConnectX-6 Single Port HDR100 QSFP56 Infiniband, dedicated management port for KVM over LAN. It is configured with SLURM job scheduler. This cluster is attached with 150 TB Parallel file system storage for high throughput read/write, 300 TB storage for home area. Software: Intel Cluster studio XE with AI tool kit, in addition to open source compilers like gcc, gfortran.
- The newly established media room is aimed towards organising state-of-the-art recording of lectures and seminars, interactive sessions with students, and live streaming to platforms like YouTube. Key integrated equipment include Remote-controlled PTZ 4K cameras positioned for optimal capture, recorders, a 24 inch table-mounted interactive touch/pen display, high-lumen projector and appropriate screen, wireless lapel mics, ceiling-mounted mic array with noise cancellation for clear audience voice capture, and dual motorized boards (whiteboard and green chalkboard). The interiors have been designed for efficient acoustics, while keeping in mind the aesthetic aspects. Double-glazed windows provide for sound insulation. The attached control room is equipped with an advanced video switcher and SSD recorder. The control room also has feeds, via optical fiber, coming from PTZ cameras in other lecture halls, which allows remote recording.
- Apple iMac , Mac Mini and Ipad pro, 4K PTZ Camera with Microphone are purchased and installed in the Director's office.

- 4K PTZ Camera with Microphone is purchased and installed in the G6 meeting room
- The internet bandwidth speed is upgraded to 67 Mbps 1:1 fiber loop connection.
- Zoom Academic license 30 users are renewed for one more year.
- Sharp multifunction printers purchased and installed in the Civil engineer office and RSA
- Maple software upgraded from the version 2019 to 2023.
- Epson EH-TW750 projector purchased and installed in the Hall 123, 326, Alladi hall, Chandrasekar Hall and new guest house.
- About 20 user licenses of Overleaf software are purchased for the use of thesis documentation.

Activities :

Mr. B Raveendra Reddy attended the CISAG meeting held at BARC, Mumbai on 3/11/2023.

The System team have supported all the conferences/workshops/seminars/events at IMSc.

The Media team have supported and fulfilled the requirements for all the virtual classes, official meetings, conference, workshops, seminars, events and webinars. In the year 2023-24 about 21420 minutes (357 hours) of video content are recorded by the media team.

6.2 The Library

The Institute Library holds a total collection of 77638 books and bound periodicals as on March 31, 2024 inclusive of current year's addition.

The NBHM has recognized this Institute library as the Regional Library in the areas of Mathematics and Allied subject disciplines - in order to share our information resources to all bonafide members of other academic and research institutions.

An average of about 2500 outside users in a year from colleges, universities and research institutions from different parts of the country make use of the library facilities for their academic and research information needs. The library has a well balanced collection both print and online on the major subject areas of research such as Theoretical Physics, Mathematics and Theoretical Computer Science. The library subscribes to over 350 national and international journals.

The library has access to over 3500+ online journals from major publishers such as Elsevier, American Mathematical Society, American Physical Society, Springer Verlag, World Scientific, Institute of Physics, Wiley, etc.

Library has also access to Nature online, Science Online, ACM Digital Library, SIAM Journals Archive, Duke Mathematical Journal, and JSTOR Full digital archive. It has also perpetual online access to backfile collection of journals contents from Volume 1 from some of the major publishers like Elesevier under DAE consortium, Springer, World Scientific, Wiley, deGruyter, Cambridge University Press, Turpion, IOP Publishing and Annual Reviews Electronic Backvolume collection. Access to online journals is restricted to members of the Institute. Also, remote access during work from home situations to the subscribed online resources was facilitated by institutes' VPN (Virtual Private Network) service.

Services:

Apart from developing the collection, the library offers reprographic and inter library loan services. Library has migrated from commercial proprietary software Libsys to open source software Koha on a linux platform, the library catalogue has been computerized and made available online to the readers both within and outside the Institute Campus. Online request for acquisition of books and status of borrowings have also been enabled using Koha. Library has implemented RFID based system for self check-in and checkout of library materials.

With the help of RFID enabled access control system, the library provides effective 24x7 access to its resources,perhaps the only library of this kind in the country.

Library has a website dedicated to host all the electronic information resources and to provide information about the library and its services. Library is a member of DAE Libraries Consortium that subscribes to SCIENCE DIRECT SERVICE of Elsevier.

Library is also coordinating the MathSciNet consortium which provides online access to MathSciNet for participating institutions in the southern region. Library is an institutional

member of AMS, MALIBNET, CURRENT SCIENCE Association, and IAPT.

IMSc Photo Archive

Photos are one of the most important components of the IMSc archives to provide historical and evidential sources of information. Library has photographs of various activities of IMSc since inception.

The physical and digital photographs were described with the help of IMSc Annual Reports, various books authored by the founder of IMSc and other publications. The Photographs were scanned as high resolution images and they are organised according to the events along with the date of the event. Identified the people in the photographs and tagged them with their names. The Photo Archive is browsable and searchable.

The Library uses "Piwigo" an open source photo management software for digital archiving. So far, the IMSc Photo Archive hosts approximately 1,700 photographs and it's still expanding.

The Physical photographs are converted into albums for preservation with the help of Roja Muthiah Research Library, Chennai.

Meeting on "The Role of the Physical Library in the Era of Internet"

Library in collaboration with Sitabhra Sinha organised one day meeting on "The Role of the Physical Library in the Era of Internet" held at The Institute on 29 December 2023.

The meeting was aimed to think about the ways in which the conventional brick-and-mortar library can reimagine its purpose so as to become even more and more information is accessible online via internet. The meeting was also an opportunity to honor Dr. Paul Pandian, the chief librarian of IMSc, on the occasion of his retirement. There were seven invited talks that were attended by 60 participants.

In addition, library also assists in annual report preparation that includes compilation of publications and other editorial processes.

Acknowledgment:
The Library gratefully acknowledges the donation of valuable books, journals and other reading materials received during the current year from the persons and organizations mentioned below:

R. Balasubramanian, IMSc
Kamal Lodaya, IMSc
Soumya Sur, IMSc
IGCAR, Kalpakkam
Director's office
V. Ravindran, IMSc
Raghavendra Singh, IMSc
A Vijaya Kumar
IISER, Mohali
NBHM