# THE INSTITUTE OF MATHEMATICAL SCIENCES

## C. I. T. Campus, Taramani,

## Chennai - 600 113.

# ANNUAL REPORT

## Apr 2018 - Mar 2019

**Foreword**

I am very pleased to present the annual report of the Institute for 2018-2019 and put forth the distinctive achievements of its members during the year along with a perspective for the future.

During the period April 2018 - March 2019, there were 155 students pursuing their PhD and 39 scholars pursuing their post-doctoral programme at IMSc.

Spread through this period, the Institute organized or co-sponsored several workshops and conferences. Specifically, the *IndiaEMBO Symposium on Regulatory Epigenomics: From Large Data to Useful Models* was an international conference featuring cutting-edge research, primarily funded by European Molecular Biology Organization (EMBO) and DBT-Wellcome India Alliance, with local support and some funding from IMSc. *Mechanics of Complex Matter: Criticality, intermittency and collective behaviour* was a workshop that provided graduate students and researchers with an exposure to the current developments in understanding how various materials, both soft and hard, in crystalline and amorphous forms, respond to mechanical perturbations of various kinds leading to plasticity, fracture, flow etc. *Nagarajfest* was a conference on algebraic geometry, commutative algebra and number theory. An ACM-India Summer School on *Graph Theory and Algorithms* was co-organized by IMSc faculty members and held at PSG tech Coimbatore. An international conference on *Algebras, Combinatorics, and Representation Theory* was jointly organized by IMSc and IISER Thiruvananthapuram. *The Stellar Legacy of Prof. Meghnad Saha: from Society to the Cosmos* was a conference organized on the occasion of the 125th birth anniversary of Meghnad Saha. The workshop on *Science, Journalism, Media: Communicating Science in a Changing India* brought together scientists and science journalists and led to many fruitful discussions.

We note with a lot of satisfaction that our outreach programmes like 'Teachers' Enrichment Workshop', 'Summer School Students Workshop', 'Facets', 'kaNita-kAnakam", 'Enriching Mathematics Education', 'Zero shadow day', 'IMSc Open day', 'UN International Day for Girls and Women in Science' and 'Science at the Sabha' are increasingly popular. Over the years, these events have been attracting more and more students and teachers, mainly from nearby regions, but also some from across the country. The outreach related activities in the Institute are the initiative of several institute members. Their untiring efforts, enthusiastically supported by the IMSc administration, PhD students and postdoctoral fellows, to make scientific research accessible and exciting to students and teachers at various levels, deserves all praise.

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 of the research work carried out has also been presented in international conferences.

A total of 16 students were awarded 'PhD' degree, 3 students have submitted their PhD theses. 7 students were awarded 'MSc by Research' degree, under the supervision of our faculty.

There are several ongoing collaborations between other institutions, both national and international, and research groups of IMSc. Among these, we mention a few. *Decongesting*

*India's Transportation Network using mobile devices* is an ITRA-Media Lab Asia Project involving principal investigators from IMSc, IIT Madras and IIM Bangalore. The *India-based Neutrino Observatory* is a multi-institute collaboration of which IMSc is a part. IMSc is also part of the *Belle II Collaboration* which is a multinational collaborative effort, involving 60 institutions from all over the world, to understand phenomena accessible at the KEK-B collider in Tsukuba, Japan. As a *Max Planck Partner Group in Mathematical Biology,* IMSc has been collaborating with MPIMIS Leizig on the study of biological networks.

During 2018-2019, a total of 34 lecture courses were conducted at the Institute. Additionally, a course of lectures for the undergraduate programme of CMI.

We are proud to note the awards and honors bestowed on our faculty for their contributions: V. Ravindran was elected Fellow of the Indian National Science Academy, for 2018, by the Indian National Science Academy. Parameswaran Sankaran was elected Fellow of the Indian National Science Academy, for 2018, by the Indian National Science Academy. Areejit Samal was designated Research Ambassador, for the period 2018-2022, by the Deutscher Akademischer Austauschdienst (DAAD) to promote bilateral cooperation between Germany and India. Saket Saurabh was awarded SwarnaJayanti Fellowship, for 2018, by the DST, India. Sayantan Sharma was awarded Ramanujan Fellowship, for 2018, by the SERB, DST, Government of India.

This report was compiled through the efforts of the IMSc Annual Report Committee comprising of Drs. Areejit Samal, Sayantan Sharma, Shrihari Gopalakrishna, C. R. Subramanian, S. Viswanath, Paul Pandian and Usha Devi. I owe my gratitude to all of them.

June, 2019                                                                                              **V. Arvind**

# Contents

# Chapter 1

# The Institute

## 1.1 Governing Board

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

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

Prof. **S. K. Joshi**,
Honorary Scientist Emeritus CSIR,
Vikram Sarabhai Professor,
National Physical Laboratory, New Delhi
(**Member**)

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

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

Dr. **P. Duraisamy**,
Vice Chancellor,
University of Madras, Chennai
(**Member**)

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

Shri. **A.R. Sule**, (IDAS)
Joint Secretary(R&D) to Govt. of India,
Department of Atomic Energy, Mumbai
(**Member**)

1

## 1.2 Executive Council

Prof. **S.K. Joshi**,
Honorary Scientist Emeritus CSIR,
Vikram Sarabhai Professor,
National Physical Laboratory,
New Delhi
(**Chairman**)

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

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

Shri. **A.R. Sule**, IDAS
Joint Secretary (R&D) to Govt. of India,
Department of Atomic Energy, Mumbai
(**Member** )

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

Shri. **Mangat Ram Sharma**, IAS
Principal Secretary to Government,
Secretariat, Fort St. George, Chennai
(**Member**)

Prof. **V. Arvind**,
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 Minister of Government of Tamilnadu.

**Shri. K. N. Vyas**, Chairman, Atomic Energy Commission & Secretary to Govt. of India, Department of Atomic Energy, CSM Marg, Mumbai
(**Co-Chairman**, *Governing Board*)
Shri 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. Shri 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. Mr. Vyas, as an engineer, has played a key role for completion of strategic projects. Shri Vyas has also participated in design analysis of the Test Blanket Module planned to be installed in ITER, France.
Shri 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.
Shri 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. S. K. Joshi**, Honorary Scientist Emeritus CSIR Vikram Sarabhai Professor National Physical Laboratory Dr. K.S. Krishnan Road New Delhi 110 012.
(**Member**, *Governing Board*) & (**Chairman**, *Executive Council*)
Prof. Joshi has held numerous important positions in the field of science in India, including Director General CSIR, and Director, National Physical Laboratory. He is member of several national and international academies, including the Indian National Science Academy and the Third World Academy of Sciences. For his work in physics Prof. Joshi is the recipient of numerous national and international awards, including the Won Watumull memorial Prize and the Bhatnagar Prize. He is recipient of the "Padma Sri" and the "Padma Bhushan" for his contributions.

**Prof. Mustansir Barma** Professor Emeritus, TIFR Center for interdisciplinary Science, No.36/P, Gopanapally Village, Serilingampally Mandal, Ranga Reddy - Dist Hyderabad 500107..
(**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** 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.

**Dr. P. Duraisamy, Vice Chancellor**, University of Madras, Chennai
(**Member**, *Governing Board*)
Dr. Duraisamy is a former HOD of Econometrics department in University of Madras and has a PhD from Paris University

**Prof. Sudhanshu Jha**, 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.

**Shri A.R. Sule** Joint Secretary (R & D), Department of Atomic Energy, CSM Marg, Mumbai.
(**Member**, *Governing Board & Executive Council*)



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



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



**Prof. V. Arvind**, 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 member

### 1.2.2 Director's Advisory Committees

**Academic Coordinators Committee**

| | |
|---|---|
| Prof. **V.S. Nemani** | Physics |
| Dr. **Indrava Roy** | Mathematics |
| Dr. **Vikram Sharma** | TCS |

**Annual Report Committee**

| | |
|---|---|
| Prof. **S. Viswanath** | Chair |
| Prof. **C. R. Subramanian** | |
| Prof. **Shrihari Gopalakrishna** | |
| Dr. **Paul Pandian** | (Library) |
| Dr. **Areejit Samal** | |
| Dr. **Sayantan Sharma** | |

**Approval Coordinators**

| | |
|---|---|
| Prof. **Sitabhra Sinha** | Physics |
| Prof. **K. Srinivas** | Mathematics |
| Prof. **Meena Mahajan** | TCS |
| Prof. **Gautam I. Menon** | Computational Biology |

**Associateship Programme**

| | |
|---|---|
| Prof. **V. Arvind** | Chair |
| Prof. **Venkatesh Raman** | TCS |
| Prof. **K. Srinivas &** | |
| Prof. **Pralay Chatterjee** | Mathematics |
| Prof. **Mukul Laad** | Physics |

**Alumni Committee**

| | |
|---|---|
| Prof. **Partha Mukhopadhyay** | Chair |
| Prof. **Meena Mahajan** | |
| Prof. **Sanoli Gun** | |
| Dr. **Pinaki Choudhuri** | (as CC-Chair) |
| Dr. **Paul Pandian** | Library |
| Shri. **B. Raveendra Reddy** | |

## Colloquium & Seminar

Dr. **Ganesh Ramachandran**       Physics
Prof. **Jaya N. Iyer**            Mathematics
Dr. **Vikram Sharma**            TCS


## Computer Media & Web Committee

Dr. **Pinaki Choudhuri**          Chair
Prof. **Venkatesh Raman**
Prof. **K.N. Raghavan**
Prof. **Rahul Siddharthan**
Prof. **Satyavani Vemparala**
Dr. **Sayantan Sharma**
Dr. **G. Subramoniam,**          SO'F'(Systems)
Shri. **B. Raveendra Reddy**      SO'F'(Systems)
Mr. **Vigneshwar Narayanan**      (Student Member)


## Events / Outreach

Prof. **R. Ramanujam**            Chair
Prof. **K.N. Raghavan**
Dr. **Areejit Samal**
Dr. **Ganesh Ramachandran**
Dr. **Sushmita Venugopalan**


## Internal Complaints Committee (Gender Bias Redressal)

Prof. **D. Indumathi**            Chair
Prof. **Rahul Siddharthan**
Prof. **Sanoli Gun**
Smt. **E. Gayatri**              (Accounts Officer)
Smt. **V. Geetha**               (External Member)
Shri. **S. Vishnu Prasad**        Registrar
**One Student representative**      (Nominated by the Chair)


## Grievance Redressal Committee

Prof. **Meena Mahajan**           Chair
Prof. **Amritanshu Prasad**
Prof. **Sanatan Digal**
Prof. **Sujay Ashok**

**Guest House Advisory Committee**

| | |
|---|---|
| Prof. **Pralay Chatterjee** | Chair |
| Prof. **V. Ravindran** | |
| Dr. **Indrava Roy** | |
| Shri. **S. Vishnu Prasad** | Registrar |
| **(Student Member)** | – – |

**HBNI Coordinators**

| | | |
|---|---|---|
| Prof. **Sibasish Ghosh** | Physics | Dean, Physical Sciences |
| Prof. **Sanatan Digal** | Physics | Associate Dean, Physical Sciences |
| Prof. **Vijay Kodiyalam** | Mathematics | Dean, Mathematical Sciences |
| Prof. **Gautam I. Menon** | Computational Biology | Dean, Life Sciences |

