THE INSTITUTE OF MATHEMATICAL SCIENCES

C. I. T. Campus, Taramani,

Chennai - 600 113.

ANNUAL REPORT

Apr 2020 - Mar 2021

Telephone: +91-44-2254 3100, 2254 1856
DID No.: +91-44-2254 3xxx(xxx=extension)
Fax: +91-44-2254 1586
Website: https://www.imsc.res.in

Foreword

I am very pleased to present the annual report of the Institute for the year 2020-2021 and put forth the distinctive achievements of its members during the year along with a perspective for the future. During the period April 2020 - March 2021, there were 134 students pursuing their PhD and 37 scholars pursuing their post-doctoral programme at IMSc. A total of 14 students was awarded PhD degree, 10 students have submitted their PhD thesis and 8 students was awarded MSc by Research degree. There are several ongoing collaborations between other institutions, both national and international, and research groups of IMSc. Among these, we mention a few. Arecibo 327 MHz Drift Pulsar Survey (AO327) is an international effort to discover pulsars and transients using the Arecibo radio telescope (USA). IMSc is an international research laboratory for the Indo-French Program in Mathematics. As part of the ongoing Max Planck Partner Group in Mathematical Biology, IMSc has been collaborating with MPIMIS Leizig on the study of biological networks. As part of the SPARC project, IMSc has been organising seminars jointly with the University of Bordeaux and IIT Madras. A number of research collaborations are in progress in tune with the theme of the proposal. During 2020-2021, a total of 26 lecture courses were conducted at the Institute. The Institute also organized or co-sponsored several workshops and conferences. These were all held online due to the ongoing pandemic. For instance, the Virtual Math Fest 2020 held in July 2020 featured diverse research topics and speakers from all over the country. The Virtual Meeting on Compact Stars and QCD 2020 was held in August 2020. An NCM sponsored Teacher's Enrichment workshop was organized online (November 2020 - January 2021) and saw active participation from college teachers in Tamil Nadu. The Conference on Analytic and Combinatorial number theory and the SPARC online lectures series on the Schinzel-Zassenhaus conjecture were held back-to-back in March 2021. We note with a lot of satisfaction that our outreach programmes have continued to be held, albeit with reduced vigour due to the disruption caused by the pandemic. This year, the institute organized the following events: Annular Solar Eclipse (June 2020), From Learning to Doing (August 2020), FACETS (October 2020) and the Vigyan Pratibha Teachers workshop in Tamil (December 2020). The International GeoGebra Conference, India was organized during 11-13 March 2021. The aim of this online conference was to illustrate how GeoGebra can be used to develop mathematical thinking in the learners and promote 'Higher Order Thinking'. Research productivity of the members of the Institute has been excellent throughout the year. Several high quality publications have been reported in national and international journals, and some research work carried out has also been presented in international conferences. We are proud to note the awards and honors bestowed on our faculty for their contributions: Prof. Saket Sourabh has been chosen as the recipient of the 2020 ACM India Early Career Researcher (ECR) Award. Prof. Sanoli Gun was elected as a fellow of the Indian Academy of Sciences. Prof. G. Rajasekaran was the recipient of the Elavenil-ISTA Lifetime Achievement Award for the year 2020. Dr. Garima Rani was awarded the prestigious Human Frontier Science program (HFSP) fellowship

The Hon'ble Vice-President of India, Shri M. Venkaiah Naidu, visited the Institute of Mathematical Sciences (IMSc) on 5th January 2021. He shared the stage with Thiru. K. P. Anbalagan, Hon'ble Minister for Higher Education, Government of Tamil Nadu; Selvi Apoorva IAS, Principal Secretary in the Higher Education Department, Government of Tamil Nadu; Dr. A. K. Bhaduri, Director, IGCAR, Kalpakkam, and Prof. V. Arvind, Director, IMSc. Shri Naidu planted a sapling outside the Ramanujan Auditorium. He viewed the permanent

exhibition on the history of IMSc and the temporary exhibits on INO and DAE Technologies. Inside the Auditorium, he listened with interest to a presentation by Prof. V. Arvind on the work done by IMSc scientists. During his speech to IMSc members, Shri Naidu spoke of the importance of the mathematical sciences in the development of the nation. He stressed the need for scientists to work towards improving the lives of ordinary people, and for society to live in harmony with nature. He highlighted the issues of gender equity in Science and of early learning to be in one's mother tongue. He expressed the hope that the National Education Policy would lead to better educational outcomes for Indian children and youth. The Vice President also inaugurated, remotely, the New Residential Wing of IMSc located at the DAE Nodal Centre, Pallavaram, Chennai This report was compiled through the efforts of the IMSc Annual Report Committee consisting of Drs. S. Viswanath, Shrihari Gopalakrishna, Vikram Sharma, Areejit Samal, Sayantan Sharma, Paul Pandian and Usha Devi. I owe my gratitude to all of them.

June, 2021 **V. Arvind**

Contents

1 The Institute **1**

1.1 Governing Board . . . 1

1.2 Executive Council . . . 3

1.2.1 Profiles of Governing Board and Executive Council Members . . . 4

1.2.2 Director's Advisory Committees . . . 7

1.3 Faculty . . . 11

1.4 Emeritus Faculty Members . . . 13

1.5 Scientific Staff . . . 13

1.6 Administrative & Accounts Staff members . . . 13

1.7 Project Staff . . . 14

1.7.1 Project Staff [Non Academic] . . . 14

1.7.2 Project Staff [Scientific/Academic] . . . 14

1.8 Post-Doctoral Fellows . . . 15

1.9 Ph.D. Students . . . 16

1.10 Summer Students . . . 19

2 Research and Teaching **21**

2.1 Computational Biology . . . 21

2.1.1 Research Summary & Highlights . . . 21

2.1.2 List of Publications . . . 23

2.2 Mathematics . . . 26

2.2.1 Research Summary & Highlights . . . 26

2.2.2 List of Publications . . . 29

2.3 Physics . . . 35
2.3.1 Research Summary & Highlights . . . 35
2.3.2 List of Publications . . . 44
2.4 Theoretical Computer Science . . . 57
2.4.1 Research Summary & Highlights . . . 57
2.4.2 List of Publications . . . 59
2.5 Student Programmes . . . 67
2.5.1 Degrees Awarded . . . 67
2.5.2 Lecture Courses During 2020 – 2021. . . . 71
2.6 Honours and Awards . . . 73

3 Other Professional Activities **75**

4 Colloquia & OutReach **79**

4.1 Conferences/Workshops Held at IMSc . . . 79
4.1.1 Conference (online) on Analytic and Combinatorial number theory during Mar 12 – Mar 18, 2021. . . . 79
4.1.2 SPARC online lectures series on Schinzel-Zassenhaus conjecture during Mar 24 – Mar 31, 2021. . . . 79
4.2 Other Conferences/Workshops Organized by IMSc . . . 79
4.2.1 Virtual Math Fest 2020 during Jul 20 – Jul 26, 2020. . . . 79
4.2.2 Online Interactive Mathematics Training on Number Theory and Algebra during Aug 17 – Aug 21, 2020. . . . 80
4.2.3 Virtual Meeting on Compact Stars and QCD 2020 during Aug 17 – Aug 21, 2020. . . . 80
4.2.4 Teachers' Enrichment Workshop during Nov 19, 2020 – Jan 3, 2021. . . 80
4.2.5 Chandrasekharan Centenary Symposium in Number Theory on Dec 19, 2020. . . . 80
4.2.6 Arecibo Day on Dec 22, 2020. . . . 81
4.2.7 International GeoGebra Conference, India during Mar 11 – Mar 13, 2021. . . . 81
4.3 IMSc Outreach Activities . . . 81
4.4 Seminars . . . 84

5 External Interactions **101**

5.1 Collaborative Projects with Other Institutions 101

5.1.1 Arecibo 327 MHz Drift Pulsar Survey (AO327) 101

5.1.2 Geometric methods for deep learning and topological characterization of complex networks 101

5.1.3 Indian Pulsar Timing Array (InPTA) experiment 101

5.1.4 Indo-French Program in Mathematics, IFPM 102

5.1.5 Max Planck Partner Group in Mathematical Biology 102

5.1.6 SPARC 102

5.1.7 Vigyan Pratibha 102

5.2 Conference Participation and Visits to Other Institutions 103

5.3 Visitors 109

6 Infrastructure **111**

6.1 Computer Facilities 111

6.2 The Library 112

Chapter 1

The Institute

1.1 Governing Board

Thiru. **K.P. Anbalagan**,
Hon'ble Minister for Higher Education,
Government of Tamil Nadu, Fort St.George, Chennai
(**Chairman**)

Dr. **K.N. Vyas**,
Chairman, Atomic Energy Commission & Secretary to Government of India,
Department of Atomic Energy, CSM Marg, Mumbai
(**Co-Chairman**)

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

Prof. **Amitava Raychaudhuri**,
Former Director, HRI,
Sir Tarak Nath Palith Professor of Physics
Professor Emeritus, University of Calcutta, Kolkata
(**Member**)

Prof. **S. Gowri**,
Vice-Chancellor, University of Madras,
Chepauk, Chennai
(**Member**)

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

Ms. **Apoorva**, IAS,
Principal Secretary to Govt., Higher Education Department,
Secretariat, Fort St.George, Chennai
(**Member**)

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

1.2 Executive Council

Shri. **K.N. Vyas**,
Chairman, Atomic Energy Commission, & Secretary to Government of India,
Department of Atomic Energy, CSM Marg, Mumbai
(**Chairman**)

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

Prof. **Amitava Raychaudhuri**,
Former Director, HRI,
Sir Tarak Nath Palit Professor of Physics,
Professor Emeritus, University of Calcutta, Kolkata
(**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**)

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

Selvi. **Apoorva**,IAS
Principal Secretary to Government, Higher Education Department,
Secretariat, Fort St.George, Chennai
(**Member**)

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

1.2.1 Profiles of Governing Board and Executive Council Members

Thiru **K.P. Anbalagan**, Hon'ble Minister for Higher Education, Government of Tamilnadu, Chennai
(**Chairman**, *Governing Board*)
He was previously the Information and Publicity Minister of Government of Tamilnadu.

Dr. K. N. Vyas, Chairman, Atomic Energy Commission & Secretary to Govt. of India, Department of Atomic Energy, CSM Marg, Mumbai
(**Co-Chairman**, *Governing Board* & **Chairman**, *Executive Council*)
Dr. Kamlesh Nilkanth Vyas is a Mechanical Engineering graduate from MS University, Vadodara. After completion of the training in the 22nd Batch of the BARC Training School in 1979, he joined Fuel Design Development Section of Reactor Engineering Division of BARC. Dr. Vyas has worked for design & analysis of nuclear reactor fuels. He was also responsible for design & development of a novel fuel for strategic applications. He has worked extensively in thermal hydraulics and stress analysis of critical reactor core components. Dr. Vyas, as an engineer, has played a key role for completion of strategic projects. Dr. Vyas has also participated in design & analysis of the Test Blanket Module planned to be installed in ITER, France.
Dr. Vyas has been conferred several awards, which include Indian Nuclear Society Outstanding Service Award 2011, Homi Bhabha Science and Technology Award 2006, DAE Awards in the years 2007, 2008, 2012 and 2013. He is also a Fellow of the Indian National Academy of Engineers.
Dr. K. N. Vyas was Director, Bhabha Atomic Research Centre, before he has taken over the charge of Secretary, Department of Atomic Energy and Chairman, Atomic Energy Commission on 20.09.2018.

Prof. Mustansir Barma Former Director, TIFR, Professor Emeritus, 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. **S. Gowri**, Vice-Chancellor, University of Madras, Chennai
(**Member**, *Governing Board*)
He has previously been the First Registrar of Anna University of Technology Chennai and Chairman, Faculty of Mechanical Engineering of Anna University of Technology Chennai.
He is the recipient of the National award for Outstanding Academic 2011 honoured by the Indian Society for Technical Education, New Delhi in 2012.
He has contributed to SWAYAM MOOCS and DTH of the Central Government. He is also the channel coordinator of DAKSH HD Channel, an educational channel of the MHRD.

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.

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*)

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

Prof. V. Arvind, Acting Director, IMSc Chennai
(**Member Secretary**, *Governing Board & Executive Council*)
Prof. V. Arvind was a faculty member at IIT, Madras and IIT, Delhi prior to joining IMSc as a faculty

1.2.2 Director's Advisory Committees

Annual Report Committee

Viswanath , S.	Chair
Shrihari Gopalakrishna	
Vikram Sharma	
Paul Pandian	(Library)
Areejit Samal	
Sayantan Sharma	

Alumni Committee

Meena Mahajan	
Pinaki Chaudhuri	(as CC-Chair)
Indrava Roy	Chair
Paul Pandian	
Raveendra Reddy, B.	

Computer Media & Web Committee

Pinaki Chaudhuri	Chair
Venkatesh Raman	
Raghavan, K.N.	
Rahul Siddharthan	
Satyavani Vemparala	
Sanoli Gun	
Sayantan Sharma	
Dhiraj Kumar Hazra	
Subramoniam, G.	SO'F'(Systems)
Raveendra Reddy, B.	SO'F'(Systems)
A student representative	(nominated by the Chair)

Events & Outreach Committee

Raghavan, K.N.	
Areejit Samal	Chair
Ajit C Balram	
Sushmita Venugopalan	
Varuni Prabhakar	Research Associate

Internal Complaints Committee (Gender Bias Redressal)

Sanoli Gun	Chair
Rajesh Ravindran	
Sushmita Venugopalan	
Vishnu Prasad, S.	Registrar
Indra, R.	Administrative Officer
Geetha, V.	(External Member)
A Student Representative	(Nominated by the Chair)

Grievance Redressal Committee

Meena Mahajan	Chair
Anirban Mukhopadhyay	
Sanatan Digal	
Sujay Ashok	

Guest House Advisory Committee

Pralay Chatterjee	Chair
Ravindran, V.	
Saket Saurabh	
Vishnu Prasad, S.	Registrar
A Student Representative	(Nominated by the Chair)

HBNI Coordinators Committee

Amritanshu Prasad	Dean, Student Affairs
Satyavani Vemparala	Dean, Physical Sciences
Sanatan Digal	Associate Dean, Physical Sciences
Vijay Kodiyalam	Dean, Mathematical Sciences
Sitabhra Sinha	Dean, Life Sciences

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

Vikram Sharma	Chair
Indumathi	
Prakash Saivasan	

Housing & Up-Keep Committee

Ravindran, V.	Chair
Pinaki Chaudhuri	
Chandrashekar, C.M.	
Vishnu Prasad, S.	Registrar
Indra, R.	Administrative Officer

Library Committee

C.R. Subramanian	
Amritanshu Prasad	Chair
Sitabhra Sinha	
Anirban Mukhopadhyay	
Manjari Bagchi	
C.M. Chandrashekar	
Paul Pandian	(Librarian)
A Student Representative	(nominated by the Chair)

National Science Day Committee

Ravindran, V.
Prakash Saivasan
Sushmita Venugopalan

Official Language Implementation Committee

Arvind, V.	Chair
Srinivas, K.	
Saket Saurabh	
Nita Sinha	
Vishnu Prasad, S.	Registrar
A Student Representative	(nominated by the Chair)

PDF Committees

Sanoli Gun & **Dishant Pancholi**	Mathematics
Roji Pius	HEP
Sibasish Ghosh & **Sitabhra Sinha**	&
Satyavani Vemparala & **Ajit C. Balram**	LEP

Refurbishment Committee

Saket Saurabh	Chair
Anirban Mukhopadhyay	
Chandrasekar, K.	Ex-Chief Architect, IGCAR
Vishnu Prasad, S.	Registrar
Sundar, M.	SO 'D' (Civil)
Mohan, S.	SO 'E'(Electrical)

Right To Information Act [RTI] Committee

Venkatesh Raman	Appellate Authority
Vishnu Prasad, S.	Public Information Officer

Space Planning & Allocation Committee

Arvind, V.	Chair
Amritanshu Prasad	
Indumathi	
Hassan, S.R.	
Chandrashekar, C.M.	
Subramanian, C.R.	
Vishnu Prasad, S.	Registrar

Institute Seminar Day

Areejit Samal
Sayantan Sharma
Sushmita Venugopalan

Prakash Saivasan

Tender Committee

Hassan, S.R.
Ajit C Balram

Sports/GYM Committee

Vikram Sharma
Sundar, S.
Manjari Bagchi
Student Members :
Rakesh Netha (*Cricket)*
Tanmoy Sengupta (*Foot ball& Tennis*)
Anupam Sarkar(*Badminton*)
Mrigendra Singh(*Table Tennis*)

Science at the Sabha Committee

Rahul Siddharthan	Chair
Viswanath, S.	
Vishnu Prasad, S.	

Approval Coordinators Committee

Shrihari Gopalakrishna	Physics
Srinivas, K.	Mathematics
Meena Mahajan	TCS
Sitabhra Sinha	Computational Biology

Colloquium & Seminar Committee

Nemani, V.S.	Physics
Dishant Pancholi	Mathematics
Prakash Saivasan	TCS

Summer Research Programme Committee

Venkatesh Raman	TCS
Dishant Pancholi	Mathematics
Pinaki Chaudhuri	Physics

Associates Programme Committee

Arvind, V.	Chair
Venkatesh Raman	TCS
Sanoli Gun &	
Dishant Pancholi	Mathematics
Mukul Laad	Physics

Academic Coordinators Committee

Sujay Ashok	Physics
Sundar, S.	Mathematics
Subramanian, C.R.	TCS

JEST Coordinators Committee

Ajit C Balaram	Physics(JEST)
Sanoli Gun	Mathematics(NBHM)
Vikram Sharma	TCS(JEST)
Rahul Siddharthan	CB(JGEEBILS)

Group Conveners Committee

Chandrashekar, C.M.	- LEP
Roji Pius	- HEP
Raghavan, K.N.	- Mathematics
Venkatesh Raman	- TCS
Rahul Siddharthan	- Computational Biology

The Chairs of the Committee may always co-opt any other member of IMSc when required.

1.3 Faculty

Name	*Userid*

Computational Biology

Menon, Gautam I.	menon
Samal, Areejit	asamal
Siddharthan, Rahul	rsidd
Sinha, Sitabhra	sitabhra

Mathematics

Chakraborty, Partha Sarathi	parthac
Chatterjee, Pralay	pralay
Dixit, Anup Biswanath	anupdixit
Gun, Sanoli	sanoli
Iyer, Jaya N.	jniyer
Kodiyalam, Vijay	vijay
Mohari, Anilesh	anilesh
Mukhopadhyay, Anirban	anirban
Pancholi, Dishant Mayurbhai	dishant
Prasad, Amritanshu	amri
Raghavan, K. N.	knr
Roy, Indrava	indrava

Srinivas, K.	srini
Sundar, S.	ssundar
Sushmita Venugopalan	sushmita
Viswanath, S.	svis

Physics

Adhikari, Ronojoy	rjoy
Ashok, Sujay K.	sashok
Bagchi, Manjari	manjari
Balram, Ajit C.	ajit
Chandrashekar, C.M.	chandru
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
Menon, Gautam I.	menon
Mukhopadhyay, Partha	parthamu
Nemani, Venkata Suryanarayana	nemani
Pius, Roji	rojipius
Rajesh, Ravindran	rrajesh
Ramachandran, Ganesh	ganesh
Ravindran, V.	ravindra
Sayantan Sharma	sayantans
Siddharthan, Rahul	rsidd
Sinha, Nita	nita
Sinha, Rahul	sinha
Sinha, Sitabhra	sitabhra
Vemparala, Satyavani	vani

Theoretical Computer Science

Arvind, V.	arvind
Gupta, Sushmita	sushmitagupta
Mahajan, Meena	meena
Raman, Venkatesh	vraman
Ramanujam, R.	jam
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

Subramoniam G.	gsmoni
Raveendra Reddy B.	ravi
Paul Pandian M.	pandian
Mohan S.	smohan
Usha Devi P.	usha
Sundar M.	msundar
Maruthu Pandiyan B.	maruthu

1.6 Administrative & Accounts Staff members

Vishnu Prasad S.
Registrar

Gayatri E.
Accounts Officer

Indra R.
Administrative Officer

Shankaran, K.P.
Seenivasa Raghavan N.
Usha Otheeswaran
Archana Shukla
Babu, B.
Johnson, P.
Gopinath, S.
Amulraj, D.
Janakiraman, J.
Munuswamy, N.
Rajasekaran, N.
Ravichandran, N.
Parthiban, V.
Ashfack Ahmed, G.
Geetha, M.
Padmanabhan, T.
Prema, P.
Jayanthi, S.
Baskaran, R.
Balakrishnan, J.
Moorthy, E.
Radhakrishnan, M. G.
Ramesh, M.
Tamil Mani, M.