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

| | |
|---|---|
| Dr. **Manjari Bagchi** | Chair |
| Dr. **Ganesh Ramachandran** | |
| Dr. **Vikram Sharma** | |

**Housing & Up-Keep**

| | |
|---|---|
| Prof. **V. Ravindran** | Chair |
| Dr. **Pinaki Chaudhuri** | |
| Dr. **C.M. Chandrashekar** | |
| Shri. **S. Vishnu Prasad** | Registrar |
| Smt. **R. Indra** | Administrative Officer |

**JEST Coordinators**

| | |
|---|---|
| Prof. **D. Indumathi** | Physics |
| Prof. **Pralay Chatterjee** | Mathematics |
| Prof. **Saket Saurabh** | TCS |

**Library Committee**

| | |
|---|---|
| Prof. **Amritanshu Prasad** | Chair |
| Prof. **C. R. Subramanian** | |
| Prof. **Sitabhra Sinha** | |

Prof.   **Rajesh Ravindran**
Dr. **Manjari Bagchi**
Dr. **Paul Pandian**                    S/O 'F' (Library)
Mr. **K. Chandrashekhar**               (Student Member)


## National Science Day Committee

Prof. **K.N. Raghavan**
Prof. **V. Ravindran**
Dr. **Vikram Sharma**
Dr.   **Sushmita Venugopalan**


## Official Language Implementation Committee [OLIC]

Prof. **V. Arvind**                     Chair
Prof. **K. Srinivas**
Prof. **Saket Saurabh**
Prof. **Mukul Laad**
Shri. **S. Vishnu Prasad**              Registrar
Mr. **Vinay Vaibhav**                   (Student Member)


## Mathematics PDF Committee

Prof. **K. Srinivas**
Prof.   **Pralay Chatterjee**


## Physics PDF Committee(HEP)

Prof. **Indumathi**                     HEPF Convener


## Physics PDF Committee(LEP)

Prof. **Sitabhra Sinha**
Prof. **Sibasish Ghosh**
Prof. **Satyavani Vemparala**
Prof. **Ganesh Ramachandran**


## Refurbishment Committee

Prof. **Saket Saurabh**                 Chair

Prof. **Anirban Mukhopadhyay**
Dr. **Sayantan Sharma**
Shri. **K. Chandrasekar,**          Ex-Chief Architect,       IGCAR
Shri. **S. Vishnu Prasad**          Registrar
Shri. **M. Sundar**                 S/O 'C' (Civil)
Shri. **S. Mohan**                  S/O 'E'(Electrical)


## Right To Information Act [RTI]

Prof. **Venkatesh Raman**          Appellate Authority
Shri. **S. Vishnu Prasad**          Public Information Officer


## Space Planning & Allocation Committee

Prof. **V. Arvind**                 Chair
Prof. **Gautam Menon**
Prof. **Indumathi**
Prof. **Pralay Chatterjee**
Dr. **C.M. Chandrashekar**
Shri. **S. Vishnu Prasad**          Registrar


## Summer Programme Co-ordinators

Prof. **Ramanujam**                 TCS
Prof. **Sanoli Gun**                Maths
Prof. **Pinaki Chaudhuri**          Physics


## Tender Committee

Prof. **Ramanujam**                 Chair
Prof. **Satyavani Vemparala**


## Sports/GYM Committee

Prof. **Pralay Chatterjee**
Prof. **Partha Mukhopadhyay**
Dr. **Vikram Sharma**
Dr. **Indrava Roy**
Dr. **Manjari Bagchi**
Mr. **Rakesh Netha(Student member)**          - Cricket
Mr. **Pranendu Darbar(Student member)**          - Foot ball & Tennis

Mr. **Mrigendra Singh(Student member)**      - Table Tennis
Mr. **Anupam Sarkar(Student member)**      - Badminton


**Institute Seminar Day**

Prof. **S. Viswanath**
Dr. **Arijit Ghosh**
Dr. **Areejit Samal**
Dr. **Sayantan Sharma**


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

## 1.3 Faculty

<u>*Name*</u>                                 <u>*Userid*</u>

## Computational Biology

| Name | Userid |
|------|--------|
| **Menon, Gautam I.** | menon |
| **Samal, Areejit** | asamal |
| **Siddharthan, Rahul** | rsidd |
| **Sinha, Sitabhra** | sitabhra |

## Mathematics

| Name | Userid |
|------|--------|
| **Chakraborty, Partha Sarathi** | parthac |
| **Chatterjee, Pralay** | pralay |
| **Gun, Sanoli** | sanoli |
| **Iyer, Jaya N.** | jniyer |
| **Kodiyalam, Vijay** | vijay |
| **Mohari, Anilesh** | anilesh |
| **Mukhopadhyay, Anirban** | anirban |
| **Nagaraj, D. S.** | dsn |
| **Pancholi, Dishant Mayurbhai** | dishant |
| **Prasad, Amritanshu** | amri |
| **Raghavan, K. N.** | knr |
| **Roy, Indrava** | indrava |
| **Sankaran, P.** | sankaran |
| **Srinivas, K.** | srini |
| **Sundar, S.** | ssundar |
| **Sushmita Venugopalan** | sushmita |
| **Viswanath, S.** | svis |

## Physics

| Name | Userid |
|------|--------|
| **Adhikari, Ronojoy** | rjoy |
| **Ashok, Sujay K.** | sashok |
| **Bagchi, Manjari** | manjari |
| **Chandrashekar, C.M.** | chandru |
| **Chaudhuri, Pinaki** | pinakic |
| **Date, G.** | shyam |
| **Digal, Sanatan** | digal |
| **Ghosh, Sibasish** | sibasish |
| **Gopalakrishna, Shrihari** | shri |
| **Hassan, Syed Raghib** | shassan |
| **Indumathi, D.** | indu |
| **Laad, Mukul S.** | mslaad |

| | |
|---|---|
| Menon, Gautam I. | menon |
| Mukhopadhyay, Partha | parthamu |
| Nemani, Venkata Suryanarayana | nemani |
| Rajesh, Ravindran | rrajesh |
| Rama, S. Kalyana | krama |
| Ramachandran, Ganesh | ganesh |
| Ravindran, V. | ravindra |
| Ray, Purusattam | ray |
| Sathiapalan, Balachandran | bala |
| Sayantan Sharma | sayantans |
| Shankar, R. | shankar |
| Siddharthan, Rahul | rsidd |
| Sinha, Nita | nita |
| Sinha, Rahul | sinha |
| Sinha, Sitabhra | sitabhra |
| Vemparala, Satyavani | vani |

## Theoretical Computer Science

| | |
|---|---|
| Arvind, V. | arvind |
| Ghosh, Arijit | arijitg |
| Lodaya, Kamal | kamal |
| Mahajan, Meena | meena |
| Raman, Venkatesh | vraman |
| Ramanujam, R. | jam |
| Saurabh, Saket | saket |
| Sharma, Vikram | vikram |
| Subramanian, C.R. | crs |

# 1.4  Honorary Senior Academic Members

| | |
|---|---|
| Balasubramanian, R. | balu |
| Baskaran, G. | baskaran |
| Rajasekaran, G. | graj |
| Simon, R. | simon |

# 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*

Vasudevan, T.V.

Parthiban, V.

Ashfack Ahmed, G.

Geetha, M.

Padmanabhan, T.

Prema, P.

Jayanthi, S.

Baskaran, R.

Balakrishnan, J.

Moorthy, E.

Radhakrishnan, M. G.

Rajendran, C.

Ravichandran, N.

Shankaran, K.P.

Seenivasa Raghavan N.

Otheeswaran Usha

Archana Shukla

Babu, B.

Johnson, P.

Gopinath, S.

Amulraj, D.

Janakiraman, J.

Munuswamy, N.

Rajasekaran, N.

Ramesh, M.

Tamil Mani, M.

# 1.7 Project Staff

## 1.7.1 Project Staff [Non Academic]

| *Name* | *Userid* |
|---|---|
| **Aiswaryalakshmi PL** | lakshmipl |
| **Balachander M.** | mbchander |
| **Gayathri S.** | gayathris |
| **Hari Priya T. V.** | tvhpriya |
| **Hemamalini, A.** | ahema |
| **Jayakumar P.** | jayakumarp |
| **Jegannathan J.** | jjegan |
| **Karthik M.** | mkarthik |
| **Karthikeyan B.S.** | bskarthi |
| **Kirubananth P** | kirubananth |
| **Krishna Balaji R.** | rkbalaji |
| **Mahalakshmi, G.** | gmahalakshmi |
| **Mangala Pandi P.** | mangal |

| | |
|---|---|
| Moovendan M. | moovendan |
| Nambirajan E | nambirajan |
| Narmatha, S. | snarmatha |
| Parthasarathi N. | npsarathi |
| Prashanna, K. | prasannak |
| Rajkumar S. | srajkumar |
| Ramakrishnan S. | skrishnan |
| Rethinasamy D. | drsamy |
| Sadhana R. | sadhana |
| Sakthivel Murugan E. | esakthi |
| Sathishkumar | sathishka |
| Shalieni, D. | shalienid |
| Sivasubbu Raj B. | sivaraj |
| Sreelakshmi P.K | lakshmipk |
| Srinadh, G. | gsrinadh |
| Srinivasan G. | gsvasan |
| Vaideeswaran | mveswaran |
| Vignesh Kumar T | vignesh |
| Vimalraj J. | vimalraj |
| Vinoth Babu, M. | mvinoth |

## 1.7.2   Project Staff [Scientific/Academic]

| _Name_ | _Userid_ |
|---|---|
| Able E Alias | ableea |
| Archana Mishra | amishra |
| Arya S | aryas |
| Ashwij Mayya | ashwij |
| Eleonora Dell' Aquila | edellaquila |
| Gajendra Singh Badwal | |
| Gayathri, B. | bgayathri |
| Harish, K. | |
| Janaki Raghavan | rjanaki |
| Krishanu Deyasi | krishanud |
| Md. Izhar Ashraf | ashraf |
| Nadeesh Garg | nadeeshg |
| Pradeep Kumar N | pradeepnpk |
| Saveetha H. | saveetha |
| Shakthi N. Menon | shakthi |
| Soumya Easwaran | soumyae |
| Sreejith, R. P. | sreejithrp |
| Subathra Vijayakumar | subaathrav |
| Surendra Singh Badwal | |
| Theerthagiri L. | ltgiri |
| Varuni Prabhakar | varuni |
| Vinod Kumar T. | tvinodkumar |

## 1.8   Post-Doctoral Fellows

*Name*                            *Userid*

**Computational Biology**

**Anupama Sharma**               anupama
**Sushmita Ghosh**               susmitag

**Mathematics**

**Anuj Jakhar**                  anujjakhar
**Arideep Saha**                 arideep
**Arjun Paul**                   arjunp
**Balesh Kumar**                 baleshk
**Bidyut Sanki**                 bidyuts
**Nirupama Mallick**             nirupamam
**Poornapushkala Narayanan**     porrnap
**Pranabesh Das**                pranabesh
**Rohit Varma**                  rvarma
**Sarita Agrawal**               saritaa
**Selvaraja, S.**                selvaraja
**Suratno Basu**                 suratnob
**Usha Keshav Sangale**          uksangale

**Physics**

**Aditya Banerjee**              adityab
**Amit Mukherjee**               amitm
**Aradhana Singh**               aradhanas
**Aravinda S**                   aravinda
**Arpita Choudhary**             arpitac
**Arunprasath V**                arunprasath
**Avijit Mishra**                avijitm
**Bala Subramanian, P.N.**       pnbala
**Bijoy Daga**                   bijoydaga
**Debabrata Sinha**              debabratas
**George Thomas**                georget
**Nilanjana Kumar**              nilanjanak
**Prasad V V**                   prasadvv
**Rahul Dandekar**               rsdandekar
**Shreyansh Shankar Dave**       shreyanshsd
**Sreeraj T. P.**                sreerajtp
**Srimoy Bhattacharya**          srimoyb

**Subhroneel Chakrabarti**       subhroneele

## Theoretical Computer Science

| | |
|---|---|
| **Abhisekh Sankaran** | abhisekhs |
| **Gurumuruhan Ganesan** | ghurumg |
| **Krithika R** | Krithikaraman |
| **Pallavi Jain** | pallavij |
| **Purbita Jana** | purbitajana |
| **Vibha Sahlot** | vibhasahlot |

# 1.9    Ph.D. Students

*Name*                 *Userid*

## Computational Biology

| | |
|---|---|
| **Ankit Agrawal** | aagrawal |
| **Ashwini, G.** | ashwinig |
| **Bodhayan Prasad** | bodhayanp |
| **Chandrani Kumari** | chandranik |
| **Chandrashekar K. A.** | kachandra |
| **Devanand T.** | devanandt |
| **Farhina Mozaffer** | farihinam |
| **Janani R.** | jananir |
| **Mamale Vinod Suryakant** | mvinod |
| **Rakshika Lakshmi, A.** | rakshikal |
| **Reshma M** | reshmam |
| **Ria Ghosh** | riaghosh |
| **Sreejith, R.P.** | sreejithrp |
| **Sreevidya T.S** | tssreevidya |
| **Vadnala Rakesh Netha** | rakeshnetha |
| **Vivek Ananth R. P.** | vivekananth |

## Mathematics

| | |
|---|---|
| **Ankur Sarkar** | ankurs |
| **Aritra Bhattacharya** | baritra |
| **Avijit Nath** | avijitnath |
| **Biplab Paul** | biplabpaul |
| **Chayan Karmakar** | chayank |
| **Digjoy Paul** | digjoypaul |
| **Jayakumar R.** | rjayakumar |
| **Jyothsnaa S.** | jyothsnaa |
| **Karthick Babu C G** | cgkbabu |

| | |
|---|---|
| Krishanu Roy | krishanur |
| Manas Mandal | manasm |
| Mrigendra Singh Kushwaha | mrigendra |
| Nabanita Roy | nabanitar |
| Narayanan P. A. | panarayanan |
| Neelam | neelam |
| Oorna Mitra | oornamitra |
| Piyasa Sarkar | psarkar |
| Pranendu Darbar | dpranendu |
| Priyamvad Srivastav | priyamvads |
| Ratheesh T.V | ratheeshtv |
| Rupam Karmakar | rupamk |
| Sathish Kumar, V. | vsathish |
| Siddheswar Kundu | siddheswark |
| Snehajit Misra | snehajitm |
| Sridhar P. Narayanan | sridharn |
| Sruthy Murali | sruthym |
| Sunil L Naik | sunilnaik |
| Tanmoy Bera | tanmoyb |
| Saurav Holme Choudhury | sauravhe |
| Surajit Biswas | surajitb |
| Uday Bhaskar Sharma | udaybs |
| Ujjal Das | ujjaldas |
| Vaibhav Krushankant Dimble | vaibhavkd |

## Physics

| | |
|---|---|
| Abinash Kumar Nayak | abinashkn |
| Ajjath A.H. | ajjathah |
| Akhil Antony | akhilantony |
| Amir Suhail | amirs |
| Amit Kumar | kamit |
| Amlan Chakraborty | amlanchak |
| Anand Pathak | anandb |
| Anirban Karan | kanirban |
| Ankit Aggarwal | aankita |
| Ankita Chakrabarti | ankitac |
| Anupam A. H. | anupam |
| Anupam Sarkar | asarkar |
| Anvy Moly Tom | anvym |
| Aparna Sankar | aparnas |
| Apurba Biswas, G. | apurbab |
| Apurba Dutta | dapurba |
| Arindam Mallick | marindam |
| Arindam Mitra | amitra |
| Arjun Hariharan | arjunh |
| Arkajyoti Manna | arkajyotim |
| Arnab Priya Saha | arnabps |

| | |
|---|---|
| Arpan Kundu | akundu |
| Atanu Bhatta | batanu |
| Bhargava B.A. | bhargavaba |
| Bhavya Teja, K.N. | knbteja |
| Dheeraj Kumar Mishra | dkmishra |
| Dhruv Pathak | dhruvpathak |
| Dipanjan Mandal | mdipanjan |
| Garima Rani | grani |
| Gopal Prakash | gopalp |
| Himanshu Badhani | himanshub |
| Hitesh Garg | hiteshgarg |
| Jilmy P. Joy | jilmyo |
| Jyotijwal Debnath | jdebnath |
| Kamal Tripathi | kamalt |
| Madhusudhan Raman | madhur |
| Mahaveer Prasad | mahaveerp |
| Mamale Vinod Suryakant | mvinod |
| Mohammad Shabbir | mshabbir |
| Nishant Gupta | nishantg |
| Pavan Dharanipragada | pavand |
| Pooja Mukherjee | poojamukherjee |
| Prabhat Butola | prabhatb |
| Prafulla Oak | prafullao |
| Prateek Chawla | prateekc |
| Prasanna Kumar Dhani | prasannakd |
| Prashanth Raman | prashanthr |
| Prathik Cherian J. | prathikcj |
| Pritam Sen | pritamsen |
| Pulak Banerjee | bpulak |
| Raghvendra Singh | raghvendra |
| Rathul Nath | rathulnr |
| Ravi T | travi |
| Ria Sain | riasain |
| Rusa Mandal | rusam |
| Sabiar Shaikh | sabiarshaikh |
| Sabyasachi Chowdhuri | sabyasachic |
| Sagnik Chakraborty | csagnik |
| Sahil | sahilmd |
| Sanjoy Mandal | smandal |
| Saroj Prasad Chhatoi | sarojpc |
| Sayantan Ghosh | sayantang |
| Semanti Dutta | semantid |
| Shibasis Roy | shibasisr |
| Shilpa Kastha | shilpakastha |
| Shivam Gola | shivamg |
| Shivani Singh | shivanis |
| Soumya Sur | soumyasur |
| Sourav Ballav | sballav |
| Subhankar Khatua | shubankark |

| | |
|---|---|
| **Sujoy Mahato** | sujoymahato |
| **Surabhi Tiwari** | surabhit |
| **Subashri, V.** | subashriv |
| **Sushovan Mondal** | smondal |
| **Tanmay Mitra** | tmitra |
| **Tanmay Saha** | sahatanmay |
| **Tanmoy Sengupta** | tsengupta |
| **Thiru Senthil R.** | rtsenthil |
| **Toshali Mitra** | toshalim |
| **Umang A. Dattani** | umangad |
| **Varun Gupta** | varungupta |
| **Varun Sethi** | varunsethi |
| **Vignesh, B.** | bvignesh |
| **Vigneshwar N.** | vigneshwarn |
| **Vigneshwaran K.** | vigneshwaran |
| **Vinay Vaibhav** | vinayv |

**Theoretical Computer Science**

| | |
|---|---|
| **Abhishek Sahu** | asahu |
| **Abhimanyu Choudhury** | abhimanyuc |
| **Abhranil Chatterjee** | abhranilc |
| **Anantha Padmanabha M.S.** | ananthap |
| **Anuj Vijay Tawari** | anujvt |
| **Arindam Biswas** | barindam |
| **Ashwin Jacob** | ajacob |
| **Diptapriyo Majumdar** | diptapriyam |
| **Gaurav Sood** | gauravs |
| **Jayakrishnan M.** | jayakrishnan |
| **Lawqueen Kanesh** | lawqueen |
| **Niranka Banerjee** | nirankab |
| **Prafullakumar Prabhakar Tale** | pptale |
| **Ramanathan Thinniyam Srinivasan** | thinniyam |
| **Ramit Das** | ramitd |
| **Roohani Sharma** | roohani |
| **Rian Neogi** | rianneogi |
| **Sanjukta Roy** | sanjukta |
| **Swaroop N.P.** | npswaroop |
| **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, 2018 - Mar,

2019.

| Student | Faculty |
| --- | --- |

## Computational Biology

| Student | Faculty |
| --- | --- |
| Suriya Selvarajan, CMI, Chennai | Sitabhra Sinha |
| Madhav Sankaranarayanan, ISI, Kolkata | Gautam Menon |
| Pavithra Elumalai, PSG College, Coimbatore | Areejit Samal |
| Shreya Lakhera, IISER, Pune | Sitabhra Sinha |
| Asha, P., Kumaraguru College of Technology, Coimbatore | Rahul Siddharthan |
| Shashank Tiwari, CEBS, Mumbai | Sitabhra Sinha |
| Abhirami, B., Sastra University | Rahul Siddharthan |
| Sayanur Rahman, IISER, Kolkata | Sitabhra Sinha |
| Aishwarya, N., Institute of Bioinformatics and applied Biotechnology | Rahul Siddharthan |
| Aashish Satyajith, CMI | Rahul Siddharthan |

## Mathematics

| Student | Faculty |
| --- | --- |
| Aritam Dhar, IISER, Mohali | Anirban Mukhopadhyay |
| Mariam B. Elizabeth, Pondicherry University | Anirban Mukhopadhyay |
| Greeshma, K., Calicut University | Raghavan, K.N. |
| Deepthy Saji, Pondicherry University | Sanoli Gun |
| Arnab Roy, IISER, Berhampur | Sanoli Gun |
| Naman Kumar, IIT, Kanpur | Sanoli Gun |
| Subham Saha, CMI | Sanoli Gun |
| Megha Kamath, K., ST. Aloysius, Mangalore | Raghavan, K.N. |
| Vishal Gupta, IISER, Bhopal | Raghavan, K.N. |
| Suraj Dash, ISI, Bangalore | Nagaraj, D.S. |
| Shilpi Mandal, University of Hyderabad | Nagaraj, D.S. |
| T. Sri Harshitha, University of Hyderabad | Nagaraj, D.S. |
| Amrita Soni, Samrat Prithviraj Chauhan Govt College, Ajmer | Raghavan, K.N. |
| Chitra Kumari Sharma, Raj Rishi Govt College | Raghavan K.N. |
| Jenifer Janany, T., St. Mary's College | Srinivas, K. |
| Naveen Kumar, SPC Govt College, Ajmer | Raghavan, K.N. |
| Vigneshini Bharathi, Ramanujan Institute | Sanoli Gun |
| Supriyaa, PI, PSG College | Srinivas, K. |
| Srijan Das, ISI, Bangalore | Pralay Chatterjee |
| Mihir Naik, BITS Pilani | Viswanath, S |
| Vignesh, ISI, Bangalore | Viswanath, S |
| Sujeet Bhalerao, IISER,Pune | Viswanath, S |
| Manasa Bhat, SBC, Karkala, Karnataka | Sanoli, Gun |