1.7 Project Staff

1.7.1 Project Staff [Non Academic]

Name	*Userid*
Balachander M.	mbchander
Gayathri S.	gayathris
Hari Priya T.V.	tvhpriya
Hemamalini A.	ahema
Imran Khan H.	imrankhan
Karthikeyan B.S.	bskarthi
Karthikeyan M.	mkarthikeyan
Kirubananth P.	kirubananth
Krishna Balaji R.	rkbalaji
Kavyaa Kumaravel	kavyaak
Manikandan Sambasivam	
Moovendan M.	moovendan
Narmatha S.	snarmatha
Parthasarathi N.	npsarathi
Prashanna K.	prasannak
Rajkumar S.	srajkumar
Rethinasamy D.	drsamy
Sadhana R.	sadhana
Sakthivel Murugan E.	esakthi
Shalieni D.	shalienid
Sivasubbu Raj B.	sivaraj
Sreelakshmi P.K.	lakshmipk
Srinadh G.	gsrinadh
Srinivasan G.	gsvasan
Sree Raj T.P.	sreeraj
Thennarasu S.D.	sdthennarasu
Vaideeswaran	mveswaran
Vimalraj J.	vimalraj
Vinoth Babu M.	mvinoth

1.7.2 Project Staff [Scientific/Academic]

Name	*Userid*
Gajendra Singh Badwal	
Janaki Raghavan	rjanaki
Md. Izhar Ashraf	ashraf
Pavithra Elumalai	pavithrae
Shaily Verma	shailyverma
Shakthi N. Menon	shakthi
Soumya Easwaran	soumyae

Sudharshan A.	
Surendra Singh Badwal	
Varuni Prabhakar	varuni
Vinod Kumar T.	tvinodkumar

1.8 Post-Doctoral Fellows

Name	*Userid*
Computational Biology	
Nayana Mukerjee	nayanam
Om Prakash	omprakash
Sushmita Ghosh	susmitag
Mathematics	
Abhishek T. Bharadwaj	abhishektb
Abishek Juyal	ajuyal
Amit Kumar Singh	amitsingh
Anbu Arjunan	aanbu
Anuj Jakhar	anujjakhar
Jyotirmoy Ganguly	jyotirmoy
Kathiravan T.	tkathiravan
Neha Prabhu	nehap
Selvaraja S.	selvaraja
Soumya Dey	soumyadey
Usha Keshav Sangale	uksangale
Veekesh Kumar	veekeshk
Physics	
Abhiram Kaushik B	abhiramkb
Amit Mukherjee	amitm
Arghya Chattopadhyay	arghyac
Arpan Das	arpandas
Arpita Choudhary	arpitac
Asweel Ahemed A Jaleel	asweel
Chandreyee Roy	chandreyeer
Chandrima Paul	chandrimap
Gautam Sharma	gsharma
Prasad V.V.	prasadvv
Projesh Roy	projeshkr
Rahul Dandekar	rsdandekar

Samapan Sikdar	samapans
Shreyansh Shankar Dave	shreyanshsd
Sitender Pratap Kashyap	sitenderpk
Subhroneel Chakrabarti	subhroneelc
Suman Dutta	sumand

Theoretical Computer Science

Anupam Mondal	anupamm
Gurumuruhan Ganesan	ghurumg
Sameera Muhamed Salam	sameerams
Shaily Verma	shailyverma
Vibha Sahlot	vibhasahlot

1.9 Ph.D. Students

Name	*Userid*

Computational Biology

Ajay Subbaroyan	sajay
Ajaya Kumar Sahoo	ajayaks
Aniruddha, N.	naniruddha
Chandrani Kumari	chandranik
Chandrashekar K. A.	kachandra
Devanand T.	devanandt
Farhina Mozaffer	farihinam
Janani R.	jananir
Pavitra S.	spavitra
Rakshika Lakshmi, A.	rakshikal
Reshma M	reshmam
Ria Ghosh	riaghosh
Roni Saiba	ronis
Sreevidya T.S	tssreevidya
Sunayanaa Sridharan	sunayanaas
Vadnala Rakesh Netha	rakeshnetha
Vivek Ananth R.P.	vivekananth

Mathematics

Ankur Sarkar	ankurs
Aritra Bhattacharya	baritra
Arunabha Mukhopadhyay	arunabham
Dhananjaya Saha	dhananjayas
Digjoy Paul	digjoypaul

Jayakumar R.	rjayakumar
Joseph Judy	josephjudy
Karthick Babu C.G.	cgkbabu
Krishanu Roy	krishanur
Manas Mandal	manasm
Manav Gaddam	manavg
Mrigendra Singh Kushwaha	mrigendra
Namitha C.H	namithach
Neelam	neelam
Oorna Mitra	oornamitra
Piyasa Sarkar	psarkar
Priyamvad Srivastav	priyamvads
Rashi Sanjay Lunia	rashisl
Ratheesh T.V	ratheeshtv
Sathish Kumar, V.	vsathish
Siddheswar Kundu	siddheswark
Sridhar P. Narayanan	sridharn
Sruthy Murali	sruthym
Sunil L Naik	sunilnaik
Suhas Rao Devraj	suhasrao
Tanmoy Bera	tanmoyb
Saurav Holme Choudhury	sauravhe
Ujjal Das	ujjaldas

Physics

Abinash Kumar Nayak	abinashkn
Adarsh Sudhakar	adarshsu
Ajjath A.H.	ajjathah
Akhil Antony	akhilantony
Amir Suhail	amirs
Amit Kumar	kamit
Amit Suthar	amitsuthar
Amlan Chakraborty	amlanchak
Anand Pathak	anandb
Anjali Kundalpady	anjalik
Anupam A.H.	anupam
Anupam Sarkar	asarkar
Aparajitha Karthikeyan	aparajithak
Aparna Sankar	aparnas
Apurba Biswas, G.	apurbab
Arindam Mitra	amitra
Arjun Hariharan	arjunh
Arkajyoti Manna	arkajyotim
Arpan Kundu	akundu
Dhruv Pathak	dhruvpathak
Garima Rani	grani
Gopal Prakash	gopalp

Himanshu Badhani	himanshub
Hitesh Garg	hiteshgarg
Jatin Ghai	jghai
Jyotijwal Debnath	jdebnath
Kamal Tripathi	kamalt
Koyena Bose	koyenb
Krishna Jalan	krishnajalan
Mamale Vinod Suryakant	mvinod
Manish	manishd
Mohammad Shabbir	mshabbir
Nishant Gupta	nishantg
Pavan Dharanipragada	pavand
Pooja Mukherjee	poojamukherjee
Prabhat Butola	prabhatb
Prateek Chawla	prateekc
Prem Kumar	premk
Pritam Sen	pritamsen
Raghvendra Singh	raghvendra
Rakesh Dora	prakeshdora
Ravi T	travi
Ria Sain	riasain
Ravi Shanker	rshanker
Sabiar Shaikh	sabiarshaikh
Sabyasachi Chowdhuri	sabyasachic
Sahil	sahilmd
Samim Akhtar	saminakhtar
Saroj Prasad Chhatoi	sarojpc
Sayantan Ghosh	sayantang
Semanti Dutta	semantid
Shibasis Roy	shibasisr
Shivam Gola	shivamg
Shivani Singh	shivanis
Soumya Sur	soumyasur
Soumen Podder	soumenp
Sourav Ballav	sballav
Subhankar Khatua	shubankark
Sujoy Mahato	sujoymahato
Surabhi Tiwari	surabhit
Subashri, V.	subashriv
Sushovan Mondal	smondal
Sumit Shaw	sumitshaw
Tanmay Mitra	tmitra
Tanmay Saha	sahatanmay
Tanmoy Sengupta	tsengupta
Toshali Mitra	toshalim
Umang A. Dattani	umangad
Vaibhav Pathak	vaibhavp
Varun Gupta	varungupta
Vigneshwaran K.	vigneshwaran

Vinay Vaibhav	vinayv

Theoretical Computer Science

Abhishek Sahu	asahu
Abhimanyu Choudhury	abhimanyuc
Abhranil Chatterjee	abhranilc
Anannya Upasana	anannyaupad
Arindam Biswas	barindam
Ashwin Jacob	ajacob
Gaurav Sood	gauravs
Jayakrishnan M.	jayakrishnan
Koduri Siddharth Choudary	kodurisc
Lawqueen Kanesh	lawqueen
Niranka Banerjee	nirankab
Ramit Das	ramitd
Roohani Sharma	roohani
Rian Neogi	rianneogi
Sanjukta Roy	sanjukta
Souvik Saha	souviks
Yogesh Dahiya	yogeshdahiya

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, 2020 - Mar, 2021.

Student	Faculty
Mathematics	
Indulal, Anagha, Pondicherry University	Gun, S.
P., Deepthi C., RIASM, University of Madras	Gun, S.
Devraj, Suhas R., Pondicherry University	Raghavan, K.N.
Bhat, Meghana, Pondicherry University	Raghavan, K.N.
Physics	
Singh, Mihir IISER, Mohali,	Sharma, S.
Dey, Suroj, IISER, Mohali,	Sharma, S.
Shweta Jain, NIT, Trichy	Dhiraj Hazra
Kushal Lodha, IIT-Kharagpur, Kharagpur	Dhiraj Hazra
Shashank Gandhi , IIT-Madras, Chennai	Dhiraj Hazra

Chapter 2

Research and Teaching

2.1 Computational Biology

2.1.1 Research Summary & Highlights

Computational Biology

Fungal secondary metabolites constitute a diverse chemical space for drug disocvery. Through a large-scale literature mining and manual curation effort, a dedicated resource, MeFSAT (https://cb.imsc.res.in/mefsat/), was built compiling information on 184 medicinal fungi, 1830 secondary metabolites and 149 therapeutic uses. Thereafter, the following analyses were performed for the secondary metabolite space of medicinal fungi. Firstly, by comparing the physicochemical properties of secondary metabolites in MeFSAT database with other small molecule collections, it was shown that fungal secondary metabolites have high stereochemical complexity and shape complexity similar to other natural product libraries. Secondly, based on multiple scoring schemes, a subset of 228 drug-like secondary metabolites were filtered within MeFSAT database. Thirdly, by constructing and analyzing chemical similarity networks, it was shown that the chemical space of secondary metabolites in MeFSAT database is highly diverse. See publication [**V2**] for detailed results from this study.

During the COVID-19 pandemic, there has been particular interest in finding lead molecules against SARS-CoV-2 within the IMPPAT database. In this direction, one study study [**V1**] focussed on two human proteases, TMPRSS2 and cathepsin L, that play a key role in host cell entry of SARS-CoV-2. Virtual screening of 14011 phytochemicals produced by Indian herbs was performed to predict 96 inhibitors of TMPRSS2 and 9 inhibitors of cathepsin L among phytochemicals of Indian herbs. Molecular dynamics simulations was also performed to analyze the stability of the protein-ligand complexes for top inhibitors of TMPRSS2 and cathepsin L predicted from the study. Obviously, experimental studies are needed for the validation of the predicted phytochemical inhibitors of TMPRSS2 and cathepsin L from the computational study [**V1**].

Potential inhibitors for COVID-19

Our work with NISER on finding potential inhibitors for COVID-19 which has been listed here:
Coverage in: Dinamalar Pattam: $Thavarangalil COVID-19 Marundhu!(Tamil)$
https://www.imsc.res.in/ asamal/doc/Pattam_Molecules.pdf

Endocrine Disrupting Chemicals - DEDuCT 2.0

In spite of challenges in the regulatory assessment of endocrine disrupting chemicals (EDCs), growing interest has led to rapid expansion of published literature on EDCs. In a recent study, IMSc researchers have explored how academic research can inform current chemical regulations on EDCs. For this study, an updated knowledgebase, DEDuCT 2.0, was built containing 792 potential EDCs with supporting evidence from 2218 published research articles. Thereafter, the distributions of potential EDCs across 36 chemical lists which are part of inventories, guidelines and regulations was studied. Notably, several potential EDCs were found to be distributed across diverse chemical lists, and further, some of these chemical lists with potential EDCs are in day-to-day product categories such as 'Food additives and Food contact materials' and 'Cosmetics and household products'. Several of these EDCs in day-to-day product categories are also produced in high volume across the world. Lastly, using an example, it was shown how diverse information in DEDuCT 2.0 can be helpful in the risk assessment of EDCs. See publication [**K2**] for detailed results from this study. Human milk is the vital source of nourishment for infants. Environmental chemicals which make into the breast milk constitute the human milk exposome. Since it is important to understand the effects of these human milk contaminants on maternal and infant health, a unique resource, ExHuMId (https://cb.imsc.res.in/exhumid/), was built containing detailed information on 101 environmental contaminants detected in human milk samples across 13 Indian states, compiled from 36 published research articles. After compiling the human milk exposome, the following analyses were performed on the chemical space. Firstly, through a comparative analysis with global chemical regulations and guidelines, human milk contaminants of high concern, such as potential carcinogens, endocrine disruptors and neurotoxins were identified. Secondly, an analysis of the physicochemical properties of the human milk contaminants was performed. Thirdly, using a systems biology approach, potential interactions between human milk contaminants and genes relevant for lactation, cytokine signalling and xenobiotic transport were identified. See publication [**K1**] for detailed results from this study. This work has received coverage in Nature India after publication.

Early screening of environmental chemicals for potential neurotoxicity is important for human well-being. In this direction, the first dedicated resource, NeurotoxKb (https://cb.imsc.res.in/neurotoxkb/), was built containing information on 475 potential non-biogenic neurotoxicants curated from 835 published studies specific to mammals. After building NeurotoxKb, the following analyses were performed. Firstly, a comparative analysis of NeurotoxKb with 55 chemical lists which include inventories, regulations and guidelines, found that several potential neurotoxicants are both in regular use and produced in high volume. Secondly, a comparative analysis of NeurotoxKb and chemicals detected in 31 different human biospecimens, found that several potential neurotoxicants have been detected in different biospecimens. Thirdly, a hazard priority list of 18 potential neurotoxicants was proposed. Fourthly, the network of interactions between potential neurotoxicants and human neuroreceptors was explored. Fifthly, the chemical similarity network was constructed to reveal the diversity of the toxicological space of 475 potential neurotoxicants in NeurotoxKb. See publication [**R**] for detailed results from this study.

Epidemiological model for India: INDSCI-SIM

Gautam Menon, Sitabhra Sinha, Pinaki Chauduri and Dhiraj Kumar Hazra from IMSc in collaboration with scientists from Pune University (Pune) IISc (Bengaluru) and BITS-Pilani (Goa) have been working on the development of INDSCi-SIM model, which is a detailed, India-specific, epidemiological model for analysing the spread of COVID-19 in India, with parameters based on clinical studies and demographic data, including age stratification, migration, contact matrix information. Using this model, it is possible to compare the effects of multiple non-pharmaceutical interventions – including different types of lock-downs, quarantines and expanded testing – in altering the trajectory of the pandemic. Finally, the model can be used to forecast the requirements that will be placed on the health care system, including requirements for hospital beds and for critical care. The INDSCI-SIM code can simulate disease progression at arbitrary granularity (country/states/districts) and an online dashboard can be used by local administrators to plan their interventions. The model has been successfully incorporated into the resource planning and interventions by some local governments (e.g. Pune, Karnataka).

We have been publishing regular reports which are available online 'indscicov.in/indscisim', and a manuscript is now in preparation.
https://indscicov.in/for-scientists-healthcare-professionals/mathematical-modelling/indscisim/

Sitabhra Sinha of IMSc was part of the Public Health Working Group set up by the Ministry of Health Family Welfare, Government of India in March this year under Union Secretary (H) to review the evolving scenario of COVID19 and guide public health response to the same. He has been evaluating the epidemiological situation of the COVID19 pandemic in India from March, and our work has been featured in the electronic and print media prominently from that time.

Sinha S. (2020) Epidemiological Dynamics of the COVID-19 Pandemic in India: An Interim Assessment. In STATISTICS AND APPLICATIONS (Vol. 18, No.1, pp. 333–350) https://ssca.org.in/media/21_18_1_2020_SA_SSinha_Uq5HK22.pdf

Multidisciplinary Research

Chandrani Kumari, Gautam Menon and Rahul Siddharthan were part of a multidisciplinary team, with doctors at Apollo Hospitals and biomedical researchers at IIT Madras, that studied the role of circulating progenitor cells in predicting vasoplegia, which is associated with ICU morbidity and organ failure. This work was published in PLOS ONE https://doi.org/10.1371/journal.pone.0242375

Media coverage appeared in 'The Hindu', November 2020 : https://www.thehindu.com/sci-tech/science/pilot-study-finds-potential-signal-indicative-of-loss-of-tone-in-blood-vessels-after-cardiac-surgery/article33201645.ece

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.

[**A**]
Ankit Agrawal, Nirmalendu Ganai*, Surajit Sengupta*, and Gautam I. Menon.
Nonequilibrium biophysical processes influence the large-scale architecture of the cell nucleus.
Biophys J, **118(9)**, 2229–2244, 2020.

[**C**]
Sanhita Nandi*, Uma Rani Potunuru*, Chandrani Kumari, Abel Arul Nathan*, Jayashree Gopal*, Gautam I.Menon, Rahul Siddharthan, Madhulika Dixit*, and Paul Ramesh Thangaraj*.
Altered kinetics of circulating progenitor cells in cardiopulmonary bypass (CPB) associated vasoplegic patients: A pilot study.
PLOS ONE, **15(11)**, 1–17, 2020.
DOI = doi.org/10.1371/journal.pone.0242375.

[**K1**]
Bagavathy Shanmugam Karthikeyan, Janani Ravichandran, S.R. Aparna, and Areejit Samal.
ExHuMId: A curated resource and analysis of Exposome of Human Milk across India.
Chemosphere, **271**, 129583, 2021.

[**K2**]
Bagavathy Shanmugam Karthikeyan, Janani Ravichandran, S.R. Aparna, and Areejit Samal.
DEDuCT 2.0: An updated knowledgebase and an exploratory analysis of the current regulations and guidelines from the perspective of endocrine disrupting chemicals.
Chemosphere, **267**, 128898, 2021.

[**M1**]
Brody H. Foy*, Brian Wahl*, Kayur Mehta*, Anita Shet*, Gautam I. Menon, and Carl Britto*.
Comparing covid-19 vaccine allocation strategies in india: A mathematical modelling study.
International Journal of Infectious Diseases, **103**, 431–438, 2021.

[**M2**]
N. Shankaraiah*, Surajit Sengupta*, and Gautam I. Menon.
Disorder-induced enhancement of local hexatic correlations in two-dimensional fluids.
Journal of Physics: Condensed Matter, **32(18)**, Article. 184003, 2020.

[**Mu**]
Nayana N. Mukherjee and Vitaly V. Volpert*.
Bifurcation scenario of turing patterns in prey-predator model with nonlocal consumption in the prey dynamics.
Communications in Nonlinear Science and Numerical Simulation, **96**, 105677, 2020.

[**P1**]
OM PRAKASH.
Hydrophobicity as a parameter to quantify relative efficacy of receptor determinants during host virus interaction.
2020.
(Preprint: DOI: 10.26434/chemrxiv.12424376.v1).

[**P2**]
Om Prakash.
Neuroligin affects metastatic performance of cd66+ cells.
2020.
(Preprint: doi: https://doi.org/10.1101/2020.07.29.226274).

[**P3**]
OM PRAKASH.
Protocol for clustering of non-unified protein sequences through memory-map guided deep learning.
2020.
(Preprint: doi: https://doi.org/10.1101/2020.08.15.252114).

[**P4**]
OM PRAKASH.
Invasion performance-similarity found among multiple cell systems.
2020.
(Preprint: doi: https://doi.org/10.1101/2020.08.15.252445).

[**R**]
Janani Ravichandran, Bagavathy Shanmugam Karthikeyan, Palak Singla, S.R. Aparna, and Areejit Samal.
NeurotoxKb 1.0: compilation, curation and exploration of a knowledgebase of environmental neurotoxicants specific to mammals.
Chemosphere, 2021.
(To be published).

[**S1**]
Marzieh Eidi[*], **Amirhossein Farzam**[*], **Wilmer Leal**[*], **Areejit Samal, and Jürgen Jost**[*].
Edge-based analysis of networks: Curvatures of graphs and hypergraphs.
Theory in Biosciences, **139**, 337, 2020.

[**S2**]
Amirhossein Farzam[*], **Areejit Samal, and Jürgen Jost**[*].
Degree difference: a simple measure to characterize structural heterogeneity in complex networks.
Scientific Reports, **10**, 21348, 2020.

[**S3**]
Areejit Samal, Sunil Kumar*, Yasharth Yadav*, and Anirban Chakraborti*.
Network-centric Indicators for Fragility in Global Financial Indices.
Frontiers in Physics, **8**, 624373, 2021.

[**S4**]
Areejit Samal, Hirdesh K. Pharasi*, Sarath Jyotsna Ramaia*, Harish Kannan*, Emil Saucan*, Jürgen Jost*, and Anirban Chakraborti*.
Network geometry and market instability.
Royal Society Open Science, **8**, 201734, 2021.

[**V1**]
R.P. Vivek-Ananth, Abhijit Rana*, Nithin Rajan, Himansu S. Biswal*, and Areejit Samal.
In silico identification of potential natural product inhibitors of human proteases key to SARS-CoV-2 infection.
Molecules, **25(17)**, 3822, 2020.

[**V2**]
R.P. Vivek-Ananth, Ajaya Kumar Sahoo, Kavya Kumaravel, Karthikeyan Mohanraj, and Areejit Samal.
MeFSAT: A curated natural product database specific to secondary metabolites of medicinal fungi.
RSC Advances, **11**, 2596, 2021.