## Physics

| Student | Faculty |
| --- | --- |
| Pradhyumna P, Anna University (MIT) | Ravindran, V. |
| Yuva Priya, M, Madras Christian College | Indumathi, D. |

| | |
|---|---|
| Merlin Varghese, Calicut University | Satyavani Vemparala |
| Varun Madan Mohan, IISER, Mohali | Satyavani Vemparala |
| Subramanian Bhat, K.N., Central University of Karnataka | Indumathi, D. |
| Saranyan Sankrith, S, Sairam Institute of Technology | Ravindran, V. |
| Nithishwar, M.A., IISER, Mohali | Manjari Bagchi |
| Om Gupta, IISER, Kolkata | Manjari Bagchi |
| Archisiman Saha, ISERC, Visva Bharati | Sitabhra Sinha |
| Rahul Sharan, IISER, Kolkata | Sitabhra Sinha |
| Pitambar Sai Goyal, Loyala, ICAM | Indumathi, D. |
| Ramakrishnan, University of Madras | Ravindran, V. |
| Pujarani Swain, Fakir Mohan University, Odisa | Sanatan Digal |
| Anubhab Sur, IISER, Kolkata | Ravindran, V. |
| Nidhi Gupta, LNMIIT, Jaipur | Chandrasekhar, C.M. |
| Pratyush Kumar, BITS, Pilani, Goa | Sitabhra Sinha |
| Sarvesh Srinivasan, BITS, Pilani, Goa | Chandrasekhar, C.M. |
| Rishi Gangadhar, G, IISER, Mohali | Balachandran Sathiapalan |
| Vikram Ramesh, IIT, Kharagpur | Balachandran Sathiapalan |
| Fahad, P., Cochin University | Rajesh, R. |

**Theoretical Computer Science**

| | |
|---|---|
| Subhashini, H., PSG College of Technology, Coimbatore | Ramanujam, R. |
| Raj Adhitya Kumar, BITS, Pilani, Hyderabad | Ramanujam, R. |
| Adhitya Subramanian, Shiv Nadar University, Noida | Ramanujam, R. |
| Fazle Rahman Ejazi, IIT Patna | Ramanujam, R |
| Pradeesh, S., Knowledge Institute of Technology, Salem | Ramanujam, R. |
| Rahul, B.S., BITS Pilani, Goa | Ramanujam, R. |
| Rajhesh, R., PSG College of Technology, Coimbatore | Ramanujam, R. |
| Magilan, S., VIT, Chennai | Ramanujam, R. |
| Mohith Jagalmohanan, NIT, Calicut | Ramanujam, R. |
| Gopinath Das, IIIT Bhubaneswar | Ramanujam, R. |
| Parshudar, P.K., PSG College of Technology, Coimbatore | Ramanujam, R. |
| Ativ Joshi, Ahmedabad University | Ramanujam, R. |
| Anunay Kumar, IIEST, Shibpur | Ramanujam, R. |
| Akhila, K., IIITM, Kerala | Ramanujam, R. |
| Ranjani, G.S., CMI, Chennai | Ramanujam, R. |
| Jiteshwar, C.A., BIT, Mersa, Ranchi | Ramanujam, R. |
| Akash Gupta, Thapar University, Patiala | Ramanujam, R. |
| Pankaj Kumar,CMI | Venkatesh Raman |

# 1.11   Other Students

Students also do their projects under the supervision of our faculty during the academic year.The following students visited the institute during Apr, 2018 - Mar, 2019.

| Student | Faculty |
| --- | --- |

## Mathematics

| | |
| --- | --- |
| Chopra, Divya, Central University of Rajasthan, Rajasthan | Srinivas, K. |
| Setia, Swati, HRI Allahabad | Srinivas, K. |
| D. Kiran, IISER, Bhopal | Srinivas, K. |
| B. S. Rahul, BITS Pilani, Goa Campus | Srinivas, K. |

## Physics

| | |
| --- | --- |
| Sharma, Sanchita, IACS | Ashok, Sujay K. |
| Lloyd, Juzel , Howard University | Bagchi, Manjari |
| Meyers, Natalie Ann, University of Wisconsin-Milwaukee | Bagchi, Manjari |

## Theoretical Computer Science

| | |
| --- | --- |
| Dhamapurkar, Shyam, Pune University | Mahajan, Meena B. |
| Thatte, Mitali, IISER Pune | Mahajan, Meena B. |
| Priyanka, J., PSG College of Science and Technology, Coimbatore | Ramanujam, R. |

# Chapter 2

# Research and Teaching

## 2.1 Computational Biology

### 2.1.1 Research Summary & Highlights

The nuclei of mouse stem cells in their transitional state exhibit the remarkable mechanical property of auxeticity, i.e. a negative Poissons ratio. A theory for this behaviour has been developed which locates it in the coupling of chromatin density fluctuations with a pliant and soft nuclear envelope.

With Surajit Sengupta and N. Shankaraiah of the TCIS-TIFR, a theory of novel correlations of orientational order in a model disordered colloidal system has been developed. This work suggests that such correlation functions should be measurable in systems of colloids on rough substrates.

Work with Prof. Sandhya Koushika (TIFR, Mumbai) on a biophysical approach to axonal transport that combines both experiments and biophysical theory and simulations is being prepared for publication. Among other things, this work suggests that "dynamics reservoirs" formed by stalled vesicle clusters along the axon might be the source of robustness of axonal transport, even in the presence of multiple blocks as well as traffic jams.

A earlier model for phototaxis in cyanobacteria, the motion of bacteria away from or towards a source of light is extended to understand the behaviour of such bacteria when bacterial colonies are exposed to complex light input. We emphasize collective effects in our model, since these bacteria are known to interact and exert forces on each other through extensions called type-IV pili Our agent-based model reproduces most features of what is experimentally seen. It points out that distinguishing between various proposed mechanisms for how bacteria integrate information and convert this into decisions regarding motion is hard to do at the level of colony shapes alone, precisely because such motion is collective [M]

We have developed a new method to study persistent homology in unweighted networks using Discrete Morse theory [K]. The current scheme for the filtration of edges while studying persistent homology in complex networks depends on weights of edges (1-simplices), and thus,

we realized that there is no consistent method to filtrate edges in unweighted graphs where the edges have no assigned weights. Motivated by Discrete Morse theory developed by Robin Forman, we have developed a new algorithm to assign weights to vertices (0-simplices), edges (1-simplices), triads (2-simplices), and higher-order simplices in clique complex representation of an unweighted graph such that the assigned weights to simplices satisfy discrete Morse function. In addition, we have produced a rigorous proof for the generality of this algorithm. An important advantage of our algorithm which assigns weights to vertices, edges, triads and higher-simplices based on discrete Morse function is that the result of the network filtration depends only on simplices with critical weights. Thus, our algorithm leads to a reduced filtration scheme based on weights of critical simplices rather than weights of all simplices in the clique complex of a graph. Moreover, we have also empirically shown that our algorithm is able to assign weights to simplices such that the number of critical simplices in very close to the theoretical best-case scenario given by Forman in his classic work. Subsequently, we have used our new method to investigate several model and real-world unweighted complex networks. We importantly show that our method can easily distinguish between random, small-world, scale-free, spherical and hyperbolic graphs.

Forman-Ricci curvature is a concept inspired from Riemannian and polyhedral geometry, and this measure has several advantages for the analysis of large-scale networks [**S1**, **S2**]. Firstly, most traditional graph-theoretic measures such as degree and clustering coefficient are vertex-specific, and in contrast, Forman-Ricci curvature is a measure for edges in networks. Secondly, the mathematical formula of the Forman-Ricci curvature elegantly allows for the analysis of weighted and unweighted graphs. Thirdly, the definition of the Forman-Ricci curvature can be extended to the realm of directed graphs [**Sr**]. Fourthly, an important distinguishing feature of the Forman-Ricci curvature, in contrast to the other well-known discretization, namely, Ollivier-Ricci curvature, is its simplicity and suitability from a computational perspective for analysis of very large networks. In a recent contribution, we showed that Forman-Ricci curvature in sparse model and real-world networks is highly correlated with the more computationally-expensive Ollivier-Ricci curvature [**S1**]. This work was covered by Nature India and has been the subject of a recent press release by Max Planck Society.

We have developed a computational pipeline which integrates data from high-throughput experiments and bioinformatic predictions to identify secreted and cell membrane proteins in fungal genomes [**Vi**]. Subsequently, we have applied our computational pipeline to identify and analyse the secretomes and cell membrane proteins in ten Aspergillus species known to cause aspergillosis. Moreover, we have identified small secreted and effector-like proteins similar to agents of fungal-plant pathogenesis within each secretome. A comparison with humans revealed that at least 70 *percent* of Aspergillus secretomes have no sequence similarity with the human proteome. An analysis of antigenic qualities of Aspergillus proteins revealed that the secretome is significantly more antigenic than cell membrane proteins or the complete proteome. Finally, overlaying an gene expression dataset, four A. fumigatus proteins upregulated during infection and with available structures, were found to be structurally similar to known drug target proteins in other organisms, and were able to dock in silico with the respective drug.

We have used molecular dynamics to simulate an amorphous glassy polymer with long chains to study deformation mechanism of crazing and associated void statistics. The Van der Waals interactions and the entanglements between chains constituting the polymer play a crucial role in crazing. Thus, we have reconstructed two underlying weighted networks, namely,

the Van der Waals network and the Entanglement network from polymer configurations extracted from the molecular dynamics simulation. Subsequently, we have performed graph-theoretic analysis of the two reconstructed networks to reveal the role played by them in crazing of polymers. Our analysis captured various stages of crazing through specific trends in the network measures for Van der Waals networks and entanglement networks [**V**].

*Science, Journalism, Media: Communicating Science in a Changing India*

In collaboration with the Indian Academy of Sciences, IMSc organized a two-day workshop on "Science, Journalism, Media: Communicating Science in a Changing India" during August 20 - 21, 2018. The workshop was organized by Rahul Siddharthan and Gautam Menon from the Computational Biology group at IMSc. It brought together about 80 panelists and participants, largely scientists interested in communicating to the public across multiple media and science journalists with an interest in accurately describing Indian science, its breakthroughs as well as its problems. It tried to provide scientists with an idea of "what journalists really want as well as to provide journalists with an idea of scientist's concerns about how their work was represented. The workshop was attended by a large number of journalists, including from such prominent outlets as the Hindu, the Indian Express, the Eastern Chronicle, Nature India, Anandabazar and the Wire as well as governmental organizations such as Vigyan Prasar. Large-scale science funders such as the DBT-Wellcome India Alliance were represented, as was the Indian Academy of Science along with scientists from NCBS, TIFR, INSTEM, IITM and JNCASR. Local language sites such as ippodhu.com, as well several independent science writers and individuals involved in science communication participated. The format was based on panel discussions rather than long talks. Each panelist made short presentations before opening the topic to discussion, enabling active participation by all attendees. Prof. K. VijayRaghavan, PSA to the GOI, attended the workshop and was part of a panel. The program was exceptionally successful. Its proceedings were videographed and are available freely from: https://www.imsc.res.in/ scimedia/

Figure 2.1: Science, Journalism, Media: Communicating Science in a Changing India (20th - 21st Aug 2018)

*Symposium on Regulatory Epigenomics*

Rahul Siddharthan of IMSc was one of four organizers and the local organize of the India-EMBO Symposium on Regulatory Epigenomics: From Large Data to Useful Models, held in Muttukadu near Chennai from March 10-13, 2019. The event was primarily funded by European Molecular Biology Organization (EMBO) and DBT-Wellcome India Alliance (IA), with local support and some funding from IMSc. It featured 19 speakers including 11 international speakers, and about 70 participants, mostly from India. It is one of three symposia funded by EMBO and IA annually in India. The event was praised by speakers and participants as of very high quality and a rare opportunity for Indian students to hear about cutting-edge work in this field as well as to interact with speakers over coffee and meals. Website: http://meetings.embo.org/event/19-regulatory-epigenomics.

*Size matters*

Rahul Siddharthan and Gautam Menon are investigators, with Leelavati Narlikar (NCL Pune; principal investigator), Uma Ram (obstretician and gynaecologist at Seethapathy Clinic, Chennai) and Ponnusamy Saravanan (endocrinologist and professor at Warwick, UK) of a project "Size Matters" on predicting risk for pregnant women of delivering babies that are "small for gestational age". This project is funded by BIRAC, DBT and the Bill and Melinda Gates Foundation, and will use data from the Gates Foundations "knowledge integration initiative as well as in-house data from our clinical collaborators, and will run for 18 months from start of funding. Leelavati Narlikar and Rahul Siddharthan also attended a "Gates

Grand Challenges Partners Meeting in New Delhi, from March 14-16, 2019, and presented this proposal. The meeting was attended by awardees, officials from India, Brazil and Africa, as well as organizers and platform experts from those countries and the USA.

## 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.

[**K**]
**Harish Kannan, Emil Saucan\*, Indrava Roy, and Areejit Samal**.
Persistent homology of unweighted complex networks via discrete Morse theory.
2019.
arXiv: 1901.00395 (Submitted).

[**M**]
**Shakti Menon, P. Varuni, and Gautam I. Menon**.
Information integration and collective motility in phototactic cyanobacteria.
2019.
BIORXIV/2019/590778 (Submitted).

[**R**]
**Renu Maan\*, Garima Rani, Gautam I. Menon, and Pramod Pullarkat\***.
Modeling cell-substrate de-adhesion dynamics under fluid shear.
*Physical Biology*, **15**, 046006, 2018.

[**S1**]
**Areejit Samal, R.P. Sreejith, Jiao Gu\*, Shiping Liu\*, Emil Saucan\*, and Jürgen Jost\***.
Comparative analysis of two discretizations of Ricci curvature for complex networks.
*Scientific Reports*, **8**, 8650, 2018.

[**S2**]
**Emil Saucan\*, Areejit Samal, Melanie Weber\*, and Jürgen Jost\***.
Discrete curvatures and network analysis.
*MATCH Communications in Mathematical and in Computer Chemistry*, **80(3)**, 605, 2018.

[**Si1**]
**Vishaka Datta\*, Sridhar Hannenhalli\*, and Rahul Siddharthan**.
Chipulate: A comprehensive chip-seq simulation pipeline.
*PLOS Computational Biology*, **15(3)**, e1006921, 2019.

**[Si2]**
**Vishaka Datta**[*]**, Rahul Siddharthan, and Sandeep Krishna**[*].
Detection of cooperatively bound transcription factor pairs using chip-seq peak intensities and expectation maximization.
*PLOS One*, **13(7)**, e0199771, 2018.

**[Si3]**
**Sundar Ram Shankaranarayanan**[*]**, Giuseppe Inairi**[*]**, Md Hashim Reza**[*]**, Bhagya C Thimmappa**[*]**, Promit Ganguly**[*]**, Marco A Coelho**[*]**, Sheng Sun**[*]**, Rahul Siddharthan, Christian Tellgren-Roth**[*]**, Thomas L Dawson Jr**[*]**, Joseph Heitman**[*]**, and Kaustuv Sanyal**[*].
Centromere-mediated chromosome break drives karyotype evolution in closely related malassezia species.
2019.
bioRxiv doi:10.1101/533794 (Submitted).

**[Sr]**
**Emil Saucan**[*]**, R.P. Sreejith, R.P. Vivek-Ananth, Jürgen Jost**[*]**, and Areejit Samal**.
Discrete Ricci curvatures for directed networks.
*Chaos, Solitons Fractals*, **118**, 347, 2019.

**[T]**
**Kamal Tripathi and Gautam I. Menon**.
Chromatin compaction, auxeticity and the epigenetic landscape of stem cells.
2018.
(Submitted).

**[V]**
**Sudarkodi Venkatesan, R.P. Vivek-Ananth, R.P. Sreejith, Pattulingam Mangala-pandi, Ali A. Hassanali**[*]**, and Areejit Samal**.
Network approach towards understanding the crazing in glassy amorphous polymers.
*Journal of Statistical Mechanics: Theory and Experiment*, **4**, 043305, 2018.

**[Vi]**
**R.P. Vivek-Ananth, Karthikeyan Mohanraj, M. Vandanashree, Anupam Jhingran**[*]**, James P. Craig, and Areejit Samal**.
Comparative systems analysis of the secretome of the opportunistic pathogen Aspergillus fumigatus and other Aspergillus species.
*Scientific Reports*, **8**, 6617, 2018.

## 2.2 Mathematics

### 2.2.1 Research Summary & Highlights

**Analytic Number Theory**

Let $L(sym^j f, s)$ be the j-th symmetric power $L$-function associated to a primitive holomorphic Hecke eigenform $f$ for the full modular group $SL(2, \mathbb{Z})$ and let $\lambda_{sym^j f}(n)$ denote its $n$-th Fourier coefficients. Asymptotic formulas for the sums

$$\sum_{n \leq x} |\lambda_{sym^3 f}(n)|^2 \quad \text{and} \quad \sum_{n \leq x} |\lambda_{sym^4 f}(n)|^2$$

with improved error terms for $x \geq x_0$ (large) have been proved [**Ks**]

**Differential Geometry**

Foliated manifolds with a symplectic structure on the leaves are being investigated. A leafwise symplectic form is called a strong symplectic form if the form on the leaves is the restriction of a closed two form on the manifold. Strong symplectic foliations are believed to have many of the rigidity properties seen in symplectic manifolds. To explore this idea, a classification of symplectically foliated fillings of certain contact foliated manifolds was attempted. In particular, the foliated sphere cotangent bundle of the Reeb foliation on the three-sphere was studied. In the work *[PV*], it was proved that the corresponding disk cotangent bundle is the unique minimal symplectic filling up to symplectic deformation equivalence.

**Modular forms**

Ramanujan introduced the famous function as coefficients of the following infinite product: Let

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

Ramanujan's investigation about the arithmetic properties of this function led to the theory of modular forms. Development of this theory led to the solutions of some of the outstanding problems in Mathematics, e.g. Fermat's last theorem, Serre's conjecture, Sato-Tate conjecture and so on. One of the most well-known open problems about Ramanujan's $\tau$ function is a conjecture of Lehmer which states that $\tau(n) \neq 0$, for all n.

This conjecture has been investigated by several distinguished mathematicians, e.g. Deligne, Serre, Rankin, Selberg and so on. In joint work with J.M. Deshouillers, Y.F. Bilu and F. Luca, Sanoli Gun of IMSc showed that the first $k$ many $\tau$ -values are non-zero if and only if infinitely many blocks of consecutive values of $\tau$ of length 2k are non-zero. In order to prove this, we use certain techniques of Ramanujan, some recently developed Sieve theoretic tools and the Sato-Tate conjecture which is now a theorem.

**Operator Algebras**

The article [**M2**] deal with translation invariant pure states in two-sided infinite quantum spin chain $C^*$-algebra with additional discrete and continuous symmetries. The main result

proves a general mathematical result on symmetry breaking for ground states of Hamiltonians with additional symmetries. In particular, a corollary of it says that one-lattice dimensional Heisenberg anti-ferromagnet model $H_{XXX}$ does not admit a unique ground state if its spin degrees of freedom is an even integer. The paper [**M1**] gives a criteria for an element to be extremal in the convex set of unital completely positive maps with a given faithful normal state.

**Representation Theory**

Polynomial representations of general linear groups can be viewed as modules for the Schur algebra. This algebra is the commutant for the action of the symmetric group on tensor space by permuting the tensor factors. Schur-Weyl duality relates these representations to representations of the symmetric group.

The commutant of the alternating group on tensor space, called the alternating Schur algebra, was studied in [**P2**]. This algebra is a $\mathbf{Z}/2\mathbf{Z}$-graded algebra, its 0th graded part being the classical Schur algebra $S$. It's 1th graded part is an $(S, S)$ bimodule $S^-$. The fucntor $M \mapsto S^- \otimes M$ was defined as the Koszul duality functor on the category of $S$-modules. Under Schur-Weyl duality, this functor corresponds to multiplication by the sign characacter of a representation of the symmetric group. This definition was shown to be consistent with a more abstract notion of Koszul duality defined by Krause on the category of strict polynomial functors.

A combinatorial interpretation of the structure constants of this algebra was used to study properties of Koszul duality.

A systematic study of $\pi$-systems of symmetrizable Kac-Moody algebras was undertaken and many fundamental properties were established [**R2**]. Orbits under the Weyl group were determined in many cases of interest in physics. For symmetrizable hyperbolic Kac-Moody algebras, general principles for constructing $\pi$-systems were developed. This was used to determine the set of maximal hyperbolic diagrams in ranks 3-10 relative to the partial order of admitting a $\pi$-system.

The Gelfand-Tsetlin and Chari-Loktev bases of representations of special linear Lie algebras were studied. The transition matrix between the two bases was shown to be triangular with respect to the row-wise dominance partial order on the set of Gelfand-Tsetlin patterns [**R1**].

A conference on Representation theory was jointly organized at IISER, Thiruvananthapuram, funded by IMSc and IISER Thiruvananthapuram. The program consisted of 13 invited talks and 12 contributed talks.

## 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.

**[G1]**
**Y. Bilu\*, J-M. Deshouillers\*, S. Gun, and F. Luca\***.
Erratic behavior of Fourier-coefficients of modular forms in short intervals.
*Compositio Math*, **154(11)**, 2441, 2018.


**[G2]**
**S. Gun and W. Kohnen\***.
On the Ramanujan-Petersson conjecture for modular forms of half-integral weight.
*Forum Mathematicum*, 2019.
(To be published).