2.2 Mathematics

2.2.1 Research Summary & Highlights

Algebra The IMSc Algebraic Combinatorics Seminar has been running successfully online since April 2020. Weekly talks are given by the world's leading experts in Algebraic Combinatorics as well as by IMSc's own faculty, postdoctoral fellows and students. These seminars have helped expose our researchers to the latest developments in the area, and have improved our visibility in the community.

Algebraic Geometry

The study of Kostant-Kumar modules for symmetrizable Kac-Moody algebras was continued, including the problem of saturation for them.

Algebraic Number Theory

A well-known conjecture of Gauss states that there are infinitely many real quadratic fields with class number one. This is still unresolved. In [**H**], we investigate the class number

one problem for the two parametric family of real quadratic fields $\mathbb{Q}(\sqrt{d})$ with square-free discriminant $d = m^2 + 2r$ for any positive integers m and r.

In [**Kot**] we investigate the solutions of the generalized Lebesgue-Ramanujan-Nagell equation.

Analytic Number Theory

In [**Gu1**], assuming Dickson's conjecture, the authors show that the set $\mathcal{V}$ of values of the Euler's totient function φ contains arbitrarily large arithmetic progressions with common difference 4. This leads to the question of proving unconditionally that this set $\mathcal{V}$ has a positive upper Banach density.

Modular forms

Ramanujan introduced the famous τ function as

$$\Delta(z) := \sum_{n\geq 1} \tau(n)q^n = q\prod_{\ell\geq 1}(1-q^\ell)^{24}$$

and made three conjectures about it which marks the beginning of the theory of modular forms. One of his conjecture is that $|\tau(p)| \leq 2p^{11/2}$ for any prime p which is now a theorem of Deligne. The analogue of this conjecture for Fourier-coefficients of half-integer weight modular forms is widely open. In [**Gu4**], the authors show that the conjectural bound of the Ramanujan conjecture for half-integer weight modular forms is optimal by producing large Fourier-coefficients. In fact, they do it by by producing large Fourier-coefficients at fundamental discriminants which are intricately linked to critical L-values by a result of Waldspurger.

In [**Gu2**], the author gives an exposition for master and graduate students (as part of Ramaswami Aiyer award lecture) on the state-of-the-art about the question of large Fourier-coefficients.

Let E_k for $k \geq 4$ be the normalized Eisenstein series of weight k for level one, D be the closure of the standard fundamental domain of the Poincaré upper half plane modulo $SL_2(\mathbb{Z})$. Rankin and Swinnerton-Dyer showed that all zeros of E_k in D are of modulus one. In [**Gu6**], the authors study the critical points of E_k. They show that they are simple by exploiting the Lie algebra structure of quasi-modular forms for level one. By applying analytic methods, they count zeros belonging to D as well as those belonging to γD, for any $\gamma \in SL_2(\mathbb{Z})$. This is the first instance where precise information about the location of all the zeros of an infinite family of (non-modular) quasi-modular forms is obtained.

Let f, g be distinct normalized Hecke eigenforms of weights k_1, k_2 lying in the subspace of newforms with Fourier coefficients $\{n^{(k_1-1)/2}\lambda_f(n)\}_{n\in}$ and $\{n^{(k_2-1)/2}\lambda_g(n)\}_{n\in}$ respectively. For such newforms f, g of CM type and primes p, in [**Gu5**], the authors study the natural density of the set

$$S = \{p \mid \lambda_f(p) = \lambda_g(p)\}.$$

They show that the upper natural density of S is $\leq 3/4$ if $f \neq g$ and it is equal to $1/2$ when f and g have different weights and have the same associated CM (quadratic) field. Further, f and g have different associated CM (quadratic) fields if and only if the natural density of S is $1/4$. When at least one of f, g is a non-CM form, they study the natural density of the sets

$$S_+(x, \alpha) = \{p \leq x \mid \theta_f(p) + \theta_g(p) = \alpha\}$$

and

$$S_-(x, \beta) = \{p \leq x \mid \theta_f(p) - \theta_g(p) = \beta\}$$

where $\theta_f(p), \theta_g(p) \in [0, \pi]$ are the angles associated to the p-th Hecke eigen values of f, g respectively and $\alpha \in [0, 2\pi]$, $\beta \in [-\pi, \pi]$. In this case, they show that $S_+(x, \alpha)$ and $S_-(x, \beta)$ have natural density zero when f and g are distinct and not twist of each other. Finally, they establish a curious link between the elements of these sets and sign changes of Fourier coefficients at prime powers which allows them to improve a number of existing results in this set-up.

Transcendental number theory

Let $\Gamma \subset \overline{\mathbb{Q}}^\times$ be a finitely generated multiplicative group of algebraic numbers. Let $\delta, \beta \in \overline{\mathbb{Q}}^\times$ be algebraic numbers with β irrational. In this work, I prove that there exist only finitely many triples $(u, q, p) \in \Gamma \times \mathbb{Z}^2$ with $d = [\mathbb{Q}(u) : \mathbb{Q}]$ such that

$$0 < |\delta q u + \beta - p| < \frac{1}{H^\varepsilon(u) q^{d+\varepsilon}},$$

where $H(u)$ denotes the absolute Weil height. As an application of this result, we also prove a transcendence result, which states as follows: Let $\alpha > 1$ be a real number. Let β be an algebraic irrational and λ be a non-zero real algebraic number. For a given real number $\varepsilon > 0$, if there are infinitely many natural numbers n for which $||\lambda\alpha^n + \beta|| < 2^{-\varepsilon n}$ holds true, then α is transcendental, where $||x||$ denotes the distance from its nearest integer. When α and β both are algebraic satisfying same conditions, then a particular result of Kulkarni, Mavraki and Nguyen asserts that α^d is a Pisot number. When β is algebraic irrational, our result implies that no algebraic number α satisfies the inequality for infinitely many natural numbers n. Also, our result strengthens a result of Wagner and Ziegler. The proof of our results uses the Subspace Theorem based on the idea of Corvaja and Zannier [**?**] together with various modification play a crucial role in the proof. This work has been proved in [**Ku2**].

Let $f(z) = \sum_{n=0}^{\infty} a_n z^n$ be a power series with integer coefficients and converging in the disc $D = \{z : |z| < R\}$ for some $R > 0$. In 1985, Laohakosol proved, using Ridout theorem, that the largest prime factors of partial sums of $f(b)$ for a rational number $0 < |b| < R$ is unbounded, if $f(b)$ is a non-zero algebraic number. In this article, we prove, using the subspace theorem, similar results for other approximation of $f(b)$. Moreover, we prove the number field analogue of Laohakosol's result. This work has been proved in [**Ku1**].

Research work is in progress 'on providing a new necessary and sufficient criteria', for the non-vanishing of L(1,f) for an algebraic valued periodic function f of period N. We intend to apply this results in understanding Erdős conjecture.

Mrigendra Singh Kushwaha, KN Raghavan and S Viswanath of IMSc obtained a combinatorial model for the so-called Kostant-Kumar modules - important submodules of tensor products of integrable highest weight representations of Kac-Moody algebras. This supplies a key missing link in a classical area of representation theory that has been studied by mathematicians for more than 50 years. The paper titled "A study of Kostant-Kumar modules via Littelmann paths" appeared in "Advances in mathematics" in January 2021.

Outreach Activities - Maths

We have organized International GeoGebra Conference, India during 11-13 March, 2021. The aim of this online conference was to illustrate how GeoGebra can be used to develop mathematical thinking in the learners and promote 'Higher Order Thinking'.

The conference featured 10 invited talks by experts in GeoGebra from around the world, 1 panel discussion on role of GeoGebra in motivating underachievers, 15 short presentations by teachers from schools and colleges in India and abroad discussion how they are using GeoGebra in their classrooms. We had received more than two thousand registrations from participants in India and abroad.

Also, for participants who have never used GeoGebra before we had organized introductory workshops on GeoGebra in 9 different languages, i.e Bengali, English, Gujrati, Hindi, Kannada, Malayalam, Marathi, Tamil, and Telugu.

More details about the events can be found at: https://sites.google.com/view/igci2021

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.

[**A1**]
Anbu Arjunan.
Decomposability of multiparameter car flows.
2020.
arXiv:2008.04752 (Submitted).

[**A2**]
Anbu Arjunan.
Remarks on ccr and car flows over closed convex cones.
2020.
(Submitted).

[**A3**]
Anbu Arjunan.
Opposite product system for the multiparameter car flows.

2021.
(Preprint: arXiv:2101.00285).

[C]
Indranil Biswas*, Pralay Chatterjee, and Chandan Maity*.
The second cohomology groups of nilpotent orbits in classical lie algebras.
Kyoto J. Math., **60(2)**, 717–799, 2020.

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2.3 Physics

2.3.1 Research Summary & Highlights

Astrophysics and Cosmology

"Indian Pulsar Timing Array" experiment is continued which has become a full member of the "International Pulsar Timing Array" in February 2021. This experimen ails to detect nano-Hertz gravitational waves. Observations using the upgraded Giant Metrewave Radio Telescope (uGMRT) have been performed.

Thorough analytical expressions for dynamical contributions in the time-derivatives of the spin or orbital frequency of pulsars have been derived. It has been shown that that unique pulsars for which the effects of the dynamical terms are significant can exist.

Magnetars are magnetically powered neutron star with a very high value of the surface magnetic field. In their quiescent state, magnetars emit persistent X-rays, but no radio pulsations. However, there are a handful of magnetars that enter into a radio active state for some time when they emit radio pulsations. These radio active states are often accompanied by X-ray bursts. A program with the upgraded Giant Metrewave Radio Telescope (Kodad, Pune) is running (in collaboration with scientists of other institutes) to search radio pulsations from newly discovered magnetars or when x-ray bursts or radio pulsations are reported by other telescopes at different frequencies. The first detection of the low-frequency radio waves from the magnetar Swift J1818.0-1607 has been reported by this group. Radio pulsations have been searched from two other magnetars, SGR J1935+2154 and SGR 1830-0645. The non-detection of any radio pulsation agreed with independent searches by other radio telescopes at other radio frequencies. The imaging studies provided upper limit of radio brightness of these two sources. Four astronomer's telegram have been published so far from this campaign.

The population of normal pulsars in the Galactic field in an 'evolutionary' approach have been revisited. By comparing the distributions of various parameters of synthetic pulsars detectable by the Parkes Multibeam Pulsar Survey, the Pulsar Arecibo L-band Feed Array Survey, and two Swinburne Multibeam surveys with those of the real pulsars detected by the same surveys, it was found that a good and physically realistic model can be obtained by using a uniform distribution of the braking index in the range of 2.5 to 3.0, a uniform

distribution of the cosine of the angle between the spin and the magnetic axis in the range of 0 to 1, a log-normal birth distribution of the surface magnetic field with the mean and the standard deviation as 12.85 and 0.55 respectively while keeping the distributions of other parameters unchanged from the ones most commonly used in the literature. The universal pulsar 'death-line' has been replaced by a 'death-condition' specific to each individual pulsar. With this improved model, it has been predicted that an all-sky pulsar survey with phase-I SKA-MID would detect about nine thousand normal pulsars in the Galactic field. Among these pulsars, a considerable number would produce continuous gravitational waves in the operational range of the future ground-based gravitational waves detectors like LIGO A+, and in certain cases, the spin-down limit of the gravitational wave strains would be well below the detection sensitivity limit.

We are the first to detect the low-frequency radio waves from the magnetar Swift J1818.0-1607 after the high-frequency radio pulsations were reported by other groups. We also searched for radio pulsations from two other magnetars, SGR J1935+2154 and SGR 1830-0645. We did not detect any radio pulsations from these two sources which agreed with independent searches by other radio telescopes at other radio frequencies. Our imaging study provided an upper limit of radio brightness of these two sources. Four astronomer's telegram have been published so far from this campaign.

In a recent research work, Dhiraj Kumar Hazra in collaboration with Paoletti, Finelli and Smoot introduced a new model of reionization that allows us to combine cosmological and astrophysical data in a conservative approach to provide best possible constraints.

Classical and Quantum Gravity, Black Holes, Cosmology

Foundation of a configuration space approach to few body problem in curved space is under development. Dixon's gravitational multipole moments of a compact object moving in an arbitrary background and it's fibre bundle description are crucial ingredients that go into the analysis.

Condensed Matter Physics

We have studied the response of different model disordered systems to diverse kinds of perturbations, be it a static but spatially varying potential or some external drive in the form of shear or even internal drive in the form of active forcing, as discussed below.

We have studied [**Chau2**] the remarkable behaviour of dense active matter comprising self-propelled particles at large Pet numbers, over a range of persistence times, from very small persistences, when the active fluid undergoes a slowing down of density relaxations leading to a glass transition as the active propulsion force reduces, to infinite persistence, when as forcing reduces, the fluid jams at a critical point, with stresses along force-chains. For intermediate persistence time, a decrease in forcing drives the fluid through an intermittent phase before dynamical arrest at low forcings. This intermittency is a consequence of periods of jamming followed by bursts of plastic yielding associated with Eshelby deformations. On the other hand, an increase in forcing leads to an increase in the burst frequency; the correlated plastic events result in large scale vorticity and turbulence. Dense extreme active matter brings together the physics of glass, jamming, plasticity and turbulence, in a new state of

driven classical matter.
In this work, we have shown that extreme activity in biological systems or synthetic active matter, in the form of persistent motion, leads to a fascinating manifestation of the physics of glass, jamming, plasticity and turbulence, in a new state of driven classical matter, which has been published in Nature Communications.
Using extensive nonequilibrium molecular dynamics simulations, we have investigated a glass-forming binary Lennard-Jones mixture under shear [**Chau1**]. Both supercooled liquids and glasses are considered. Our focus is on the characterization of inhomogeneous flow patterns such as shear bands that appear as a transient response to the external shear.

For the supercooled liquids, we analyze the crossover from Newtonian to non-Newtonian behavior with increasing shear rate. Above a critical shear rate, where a non-Newtonian response sets in, the transient dynamics are associated with the occurrence of short-lived vertical shear bands, i.e., bands of high mobility that form perpendicular to the flow direction. In the glass states, long-lived horizontal shear bands, i.e., bands of high mobility parallel to the flow direction, are observed in addition to vertical ones.

The systems with shear bands are characterized in terms of mobility maps, stress-strain relations, mean-squared displacements, and (local) potential energies. The initial formation of a horizontal shear band provides an efficient stress release, corresponds to a local minimum of the potential energy, and is followed by a slow broadening of the band towards the homogeneously flowing fluid in the steady state. Whether a horizontal or a vertical shear band forms cannot be predicted from the initial undeformed sample. Furthermore, we show that with increasing system size, the probability for the occurrence of horizontal shear bands increases.

We have also studied [**Chau3**] the shear-response of soft polycrystalline materials, which are partially ordered solids where crystalline order extends over mesoscopic length scales, namely, the grain size. We study the Poisuielle flow of such materials in a rough channel. In general, similar to yield stress fluids, three distinct dynamical states, namely, flowing, stick-slip, and jammed can be observed, with a yield threshold dependent on channel width. Importantly, the interplay between the finite channel width, and the intrinsic ordering scale (the grain size) leads to a new type of spatiotemporal heterogeneity. In wide channels, although the average flow profile remains pluglike, at the underlying granular level, there is vigorous grain remodeling activity resulting from the velocity heterogeneity among the grains. As the channel width approaches typical grain size, the flowing polycrystalline state breaks up into a spatially heterogeneous mixture of flowing liquid like patches and chunks of nearly static grains. Despite these static grains, the average velocity still shows a parabolic profile, dominated by the moving liquid like patches. However, the solid-liquid front moves at nearly constant speed in the opposite direction of the external drive.

In the context of structure formation and corresponding dynamics, the impact on structural ordering in two-dimensional systems via the interplay of size bidispersity and quenched disorder in the form of an externally applied spatially random potential, has been studied for a system of hard disks [**H2**] using Monte Carlo simulations. By scanning across a wide range of dense packing fractions, size ratios and roughness of the applied potential, the phase diagram is constructed, which demonstrates that both quenched and size disorders shift the onset of translational order to higher packings, while maintaining the presence of the intermediate hexatic phase. At larger disorder strengths, the signatures of structural order are absent within the range of investigated packing fractions. Further, the dynamics with increasing

potential strength is analysed for the mono-component system to obtain a spatio-temporal description of the melting process.
Finally, the influence of the externally rough field on the MerminWagner fluctuations, characteristic to two-dimensional systems, is investigated. In a related work [**H1**], the response of a model two-dimensional colloidal glass former to an externally imposed spatially random potential, which acts as a quenched disorder, is investigated using numerical simulations, motivated by recent experiments and also mean field predictions. The external potential induces the onset of the glassy dynamics at increasingly smaller field roughness, with increasing packing fraction of the particulate assembly, and the existence of aging processes within the glassy regime is also observed. Furthermore, along the axis of increasing field roughness, the dynamical slowdown is not correlated to the hexatic order within the supercooled regime.

A collective mode is a paradigmatic property of physical systems ranging from liquid helium to frustrated magnets. Recent investigations of fractional quantum Hall states have revealed that their collective excitation forms an analog of the spin-2 graviton particle. We showed [**Co6**] that a sudden change in the experimentally controllable parameters such as an in-plane magnetic field can serve as a dynamical probe of the graviton. These results demonstrate that the fractional quantum Hall effect provides an ideal platform to study the interplay of exotic collective excitations and emergent quantum geometry in topological phases of matter. Our research efforts in the past year have focused on exotic fractional quantum Hall states [**Co6**, **Co4**, **Co3**, **Co8**, **Co5**] and a study of their collective excitations [**Co7**, **Co6**]

Following on our idea of an exotic $\mathbb{Z}_n$ parton state in the second Landau level, we worked out the role of finite-width in stabilizing it. Our study shows that in small width samples, the proposed parton state may be more stable than the conventional Laughlin state [**Co5**] We also furthered our parton proposal by: i. predicting that FQHE could be observed at 2+4/9. Intriguingly, this parton state presents the first example of a single-component Abelian FQHE state at filling factor p/q which has a degeneracy greater than q [**Co3**].
ii. predicting that a novel non-Abelian state could be stabilized in the 3/7-filled second Landau level of GaAs or the zeroth Landau level of bilayer graphene [**Co4**].

We also studied the close-competition between the liquid and crystal states in the regime of low-filling factors. Our results suggest that even at low-filling factors, the liquid state could prevail over the crystal [**Co8**].

Finally, we studied a problem combining ideas from FQHE and non-equilibrium dynamics. A collective excitation is a paradigmatic property of a wide range of physical systems. Recent studies of FQHE states have revealed that their collective excitation is analogous to the spin-2 graviton particle. We showed that in a bilayer FQHE a sudden change in the electric or in-plane magnetic field can serve as a dynamical probe of the graviton [**Co6**]. These results demonstrate that FQH bilayers provide an ideal platform to study the interplay of the emergent quantum geometry and collective excitations of interacting topological phases

Figure 2.1: [Co5]Quench dynamics of collective modes in fractional quantum hall bilayers.

of matter.

Flow of Polycrystalline Softmatter

In a collaborative work involving researchers from IMSc and IIT-B, we have reported how the flow of polycrystalline soft matter in channels exhibits a rich interplay between grain sizes and confining lengthscales, leading to novel spatiotemporal heterogeneities, with large variation in the phenomenology as the width of the channel is varied. This work [121], published in Physical Review Letters, should spur more work on understanding how the morphology of polycrystalline matter responds to external drive, specially in the context of rheological applications. Sarkar, T., Chaudhuri, P., Sain, A. (2020). Poiseuille Flow of Soft Polycrystals in 2D Rough Channels. In PHYSICAL REVIEW LETTERS (Vol. 124, Issue 15). AMER PHYSICAL SOC. https://doi.org/10.1103/PhysRevLett.124.158003

Fractional quantum Hall effect

The fractional quantum Hall effect (FQHE) forms a paradigm in our understanding of strongly- correlated quantum many-body systems. The FQHE in the lowest Landau level (LLL) is well- understood in a unified manner using the framework of composite fermions. However, such a unified description of FQHE states in the second LL (SLL) has been lacking. We propose that a unified description of FQHE states in the SLL can be obtained using the parton construction.

We elucidate in detail that parton wave functions capture all the FQH states observed in the SLL [11, 12]. In the publication titled “Interplay between fractional quantum Hall liquid

and crystal phases at low filling" [10] , we revisit the issue of the nature of the ground state at low filling factors by studying the competition between the fractional quantum Hall effect (FQHE) liquid and the Wigner crystal phases. Our calculations suggest that rather than forming a full-fledged crystal immediately below filling factor 1/6, the system finds it advantageous to remain in the FQHE liquid phase while creating strong short-range crystalline correlations. In particular, we predict that the ground state at filling factor 1/7 is an FQHE liquid.

Figure 2.2: Filling Factor ν .

https://twitter.com/IMScChennai/status/1296351081220341760
https://twitter.com/IMScChennai/status/1293042206329245697

Non-perturbative QCD, Lattice Gauge Theory, QGP

Z_N symmetry of $SU(N)$ gauge theories is studied in the presence of matter fields. This symmetry is associated with the class of allowed gauge transformation at finite temperature. Gauge transformations which are not periodic in the temporal direction can act only on the gauge fields, thereby do not leave the action invariant. It is expected that, due to this explicit breaking of Z_N, there will be suppression of some Z_N states that are oberved in the case of pure $SU(N)$. In [**Di1**] and [**Di2**], it is shown that the matter fields in the parition function can be integrated by considering only the temporal gauge fields as well as the temporal modes of the matter fields. The results show that though the action is not invariant, partition function averages exhibit the Z_N symmetry. These results are validated by Monte Carlo simulations for the case Z_2 gauge theory. The latter also suggest that the realizaton of symmetry is driven by dominance of the "entropy" or "density of states".