**[G3]**
**S. Gun, W. Kohnen\*, and B. Paul**.
Arithmetic behaviour of Hecke eigenvalues of Siegel cusp forms of degree two.
2019.
(Submitted).


**[G4]**
**S. Gun, B. Kumar, and B. Paul**.
The first simultaneous sign change and non-vanishing of Hecke eigenvalues of newforms.
*J. Number Theory*, 2018.
(To be published).


**[G5]**
**S. Gun, M.R. Murty\*, and P. Rath\***.
Transcendental sums related to the zeros of zeta functions.
*Mathematika*, **64(3)**, 875, 2018.


**[G6]**
**S. Gun, B. Paul, and J. Sengupta\***.
On Hecke eigenvalues of Siegel modular forms in the Maass space.
*Forum Mathematicum*, **30(3)**, 775, 2018.


**[G7]**
**S. Gun and B. Saha\***.
Multiple Lerch zeta functions and an idea of Ramanujan.
*Michigan Math J.*, **67(2)**, 267, 2018.


**[G8]**
**S. Gun and Jyothsnaa Sivaraman**.
On existence of Euclidean ideal classes in real cubic and quadratic fields with cyclic class group.
*Michigan Math J*, 2019.
(To be published).


**[K]**
**Srinivas Kotyada and Subramoni Muttukrishnan\***.

A survey of Certain Euclidean Number Fields.
In Azizul Hoque Kalyan Chakraborty and Prem Prakash Kalyan Chakraborty et al, editors,
 *ICCGNFRT 2017*. Springer, Mar 2019.
89016025 (To be published).


[**Ks**]
**Sankaranarayanan A∗, Saurabh Singh∗, and K. Srinivas**.
Discrete Mean square estimates for Coefficients of Symmetric power $L$-functions.
*Acta Arithmetica*, 2018.
AA 180819 (To be published).


[**M1**]
**Anilesh Mohari**.
Extremal unital completely positive maps and their symmetries.
*Complex Anal. Oper. Theory*, **12(07)**, 1739, 2018.


[**M2**]
**Anilesh Mohari**.
Spontaneous $su_2(c)$ symmetry breaking in the ground states of quantum spin chain.
*Journal of Mathematical Physics*, **59(11)**, 117011, 2018.


[**N**]
**Avijit Nath and Parameswaran Sankaran**.
On generalized Dold manifolds.
*Osaka Jour. Math.*, **56**, 75, 2019.


[**P1**]
**Amritanshu Prasad, Digjoy Paul, and Arghya Sadhukhan∗**.
Tableau correspondences and representation theory.
In *International conference on algebra, discrete mathematics, and applications, Contemporary Mathematics*. American Mathematical Society, Dec 2018.
(To be published).


[**P2**]
**Thangavelu Geetha∗, Amritanshu Prasad, and Shraddha Srivastava**.
Schur Algebras for the Alternating Group and Koszul Duality.
2019.
arXiv:1902.02465 (Submitted).


[**P3**]
**Amritanshu Prasad**.
Knuth's moves on timed words.
*The Mathematics Student*, **87(3–4)**, 1, 2018.


[**P4**]
**Amritanshu Prasad**.
A timed version of the plactic monoid.

2018.
(Submitted).

**[R1]**
**K.N. Raghavan, B. Ravinder*, and Sankaran Viswanath**.
A relationship between Gelfand-Tsetlin bases and Chari-Loktev bases for irreducible finite
  dimensional representations of special linear Lie algebras.
In *Contemporary Mathematics: Proceedings of the International Conference on Algebra, Discrete Mathematics and Applications held at Aurangabad, Maharashtra, India, during 9–11
  December 2017.*, Feb 2019.
(To be published).

**[R2]**
**Lisa Carbone*, K.N. Raghavan, Biswajit Ransingh*, Krishanu Roy, and Sankaran
  Viswanath**.
π-systems of symmetrizable Kac-Moody algebras.
2019.
(Preprint: arXiv:1902.06413).

**[S]**
**T. Mubeena* and Parameswaran Sankaran**.
Twisted conjugacy and quasi-isometric rigidity in irreducible lattices in semisimple lie groups.
*Indian Journal of Pure and Applied Mathematics,*, 2018.
(To be published).

**[Sa1]**
**Parameswaran Sankaran**.
Quasi-isometry and rigidity.
In X.-Z. Li X. Cao S. Deo. P. K. Roy, P. Das, editor, *Mathematical Analysis and Applications
  in Modeling.* Springer., Oct 2018.
(To be published).

**[Sa2]**
**Parameswaran Sankaran**.
The vector field problem for homogeneous spaces.
In Jie Wu. Mahender Singh, Yongjin Song, editor, *Algebraic topology and related topics. Proceedings of the Seventh East Asian Conference in Algebraic Topology.*, page 223. Springer-
  Verlag., Jan 2019.

**[Sa3]**
**Daciberg L. Gonçalves* and Parameswaran Sankaran**.
Twisted conjugacy in PL-homeomorphism groups of the circle.
*Geometriae Dedicata*, 2018.
(To be published).

**[Sa4]**
**Arghya Mondal* and Parameswaran Sankaran**.

Geometric cycles in locally hermitian symmetric spaces and automorphic representations.
*Transformation Groups*, 2019.
(To be published).


[**Si1**]
**Jyothsnaa Sivaraman**.
Existence of Euclidean ideal classes beyond certain rank.
2018.
(To be published).


[**Si2**]
**Jyothsnaa Sivaraman**.
Primitive roots for Pjateckii-Sapiro primes.
2018.
(Submitted).


[**V**]
**Francisco Presas**[*] **and Sushmita Venugopalan**.
Symplectic foliated fillings of sphere cotangent bundles.
2018.
Arxiv eprint 1809.10363 (Submitted).


# 2.3   Physics

## 2.3.1   Research Summary & Highlights

**Astrophysics**

The "Indian Pulsar Timing Array" experiment is being continued.

Pulsar surveys to discover new pulsars are being undertaken using the upgraded GMRT.

Precision timing analysis of radio pulsars is used as a tool to probe various aspects of fundamental physics, and the most basic task is to measure the spin and thr orbital periods of pulsars and the rate of the change of these periods as accurately as possible. However, the measured values of the rate of change of the orbital and the spin periods are affected by different dynamical effects like velocity and acceleration of the pulsars relative to the solar system. For last few decades, some simplistic models have been used to eliminate these dynamical effects and estimate the intrinsic values of the rate of change of periods. However, these simplified models are valid only for pulsars close to the solar system. We have recently developed a more accurate model, which is valid for even pulsars far away from the solar system. Being very accurate, this model has obtained popularity among all pulsar astronomers worldwide. As an example, this model has been used to place the the best ever limit of the non-violation of the universality of free fall, one of the fundamental aspect of Einstein's general theory of relativity (by Archibald et al. 2018, Nature 559, 730). The python code to implement this model is developed and the same is publicly available at

, and the paper describing the model has been published recently by Manjari Bagchi and Dhruv Pathak of IMSc [**P**]. This work is a part of Dhruv Pathak's PhD thesis.

## Classical and Quantum Gravity, Black Holes, Cosmology

In an ongoing effort, the self-force problem is being looked at in the context of gravitational wave astronomy. There are various approaches. Among then there is one approach, mainly due to Abraham Harte, where an attempt is made to define the problem non-perturbatively. The problem of orbit construction and the relevance of tubular geometry are being explored in this context.

## Condensed Matter Physics

We have studied the yielding response, in the athermal quasi static limit, of a model amorphous material having inclusions in the form of randomly pinned particles [**Ch1**]. We show that, with increasing pinning concentration, the plastic activity becomes more spatially localized, resulting in smaller stress drops, and corresponding increase in the magnitude of strain where yielding occurs. We demonstrate that, unlike the spatially heterogeneous and avalanche led yielding in the case of the unpinned glass, for the case of large pinning concentration, yielding takes place via a spatially homogeneous proliferation of localized events.

Polycrystals 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 [**Ch6**], and observe that the response can be very different, compared to amorphous materials. In general, similar to yield stress fluids, three distinct dynamical states, namely, flowing, stick-slip and jammed can be observed, depending on the channel width and applied body force (eg, gravity). Importantly, the interplay between the finite system size (the channel width), and the inherent ordering scale (the grain size) leads to new type of spatiotemporal heterogeneity. In relatively wide channels, although the average flow profile remains simple plug like, at the underlying granular level, there is vigorous grain remodelling activity resulting from the velocity heterogeneity among the grains. As the channel width approaches typical grain size, the flowing polycrystalline state surprisingly 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.

To broaden our understanding of granular rheology, we have probed the steady-shear rheology of a model adhesive dispersion [**Ch4**]. We vary the range of the attractive forces as well as the strength of the dissipation. For large dissipative forces, the rheology is displays Herschel-Bulkley form. Decreasing the strength of dissipation, inertial effects show up. The stress decreases via an effective Johnson-Samwer law, where the effective temperature is exclusively due to shear-induced vibrations. During flow particles prefer to rotate around each other such that the dominant velocities are directed tangentially to the particle surfaces. This tangential channel of energy dissipation and its suppression leads to a discontinuity in the flow curve, and an associated discontinuos shear thinning transition. We set up an analogy with frictional systems, where the phenomenon of discontinuous shear thickening occurs.

In the context of particle-laden chaotic flows, we have investigated [Ch3] the effects of a two-dimensional, incompressible, turbulent flow on mono-disperse soft granular particles and show the emergence of a crystalline phase due to the interplay of Stokesian drag (measured through the Stokes number) and short-range inter-particle interactions. We quantify this phase through the bond order parameter and local density fluctuations and find a sharp transition between the crystalline and non-crystalline phase as a function of the Stokes number. Furthermore, the nature of preferential concentration, as characterised by the radial distribution function and the correlation dimension, is significantly different from that of particle-laden flows in the absence of repulsive potentials.

To understand the response of glasses to applied stress, we have studied [Ch2] the fluidisation process in a three-dimensional colloidal glass model. In order to disentangle possible boundary effects from finite size effects in the process of fluidisation, we implement a novel geometry-constrained protocol with periodic boundary conditions. We show that this protocol is well controlled and that the longtime fluidisation dynamics is, to a great extent, independent of the details of the protocol parameters. Our protocol, therefore, provides an ideal tool to investigate the bulk dynamics prior to yielding and to study finite size effects regarding the fluidisation process. Our study reveals the existence of precursors to fluidisation observed as a peak in the strain-rate fluctuations, that allows for a robust definition of a fluidisation time. Although the exponents in the power-law creep dynamics seem not to depend significantly on the system size, we reveal strong finite size effects for the onset of fluidisation.

Extreme active matter, an assembly of self-propelled particles with large persistence time and high Pclet number, exhibits remarkable behaviour at high densities, which we have investigated using numerical simulations [Ch5]. At small persistence, the assembly undergoes a gradual slowing down of density relaxations, as one reduces the active propulsion force, until at the glass transition, the relaxation times diverge. In the other limit of infinite persistence, the fluid jams on lowering the forcing, at a critical threshold. In between these limits, the approach to dynamical arrest goes through a phase characterised by intermittency, which is a consequence of long periods of jamming followed by bursts of plastic yielding associated with Eshelby deformations.

**Discovery of Helium from Andhra Pradesh**

This lecture was organized to celebrate the 150th anniversary of the discovery of the element Helium that happened during a total solar eclipse observed by European astronomers from Machilipatnam and Guntur in 1868. Helium remains the only element to have been discovered first in space, before being found on Earth. The story of this discovery itself is fascinating the truth behind who among Janssen, Lockyer and Pogson (of Madras Observatory) should get the credit, was cleared up only a few years ago. More importantly, this discovery truly marks the beginning of modern astrophysics. This beginning is intricately linked with the history of thermodynamics, atomic theory, and chemistry. Dr. Niruj Mohan Ramanujam presented this lecture.
https://www.youtube.com/watch?v=eEbSV6HNWGU
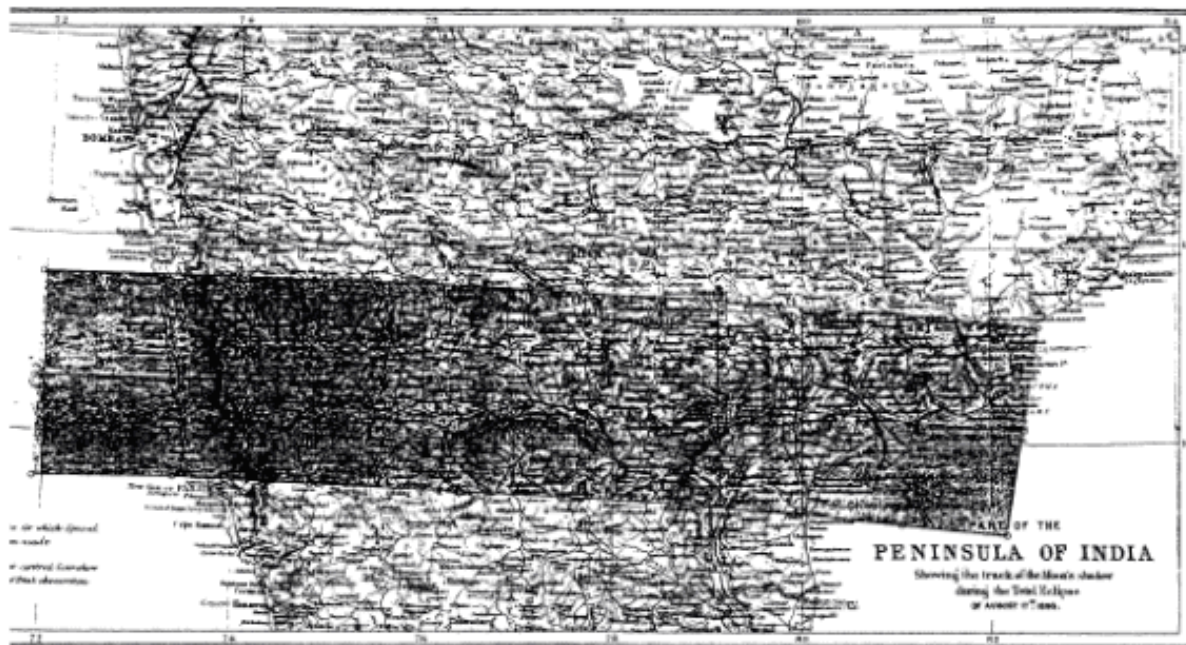
Path of totality on 18 Aug 1868 (calculated by Major Tennant)
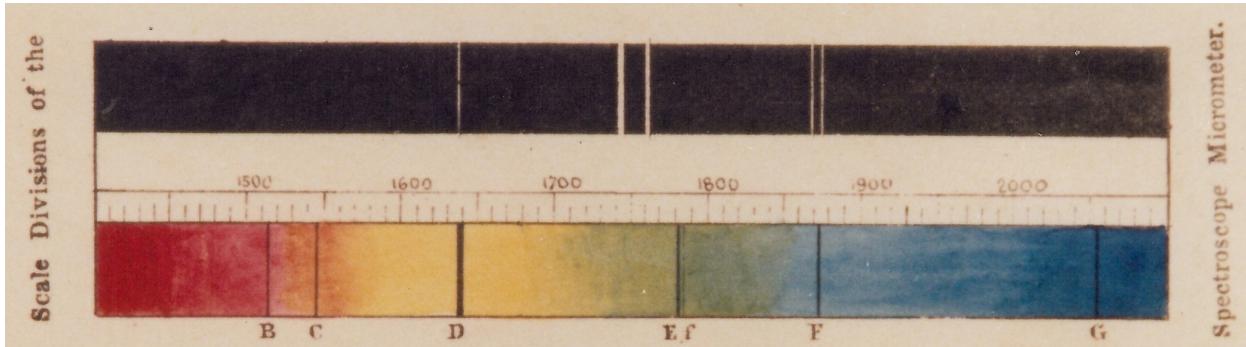
Figure 2.2:

Figure 2.4:

## Mechanics of Complex Matter

A workshop on "Mechanics of Complex Matter: Criticality, intermittency and collective behaviour" was organized by Pinaki Chaudhuri and Purusattam Ray at IMSc during March 04-07, 2019. It is the seventh such workshop in the Fracmeet series of meetings that has been held at IMSc since 2012. The workshop also had strong participation of scientists from IGCAR, thus providing a scope for increased contact and exploration of possible collaborations between IMSc and IGCAR on the physics of materials.

## Non-perturbative QCD, Lattice Gauge Theory, QGP

We have made a detailed characterization of the rich topological structures in finite temperature QCD near the chiral crossover transition at vanishingly small baryon densities. Our publication [1] is one of the first works to identify and characterize the fractionally charged topological objects in QCD called instanton-dyons, that may hold a key to our understanding of the origin of many non-perturbative properties of hadronic matter.

## Nonlinear Dynamics, Solitons and Chaos

Cortical bone, found in the central part of long bones like femur, is primarily responsible for maintaining structural integrity. Cortical bone is of two types: Plexiform bone and Haversian bone. The specific role of the structure of the network of pores in bone on its fracture behaviour under compression is examined. CT scan images of the sample pre- and post- compressive failure show the existence of local weak planes formed by aligned thin long pores extending through the length. It is shown that the physics of the fracture process, for both plexiform bone and Haversian bone, is captured by a two dimensional random spring network model that reproduces well the macroscopic response and qualitative features of fracture paths obtained experimentally, as well as avalanche statistics seen in experiments on porcine bone [Ra2].

The nature of the velocity distribution of a driven granular gas, though well studied, is unknown as to whether it is universal or not, and if universal what the distribution is. The tails of the steady state velocity distribution is determined exactly for a microscopic model for a granular gas in two dimensions within the well-mixed limit. It is shown that there are two universal regimes depending on how the system is driven. In the more generic universal regime, the distribution is a gaussian with logarithmic corrections. In the second universal

40

regime, the distribution is an exponential with additional logarithmic corrections. Both of these are in contradiction to well accepted results based on phenomenological modelling. Data from experiments are re-anlaysed to show that they may be reinterpreted to fall into one of the two universality classes [**Pr**].

Models with only hard interactions have been studied for a long time as the simplest models to show phase transitions. In these models, the phases and phase transitions are determined by only the shape and density of the particles. Here, the phase diagram and nature of the phase transitions are determined for a system of hard cubes on a three dimensional cubic lattice. By implementing a Monte Carlo algorithm with a cluster move, it is possible to access densities close to full packing. It is shown that the system undergoes three phase transitions with increasing density, contrary to what was seen and expected up to now [**V**].

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**]

The large scale structure of homo-polymers and primary structures of proteins undergo similar phase transitions with decreasing temperature. In a good solvent, polymers are in a random coil conformation that is dominated by entropy, while in a poor solvent they are in a compact globular conformation that is dominated by energetic interactions between monomers. The two phases are separated by a continuous extended-collapsed phase transition. Here, the flat energy interacting growth walk algorithm is employed to estimate accurately the density of states of an interacting self avoiding walk on a face centered cubic lattice. Using the computed density of states, by analysing the specific heat and zeros of the partition function, it is shown that interacting self avoiding walk on face centered cubic lattice exhibits a second order coil globule transition. The accuracy of the algorithm in estimating density of states allows the determination of the transition temperature accurately even with walks of short walk lengths [**Ra1**]

**Particle Physics**

It was shown in Ref. [**N1**] that for a heavy vector-like quark model with a down type isosinglet, branching ratio for $c \to u\gamma$ decay is enhanced by more than $\mathcal{O}(10^2)$ as compared to that in the Standard model when QCD corrections to next-to-leading order are incorporated. In a left-right symmetric model (LRSM) along with a heavy vector-like fermion, enhancement of this order can be achieved at the bare (QCD uncorrected) level itself. We proposed that a measurement of the photon polarization could be used to signal the presence of such new physics inspite of the large long distance effects. We found that there is a large region within the allowed parameter space of the model with vector-like quark and additional left-right symmetry, where depending on the exact size of the long distance contribution, the photon polarization can be dominantly right-handed.

In Ref. [**N2**], leptoquark production and decay was studied at the proposed $e^-p$ collider operating with 150 GeV electron and 7 TeV proton beam for the $\tilde{R}_2$ class of models. In addition to the coupling of leptoquark with the lepton and jet, the model also has right handed neutrinos, coupled to the leptoquark. The collider signatures of a number of final states, that can originate from leptoquark decay into the standard model particles, as well as, the final states that originate from further decay of the produced sterile neutrinos were analyzed. We found that the final state $\bar{b}\ell^-\tau^- + \text{n-jets}\,(\text{n} \geq 2) + E_T$ is the best one to probe a leptoquark and a right-handed neutrino, as the background from Standard Model is negligible. The statistical significance of this signal for a leptoquark of mass 1.1 TeV can be 11 $\sigma$ with data from LHeC running for one year. With implementation of invariant mass cuts, the final states with a lepton and light jets can also achieve similar significance.

The radiative decays of $b$-baryons facilitate the direct measurement of photon helicity in $b \to s\gamma$ transitions thus serving as an important test of physics beyond the Standard Model. In this paper we analyze the complete angular distribution of ground state $b$-baryon ($|lambda_b^0$ and $\Xi_b$) radiative decays to multibody final states assuming an initially polarized $b$-baryon sample. Our sensitivity study suggests that the photon polarization asymmetry can be extracted to a good accuracy along with a simultaneous measurement of the initial $b$-baryon polarization. With higher yields of $b$-baryons, achievable in subsequent runs of the Large Hadron Collider (LHC), we find that the photon polarization measurement can play a pivotal role in constraining different new physics scenarios. This has been presented in Ref. [**R4**].