Quantum anomalies influence many important properties of quantum field theories. In the context of QCD with two light quark flavors, effective magnitude of the anomalous U(1) part of the flavor symmetry is believed to influence the nature of finite temperature chiral phase transition. From an extensive ab-initio study [Sh3], it is now shown that the anomalous U(1) symmetry remains significantly broken near the chiral phase transition even when light quark masses are lowered by a factor of three compared to its physical values.
The origin of this symmetry breaking may be topological and significant new evidences have been provided in a new lattice study [Sh2]. The role of anomalous currents have been also studied in the context of strongly interacting quantum electrodynamics in presence of an external magnetic field, far away from equilibrium. It has been shown for the first time [Sh], how the transfer of chirality occurs from the fermion sector resulting in an exponential growth of magnetic field modes of a particular helicity, eventually leading to a late-time turbulence.

The interesting consequences of this phenomena in natural processes are also discussed [Sh]

Quantum Matter

Our recent work [**L**] on Iron oxychalcogenide materials as part of a multinational research enterprise with 20 experimentalists and 3 theorists is now accepted for publication in Nature Partner Journal: Quantum Matter. Here, we have conducted an exhaustive range of experiments and extensive theoretical analysis to demonstrate a rare, novel, hidden spin-quadrupolar (or a liquid crystal-like spin nematic state of matter) in a Mott insulator. This has numerous implications for understanding the physics of these exotic materials, many of which are high temperature superconductors. It now seems that an electronic nematic phase, either orbital or spin-driven, influences the superconductivity, which emerges in its direct proximity.

Quantum Precision Thermometry

In our work [**Chak**] we proposed an alternative method to measure the temperature of a bath using the weak measurement scheme with a finite-dimensional probe. The precision offered by the present scheme not only shows similar qualitative features as the usual quantum-Fisher-information-based thermometric protocols, but also allows for flexibility over setting the optimal thermometric window through the judicious choice of post-selection measurements.

Quantum Walks and Dirac Cellular Automata

In a collaborative work involving researchers from IMSc and Joint Quantum Institute, University of Maryland, we have demonstrated the circuit-based implementation of a discrete-time quantum walk in position space on a five-qubit trapped-ion quantum processor. Using the same framework, by encoding the space of walker positions in particular multi-qubit states and by programming the system to operate with different quantum walk parameters, experimental realization of Dirac cellular automaton with tunable mass parameter was demonstrated. The quantum walk circuits and position state mapping we have reported scale favorably to a larger model and physical systems, allowing the implementation of any algorithm based on discrete-time quantum walks algorithm and the dynamics associated with the

discretized version of the Dirac equation. This work was published in Nature communication [Si].

Soft plus Virtual(SV) and next to SV

We have worked on formulating a framework to study soft plus virtual (SV) and next to SV (NSV) contributions to inclusive as well as differential distributions for the production of colorless state in hadron colliders.
We studied the perturbative structure of threshold enhanced logarithms in the coefficient functions of deep inelastic scattering (DIS) and semi-inclusive e^+e^- annihilation (SI) processes and Drell Yan and Higgs productions and we setup a framework to sum them up to all orders in perturbation theory.
Threshold logarithms show up as the distributions from the soft plus virtual (SV) and as logarithms log(1-z) from next to SV (NSV) contributions. We used the Sudakov differential and the renormalisation group equations along with the factorisation properties of parton level cross sections to obtain the resummed result that predicts SV as well as next to SV contributions to all orders in strong coupling constant. In Mellin N space, we resumed the large logarithms of N keeping 1/N corrections.

Statistical Mechanics

The problem of enumerating the numbering of tilings of lattices with rigid rods of length k has a long history. The only solution that is known is for dimers on planar lattices. Here, rigorous results are obtained for the asymptotic behavior of the entropy of full coverings in the limit of large k. Based on non-rigorous perturbative series expansion, it is conjectured that this large-k behavior of entropy per site is super-universal and continues to hold on all d-dimensional hyper-cubic lattices, with $d \geq 2$ [R2].

Multiphase materials, such as composite materials, exhibit multiple competing failure mechanisms during the growth of a macroscopic defect. For the simulation of the overall fracture process in such materials, a two-phase spring network model that accounts for the architecture between the different components as well as the respective disorders in their failure characteristics is developed. In the specific case of a plain weave architecture, it is shown that any offset between the layers reduces the delocalization of the stresses at the crack tip and thereby substantially lowers the strength and fracture toughness of the overall laminate. The avalanche statistics of the broken springs do not show a distinguishable dependence on the offsets between layers. The power-law exponents are found to be much smaller than that of disordered spring network models in the absence of a crack [R3].

Foraging and other natural phenomena show superdiffusive transport that are described by Levy walks. A model experimental system, an octanoic acid drop on aqueous unsaturated OA solutions, for studying L walks in controlled environments is prsented. The drop spontaneously moves due to unbalanced Marangoni forces, in a manner that mimics biological propulsion in living systems. The drop motion is shown to be a L walk by demonstrating superdiffusive transport, L-stable distributed step lengths, and power-law decay in the velocity autocorrelation function, with consistent exponents. [R1].

The large scale behavior of a collection of hard core run and tumble particles on a one-dimensional lattice with periodic boundary conditions is studied. Each particle has persistent

motion in one direction decided by an associated spin variable until the direction of spin is reversed. The run and tumble model is mapped on to a mass transfer model with fluctuating directed bonds. The steady-state single-site mass distribution in the mass model is calculated within a mean field approximation for larger spin-flip rates and by analyzing an appropriate coalescence-fragmentation model for small spin-flip rates. The hydrodynamic coefficients of diffusivity and conductivity are also calculated for both large and small spin-flip rates and it is shown that the Einstein relation is violated in both regimes [**D3**].

A Mpemba effect refers to the counterintuitive result that, when quenched to a low temperature, a system at higher temperature may equilibrate faster than one at intermediate temperatures. An exactly solvable model where the underlying reasons for the effect can be pinpointed is lacking. Through an exact analysis of the inelastic driven Maxwell gas, a simplified model for a granular gas, where the rate of collision is assumed to be independent of the relative velocity, the conditions under which the Mpemba effect is present is determined for this model. For monodispersed gases, it is shown that the Mpemba effect is present only when the initial states are allowed to be nonstationary, while for bidispersed gases, it is present for some steady-state initial states. It was possible to demonstrate the existence of the strong Mpemba effect for bidispersed Maxwell gas, wherein the system at higher temperature relaxes to a final steady state at an exponentially faster rate leading to smaller equilibration time. [**Bi**].

Shock propagation in conservative as well as dissipative systems has been a topic of interest for a long time. Well-known examples include the spread of disturbance after a nuclear explosion. The solution for the radial distribution of pressure, density, temperature and flow velocity fields in a blast wave propagating through a medium at rest, following an intense explosion, starting from hydrodynamic equations, is one of the classic problems in gas dynamics. However, there is very little direct verification of the theory and its assumptions from simulations of microscopic models. Here, the results and assumptions of the hydrodynamic theory are compared with results from large scale event driven molecular dynamics simulations of a hard sphere gas in three dimensions. It is found that the predictions for the radial distribution of the thermodynamic quantities do not match well with the numerical data. The theory is improved by replacing the ideal gas law with a more realistic virial equation of state for the hard sphere gas. While this improves the theoretical predictions, it still fails to describe the data well. To understand the reasons for this discrepancy, the different assumptions of the hydrodynamic theory are tested within the simulations. A key assumption of the theory is the existence of a local equation of state. This assumption is validated by showing that the local pressure, temperature and density obey the equation of state for a hard sphere gas. However, the probability distribution of the velocity fluctuations has non-gaussian tails, especially away from the shock front, showing that the assumption of local equilibrium is violated. This, along with neglect of heat conduction, could be the possible reasons for the mismatch between theory and simulations [**Jo**].

String Theory

Extending the previous work on constructing string bits theory, a covariant approach to latticising a higher dimensional field theory has been developed in any time-oriented curved background with conformally flat Cauchy slices. This procedure preserves a lattice remnant of all the global and local symmetries, including diffeomorphism. Noether's theorems have been shown to hold true at the classical level. Quantisation and lattice perturbation theory

are yet to be studied.

In two papers[[**As1**], [**As2**], we showed how co-dimension two defects in gauge theories can be embedded into string theory using fractional D-branes. This is part of the geometric engineering programme in which physical properties are encoded in (stringy) geometry. The string theoretic framework should allow us to better understand and explore the physics of defects.

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**]
Alessio Caciagli*, **Rajesh Singh***, **Darshana Joshi***, **R. Adhikari, and Erika Eiser***.
Controlled optofluidic crystallization of colloids tethered at interfaces.
Phys. Rev. Lett., **125**, 068001, 2020.

[**Ad**]
Debasmita Mondal*, **Ronojoy Adhikari, and Prerna Sharma***.
Internal friction controls active ciliary oscillations near the instability threshold.
SCIENCE ADVANCES, **2020(6)**, eabb0503, 2020.

[**Aj1**]
A. Ajjath, Goutam Das*, **M. Kumar***, **Pooja Mukherjee, V. Ravindran, and Kajal Samantha***.
Resummed drell-yan cross-section at n^3ll.
In *Journal of High Energy Physics, V.2020, Article number: 153 (2020)*, page Article number: 153 (2020). Springer, 2020.

[**Aj2**]
A. Ajjath, Pooja Mukherjee, and V. Ravindran.
Infrared structure of su(n) (1) gauge theory to three loops.
Journal of High Energy Physics, **2020**, Article number: 156 (2020), 2020.

[**As1**]
Sujay K. Ashok, Marco Billo*, **Marialuisa Frau***, **Alberto Lerda***, **and Sujoy Mahato**.
Surface defects from fractional branes - part i.
Journal of High Energy Physics, **07(2020)**, Article. 051, 2020.
DOI = 10.1007/JHEP07(2020)051.

[**As2**]
Sujay K. Ashok, Marco Billo*, Marialuisa Frau*, Alberto Lerda*, and Sujoy Mahato.
Surface defects from fractional branes - part ii.
Journal of High Energy Physics, **08(2020)**, Article. 058, 2020.
DOI = 10.1007/JHEP08(2020)058.

[**As3**]
Sujay K. Ashok, Varun Gupta, and Nemani V. Suryanarayana.
On bps strings in n = 4 yang-mills theory.
Journal of High Energy Physics, **01(2021)**, Article. 008, 2021.
DOI = 10.1007/JHEP01(2021)008.

[**As4**]
Sujay K. Ashok, Dileep P. Jatkar*, and Madhusudham Raman*.
Triangle groups: Automorphic forms and nonlinear differential equations.
SIGMA, **16(2020)**, Article. 102, 2020.
DOI = 10.3842/SIGMA.2020.102.

[**As5**]
Sujay K. Ashok and Jan Troost*.
Superstrings in thermal anti-de sitter space.
Journal of High Energy Physics, 2021.
2012.08404 [hep-th] (Submitted).

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Abhimanyu Susobhanan*, Yogesh Maan*, Bhal Chandra Joshi*, T. Prabu*, Shantanu Desai*, K. Nobleson*, Sai Chaitanya Susarla*, Raghav Girgaonkar*, Lankeswar Dey*, Neelam Dhanda Batra*, Yashwant Gupta*, A. Gopakumar*, Manjari Bagchi, Avishek Basu*, Suryarao Bethapudi*, Arpita Choudhary, Kishalay De*, M. Krishnakumar*, P. Manoharan*, Arun Kumar Naidu*, Dhruv Pathak, Jaikhomba Singha*, and Mayuresh P. Surnis*.
pinta: The ugmrt data processing pipeline for the indian pulsar timing array.
Publications of the Astronomical Society of Australia, 2020.
arXiv:2007.02930 (To be published).

[**Ba**]
Madhusudhan Raman* and P. Bala Subramanian.
Chebyshev wells: Periods, deformations, and resurgence.
Phys. Rev. D, **101(12)**, 126014, 2020.

[**Bal**]
Chethan Krishnan*, Rohit Shekhar*, and P. BalaSubramanian.
A hairy box in three dimensions.
Nucl. Phy. B, **958**, Article. 115115, 2020.

[**Ball**]
Sourav Ballav and Arkajyoti Manna.
Recursion relations for scattering amplitudes with massive particles.
Journal of High Energy Physics, **2021**, Article. 295, 2021.

[**Bas1**]
G. Baskaran, V. Muthukumar*, K. Muttalib*, and T. Ramakrishnan*.
P. w. anderson (1923-2020).
Current Science, **118(10)**, 1624–1627, 2020.

[**Bas2**]
Zheng-Cheng Gu*, Hong-Chen Jiang*, and G. Baskaran.
Emergence of p plus ip superconductivity in two-dimensional doped dirac systems.
Phys. Rev. B, **101(20)**, 205147, 2020.

[**Bi**]
Apurba Biswas, V. V. Prasad*, and R. Rajesh.
Mpemba effect in driven granular maxwell gases.
Physical Review E, **102(1)**, 012906, 2020.
DOI = 10.1103/PhysRevE.102.012906.

[**C1**]
Subhroneel Chakrabarti, Suresh Govindarajan*, P. Shanmugapriya*, Yogesh K. Srivastava*, and Amitabh Virmani *.
Black hole hair removal for n=4 chl models.
Journal of High Energy Physics, **2021**, Article. 125, 2021.

[**C2**]
Subhroneel Chakrabarti, Divyanshu Gupta*, Arkajyoti Manna, and Madhusudhan Raman*.
Irrelevant deformations of chiral bosons.
Journal of High Energy Physics, **2021**, Article. 28, 2021.

[**C3**]
Subhroneel Chakrabarti and Madhusudhan Raman*.
Chiral decoupling from irrelevant deformations.
Journal of High Energy Physics, **2020**, Article. 190, 2020.

[**Ch**]
A. Chakraborty, S. Easwaran, and S. Sinha.
Uncovering hierarchical structure of international forex market by using similarity metric between fluctuation distributions of currencies.
Acta Physica Polonica A, **138(1)**, 105–115, 2020.

[**Cha**]
Taushif Ahmed*, Pulak Banerjee*, Amlan Chakraborty, Prasanna K. Dhani*, and V. Ravindran.

Form factors with two operator insertions and the principle of maximal transcendentality.
Phys. Rev. D, **102**, 061701, 2020.

[**Chak**]
Arun Kumar Pati*, **Chiranjib Mukhopadhyay***, **Sagnik Chakraborty, and Sibasish Ghosh**.
Quantum precision thermometry with weak measurements.
Phys. Rev. A, **102(1)**, 012204, 2020.

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Pragati Gupta* **and C. Chandrashekar**.
Digital quantum simulation framework for energy transport in an open quantum system.
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[**Chan2**]
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Non-markovian channel from the reduced dynamics of a coin in a quantum walk.
Phys. Rev. A. , and C. M. Chandrashekar, **102**, 062209, 2020.

[**Chan3**]
S. Srikara* **and C. Chandrashekar**.
Quantum direct communication protocols using discrete-time quantum walk.
Quantum Information Processing, **19(9)**, Article. 295, 2020.

[**Chau1**]
Mehrdad Golkia*, **Gaurav P. Shrivastav***, **Pinaki Chaudhuri, and Juergen Horbach***.
Flow heterogeneities in supercooled liquids and glasses under shear.
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[**Chau2**]
Rituparno Mandal*, **Pranab J. Bhuyan***, **Pinaki Chaudhuri, Chandan Dasgupta***, **and Madan Rao***.
Extreme active matter at high densities.
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Tanmoy Sarkar*, **Pinaki Chaudhuri, and Anirban Sain***.
Poiseuille flow of soft polycrystals in 2d rough channels.
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DOI = 10.1103/PhysRevLett.124.158003.

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Ajit C. Balram.

A non-abelian parton state for the ν=2+3/8 fractional quantum hall effect.
SciPost Physics, **10(4)**, 083, 2021.

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Ajit Coimbatore Balram.
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Phys. Rev. B, **103(15)**, 155103, 2021.

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Ajit Coimbatore Balram and Arkadiusz Wójs*.
Fractional quantum hall effect at ν=2+4/9.
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Non-abelian fractional quantum hall state at 3/7-filled landau level.
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Bo Yang* and Ajit Coimbatore Balram.
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[**Co8**]
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Interplay between fractional quantum hall liquid and crystal phases at low filling.
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Exact hyperuniformity exponents and entropy cusps in models of active-absorbing transition.
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Hard core run and tumble particles on a one dimensional lattice.
Physical Review E, **102(6)**, Article. 062111, 2020.
DOI = 10.1103/PhysRevE.102.062111.

[**Da**]
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Re-visiting gravitational wave events via pulsars.
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Minati D. Biswal*, Sanatan D. Digal, Vinod . Mamale, and Sabiar Shaikh.
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z_3 metastable states in pnjl model.
PHYS. REV. D, **102(7)**, 074020–1, 2020.
DOI = 10.1103/PhysRevD.102.074020.

[**Du**]
S. Dutta, B. Sathiapalan, and H. Sonoda*.
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Nuclear Physics B, **956**, Article. 115022, 2020.

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Suman Dutta and J. Chakrabarti*.
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Physical Chemistry Chemical Physics, **2020(31)**, 17731–17737, 2020.

[**G1**]
Suchetana Goswami*, Sibasish Ghosh, and A. Majumdar*.
Protecting quantum correlations in presence of generalised amplitude damping channel: the two-qubit case.
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[**G3**]
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[**H1**]
Arjun H and Pinaki Chaudhuri.
Glass forming liquid in a quenched random potential.
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DOI = 10.1088/1361-648X/ab9b52.

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Probing primordial features with the stochastic gravitational wave background.
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Generating primordial features at large scales in two field models of inflation.
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Generating pbhs and small-scale gws in two-field models of inflation.
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Joining bits and pieces of reionization history.
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[**Ha7**]
Ryan E. Keeley*, Arman Shafieloo*, Dhiraj Kumar Hazra, and Tarun Souradeep*.
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S. A. Khan* and R. Jagannathan.
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Ramaswamy Jagannathan and Sameen Ahmed Khan*.
On the deformed oscillator and the deformed derivative associated with the tsallis q-exponential.
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Renjan Rajan John*, Ryota Kojima*, and Sujoy Mahato.

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Mathematical model shows how sleep may affect amyloid-beta fibrillization.
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[**Sh4**]
Lukas Mazur*, **Olaf Kaczmarek***, **and Sayantan Sharma**.
Eigenvalue spectra of QCD and the fate of $U_A(1)$*breakingtowardsthechirallimit*.
2021.
arXiv : 2102.06136(*Submitted*).

[**Sh5**]
Sayantan Sharma.
Recent theoretical developments on QCD matter at finite temperature and density.
2021.
arXiv:2103.13641 (hep-lat) (Submitted).

[**Si**]
C. Alderete*, **Shivani Singh, Nhung H. Nguyen***, **Daiwei Zhu***, **Radhakrishnan Balu***, **Christopher Monroe***, **C. Chandrashekar, and Norbert M. Linke**.
Quantum walks and dirac cellular automata on a programmable trapped-ion quantum computer.
Nature Communications, **11**, Article number: 3720 (2020), 2020.

[**Sin**]
Rojalin Padhan*, **Sanjoy Mandal***, **Manimala Mitra***, **and Nita Sinha**.
Signatures of (r)over-tilde(2) class of leptoquarks at the upcoming ep colliders.
Phys. Rev. D, **101**, 075037, 2020.

[**Sinh1**]
Sitabhra Sinha.
Epidemiological dynamics of the covid-19 pandemic in india: An interim assessment.
Statistics and Applications(New Series), **18(1)**, 333350, 2020.

[**Sinh2**]
Sitabhra Sinha.
Why should we be mindful of nonlinear dynamics in the midst of a global pandemic.
Indian Acad Sci Conf Ser., **3(1)**, 209–212, 2020.

[**Sr**]
Bhattacharya Srimoy, Soumitra Nandi*, **Patra Sunando Kumar***, **and Ria Sain**.
Detailed study of the lambda(b) -¿ lambda l(+) l(-) decays in the standard model.
Phys. Rev. D, **101(7)**, Article. 073006, 2020.

2.4 Theoretical Computer Science

2.4.1 Research Summary & Highlights

Algorithms and Data Structures

In our previous work , we proved the W[1]-hardness of the KONIG EDGE DELETION problem, which was a long standing open problem in the field of parameterized complexity for over 7 years. We also show that a variant of this problem, called KONIG EDGE DELETION DISJOINT FROM MATCHING, is fixed-parameter tractable. In [**N3**], we study a generalization of the DIRECTED FEEDBACK VERTEX SET problem. Our results include a $O(2^{k^3 \log k})$ algorithm for the problem, and a $O(2^{k \log k})$ algorithm for some special cases of the problem, which matches the best known algorithm for DIRECTED FEEDBACK VERTEX SET. These results are an improvement over a previous paper in literature. In [**N2**], we study the complexity of recognizing the class of k-Clique Extendible Orderable (abbr. k-CEO) graphs. These graphs are a generalization of the well-known comparability graphs, for which there is a polynomial time recognition algorithm. In fact, comparability graphs are exactly the 2-CEO graphs. 3-CEO graphs also arise as the neighborhood of a vertex in a visibility graph. We show that recognition of these graphs is NP-hard for each $k \geq 3$. This resolves an open problem posed by Spinrad on the complexity of the recognition of 3-CEO graphs. A previous result in literature showed that one can find a maximum clique in k-CEO graphs in time $O(n^k)$. We show that, under some complexity assumptions, that one cannot find a maximum clique in these graphs in time faster than $O(n^k)$, proving that the result is tight.

Computational Complexity

The proof system Merge Resolution (MRes) is a refutational proof system for prenex quantified Boolean formulas (QBF) with a CNF matrix and was defined in [**M5**]. 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. As demonstrated in [**M5**], 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 [**M4**], 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 [**M1**], a *tight characterisation of proof size in resolution for quantified Boolean formulas (QBF) by circuit complexity* was provided. Such a characterisation was previously known for a hierarchy of QBF Frege systems, but leaving open the most important case of QBF resolution. Different from the Frege case, the new characterisation uses a new version of decision lists as its circuit model, which is stronger than the CNFs the system works with. This decision list model is well suited to compute countermodels for QBFs.

The new characterisation was shown to work for both *Q-Resolution and QU-Resolution,*

which were shown to be polynomially equivalent for QBFs of bounded quantifier alternation.

Using the new characterisation, a *size-width relation for QBF resolution* was obtained, in the spirit of the celebrated result for propositional resolution (Ben-Sasson & Wigderson, J. ACM 2001). However, the new result is not just a replication of the propositional relation – intriguingly ruled out for QBF in previous research (Beyersdorff et al., ACM ToCL 2018 – but shows a different dependence between size, width, and quantifier complexity.

This new technique based on size-wdth was used to elegantly reprove known QBF hardness results and unify previous lower-bound techniques in the QBF domain.

The work in [**M3**] made some progress concerning the border complexity of algebraic branching programs. Nisan showed in 1991 that the width of a smallest noncommutative single-(source,sink) algebraic branching program (ABP) to compute a noncommutative polynomial is given by the ranks of specific matrices. This means that the set of noncommutative polynomials with ABP width complexity at most k is Zariski-closed, an important property in geometric complexity theory. It follows that approximations cannot help to reduce the required ABP width. It was mentioned by Forbes that this result would probably break when going from single-(source,sink) ABPs to trace ABPs. In [**M3**], Forbes' hunch was proven to be correct. Furthermore, in the commutative monotone setting, a result similar to Nisan, but concerning the analytic closure, was established. The same behavior was observed here: The set of polynomials with ABP width complexity at most k is closed for single-(source,sink) ABPs and not closed for trace ABPs. The proofs reveal an intriguing connection between tangent spaces and the vector space of flows on the ABP. Finally, some additional observations on VQP and the closure of VNP were made, establishing separation between the two classes.

In [**M2**], the MaxSAT Resolution rule was studied in the context of certifying unsatisfiability. It was shown that when augmented with weakening, the resulting proof system MaxResW p-simulates and is exponentially more powerful than tree-like resolution. In devising a lower bound technique specific to MaxResW (and not merely inheriting lower bounds from Resolution), a new semialgebraic proof system called the SubCubeSums proof system was defined. This system, which p-simulates MaxResW, is a special case of the Sherali-Adams proof system. In expressivity, it is the integral restriction of conical juntas studied in the contexts of communication complexity and extension complexity. It was shown that Resolution cannot simulate SubCubeSums. Using a proof technique qualitatively different from the lower bounds that MaxResW inherits from Resolution, Tseitin contradictions on expander graphs were shown to be hard to refute in SubCubeSums. A new lower bound technique via lifting was also established: for formulas requiring large degree in SubCubeSums, their XOR-ification requires large size in SubCubeSums.

Graph Theory and Combinatorics

In an earlier work, the notions of incremental monotone update versions of problems in NP and PH were introduced and their computational complexities were studied. In further continuation of this work, an investigation of the computational complexity of incremental monotone update versions of counting problems in $\#P$ was carried out [**Su3**]. Also being carried out is such a study with respect to parameterised problems.

Given a connected undirected network $G = (V, E)$, a *causal failure* denoted $V_1 \to V_2$ is

defined as the failure of *all* vertices in the set $V_1 \subseteq V$ causing the failure of all vertices in the set $V_2 \subseteq V$. A causal failure $V_1 \to V_2$ is said to be *applied* when all vertices in V_1 fail. In [Su4], we propose two optimisation problems which, given a network G and a set $\mathcal{C}$ of causal failures, finds respectively a maximum or minimum set of causal failures whose application results in a graph with some constraints on its connected components. We provide various practical application scenarios wherein causal failures occur. We further show that decision problems associated with these optimisation problems are both NP-complete. We present an integer linear programming formulation for both optimization problems and also polynomial-time heuristics for approximating them. Moreover, we analyze the equivalence of causal node failures and causal edge failures, and reveal that the model of causal node failures is a general version for all kinds of causal failures. Finally, we present extensive empirical evaluations to study the performance of our heuristics.

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**]
Niranka Banerjee, Saket Saurabh, and Venkatesh Raman.
Optimal output sensitive fault tolerant cuts.
In Nitin Saxena and Sunil Simon, editors, *Proceedings of 40th IARCS annual FSTTCS Conference*, page 10:1. LiPiCs, Dec 2020.

[**B2**]
Niranka Banerjee, Venkatesh Raman, and Saket Saurabh.
Fully dynamic arboricity maintenance.
Theoretical Computer Science, **822**, 1–14, 2020.

[**Bi**]
Arindam Biswas, Venkatesh Raman, and Saket Saurabh.
Approximation in (poly)logarithmic space.
In Javier Esparza and Daniel Král', editors, *45th International Symposium on Mathematical Foundations of Computer Science, MFCS 2020*, page 16:1. LiPiCs, Aug 2020.

[**D**]
S. Hegde* and Suresh Dara.
Further results on erds-faber-lovasz conjecture.
AKCE International Journal of Graphs and Combinatorics, **17(1)**, 614–631, 2020.

[**G**]
Ghurumuruhan Ganesan.
Linearized decomposition codes and finite integer set coverings.
Discrete Mathematics, **343(11)**, Article. 112069, 2020.

[**Ga1**]
Ghurumuruhan Ganesan.
Euclidean travelling salesman problem with location-dependent and power-weighted edges.
Journal of Theoretical Probability, **xx(xx)**, xx, 2021.

[**Ga2**]
Ghurumuruhan Ganesan.
Constrained minimum passage time in random geometric graphs.
Algorithmica, **83(2)**, 576588, 2021.

[**Ga3**]
Ghurumuruhan Ganesan.
Nominal correlation of inhomogeneous random sequences.
Statistics Probability Letters, **169**, Article. 108956, 2021.

[**Ga4**]
Ghurumuruhan Ganesan.
Deviation estimates for eulerian edit numbers of random graphs.
Statistics Probability Letters, **171**, 109025, 2021.

[**Gu1**]
Edith Elkind*, **Piotr Faliszewski***, **Sushmita Gupta, and Sanjukta Roy**.
Algorithms for evaluating candidate success in structured elections.
In *Proceedings of the 19th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS), 2020*, pages 366–374, 2020.
ifaamas.org/Proceedings/aamas2020/pdfs/p366.pdf.

[**Gu2**]
Sushmita Gupta, Pallavi Jain, Sanjukta Roy, Saket Saurabh, and Meirav Zehavi*.
On the (parameterized) complexity of almost stable marriage.
In *Proceedings of the IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS)*, pages 24:1–24:12, 4 2020.
drops.dagstuhl.de/opus/volltexte/2020/13265/pdf/LIPIcs-FSTTCS-20.

[**Gu3**]
Sushmita Gupta, Pallavi Jain, Aditya Petety*, and Sagar Singh*.
Parameterized complexity of d-hitting set with quotas.
In *Proceedings of the 47th International Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM)*, page 293–307, 2021.
https://www.springer.com/gp/book/9783030677305.

[**Gu4**]
Sharmistha Chatterjee* and Sushmita Gupta.
An incremental real-time learning framework for sentiment classification: Indian gen- eral election 2019, a case study.
In *Proceedings of the IEEE 6th International Conference on Big Data Analytics (ICBDA), 2021*, 2021.

[**Gu5**]
Akanksha Agrawal*, **Sushmita Gupta, Pallavi Jain, and R. Krithika***.
Quadratic vertex kernel for split vertex deletion.
Theoretical Computer Science, **833**, 164–172, 2020.

[**Gu6**]
Sushmita Gupta, Pallavi Jain, Sanjukta Roy, Saket Saurabh, and Meirav Zehavi*.
Gehrlein stability in committee selection: parameterized hardness and algorithms.
Autonomous Agents and Multi-Agent Systems, **34(1)**, Article. 27, 2020.

[**Gu7**]
Sushmita Gupta, Pallavi Jain, and Saket Saurabh.
Well-structured committees.
In Proceedings of the 29th International Joint Conference on Artificial Intelligence (IJCAI), pages 189–195, 2020.
https://www.ijcai.org/proceedings/2020/.

[**Gu8**]
Sushmita Gupta, Sanjukta Roy, Saket Saurabh, and Meirav Zehavi*.
Quadratic vertex kernel for rainbow matching.
Algorithmica, **82**, 881–897, 2020.
https://doi.org/10.1007/s00453-019-00618-0.

[**J1**]
Ashwin Jacob, Fahad Panolan*, **Venkatesh Raman, and Vibha Sahlot**.
Structural parameterizations with modulator oblivion.
In Yixin Cao and Marcin Pilipczuk, editors, *15th International Symposium on Parameterized and Exact Computation (IPEC 2020),*. LiPiCS, Dec 2020.

[**J2**]
Ashwin Jacob, Diptapriyo Majumdar*, **and Venkatesh Raman**.
Parameterized complexity of deletion to scattered graph classes.
In Yixin Cao and Marcin Pilipczuk, editors, *15th International Symposium on Parameterized and Exact Computation (IPEC 2020),*, page 18:1. LiPiCS, Dec 2020.

[**J3**]
Aritra Banik*, **Ashwin Jacob, Venkatesh Raman, and Vijay K. Paliwal***.
Fixed-parameter tractability of (n - k) list coloring.
Theory of Computing Systems, **64(7)**, 1307–1316, 2020.
DOI = 10.1007/s00224-020-10014-9.

[**J4**]
Ashwin Jacob, Diptapriyo Majumdar*, **and Venkatesh Raman**.
Parameterized complexity of conflict-free set cover.
Theory of Computing Systems, 2021.
(To be published) DOI = 10.1007/s00224-020-10022-9.

[**Ja1**]
Pratibha Choudhary*, **Pallavi Jain, R. Krithika***, **and Vibha Sahlot**.
Vertex deletion on split graphs: Beyond 4-hitting set.
Theoretical Computer Science, **845**, 21–37, 2020.

[**Ja2**]
Pallavi Jain, Lawqueen Kanesh, and Pranabendu Misra*.
Conflict free version of covering problems on graphs: Classical and parameterized.
Theory of Computing Systems 64(6), **64(6)**, 1067–1093, 2020.

[**K**]
Akanksha Agrawal*, **Lawqueen Kanesh, Saket Saurabh, and Prafullkumar Tale**.
Paths to trees and cacti.
Theoretical Computer Science, **860**, 98–116, 2021.

[**M1**]
Olaf Beyersdorff*, **Joshua Blinkhorn***, **and Meena Mahajan**.
Hardness characterisations and size-width lower bounds for QBF resolution.
In *35th ACM/IEEE Symposium on Logic in Computer Science LICS*, pages 209–223. ACM, Jul 2020.

[**M2**]
Yuval Filmus*, **Meena Mahajan, Gaurav Sood, and Marc Vinyals***.
MaxSAT resolution and subcube sums.
In *23rd International Conference on Theory and Applications of Satisfiability Testing (SAT), LNCS 12178.*, pages 295–311. Springer, Jul 2020.

[**M3**]
Markus Bläser*, **Christian Ikenmeyer***, **Meena Mahajan, Anurag Pandey***, **and Nitin Saurabh***.
Algebraic branching programs, border complexity, and tangent spaces.
In *35th Computational Complexity Conference (CCC)*, pages 21:1–21:24. LIPIcs, Jul 2020.

[**M4**]
Olaf Beyersdorff*, **Joshua Blinkhorn***, **Meena Mahajan, Tomá Peitl***, **and Gaurav Sood**.
Hard QBFs for merge resolution.
In *Proceedings of 40th FSTTCS Conference, LIPIcs vol 182*, pages 12:1–12:15. Schloss Dagstuhl LZI, Dec 2020.

[**M5**]
Olaf Beyersdorff*, **Joshua Blinkhorn***, **and Meena Mahajan**.
Building strategies into QBF proofs.
Journal of Automated Reasoning, **65(1)**, 125–154, 2021.
DOI = 10.1007/s10817-020-09560-1.

[**M6**]
Arkadev Chattopadhyay*, **Meena Mahajan, Nikhil Mande***, **and Nitin Saurabh***.
Lower bounds for linear decision lists.
Chicago Journal of Theoretical Computer Science, **20(1)**, 1, 2020.

[**Mo**]
Amitava Bhattacharya* **and Anupam Mondal**.
Covering the plane by a sequence of circular disks with a constraint.
Computational Geometry, **91**, Article. 101680, 2020.

[**N1**]
Mathew C. Francis*, **Rian Neogi, and Venkatesh Raman**.
Recognizing k-clique extendible orderings.
In Isolde Adler and Haiko Müller, editors, *Graph-Theoretic Concepts in Computer Science - 46th International Workshop, WG 2020*, page 274. Springer, Jun 2020.

[**N2**]
Mathew Francis*, **Rian Neogi, and Venkatesh Raman**.
Recognizing k-clique extendible orderings.
2020.
arXiv:2007.06060 (cs).

[**N3**]
Rian Neogi, M.S. Ramanujan*, **Saket Saurabh, and Roohani Sharma**.
On the parameterized complexity of deletion to h-free strong components.
2020.
(arXiv:2005.01359 (cs)).

[**P1**]
Neeldhara Misra*, **Fahad Panolan, and Saket Saurabh**.
Subexponential algorithm for d-cluster edge deletion: Exception or rule?
Journal of Computer and System Sciences, **113**, 150–162, 2020.

[**P2**]
Pranabendu Misra*, **Fahad Panolan, M. Ramanujan***, **and Saket Saurabh**.
Linear representation of transversal matroids and gammoids parameterized by rank.
Theoretical Computer Science, **818**, 51–59, 2020.

[**R1**]
Pratibha Choudhary* **and Venkatesh Raman**.
Structural parameterization of tracking paths.
In Gennaro Cordasco, Luisa Gargano, and Adele A.Rescigno, editors, *Proceedings of the 21st Italian Conference on Theoretical Computer Science*, page 15. CEUR Workshop Proceedings, Sep 2020.

[**R2**]
Sukanya Pandey*, **Venkatesh Raman, and Vibha Sahlot**.

Parameterizing role coloring on forests.
In T. Bures et al., editor, *Proceedings of SOFSEM 2021 (Theory and Practice of Computer Science)*, page 308. Springer, Jan 2021.

[**R3**]
Pranav Arora*, **Aritra Banik***, **Vijay Kumar Paliwal***, **and Venkatesh Raman**.
List-coloring - parameterizing from triviality.
Theoretical Computer Science, **821**, 102–110, 2020.

[**R4**]
Aritra Banik*, **Pratibha Choudhary***, **Daniel Lokshtanov***, **Venkatesh Raman, and Saket Saurabh**.
A polynomial sized kernel for tracking paths problem.
Algorithmica, **82**, 41, 2020.

[**R5**]
Aritra Banik*, **Pratibha Choudhary***, **Venkatesh Raman, and Saket Saurabh**.
Fixed-parameter tractable algorithms for tracking shortest paths.
Theoretical Computer Science, **846**, 1, 2020.

[**R6**]
Dishant Goyal*, **Varunkumar Jayapaul***, **and Venkatesh Raman**.
Elusiveness of finding degrees.
Discrete Applied Mathematics, **286**, 128–139, 2020.

[**R7**]
Venkatesh Raman, M. Ramanujan*, **and Saket Saurabh**.
A characterization of konig-egervary graphs with extendable vertex covers.
Information Processing Letters, **161**, Article. 105964, 2020.

[**S**]
Aritra Banik*, **Vibha Sahlot, and Saket Saurabh**.
Approximation algorithms for geometric conflict free covering problems.
Computational Geometry, **89**, 101591, 2020.

[**Sa**]
Stephane Bessy*, **Marin Bougeret***, **R. Krithika***, **Abhishek Sahu, Saket Saurabh, Jocelyn Thiebaut***, **and Meirav Zehavi**.
Packing arc-disjoint cycles in tournaments.
Algorithmica, **83(5)**, 1393 – 1420, 2021.

[**Sau1**]
Fedor V. Fomin*, **Daniel Lokshtanov***, **Fahad Panolan***, **Saket Saurabh, and Meirav Zehavi***.
Hitting topological minors is fpt.
In *STOC 2020: Proceedings of the 52nd Annual ACM SIGACT Symposium on Theory of ComputingJune 2020*, page 13171326, Jun 2020.

[**Sau2**]
Daniel Lokshtanov*, **Pranabendu Misra***, **Micha322; Pilipczuk***, **Saket Saurabh, and Meirav Zehavi***.
An exponential time parameterized algorithm for planar disjoint paths.
In *STOC 2020: Proceedings of the 52nd Annual ACM SIGACT Symposium on Theory of Computing*, page 13071316, Jun 2020.

[**Sau3**]
Akanksha Agrawal*, **D. Lokshtanov***, **P. Misra***, **Saket Saurabh, and M. Zehavi***.
Polylogarithmic approximation algorithms for weighted-f-deletion problems.
ACM TRANSACTIONS ON ALGORITHMS, **16(4)**, Article No.: 51, 2020.

[**Sau4**]
Akanksha Agrawal*, **Fahad Panolan***, **Saket Saurabh, and Meirav Zehavi** *.
Simultaneous feedback edge set: A parameterized perspective.
ALGORITHMICA, **83(2)**, 753774, 2020.

[**Sau5**]
Akanksha Agrawal* **Agrawal, F. Fomin***, **D. Lokshtanov***, **Saket Saurabh, and Prafullkumar Tale**.
Path contraction faster than 2(n).
SIAM JOURNAL ON DISCRETE MATHEMATICS, **34(2)**, 13021325, 2020.

[**Sau6**]
Marek Cygan*, **Pawe322; Komosa***, **Daniel Lokshtanov***, **Marcin Pilipczuk***, **Micha322; Pilipczuk***, **Saket Saurabh, and Magnus Wahlström**.
Randomized contractions meet lean decompositions.
ACM Transactions on Algorithms, **17(1)**, Article. 6, 2021.

[**Sau7**]
Fedor V. Fomin*, **Petr A. Golovach***, **Daniel Lokshtanov***, **Fahad Panolan***, **Saket Saurabh, and Meirav Zehavi***.
Going far from degeneracy.
SIAM Journal on Discrete Mathematics, **34(3)**, 1587–1601, 2020.

[**Sau8**]
Fedor V. Fomin*, **Daniel Lokshtanov***, **Saket Saurabh, and Dimitrios M. Thilikos**.
Bidimensionality and kernels.
SIAM J. Comput., **49(6)**, 13971422, 2020.

[**Sau9**]
Sudeshna Kolay*, **Pranabendu Misra***, **M. Ramanujan***, **and Saket Saurabh**.
Faster graph bipartization.
Journal of Computer and System Sciences, **109**, 45–55, 2020.

[**Sau10**]
R. Krithika*, **Ashutosh Rai***, **Saket Saurabh, and Prafullkumar Tale***.

Parameterized and exact algorithms for class domination coloring.
Discrete Applied Mathematics, **291**, 286–299, 2021.

[**Sau11**]
Daniel Lokshtanov*, **Fahad Panolan***, **Saket Saurabh, Roohani Sharma***, **and Meirav Zehavi***.
Covering small independent sets and separators with applications to parameterized algorithms.
ACM Transactions on Algorithms, **16(3)**, Article. 32, 2020.

[**Sau12**]
Diptapriyo Majumdar*, **M. Ramanujan***, **and Saket Saurabh**.
On the approximate compressibility of connected vertex cover.
Algorithmica, **82**, 2902–2926, 2020.

[**Su1**]
C.R. Subramanian.
Inductive graph invariants and algorithmic applications.
In Weili Wu and Zhongnan Zhang, editors, *Combinatorial Optimization and Applications - 14th International Conference, COCOA 2020, Dallas, Texas, USA, LNCS 12577*, pages 780–801. Springer, Dec 2020.

[**Su2**]
N.R. Aravind* **and C.R. Subramanian**.
Intersection dimension and graph invariants.
Discussiones Mathematicae Graph Theory, **41(1)**, 153–166, 2021.
DOI = 10.7151/dmgt.2173.

[**Su3**]
C.R. Subramanian.
Complexity of 3-coloring and incremental update problems.
2020.
(Submitted).

[**Su4**]
Zuyuan Zhang*, **Sridhar Radhakrishnan***, **C.R. Subramanian, Kash Barker***, **and Andres D. Gonzalez***.
Causal node failures and computation of giant and small components in networks.
2021.
(Submitted).

Books/Monographs Authored/Edited

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

[S]
Apurva Mudgal* and C.R. Subramanian, editors.
Algorithms and Discrete Applied Mathematics - 7th International Conference, CALDAM 2021, Rupnagar, India, Proceedings. ISBN 978-3-030-67898-2, volume 12601 of *Lecture Notes in Computer Science*.
Springer, Springer Nature Switzerland AG., 2021.

2.5 Student Programmes

2.5.1 Degrees Awarded

Doctoral Degrees Awarded during 2020 – 2021

Mathematics

Name: **Paul, Digjoy**
Thesis Title: The multiset partition algebra
Thesis Advisor: Prasad, Amritanshu
University: HBNI
The thesis defence has received tweets on twitter.com, which may be found at the following link:
https://twitter.com/IMScChennai/status/1313358385996197888

Name: **Roy, Krishanu**
Thesis Title: Pi-systems of symmetrizable Kac-Moody algebras
Thesis Advisor: Raghavan, K. N.
University: HBNI

Name: **Ray, Nabanita**
Thesis Title: Projective Bundle and Blow-up
Thesis Advisor: Sanoli Gun
University: HBNI

Name: **Misra, Snehajit**
Thesis Title: Higgs bundles on ruled surfaces
Thesis Advisor: Sanoli Gun
University: HBNI

Physics

Name: **Joy, Jilmy P.**
Thesis Title: Shock propagation in dilute inelastic and elastic media
Thesis Advisor: Rajesh, R.
University: HBNI

Name: **Vigneshwar, N.**
Thesis Title: Entropy driven phase transition in hard core lattice gas models in three dimensions
Thesis Advisor: Rajesh, R.
University: HBNI

Name: **Devanand, T.**
Thesis Title: Allosteric effects in protein dynamics and their interactions with membranes
Thesis Advisor: Satyavani Vemparala
University: HBNI
The thesis defence has received tweets on twitter.com, which may be found at the following link: https://twitter.com/IMScChennai/status/1282549882239082497

Name: **Dheeraj Kumar Mishra**
Thesis Title: Thermodynamic corrections due to an invariant ultraviolet scale and its implications
Thesis Advisor: Sibasish Ghosh
University: HBNI

Name: **Shilpa Kastha**
Thesis Title: Gravitational waves from compact binary coalescences: Tests of General Relativity and Astrophysics
Thesis Advisor: Manjari Bagchi
University: HBNI

Name: **Prafulla Shrikant Oak**
Thesis Title: Holographic and exact RG beta function computations of the Sine- Gordon model
Thesis Advisor: Balachandran Sathiapalan
University: HBNI

Name: **Prathik Cherian J**
Thesis Title: Beyond quantum nonlocality in continuous variable systems and thermalization of a qubit
Thesis Advisor: Sibasish Ghosh
University: HBNI

Theoretical Computer Science

Name: **Choudhary, Pratibha**
Thesis Title: Parameterized Complexity of Tracking Paths
Thesis Advisor: Raman, Venkatesh
University: IIT Jodhpur

Name: **Roohani Sharma**
Thesis Title: Advancing the Algorithmic tool-kit for parameterized cut problems
Thesis Advisor: Saurabh, Saket

University: HBNI
This thesis has got Honorable mention in the ACM India Doctoral Dissertation Award. Also thesis defence has received tweets on twitter.com, which may be found at the following link: https://twitter.com/IMScChennai/status/1293533380940685312

Name: **Anantha Padmanabha**
Thesis Title: Propositional Term Modal Logic
Thesis Advisor: Ramanujam, R.
University: HBNI

Doctoral Theses Submitted during 2020 – 2021

Mathematics

Name: **Narayanan, P A**
Thesis Title: Eigenvalue statistics of higher rank Anderson tight binding model over the canopy tree
Thesis Advisor: Kodiyalam, Vijay
University: HBNI

Name: **Narayanan, Sridhar P.**
Thesis Title: Two restriction problems in the representation theory of symmetric groups
Thesis Advisor: Prasad, Amritanshu
University: HBNI

Name: **Das, Ujjal**
Thesis Title: On the Hardy type potentials
Thesis Advisor: Kodiyalam, Vijay
University: HBNI

Physics

Name: **Ballav, Sourav**
Thesis Title: Surface Operators, Seiberg-dual Quivers and Contours
Thesis Advisor: Ashok, Sujay K.
University: HBNI

Name: **Anand Pathak**
Thesis Title: Uncovering Functional Correlates of Structural Organization in Brain Networks at Multiple Scales : From the worm to the human
Thesis Advisor: Sitabhra Sinha
University: HBNI

Name: **Garima Rani**
Thesis Title: Understanding the mechanical response of bacterial cell walls and cell mem-

branes against antimicrobial agents
Thesis Advisor: Satyavani Vemparala
University: HBNI

Name: **Abinesh Kumar Nayak**
Thesis Title: Right-Handed currents and Electroweak penguins in B decays
Thesis Advisor: Rahul Sinha
University: HBNI

Theoretical Computer Science

Name: **Banerjee, Niranka**
Thesis Title: Dynamizing Graph Classes and Output Sensitive Fault Tolerant Subgraphs
Thesis Advisor: Raman, Venkatesh
University: HBNI

Name: **Kanesh, Lawqueen**
Thesis Title: Parameteried complexity of conflict free solutions
Thesis Advisor: Saurabh, Saket
University: HBNI

Name: **Tale, Prafullkumar Prabhakar**
Thesis Title: Some Results On Graph Contraction Problems
Thesis Advisor: Saurabh, Saket
University: HBNI

Masters Degrees Awarded during 2020 – 2021

Physics

Name: **Sabyasachi Chowdhury**
Thesis Title: Numerical Analysis of ising model in one and two dimension
Thesis Advisor: Ganesh Ramachandran
University: HBNI

Name: **Pavan Dharanipragada**
Thesis Title: ERG for 3 theory
Thesis Advisor: Nemani Suryanarayana
University: HBNI

Name: **Akhil Antony**
Thesis Title: Reconstructing inflationary potential using observed cosmological correlations
Thesis Advisor: Dhiraj Kumar Hazra
University: HBNI

Name: **Amit Kumar**
Thesis Title: Blast dynamics in dilute granular systems
Thesis Advisor: Rajesh Ravindran
University: HBNI

Name: **Gopal Prakash**
Thesis Title: Application of Optimal Transport theory to Many-Body quantum systems
Thesis Advisor: Syed R Hassan
University: HBNI

Name: **Raghvendra Singh**
Thesis Title: Hamiltonian Formulation Of Gravity
Thesis Advisor: Sujay K. Ashok
University: HBNI

Theoretical Computer Science

Name: **Choudhury, Abhimanyu**
Thesis Title: Dependency Schemes in Quantified Boolean Formulas
Thesis Advisor: Mahajan, Meena B.
University: HBNI

Name: **Rian Neogi**
Thesis Title: Algorithms for submodular Function Maximization : A Survey
Thesis Advisor: Raman, Venkatesh
University: HBNI

Masters Theses during 2020 - 2021
External Master's Theses

Physics

Name: **Aditi Krishak**
Thesis Title: Reconstruction of Reionization History
Thesis Advisor: Dhiraj Hazra
University: IISER, Bhopal

Name: **Sharvari Naik**
Thesis Title: Inflation: Baby steps of the Universe down the hill
Thesis Advisor: Dhiraj Hazra
University: Xavier's College, Mumbai

2.5.2 Lecture Courses During 2020 – 2021.

The following **lecture courses** were offered during 2020 – 2021.

Course Title	Period	Lecturer
Mathematics		
Algebra II	Jan-May 2020	Kodiyalam, Vijay
Algebraic Number Theory	Jan-Apr 2020	Gun, S.
Topology II	Jan-May 2020	Raghavan, K. N.
Algebra I	Aug-Dec 2020	Prasad, Amritanshu
Commutative Algebra	Aug-Nov 2020	Gun, S.
Laplace transforms- NPTEL 1 month course	Sep-Dec 2020	Roy, Indrava
Measure theory- NPTEL 3 month course	Sep-Dec 2020	Roy, Indrava
Algebraic Number Theory	Jan-Apr 2021	Gun, S.
Complex Analysis	Jan-May 2021	Srinivas, K.
Physics		
Advanced Condensed Matter Physics	Jan-May 2020	Coimbatore Balram, Ajit
Cosmology and Gravitation	Jan-Apr 2020	Mukhopadhyay, Partha
Quantum Field Theory II	Jan-Apr 2020	Ashok, Sujay K.
Statistical Mechanics - II	Sep-Dec 2020	Digal, Sanatan
Mathematical Physics - II	Sep-Dec 2020	Sharma, S.
Quantum Field Theory II	Jan-May 2021	Ashok, Sujay K.
Advanced condensed matter physics	Feb-May 2021	Coimbatore Balram, Ajit
Statistical Field Theory	Feb-May 2021	Sharma, S.
Theoretical Computer Science		
Boolean Function Complexity	Jan-May 2020	Mahajan, Meena B.
Computational Complexity	Jan-May 2020	Mahajan, Meena B.
Parameterized Complexity	Jan-Apr 2020	Raman, Venkatesh
Approximation Algorithms	Aug-Dec 2020	Subramanian, C. R.
Algorithm Design and Analysis	Sep-Jan 2021	Raman, Venkatesh
Boolean Function Complexity	Feb-Jun 2021	Mahajan, Meena B.
Computational Complexity	Feb-May 2021	Mahajan, Meena B.
Computational Biology		
Biology-2	Jan-Jun 2020	Samal, Areejit
Biology-1	Oct-Feb 2021	Samal, Areejit

2.6 Honours and Awards

Sanoli Gun was awarded Fellowship, for 2021, by the Indian Academy of Sciences.

Saket Saurabh has been chosen as recipient of the 2020 ACM India Early Career Researcher (ECR) Award.

G. Rajasekaran is a recipient of the Elavenil-ISTA Lifetime Achievement Award for the year 2020.

Garima Rani has been awarded the prestigious HUMAN FRONTIER SCIENCE PROGRAM (HFSP) fellowship for this year.

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

Life membership of Astronomical Society of India (ASI) during Mar 2015 – Dec 2020.

Reviewer of NASA Post-doctoral Program during Aug 2016 – Mar 2021.

Management Committee Observer of European Cooperation in Science and technology (COST) Action CA16214 (4-years of duration till 202021) titled "The multi-messenger physics and astrophysics of neutron stars (PHAROS)" during Feb 2018 – Dec 2020.

Reviewer of GMRT observation proposals during Aug 2019 – Feb 2021.

Member of PhD student selection committee, Aryabhatta Research Institute of Observational Sciences, Beluwakhan, Uttarakhand. during Jul – Jul, 2020.

Convener of Local Organising Committee for Virtual Meeting on Compact Stars and QCD 2020 held at Online during Aug 17 – Aug 21, 2020.

Convener of Local Organising Committee for Arecibo Day held at Online on Dec 22, 2020.

Dey, Soumya

Member of National Organising Committee for Virtual Math Fest 2020 held at Online during Jul 20 – Jul 26, 2020.

Member of National Organising Committee for International GeoGebra Conference, India held at Online during Mar 11 – Mar 13, 2021.

Gun, S.

Managing Editor of IMSc monograph series during Apr 2015 – Mar 2021.

Editor of JRMS during Mar 2017 – Mar 2021.

Editor of PMSC during Jan 2018 – Mar 2021.

Editor of RMS newsletter during Jul 2019 – Mar 2021.

Editor of IJPAM during Jan 2020 – Mar 2021.

Convener of National Organising Committee for Conference (online) on Analytic and Combinatorial number theory held at IMSc during Mar 12 – Mar 18, 2021.

Convener of National Organising Committee for SPARC online lectures series on Schinzel-Zassenhaus conjecture held at IMSc during Mar 24 – Mar 31, 2021.

Mahajan, Meena B.

Member of Steering Committee for FSTTCS Conference during Oct 2016 – Dec 2020.

Member of Programme Committee, Computer Science in Russia 2020 during Jan – Jul, 2020.

Member of EATCS Presburger Award Committee

Member of Editorial Board of the journal Logical Methods in Computer Science since Jun 2020.

Member (and Paper Chair) of Board of Trustees, Computational Complexity Foundation Inc.. during Aug 2020 – Jul 2023.

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

Raghavan, K. N.

Member of School Board of the Department of Mathematics and Statistics, University of Hyderabad during Mar – Apr, 2020.

Member of Board of Studies, Mathematical Sciences, HBNI

Secretary of Forum D'Analystes

Associate Editor of Indian Journal of Pure and Applied Mathematics

Board Member, Chair (Exams) of National Board for Higher Mathematics

Member of School Board, School of Mathematics and Statistics, University of Hyderabad

Member of Science Education Panel, Indian Academy of Sciences

Convener of National Organising Committee for Teachers' Enrichment Workshop held at MEPCO Engineering College, Sivakasi (online) during Nov 19, 2020 – Jan 3, 2021.

Rajesh, R.

Member of Board of Studies in Physics at CMI during Nov 2018 – Oct 2020.

Raman, Venkatesh

Vice President since 2018 of ACM-India Executive Council during Jun 2016 – Jun 2020.

Member of Program Committee of 30th International Symposium on Algorithms and Computation (ISAAC) during Mar 2019 – Dec 2020.

Convener of National Organising Committee for Computational Thinking in Schools (CTiS) 2020 held at Virtual during Oct 2 – Oct 3, 2020.

Convener of National Organising Committee for Pre RMS Conference Symposium on Discrete Mathematics held at Central University of Rajasthan on Dec 27, 2020.

Convener of National Organising Committee for COMPUTE 2020 held at VNIT Nagpur (virtually) during Dec 9 – Dec 12, 2020.

Samal, Areejit

Associate Editor of Heliyon Applied Biosciences (Cell Press) during Nov 2019 – Mar 2021.

Associate Editor of Theory in Biosciences (Springer) during Jul 2020 – Mar 2021.

Sharma, S.

Co-organizer for the Virtual Meeting on Compact Stars and QCD2020 held Online at ICTS-TIFR, Bengaluru, during Aug 17-21, 2020.

Co-organizer for the Virtual Meeting on Extreme Non equilibrium QCD held Online at ICTS-TIFR, Bengaluru during Oct 5-9, 2020.

Srinivas, K.

Member of School Advisory Board, SRTM University, Nanded, Maharashtra during Jan 2019 – Dec 2020.

Member of Board of Studies, SRTM University, Nanded during Jan 2020 – Mar 2021.

Co-Managing Editor of Hardy Ramanujan Journal

Convenor of NCM TEW Programme Committee

Convener of Local Organising Committee for Online Interactive Mathematics Training on Number Theory and Algebra held at Bandhu Odisha (Virtual) during Aug 17 – Aug 21, 2020.

Convener of National Organising Committee for Chandrasekharan Centenary Symposium in Number Theory held at VIT, Vellore in Virtual Mode on Dec 19, 2020.

Subramanian, C. R.

Co-Chair of the PC of Programme Committee of the 7th International Conference on Algorithms and Discrete Applied Mathematics (CALDAM-2021), Rupnagar, India. during Mar 2020 – Feb 2021.

Co-Chair of the PC of Programme Committee, 7th International Conference on Algorithms and Discrete Applied Mathematics (CALDAM-2021), IIT-Ropar, February 2021. during Mar 2020 – Mar 2021.

PC Co-Chair of Programme Committee, 7th International Conference on Algorithms and Discrete Applied Mathematics (CALDAM-2021), IIT-Ropar, February 11-13, 2021.

Chapter 4

Colloquia & OutReach

4.1 Conferences/Workshops Held at IMSc

4.1.1 Conference (online) on Analytic and Combinatorial number theory during Mar 12 – Mar 18, 2021.

A weeklong online conference with an array of distinguished speakers from across the Globe was organised.

Here is a link to the speaker list in the conference webpage

https://sites.google.com/view/balu70fest/speakers

4.1.2 SPARC online lectures series on Schinzel-Zassenhaus conjecture during Mar 24 – Mar 31, 2021.

Prof Yuri Bilu (University of Bordeaux) will give an online (six hour) lecture course to explain the recent marvellous proof, by Vesselin Dimitrov, of the Schinzel-Zassenhaus conjecture. Here is a link to the webpage

https://sites.google.com/view/schinzel-zassenhaus/home

4.2 Other Conferences/Workshops Organized by IMSc

4.2.1 Virtual Math Fest 2020 during Jul 20 – Jul 26, 2020.

VMF2020 was the first such elaborate virtual mathematics conference that happened in India. We organized 3 symposiums, one on each of the following broad areas:

1) Algebra and Number Theory

2) Analysis and PDE

3) Topology, Geometry and Dynamics

We had an excellent line-up of talks by some of the finest researchers in India.

Apart from the 3 symposiums, the conference featured some plenary talks and panel discussion sessions on various aspects of mathematics.

The whole conference was live-streamed on YouTube, so that anybody can attend.

There was no registration fee. Number of registrations was around 3790.

4.2.2 Online Interactive Mathematics Training on Number Theory and Algebra during Aug 17 – Aug 21, 2020.

An online outreach programme for undergraduate students of Odisha was organized during August 17 - 20, 2020. About 60 students participated. Prof. Binod Sahu from NISER, Bhubaneswar and Prof. K. Srinivas from IMSc Chennai were the resource people for this event.

4.2.3 Virtual Meeting on Compact Stars and QCD 2020 during Aug 17 – Aug 21, 2020.

This conference had talks on cutting edge research on theoretical QCD and its application of the astrophysical properties of compact stars. For the benefit of the students, there were some lectures on stellar structure and evolution too. This program was a concise virtual version of our original program CSQCD-2020, whose description is given below

This was supposed to be an online meeting hosted at ICTS-TIFR, Bangalore. However, due to the pandemic, the conference was converted to an online mode.

4.2.4 Teachers' Enrichment Workshop during Nov 19, 2020 – Jan 3, 2021.

Prof. K.N. Raghavan of IMSc was the academic convener of the programme and also a resource person for it.

4.2.5 Chandrasekharan Centenary Symposium in Number Theory on Dec 19, 2020.

The Chandrasekharan Centenary Symposium in Number Theory was organized as part of the 86th Annual Conference of IMS which was held online during the period December 17 - 20, 2020. The speakers were Prof. Shanta Laishram, ISI, Delhi, Prof. Stephan Baier, RMVU, Belur, Prof. Jaban Meher, NISER, Bhubaneswar, Prof. R. Padma, VIT, Velore and Prof. K. Srinivas, IMSc.

4.2.6 Arecibo Day on Dec 22, 2020.

An online meeting to discuss science done by Indian astronomers with the Arecibo radio telescopes that was located in Puerto Rico, USA and unfortunately collapsed on 01-December-2020.

4.2.7 International GeoGebra Conference, India during Mar 11 – Mar 13, 2021.

We have organized International GeoGebra Conference, India during 11-13 March, 2021. The aim of this online conference was to illustrate how GeoGebra can be used to develop mathematical thinking in the learners and promote 'Higher Order Thinking'.

The conference featured 10 invited talks by experts in GeoGebra from around the world, 1 panel discussion on role of GeoGebra in motivating underachievers, 15 short presentations by teachers from schools and colleges in India and abroad discussion how they are using GeoGebra in their classrooms. We had received more than two thousand registrations from participants in India and abroad.

Also, for participants who have never used GeoGebra before we had organized introductory workshops on GeoGebra in 9 different languages, i.e Bengali, English, Gujrati, Hindi, Kannada, Malayalam, Marathi, Tamil, and Telugu.

More details about the events can be found at: https://sites.google.com/view/igci2021

4.3 IMSc Outreach Activities

The Hon'ble Vice-President of India, Shri M. Venkaiah Naidu, visited the Institute of Mathematical Sciences (IMSc) on 5th January 2021. He shared the stage with Thiru. K. P. Anbalagan, Hon'ble Minister for Higher Education and Agriculture, Government of Tamil Nadu; Selvi Apoorva IAS., Principal Secretary in the Higher Education Department, Government of Tamil Nadu; Dr. A. K. Bhaduri, Director, IGCAR, Kalpakkam; and Prof. V. Arvind, Director, IMSc.

Shri Naidu planted a sapling outside the Ramanujan Auditorium. He viewed the permanent exhibition on the history of IMSc and the temporary exhibits on INO and DAE Technologies. Inside the Auditorium, he listened with interest to a presentation by Prof. V. Arvind on the work done by IMSc scientists.

Thiru. Anbalagan addressed the gathering and spoke about the importance of science and mathematics education and research. He praised the role of IMSc in these fields over the years

During his speech to IMSc members, Shri Naidu spoke of the importance of the mathematical sciences in the development of the nation. He stressed the need for scientists to work towards improving the lives of ordinary people, and for society to live in harmony with nature. He highlighted the issues of gender equity in Science and of early learning being in one's mother

tongue. He expressed the hope that the National Education Policy would lead to better educational outcomes for Indian children and youth.

The Vice President also inaugurated, remotely, the New Residential Wing of IMSc located at the DAE Nodal Centre, Pallavaram, Chennai

https://vicepresidentofindia.nic.in/events

Figure 4.1: Visit by the Hon'ble Vice President, (5th Jan., 2021)

Highlights of Outreach Activities The Institute has conducted various Conferences and workshops in addition to regular seminars during the academic year 2020-21; The list of outreach activities includes the following:-

Annular Solar Eclipse: 21 June 2020 An Annular Solar Eclipse (ASE) was visible on the morning of 21 June 2020 in India, with the annular track passing through Punjab, Haryana and Uttarakhand. Solar eclipses are of huge public interest and provide an exceptional opportunity to promote science and scientific temper among the people, as well as challenge the myths surrounding the topic. The mass campaigns during past solar eclipses in India are unique in their range and reach. Given the global CoViD-19 pandemic, we provided information about the eclipse in various regional languages through our social media handles and website and encouraged the public to observe the eclipse safely from their homes. https://www.imsc.res.in/outreach/ASE2020/

From Leaning to Doing – release of online material for Madras Day, 22 August 2020 Our poster series "From Learning to Doing: Science, Education and Public Service in Chennai" was curated for IMSc's Science at the Sabha 2019. The series of 12 posters highlights some

Figure 4.2: Inauguration of the New Residential Wing, IMSc., (5th Jan., 2021)

of Chennai's traditions in science, mathematics, education, and public service, together with the people and institutions that helped to shape them. To mark 'Madras day' (founding of the city of Madras) on 22nd August, this series was made available online through our social media channels and website. https://www.imsc.res.in/outreach/ChennaiScience2019/

Facets: 12 - 15 October 2020 Facets is the Institutes's outreach program for advanced undergraduate and postgraduate students of mathematics. This program is intended for mathematics students to interact with professional mathematicians working in various fields. This year, the program was conducted online. The talks are also now available on our YouTube channel.
https://www.youtube.com/watch?v=wPIKouOnEpE&list=PLhkiT_RYTEU05LSptj3DP0o4sguX3kMQA
Organizers: Sushmita V, Varuni P Moderators: Sushmita V, Manikandan Sambasivam, Soumya Dey, Varuni P Speakers: Amritanshu Prasad, Dhiraj Kumar Hazra, Anirban Mukhopadhyay, Meena Mahajan

Vigyan Pratibha Teachers workshop (Tamil) : 23-24 December 2020 Vigyan Pratibha is a Government of India program to nurture of talent in Science and Mathematics among VIII - X students. As a regional center for the program, we are organizing a teachers workshop to introduce the program to local teachers highlighting the material that has been recently made available in Tamil. Organizers: K.N. Raghavan, Manikandan Sambasivam, Varuni P Speakers: Manikandan Sambasivam, Niruj Mohan Ramanujam (ASI-POEC), R. Ramanujam, Subashri V, Uthra Dorairajan (D G Vaishnav College), Varuni P

4.4 Seminars

Date	Speaker Affiliation	Title
1-4-2020	Oorna Mitra IMSc	Webinar: Quasi-isometries of Z^n and twisted conjugacy classes in certain linear groups
8-4-2020	Anne Schilling UC Davis	Webinar: Crystal for stable Grothendieck polynomials
15-4-2020	Anne Schilling UC Davis	Webinar: Crystal for stable Grothendieck polynomials
21-4-2020	Krishanu Roy (Zoom 872 2731 4427) IMSc	Thesis defense: pi-systems of Kac-Moody Lie algebras
22-4-2020	Arvind Ayyer IISc, Bangalore	Webinar: Combinatorics of an exclusion process driven by an asymmetric tracer
29-4-2020	G. Arunkumar IISER Mohali	Webinar: Chromatic Symmetric Function of Graphs from Borcherds Lie Algebra
6-5-2020	Mike Zabrocki York University	Webinar: Symmetric Group Characters as Symmetric Functions
13-5-2020	Nate Harman The University of Chicago	Webinar: Intermediate Algebraic Structure in the Restriction Problem
18-5-2020	Amritanshu Prasad IMSc	Webinar: Introduction to Plethysm
21-5-2020	Amritanshu Prasad IMSc	Webinar: A Timed Version of the Plactic Monoid
25-5-2020	Prafullkumar Tale PhD Defense IMSc	Webinar: Some Results about Graph Contraction Problems

11-6-2020	Deniz Kus Ruhr-University Bochum	Webinar: Quiver varieties and their combinatorial crystal structure
18-6-2020	Shubham Sinha UCSD	Webinar: Random t-cores and hook lengths in random partitions.
18-6-2020	Prathik Cherian J IMSc	Webinar: Online Ph.D. viva-voce of Mr. Prathik Cherian J
2-7-2020	Gaurav Sood IMSc	Proof complexity of MaxSAT Resolution
16-7-2020	Vikram Sharma IMSc	Root Separation Bounds
29-7-2020	B. Paul JSPS post-doctoral fellow, Kyushu University, Japan	Growth of Petersson inner products of Fourier-Jacobi coefficients of Siegel cusp forms
29-7-2020	Kamal Tripathi IMSc	Pre-Synopsis Seminar: Confined Polymers in Biophysical Contexts
30-7-2020	Arindam Biswas IMSc	Approximation in (Poly-) Logarithmic Space
31-7-2020	Sruthy Murali IMSc	Planar algebras, subfactors and quantum information theory
4-8-2020	Shyam K. Masakapalli IIT Mandi	Efficient mapping of microbial metabolic systems by integrating genomics with 13C fluxomics
5-8-2020	Yuri Bilu University of Bordeaux, France	Trinomials, singular moduli and Riffaut's conjecture
6-8-2020	Guillermo Restrepo Max Planck Institute for Mathematics in the Sciences, Leipzig	The chemical space and its three statistical regimes
6-8-2020	Sridhar P Narayanan IMSc	Two restriction problems in the representation theory of symmetric groups

6-8-2020	Digjoy Paul IMSc	Quasi p-Steinberg Characters of double covers of Symmetric and Alternating groups
11-8-2020	Ashutosh Srivastava Institute of Transformational bio-Molecules, Nagoya University, Japan	Structural and dynamical insights into mammalian circadian clock proteins
12-8-2020	J.-M. Deshouillers University of Bordeaux, France	Local distribution of values of Euler's totient function
13-8-2020	Uddipan Sarma Vantage Research, Chennai	Cell8208;specific responses to the cytokine TGF 946; are determined by variability in protein levels
13-8-2020	Roohani Sharma IMSc	Advancing the Algorithmic Tool-kit for Parameterized Cut Problems
13-8-2020	Ryan Vinroot William and Mary	Generating Functions for Involutions and Character Degree Sums in Finite Groups of Lie Type
18-8-2020	Sudip Kundu University of Calcutta	Unravelling rice cellular physiology
19-8-2020	Patrice Philippon CNRS, France	Generalisations of Schanuel‘s conjecture and applications
19-8-2020	Sandeep Choubey MPI-PKS Dresden	Governing principles of cellular decision-making: gene regulation
20-8-2020	Sangram Bagh Saha Institute of Nuclear Physics, Kolkata	Hacking God‘s Own Program with Synthetic Genetic Circuits: Artificial neural networks to microgravity sensors in living bacteria
20-8-2020	Anupam Kumar Singh IISER Pune	Asymptotics of powers in finite reductive groups
20-8-2020	Saket Saurabh IMSc	A Parameterized Approximation Scheme for Min k-Cut.

25-8-2020	Zhumur Ghosh Bose Institute, Kolkata	Roadmaps of interaction between the coding and the noncoding RNA world: Orchestrating disease biology
25-8-2020	Luke Chamandy University of Rochester	Magnetic Field Evolution in Galaxies and Common Envelope Evolution in Stars
26-8-2020	Kohji Matsumoto Nagoya University, Japan	Multiple Dirichlet series with arithmetical coefficients on the numerators
27-8-2020	Ram Rup Sarkar National Chemical Laboratory, Pune	Modelling Approaches to understand the challenges of Cancer Metabolism
27-8-2020	Subhajit Ghosh IISc, Bangalore	Total variation cutoff for random walks on some finite groups
1-9-2020	Amit Ghosh IIT Kharagpur	Systems Biology of Metabolism for Microbial Cell Factories
2-9-2020	Sinnou David University of Paris VI, France	On a conjecture of Bertrand and Villegas
3-9-2020	Abhranil Chatterjee IMSc	A Special Case of Rational Identity Testing and the BreAar-Klep Theorem
3-9-2020	Sami Assaf University of Southern California	Pieri Rules for Polynomials
5-9-2020	Om Prakash IMSc, Chennai	Theoretical add-ons for observation of interactions among biomolecules and lead compounds
7-9-2020	Susmita Ghosh IMSc	Kinetic studies on the coil-globule transition of a single flexbile charged polymer chain in poor solvent and specificity of positively charged polymer-RNA interaction.
8-9-2020	Saurav Mallik Weizmann Institute of Science, Israel	Chaperoning four billion years of protein evolution

9-9-2020	Jyothsnaa Sivaraman University of Toronto, Canada	Covering the ray class group with a product of prime ideals
10-9-2020	R.K. Brojen Singh JNU, New Delhi	Stochastic dynamics in low dimensional systems
10-9-2020	Krishnan Rajkumar Jawaharlal Nehru University	Generalizations of the Selberg integral and combinatorial connections
15-9-2020	Debarka Sengupta IIIT-Delhi	Detection and characterization of rare transcriptomes
16-9-2020	V. Kumar Murty Director, The Fields Institute, Canada	The fine Selmer group
16-9-2020	Debarshee Bagchi Center for Computation and Theory of Soft Materials Northwestern University Illinois, USA	Transport Properties of Driven Confined Polyelectrolytes
17-9-2020	Shaunak Deo TIFR	Deformations of Galois representations
17-9-2020	Prakash Saivasan IMSc	Consistency framework for relaxed memory models.
17-9-2020	Sumana Hatui IISc, Bangalore	On Schur multipliers and projective representations of Heisenberg groups
21-9-2020	Sushovan Mondal IMSc	Probing properties of dense stars with continuous gravitational waves: The case of Thorne Zytkow Objects
22-9-2020	Shailza Singh National Centre for Cell Science (NCCS) Pune	Machine Learning for Engineering Biology in the Era of Network Science
23-9-2020	Kannan Soundararajan Stanford University, USA	Equidistribution from the Chinese Remainder Theorem
23-9-2020	Balachandra Suri Institute of Science & Technology (IST), Austria	Exploring Turbulence using Exact Coherent States

24-9-2020	Biplab Bose IIT Guwahati	Percolation in Planar Cell Polarity
24-9-2020	Rijubrata Kundu IISER Pune	Generating function for the powers in $\mathrm{GL}(n, q)$
24-9-2020	Meena Mahajan IMSc	Hardness Characterisations and Size-Width Lower Bounds for QBF Resolution
28-9-2020	Sushovan Mondal IMSc	Probing properties of dense stars with continuous gravitational waves: The case of Thorne Zytkow Objects https://meet.google.com/xfo-fapt-yja
29-9-2020	Debraj Rakshit ICFO 6 The Institute of Photonic Sciences, Spain	Twistless simulation of twistronics
30-9-2020	Olivier Ramare Institut de Mathematiques de Luminy	Notes on primes in some special subsets modulo q
1-10-2020	Mohit Kumar Jolly IISc, Bengaluru	Shapeshifters in cancer: how do tumor cells switch among different phenotypes to drive aggressive behavior?
1-10-2020	Abhimanyu Choudhury IMSc	Dependency Schemes in Quantified Boolean Formulas
1-10-2020	S Viswanath IMSc	Saturation for refined Littlewood-Richardson coefficients-I
2-10-2020	Digjoy Paul IMSc	The Multiset Partition Algebra
5-10-2020	Rupam Karmakar CMI	Positive cones of cycles and Seshadri constants oncertain projective varieties
6-10-2020	Krishnakumar Sabapathy Xanadu Quantum Technologies Inc, Canada	Route to universal quantum computation - https://meet.google.com/sdj-waqd-ccc

6-10-2020	Sucheta Gokhale Innovation Center, Tata Chemicals	Systems biology of small and large systems
7-10-2020	Kaneenika Sinha IISER Pune	Central limit theorems for the error terms in Sato-Tate sequences
8-10-2020	Niranka Banerjee IMSc	Optimal Output Sensitive Fault Tolerant Cuts
8-10-2020	S Viswanath IMSc	Saturation for refined Littlewood-Richardson coefficients-2
14-10-2020	Veekesh Kumar IMSc	On simultaneous approximation of algebraic numbers
15-10-2020	Vinod Scaria Institute of Genomics and Integrative Biology (IGIB), Delhi	Genomes - from Personal to Populations and back
15-10-2020	S Viswanath MSc	Saturation for refined Littlewood-Richardson coefficients-2
15-10-2020	Debarghya Banerjee MPIDS, Goettingen	"Odd"-response in active systems
16-10-2020	Jilmy P. Joy Institute of Mathematical Sciences	Shock propagation in dilute inelastic and elastic media (thesis viva) (meet.google.com/viy-nesb-ocz)
17-10-2020	Rahul Siddharthan IMSc Chennai	The 2020 Nobels and a history of genome editing
20-10-2020	Susmita Adhikari Stanford University, USA	The structure of halos as a probe of Cosmology, Dark matter and galaxy evolution; google meet link: https://meet.google.com/mnd-esvh-oxs
20-10-2020	Marcin Zag3rski Institute of Theoretical Physics, Jagiellonian University	How is information processed in developing spinal cord?
21-10-2020	Ritabrata Munshi ISI Kolkata	Arithmetic correlation

22-10-2020	Shaon Chakrabarti National Centre for Biological Sciences, Bengaluru	Why cousins are more similar than mother-daughters: implications for cell cycle regulation
22-10-2020	Sanjukta Roy IMSc	On the (Parameterized) Complexity of Almost Stable Marriage
22-10-2020	Ajmain Yamin Stony Brook	Filtering Grassmannian Cohomology via k-Schur Functions
27-10-2020	Pan-Jun Kim Hong Kong Baptist University, Hong Kong	Computational tackling of biological systems: Circadian clock and human microbiome
28-10-2020	Arnab Pal Tel Aviv University, Israel	First Passage Under Restart
28-10-2020	Akshaa Vatwani IIT Gandhinagar	Joint extreme values of L-functions
29-10-2020	Andrea De Martino CNR Nanotec Italian Institute of Genomic Medicine, Turin, Italy	Reverse modeling metabolic networks
29-10-2020	Gaurav Sood IMSc	Hard QBFs for Merge Resolution
29-10-2020	Rosa Orellana Dartmouth College	The Howe duality for the symmetric group
4-11-2020	Wataru Takeda Nagoya University, Japan	Transcendence of values of the iterated exponential function at algebraic points
5-11-2020	Ashwin Jacob IMSc	Structural Parameterizations with Modulator Oblivion
5-11-2020	Amrutha P IISER Thiruvananthapuram	On the determinant of representations of generalized symmetric groups $Z_r \wr S_n$
5-11-2020	Anshu Bhardwaj Institute of Microbial Technology (IMTECH), Chandigarh	Data-driven approaches to understand and address Antimicrobial Resistance (AMR)

11-11-2020	Somnath Jha IIT Kanpur	Selmer multiplicities and root numbers for Artin twists of congruent elliptic curves
12-11-2020	Anu Raghunathan National Chemical Laboratory, Pune	Integrated Systems Approaches to Predict Metabolic Vulnerabilities Of Chemo-resistant Glioblastoma Cells
12-11-2020	Suryajith Chillara Univ. of Haifa	On computing multilinear polynomials using depth four circuits of bounded individual degree.
12-11-2020	Apoorva Khare IISc	Polya frequency sequences: analysis meets algebra
16-11-2020	Shibasis Roy IMSc	SU(3) flavour analysis of b-baryon decays.
17-11-2020	R. Sowdhamini National Centre for Biological Sciences, Bengaluru	Structural Analysis of Protein-Protein Interactions
18-11-2020	Arka Banerjee Stanford University	Modeling structure formation in the era of precision cosmology: application to neutrino masses. (google meet link: meet.google.com/dgc-yiwu-ikb)
18-11-2020	Gautami Bhowmik University of Lille, France	Bounds on Siegel zeros
19-11-2020	Fakhteh Ghanbarnejad Sharif University of Technology, Tehran, Iran	A three-player ecological system of pathogens
19-11-2020	Sajin Koroth Simon Fraser University	Communication complexity based approaches to KRW conjecture, lifting theorems and formula lower bounds
19-11-2020	Krishnan Rajkumar Jawaharlal Nehru University	Selberg integrals involving Schur polynomials and combinatorial connections
23-11-2020	Partha Mukhopadhyay	Institute Seminar days : A covariant approach to lattice

24-11-2020	Kavita Jain JNCASR, Bengaluru	Adaptation in changing environments
26-11-2020	Greta Panova University of Southern California	The mysterious Kronecker coefficients
27-11-2020	Manjari Bagchi, Mrigendra Singh Kushwaha	Neutron Stars as tools to probe gravitational physics, Saturation of refined Littlewood-Richardson coefficients
1-12-2020	Lawqueen Kanesh The Institute of Mathematical Sciences	Parameterized Complexity of Conflict-Free Solutions
2-12-2020	Anup Dixit CMI	The generalised Diophantine m-tuples
2-12-2020	M. Padmanath Helmholtz Inst., Mainz	Understanding sub-nuclear physics using Lattice Quantum ChromoDynamics
3-12-2020	Volodymyr Mazorchuk Uppsala University	Bigrassmannian permutations and Verma modules
4-12-2020	Amritanshu Prasad/D. Indumathi	Representation Stability for Symmetric Groups/The Sun, the Earth, and Neutrinos: The India-based Neutrino Observatory (INO)
8-12-2020	Harapriya Mohapatra National Institute of Science Education and Research (NISER), Bhubaneswar	The medley of stochastic heterogeneity in bacteria
8-12-2020	Sourav Ballav	Surface Operators, Seiberg-dual Quivers and Contours
9-12-2020	Abhishek Bichhawat Carnegie Mellon University	Principled Approaches to Data Security and Policy Enforcement
9-12-2020	Niranka Banerjee The Institute of Mathematical Sciences	Dynamizing Graph Classes and Output Sensitive Fault Tolerant Subgraph Problems

10-12-2020	Chirag Jain Indian Institute of Science, Bengaluru	Repeat-aware methods for mapping and analyses of under-explored regions in the human genome
16-12-2020	Santanu Mondal Los Alamos National Laboratory (LANL)	Parton distribution functions via moments from Lattice QCD
17-12-2020	Kalyan Sundar Chakrabarti KREA University	Conformational selection in a protein-protein interaction
17-12-2020	Rekha Biswal University of Edinburgh	Macdonald polynomials and level two Demazure modules for affine sl_{n+1}
18-12-2020	Pragati Gupta Indian Institute of Sciences	Quantum simulation of energy transport in open systems
21-12-2020	Sk Minhajur Rahaman; google meet link: https://meet.google.com/ubu-ezjt-aqb NCRA-TIFR, Pune	Pulsar radio emission and non-resonant hydrodynamic Langmuir mode instability in pulsar plasma
22-12-2020	Sutirth Dey IISER Pune	Dispersal evolution: The Drosophila Story
22-12-2020	Anand Pathak IMSc	Uncovering Functional Correlates of Structural Organization in Brain Networks at Multiple Scales : From the worm to the human
23-12-2020	Pantangi Venkata Raghu Tej SUSTech, Shenzen	EKR problems for permutation groups
24-12-2020	Oorna Mitra IMSc	Quasi-isometries of $\mathbb{Z}^n$ anTwisted Conjugacy in Certain Linear Groups
28-12-2020	Chandrima Paul	Physics Seminar
1-1-2021	Ajit C. Balram, Venkatesh Raman	Parton paradigm for the quantum Hall effect, String Matching using Discrete Fourier Transform

4-1-2021	Garima Rani TIFR Centre for Interdisciplinary Sciences, Tata Institute of Fundamental Research, Hyderabad	Understanding the mechanical response of bacterial cell walls and cell membranes against antimicrobial agents
8-1-2021	R Ramanujam,Pinaki Chaudhuri	To number theory via automata,Exploring the world of amorphous solids
12-1-2021	Debatri Chattopadhyay Centre for Astrophysics and Supercomputing, Swinburne University	Modelling Neutron Star-Black Hole Binaries: Future Pulsar Surveys and Gravitational Wave detectors [arXiv:2011.13503]; Meeting Link: https://meet.google.com/woz-idbx-pqg
12-1-2021	Abhisekh Sankaran University of Cambridge	Some recent results in finite model theory and the structure theory of classes of hypergraphs
15-1-2021	Roohani Sharma, Apurba Biswas	Reusing algorithms under conflict-free constraints, Mpemba effect in driven granular gases
19-1-2021	Dhruv Pathak IMSc	Dynamical effects in the second derivative of spin and orbital frequency of radio pulsars
19-1-2021	Abinash Kumar Nayak IMSc	Right-Handed currents and Electroweak penguins in B decays
20-1-2021	Rasmus Larsen University of Stavanger	Excited states of Bottomonia in quark gluon plasma from lattice QCD
20-1-2021	Mrigendra Singh Kushwaha IMSc	Kostant Kumar modules via Littelmann paths
21-1-2021	Srimathy Srinivasan University of Colorado	Srimathy Srinivasan: Finiteness theorems on algebraic groups with good reduction
22-1-2021	Satyavani Vemparala,Rahul Sinha	Designing Biomimetic Polymers: antimicrobial agents,Exploring the unknown using uncertainty principle

22-1-2021	Sandip Saha SNBNCBS Kolkata	Characterization Of Periodic Orbits In Open Nonlinear Dynamical Systems
25-1-2021	Sanjukta Roy IMSc	Select, Allocate, and Manipulate via Multivariate Analysis
25-1-2021	Sumantra Sarkar Los Alamos National Laboratory	Emergent behaviors of complex chemical systems
25-1-2021	Vishnudath K.N. PRL	Phenomenological Aspects of a Class of U(1) Extensions of the Standard Model with Inverse Seesaw
27-1-2021	Arindam Das Kyungpook National University, Daegu, South Korea	Testing the neutrino mass generation mechanism at the energy frontier
28-1-2021	Palak Pandoh IIT Madras	Palindromes in 1D and 2D words
28-1-2021	Fatma Cicek IIT Gandhinagar	On the Logarithm of the Riemann Zeta-function Near the Nontrivial Zeros
28-1-2021	Shouvik Roy Choudhury IITB, Mumbai	Neutrinos in Cosmology; google meet link: meet.google.com/tvk-itpg-fws
29-1-2021	Soumya Dey,Aparna Shankar	On some elements of big mapping class groups,QCD radiative corrections to the observables at the hadron colliders
3-2-2021	Rajamani Narayanan Florida International University	Gauge theories with massless fermions in 2+1 dimensions
4-2-2021	Siddhi Pathak Pennsylvania State University	Special values of L-functions and the Okada space
5-2-2021	Surabhi Tiwari	Next-to-soft corrections to differential rapidity distributions at the hadronic colliders
6-2-2021	C. G. Karthick Babu IMSc	Primes in Beatty sequence

8-2-2021	Safdar Quddus, Inspire faculty at IISc, Bangalore.	Group actions in the non-commutative geometry.
10-2-2021	Toru Kojo CCNU	From hadrons to quarks in neutron stars
10-2-2021	Ujjal Das IMSc	On the Hardy type potentials
10-2-2021	Anupam Saikia IIT Guwahati	The Iwasawa invariants of plus/minus Selmer groups of supersingular elliptic curves with isomorphic torsion
12-2-2021	Swarnendu Banerjee Agricultural and ecological research unit, ISI Kolkata	Impact of changing environment on plankton ecology
17-2-2021	Pooja Mukherjee IMSc	Next-to-Threshold Resummation in Perturbative QCD
19-2-2021	Rupam Barman IIT Guwahati	Lacunary eta-quotients and distribution of certain partition functions
19-2-2021	Pritam Majumder TIFR, Mumbai	On characterizing line graphs of hypergraphs
19-2-2021	Ajjath A H IMSc	Precision physics at the LHC : soft, next to soft and resummation effects in QCD
22-2-2021	Sujoy Mahato IMSc	Synopsis Meeting: Surface Defects from Fractional Branes
24-2-2021	Rob Pisarski BNL	"Golden Ages in Physics: Heavy Ion Physics at High Energies, and Neutron Stars"
24-2-2021	R. Balasubramanian IMSc	Product of three primes in Arithmetic progression
25-2-2021	Rajesh Mondal Stockholm University	Probing the early Universe using cosmological 21-cm signal; google meet link: meet.google.com/dve-mqis-ptb

25-2-2021	C R Subramanian IMSc	Inductive Graph Invariants and Algorithmic Applications
25-2-2021	P. A. Narayanan IMSc	Eigenvalue Statistics of Higher Rank Anderson Tight Binding Model Over The Canopy Tree
26-2-2021	Subbaroyan Ajay IMSc	Biologically Meaningful functions in Boolean Models of Living systems
3-3-2021	Adrien Florio Stony Brook University	CosmoLattice
3-3-2021	M. Manickam IISER Bhopal	Non-vanishing of the first Fourier-Jacobi coefficient of Siegel cusp form and Hecke eigenform of weight k for the full group of degree two
4-3-2021	Shasvath Kapadia ICTS-TIFR	Gravitational-Wave Astronomy: detection and inference ; google meet link: meet.google.com/yzy-ueat-dow
5-3-2021	Jyotirmoy Ganguly and Sibasish Ghosh	On the Divisibility of Character Values of the Symmetric Group, Towards universal detection of bi-partite entanglement
8-3-2021	Anupam A.H. IMSc, Chennai	Generalized BMS symmetry and Double soft graviton theorems.
10-3-2021	Atul Dixit IIT Gandhinagar	Superimposing theta structure on a generalized modular relation
10-3-2021	Ankur Sarkar IMSc	Exotic structures on manifolds
16-3-2021	Sabyasachi Chakraborty Florida State University	Heavy QCD axions in B decays
17-3-2021	Subhadip Basu IISc	Electric Field-Mediated Fibronectin6Hydroxyapatite Interaction: A Molecular Insight

18-3-2021	Sushmita Gupta IMSc	Well-Structured Committees
19-3-2021	Sridhar P Narayanan IMSc	Multiplicity of trivial and sign representations of S_n in hook-shaped representations of GL_n.
25-3-2021	Medical Division, BARC Hospital Medical Division, BARC Hospital	HBNI Lecture series on Health and Wellness - Corona virus diseases (COVID-19) pandemic and vaccination
26-3-2021	S. Pethuraj IMSc	Studies of Atmospheric Fluxes at the prototype iron calorimeter detector
26-3-2021	M.V.N. Murthy	A Physicist in Prime Number Land
31-3-2021	Gyan Prakash HRI	Sum-free sets, counting sets with small sumset and hypergraph container lemma

Chapter 5

External Interactions

5.1 Collaborative Projects with Other Institutions

5.1.1 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 (http://www.naic.edu/ deneva/drift-search). Papers have been published reporting results of this survey.

This collaboration has members rom 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.

5.1.2 Geometric methods for deep learning and topological characterization of complex networks

The project envisages a collaborative research effort of members from the Mathematics and Computational Biology groups at IMSc. In particular, it entails the application of deep and abstract mathematical ideas from algebraic topology and geometry to concrete, real-world problems arising in complex networks. We shall investigate the topological properties of particular kinds of networks (e.g. brain networks from fMRI data) via newly developed methods in persistent homology and graph Laplacians, as well as apply geometric methods to deep neural networks arising in machine learning via Formans discretized version of Ricci curvature. Both methods are expected to yield new insights in the analysis of high-dimensional data and complex networks.

5.1.3 Indian Pulsar Timing Array (InPTA) experiment

** ongoing project **

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 consortium in February 2021.

Members of this collaboration are affiliated to various institute across the country and abroad, e.g., NCRA-TIFR Pune, TIFR Mumbai, IIT-Hyderabad, West Virginia University (USA), ASTRON (The Netherlands), IMSC Chennai (Manjari Bagchi, Dhruv Pathak), etc. IMSc faculty M. Bagchi is a member (out of three) of InPTA steering committee. M. Bagchi is also the co-chair of the Education and Public outreach working group of the International Pulsar Timing Array.

5.1.4 Indo-French Program in Mathematics, IFPM

Several collaborative research works are in progress between India and France under "Indo-French Program in Mathematics, IFPM

5.1.5 Max Planck Partner Group in Mathematical Biology

This partner group was funded by Max Planck Society for 5 years with effect from April 2017. In collaboration with Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany, the mandate of this partner group is to develop geometry-inspired measures for the analysis of complex networks.

5.1.6 SPARC

We have been organising seminars jointly with University of Bordeaux and IIT Madras under this project. We already have a first version of a monograph and one accepted paper. A number of research collaborations are in progress in tune with the theme of the proposal.

5.1.7 Vigyan Pratibha

IMSc is the southern nodal centre for this project of HBCSE.

5.2 Conference Participation and Visits to Other Institutions

Coimbatore Balram, Ajit

Participated in *APS March meeting 2021* held at online during Mar 15 – Mar 19, 2021. 10 min. talk in a focus session

Dey, Soumya

Attended *CIRM Virtual Geometric Group Theory Conference* held at Online during Jun 1 – Jun 5, 2020.

Attended *Nearly Carbon Neutral Geometric Topology Conference* held at Online during Jun 1 – Jun 14, 2020.

Attended *Virtual Semester: Random and Arithmetic Structures in Topology* held at Online during Aug 17 – Dec 18, 2020.

Attended *Topics at the Interface of Low Dimensional Group Actions and Geometric Structures* held at Online during Jan 4 – Jan 15, 2021.

Gun, S.

Participated in *JNU seminar on Number theory and Special functions* held at JNU on Nov 12, 2020. Seminar Talk

Participated in *Algebra and Combinatorics seminar* held at IISc on Nov 20, 2020. Seminar Talk

Participated in *International conference on number theory and discrete Mathematics (ICNTDM) -2020 (Organised by Ramanujan Mathematical Society, India)* held at Rajagiri School of Engineering and Technology, Cochin during Dec 11 – Dec 14, 2020. Invited Talk

Participated in *Instructional School on Modular Forms funded by NCM* held at IIT Guwahati during Dec 14 – Dec 19, 2020. Course instructor

Participated in *31st V Ramaswami Aiyer Memorial Award Lecture in the 86th Annual Conference of Indian Mathematical Society - An International Meet* held at VIT, Vellore during Dec 17 – Dec 20, 2020. Award Lecture

Participated in *Recent Advances in Mathematics and Related Areas* held at KSOM during Dec 18 – Dec 22, 2020. Invited Talk

Participated in *One day colloquium sponsored by the Vaidhyanatha swamy trust* held at Ramanujan Institute for Advanced Study in Mathematics on Mar 4, 2021. Invited talk

Participated in *IWM annual conference 2020-2021* held at IIT Dharwad (Online) during Mar 27 – Mar 28, 2021. Plenary Speaker

Jacob, Ashwin

Participated in *15th International Symposium on Parameterized and Exact Computation, IPEC 2020* held at Virtual Conference during Dec 14 – Dec 18, 2020. https://algo2020.comp.polyu.edu.hk/ipec program.html

Kodiyalam, Vijay

Visited RIASM, Chennai on Feb 26, 2021. Delivered the R. Vaidyanathaswamy Endowment Lecture on "Ramanujan Graphs"

Kumar, Veekesh

Participated in *A conference on Analytic and Combinatorial Number Theory* held at Online during Mar 12 – Mar 18, 2021. Participated in this conference

Mahajan, Meena B.

Participated in *15th Computer Science in Russia Symposium (CSR)* held Online during Jun 29 – Jul 3, 2020. (originally planned at Ekaterinburg, Russia)

Participated in *23rd International Conference on Theory and Applications of Satisfiability Testing (SAT)* held online during Jul 6 – Jul 8, 2020. (originally planned at Alghero, Italy)

Participated in *35th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS)* held online during Jul 8 – Jul 11, 2020. (originally planned at Saarbrücken, Germany)

Participated in *ACM-W India Grad Cohort* held online during Jul 24 – Jul 26, 2020. Keynote speaker in one session, panelist in one panel discussion.

Participated in *35th Computational Complexity Conference* held online during Jul 28 – Jul 30, 2020. (originally planned at Saarbrücken, Germany)

Presented an online seminar at Tata Institute of Fundamental Research TIFR, Mumbai on Sep 29, 2020. Gave an STCS Seminar (online) titled "Hardness Characterisations and Size-Width Lower Bounds for QBF Resolution"

Participated in *Workshop on Matrix Rigidity* held online (originally scheduled at BITS Goa)

during Dec 13 – Dec 14, 2020.

Participated in *40th Foundations of Software Technology and Theoretical Computer Science (FSTTCS) Conference* held online (originally scheduled at BITS Goa) during Dec 15 – Dec 17, 2020.

Participated in *Dagstuhl Seminar on Computational Complexity of Discrete Problems* held online. (originally planned at Schloss Dagstuhl, Leibniz Centre for Informatics, Dagstuhl, Germany) during Mar 22 – Mar 26, 2021. Was one of the scientific organisers of the seminar.

Mukhopadhyay, Partha

Visited Department of Physics and Astronomy, University of Kentucky during Aug 1, 2020 – Mar 31, 2021. On sabbatical as a Visiting Scientist. Seminar (September 16, 2020): A Covariant Lattice and its Application to String Bits

Pathak, Dhruv

Participated in *Workshop on Testing General Relativity using Gravitational Waves* held Online Workshop during Aug 13 – Aug 14, 2020. Jointly organized by Indian Association for the Cultivation Of Science (IACS) and Indian Institute of Technology, Gandhinagar (IITGN)

Participated in *International Pulsar Timing Array (IPTA) Catch-up Meeting 2020* held at Virtual Conference (online), organized by the Australian National Telescope Facility during Sep 22 – Sep 23, 2020. Contributed slide presentation on "Dynamical effects in second derivative of spin and orbital frequency of radio pulsars"

Participated in *European Pulsar Timing Array (EPTA)-COMO Meeting 2020* held at Virtual meeting organized by the European Pulsar Timing Array (EPTA) group during Dec 2 – Dec 4, 2020. Gave a talk on "Dynamical effects in second derivative of spin and orbital frequency of radio pulsars"

Prasad, Amritanshu

Participated in *Algebraic Combinatorics Online Workshop* held at Institut Mittag Leffler, Stockholm during Apr 20 – Apr 30, 2020. (held online)

Participated in *Sage Days 110* held Fully online during Oct 29 – Oct 30, 2020. Invited speaker

Participated in *Online workshop on SageMath* held at IIT Jodhpur during Feb 15 – Feb 18, 2021. Sole instructor for the workshop.

Raghavan, K. N.

Participated in *Eleventh Summer Training Programme in Mathematics* held at RIASM, University of Madras during May 16, 2019 – May 21, 2020. Conducted six lecture + tutorial sessions (of three hours each) during this period

Participated in *Professor Shreeram Abhyankar Symposium 2020* held at Bhaskaracharya Pratishthana, Pune (online) on Jul 22, 2020. Was one of three invited speakers

Participated in *Science Academies Lecture Workshop on Linear Transformations, Matrices, and their Applications* held at S V University, Tirupati (online) during Nov 2 – Nov 7, 2020. Was one of three resource persons

Participated in *National Workshop on Algebra and Optimizations 2020* held at National Institute of Technology, Nagaland (online) during Nov 23 – Nov 25, 2020. Gave two talks in the workshop

Participated in *Discussion Meeting on Representation Theory* held at Indian Institute of Science (online) during Dec 10 – Dec 12, 2020.

Participated in *Recent Advances in Mathematics and related areas* held at Kerala School of Mathematics (online) on Dec 19, 2020. Was an invited speaker

Participated in *Ramanujan Day Celebrations* held at Ramanujan Institute for Advanced Study in Mathematics, University of Madras (online) on Dec 22, 2020. one of four resource persons

Participated in *One Day National Symposium on Mathematics and Applications (NSMA 2020)* held at IIT Madras (online) on Dec 22, 2020. Was one of three invited speakers

Participated in *UGC sponsored Two-Week Online Subject Refresher Course on Mathematics Statistics* held at Guru Jambheshwar University of Science Technology, Hisar (Haryana) (online) on Jan 27, 2021. Resource person

Participated in *One Day Colloquium sponsored by R Vaidyanathaswamy Trust* held at Ramanujan Institute for Advanced Study in Mathematics, University of Madras on Feb 4, 2021. One of four invited speakers

Visited University of Mysore during Feb 25 – Feb 26, 2021. Attended a meeting

Participated in *The Faculty Development Programme on ASPECTS OF MATHEMATICS* held at PG and Research Department of Mathematics, DG Vaishnav College (Autonomous), Chennai (online) on Mar 22, 2021. Resource person

Raman, Venkatesh

Participated in *International Conference on Number Theory and Discrete Mathematics (ICNTDM)* held at Cochin (Virtually) during Dec 11 – Dec 14, 2020. Gave an invited talk on 'Parameterizing from triviality: algorithms on graphs that are close to an easy graph class'.

Participated in *FST&TCS* held at Virtual during Dec 14 – Dec 18, 2020. Attended

Participated in *International Symposium on Parameterized and Exact Computation (IPEC)* held at Poland (Virtual) during Dec 15 – Dec 17, 2020. Attended

Samal, Areejit

Visited IIIT, Delhi on Jul 17, 2020. Computational biology webinar

Visited Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany on Aug 31, 2020. Invited webinar

Participated in *Virtual International Conference on Data Science in Biology* held at nstitute of Bioinformatics, Bengaluru during Sep 4 – Sep 6, 2020. Invited Talk

Participated in *Online Short Term Course on Research Methodology in Basic Sciences* held at University of Mumbai during Sep 21 – Sep 26, 2020. Invited talk

Visited SASTRA University, Thanjavur on Nov 16, 2020. Invited webinar

Visited Bose Institute, Kolkata on Dec 7, 2020. Invited webinar

Sharma, S.

Invited for a presentation at the online conference titled *The Dual Mysteries of Gauge Theories and Gravity*, organized in honor of Nobel laureate Prof. David Gross, held at IIT Madras during October 19-23, 2020.

Invited for a plenary talk at the *XXIV DAE-BRNS High Energy Physics Symposium* held online at NISER Bhubaneswar during 14-18 December, 2020.

Srinivas, K.

Participated in *Webinar on Number theory and its related topics* held at Virtual, Department of Mathematics, Sambalpur University, Sambalpur. during Jul 6 – Jul 15, 2020. Delivered a talk with the title 'On the zeros of zeta-functions'.

Participated in *Chennai-Tirupati Intercity Meet* held at Virtual, Department of Mathematics, IIT Madras. during Aug 27 – Aug 28, 2020. Delivered a talk with the title 'On multiplicity one conjecture for Selberg class'

Participated in *ISID-SMU Seminar* held at Virtual, ISI Delhi on Oct 21, 2020. Delivered a talk with the title 'On Ramanujan's lattice point problem

Participated in *Ramanujan's Centenary Remembrance Year* held at Pie Mathematics Association, Chennai (Virtual) on Dec 20, 2020. Delivered a talk with the title 'Counting lattice points within some contours'.

Participated in *National Mathematics Day* held at IIT Bhilai (Virtual) on Dec 22, 2020. Delivered a talk with the title 'Some reflections on Ramanujans mathematics'.

Participated in *National webinar on India, Mathematics and Ramanujan* held at Department of Mathematics, University of Calicut (Virtual) on Feb 24, 2021. Delivered a talk with the title 'On Ramanujan's lattice point problem'.

Participated in *S. S. Pillai Endowment lecture* held at Ramanujan Institute, University of Madras on Feb 24, 2021. Delivered talk with the title 'The Riemann zeta-function'.

Participated in *Balu Fest* held at IMSc, Chennai (Virtual) during Mar 12 – Mar 18, 2021. Delivered a talk with the title 'The gaps between zeros of Epstein's zeta-function'.

Subramanian, C. R.

Visited School of Computer Science, University of Oklahoma, Norman, USA. during Apr 1 – Jun 16, 2020. Interacted and collaborated with faculty and graduate students of Schools of Computer Science and Industrial and Systems Engineering.

Participated in *Probability, Geometry, and Computation in High Dimensions Boot Camp* held at Simons Institute for the Theory of Computing, Berkeley during Aug 19 – Aug 28, 2020. Online participation.

Participated in *Concentration of Measure Phenomena* held at Simons Institute for Theory of Computing, Berkeley during Oct 19 – Oct 23, 2020. Online participation

Participated in *14th International Conference on Combinatorial Optimization and Applications (COCOA-2020)* held at Dallas, Texas, USA during Dec 11 – Dec 13, 2020. Presented a paper which appears in its proceedings.

Participated in *7th International Conference on Algorithms and Discrete Applied Mathematics (CALDAM-2021)* held at IIT-Ropar, Rupnagar, Punjab, India during Feb 11 – Feb 13, 2021. Chaired an invited talk session.

5.3 Visitors

Doctoral Visitor

Anand Pathak	01.08.20 - 22.12.20	Former IMSc Research Scholar

Non-Doctoral Visitor

Aparna, S.R.	01.06.20 - 31.03.21	Stella Maris College, Chennai

Chapter 6

Infrastructure

6.1 Computer Facilities

Enhancement of Computer Facility during 2020-21

- The new Laptops were issued to newly joined faculty and those faculty requested for replacement of laptops which are older than 4 years. Macbook book Pro 13", Macbook Pro 15", Lenovo Thinkpad, Dell Latitude laptops were distributed.
- Obsolete and non working LAN switches are replaced with new ones.
- XP Pen tablets(15) were purchased and issued to the faculty on demand for their online teaching.
- Zoom Academic licenses(20) were purchased to handle the remote meetings, virtual conferences, etc.,
- The Internet bandwidth speed was upgraded to 65 Mbps(1:1) fiberloop through AIRTEL.
- Hathway Internet connections over fiber link was installed at the DAE-IMSc Nodal Center, Pallavaram, Chennai and the services were made available over WiFi for the residences of JRFs & PDFs.

Activities :

GeM registration was completed to handle online procurement activities.
Continuous system support was provided to the Institute members for the remote work during the Covid-19 Lock down period
Systems & Media team have supported and fulfilled the requirements during virtual classes, virtual official meetings, virtual conferences, webinars, etc,.

6.2 The Library

The Institute Library holds a total collection of 75434 books and bound periodicals as on March 31, 2021 inclusive of current year's addition. Due to the pandemic COVID situation - only 85 books were added during the current reporting period, from April 2020 to March 2021. 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.

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. VECC Kolkata has extended their support by providing linux based software applications to use RFID systems. 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.

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