One of the most important tests of the standard model of particle physics is the measurement of the magnetic moment of the W boson. We have shown that the radiative muon decay, which is expected to be produced in a large number as the background of various experiments (like COMET, MEG, Mu2e), can provide one of the most sensitive measurements of the W boson couplings. In this decay mode, we establish the existence of a 'new type of zero' in the odd part of normalized differential decay rate under the exchange of electron and photon energies in the SM scenario. It was shown that a suitably constructed asymmetry based on this fact enables the most sensitive probe for charge-conjugation and parity conserving dimension-four W-W-photon vertex beyond SM. The achieved sensitivity using our approach significantly exceeds the sensitivity possible at LHC or accelerators envisaged for the future
.
Using time-dependent indirect $CP$ asymmetries to measure $T$ and $CPT$ violation in $B^0$-$\bar{B}^0$ mixing, A. Karan, A. K. Nayak, R. Sinha and D. London, Phys. Lett. B781, 459 (2018) Quantum field theory, which is the basis for all of particle physics, requires that all processes respect CPT invariance. It is therefore of paramount importance to test the validity of CPT conservation. In this Letter, we show that the time-dependent, indirect CP asymmetries

involving $B$ decays to a CP eigenstate contain enough information to measure T and CPT violation in $B^0 - \bar{B}^0$ mixing, in addition to the standard CP-violating weak phases. Entangled $B^0 - \bar{B}^0$ states are not required (so that this analysis can be carried out at LHCb, as well as at the B factories), penguin pollution need not be neglected, and the measurements can be made using $B_d^0$ or $B_s^0$ mesons. This has been presented in Ref. [**R2**].

The rare decay $B \to K^{\ell^+\ell}$ is an important mode for indirect search of new physics due to the measurement of large number of observables in experiments. Using the most general parametric form of the amplitude in the Standard Model (SM), we probe the physics beyond Standard Model in a theoretically clean approach. The model-independent framework has been implemented in the maximum $q^2$ limit to highlight strong evidence of right-handed currents, which are absent in the SM. The conclusions derived are free from hadronic corrections. Next, we explain, in terms of a simple and compelling new physics scenario with only two new parameters, the discrepancies between the SM expectations and the data for the neutral-current observables $R_{K^{(*)}}$, as well as the charged-current observables $R(D^{(*)})$ while being consistent with all other data. This has been presented in Ref. [**R3**].

In a recent paper we had advanced a minimal resolution of some of the persistent anomalies in semileptonic $B$-decays. These include the neutral-current observables $R_{K^{(*)}}$, as well as the charged-current observables $R(D^{(*)})$. Recently, it has been observed that the semileptonic decays of the $B_c$ meson also hint at a similar type of anomaly. In this longer version, we discuss in detail why, if the anomalies are indeed there, it is a challenging task to explain the data consistently in terms of a simple and compelling new physics scenario. We find that the minimal scheme to achieve a reasonable fit involves the inclusion of just two (or, at worst, three with a possible symmetry relationship between their Wilson coefficients) new current-current operators, constructed in terms of the flavour eigenstates, augmented by a change of basis for the charged lepton fields. With only three unknown parameters, this class of models not only explain all the anomalies (including that in $B_c \to J/\psi\,\ell\nu$) to a satisfactory level but also predict some interesting signatures, like $B \to K\mu\tau$, $B_s \to \tau\tau$, $B \to K$ plus missing energy, or direct production of $\tau^+\tau^-$, that can be observed at LHCb or Belle-II. This has been presented in Ref. [**R1**].

We have computed [**Rav2**] ,[**Rav3**] the two-loop massless QCD corrections to the four-point amplitude g+g?H+H resulting from effective operator insertions that describe the interaction of a Higgs boson with gluons in the infinite top quark mass limit. This amplitude is an essential ingredient to the third-order QCD corrections to Higgs boson pair production. We have implemented our results in a numerical code that can be used for further phenomenological studies. Also, the NNLO QCD correction to the production from bottom quark annihilation process.

We have reported [**Rav4**] our findings on the perturbative structure of N=4 supersymmetric Yang-Mills (SYM) theory in the infrared sector by computing inclusive scattering cross sections of on-shell particles. We use half-BPS, energy-momentum tensor and Konishi operators to produce singlet states in the scattering processes to probe the soft and the collinear properties of the cross sections. By appropriately defining the infrared safe observables, we obtain collinear splitting functions up to second order in the perturbation theory. The splitting functions and the infrared finite cross sections demonstrate several interesting connections with those in the perturbative QCD. We also determine the process independent soft distribution function up to third order in the perturbation theory and show that it is universal.

We consider the production of pairs of lepton through the Drell-Yan process [**Rav5**] and the production of Higgs boson [**Rav1**, **Rav6**] at the LHC and present the most accurate prediction on their rapidity distribution. While the fixed order prediction is already known to next-to-next-to-leading order in perturbative QCD, the resummed contribution coming from threshold region of phase space up to next-to-next-to-leading logarithmic (NNLL) accuracy has been computed in this article. The formalism developed by one of us has been used to resum large threshold logarithms in the two dimensional Mellin space to all orders in perturbation theory. We have done a detailed numerical comparison against other approaches that resum certain threshold logarithms in Mellin-Fourier space.

We present here the first result [**Rav7**] on the three-loop gluon jet function in perturbative QCD. Using the three-loop coefficient functions for deep-inelastic scattering via the exchange of a virtual photon that couples to quarks or a scalar that couples to gluons and employing the KG equation, renormalization group invariance and factorization theorem, we obtain both the quark and the gluon jet functions up to the three-loop level. The former agrees with the recent result [3]. These jet functions being universal ingredients for many collider and decay processes, will play an important role in the phenomenological studies at the Large Hadron Collider.

Following the discovery of the Higgs boson at the Large Hadron Collider (LHC) and the resulting knowledge of its mass, its self-coupling is known in the standard model (SM). From this data it has been argued that the Higgs electroweak vacuum that sets the masses of all the SM particles is unstable and that the Higgs field value can quantum mechanically tunnel away to very large values, although this value in the SM is spectaculary tiny. The presence of new physics changes this conclusion and we study in [**Shr**] the effect of new vector-like fermions (quark and leptons) on Higgs electroweak vacuum stability. It is shown that in some regions of new physics parameter-space, the tunneling probability can become unacceptably large, disfavoring those points.

**The Stellar Legacy of Prof. Meghnad Saha**

The Stellar Legacy of Prof. Meghnad Saha: from Society to the Cosmos: It consisted of a conference and a day of lectures aimed at school students. It was partially funded by NASI (Chennai local chapter)

**String Theory**

In an earlier paper (arXiv:1706.03371) a holographic form of the Exact Renormalization Group (ERG) evolution operator for a (perturbed) free scalar field (CFT) in D dimensions was formulated. It was shown to be equivalent, after a change of variables, to a free scalar field action in AdSD+1 space time. We attempt to extend this result to a theory where the scalar field has an anomalous dimension. Instead of the ERG evolution operator, we examine the generating functional with an infrared cutoff, and derive the prescription of alternative quantization by using the change of variables introduced in the previous paper. The anomalous dimension is thus related in the usual way to the mass of the bulk scalar field. Computation of higher point functions remains difficult in this theory, but should be tractable in the large N version.[**S**]

A study of the connection between holographic Rg and exact RG is being undertaken in order to shed light on the AdS/CFT correspondence. The Sine Gordon theory is generalized to include several cosine terms. This is similar to the world sheet description of a string propagating in a tachyon background. This model is studied as a (boundary) 2d Euclidean field theory and also using an AdS 3 holographic bulk dual. The beta functions for the cosine vertex of this modified theory are first computed in the boundary using techniques based on the exact RG. The beta functions are also computed holographically using position space and momentum space techniques. The results are in agreement with each other and with earlier computations. The beta functions of the field strength renormalization are computed in position space. They match with the earlier results. [O]

A covariant worldline theory for string bits needs to be constructed by discretizing the worldsheet. The requirement of covariance demands that a suitable discrete differential geometry exist in this context. This construction is under progress.

Two dimensional Seiberg duality was studied in the context of surface operators in four dimensional gauge theories. Using supersymmetric localization, partition functions of Seiberg-dual quiver theories were shown to be related by contour deformations. These results were obtained for surface operators in gauge theories with and without fundamental matter multiplets.

Motivated by their appearance in supersymmetric gauge and string theories, quasi-automorphic forms associated to Hecke groups were studied and Ramanujan identities were derived exploiting a relation to Halphen systems. These also led to the derivation of higher order Chazy equations, whose Painleve property was proven.

**Quantum Black Holes**

Prof. Sujay Ashok orgnaized a public lecture on an encounter between Hawking and Ramanujan (part of the Nag memorial lecture series) by Atish Dabholkar, International Centre for Theoretical Physics. Website:https://www.imsc.res.in/outreach/lectures/

## 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.

[**A1**]
**Sujay K. Ashok, Sourav Ballav, Marco Billo*, Eleonora DellAquila*, Marialuisa Frau*, Varun Gupta, Renjan R. John*, and Alberto Lerda*.**
Surface operators, dual quivers and contours.
*European Physics Journal - C*, 2018.
1807.06316 (To be published).

[**A2**]
**Sujay K. Ashok, Sourav Ballav, Marialuisa Frau*, and Renjan R. John*.**

Surface operators in n=2 SQCD and Seiberg duality.
*European Physical Journal - C*, 2019.
1901.09630 (Submitted).


[**A3**]
**Sujay K. Ashok, Dileep P. Jatkar***, **and Madhusudhan Raman***.
Aspects of Hecke Symmetry II: Anomalies, Curves, and Chazy Equations.
*Communications in Mathematical Physics*, 2018.
1810.07919 (Submitted).


[**A4**]
**Sujay K. Ashok and Jan Troost***.
A Duality in two-dimensional gravity.
*Journal of High Energy Physics*, 2018.
1812.05822 (Submitted).


[**B**]
**Trilochan Bagarti and Shakti N. Menon**.
Milling and meandering: Flocking dynamics of stochastically interacting agents with a field
  of view.
2018.
(Preprint: arXiv:1805.00755).


[**Ba**]
**K. Stovall***, **P. Freire***, **J. Antoniadis***, **M. Bagchi, J. Deneva***, **N. Garver-Daniels***,
  **J. Martinez***, **M. McLaughlin***, **Z. Arzoumanian***, **H. Blumer***, **P. Brook***,
  **H. Cromartie** *, **P. Demorest***, **M. Decesar***, **T. Dolch***, **J. Ellis***, **R. Ferdman***,
  **E. Ferrara***, **E. Fonseca***, **P. Gentile***, **M. Jones***, **M. Lam***, **D. Lorimer***,
  **R. Lynch***, **C. Ng***, **D. Nice***, **T. Pennucci***, **S. Ransom** *, **R. Spiewak***, **I. Stairs***,
  **J. Swiggum***, **S. Vigeland** *, **and W. Zhu***.
PSR J2234+0611: A new laboratory for stellar evolution.
*The Astrophysical Journal*, **870(2)**, 74, 2019.


[**Bag**]
**BhalChandra Joshi***, **Prakash Arumugasamy***, **Manjari Bagchi, Debades
  Bandyopadhyay***, **Avishek Basu***, **Neelam Dhanda Batra***, **Suryarao Bethapudi***,
  **Arpita Choudhary, Kishalay De***, **L. Dey, A. Gopakumar, Y. Gupta, KA Kr-
  ishnakumar, Yogesh Maan, PK Manoharan, Arun Naidu, Rana Nandi, Dhruv
  Pathak, Mayuresh Surnis, and Abhimanyu Susobhanan**.
Precision pulsar timing with the ORT and the GMRT and its applications in pulsar astro-
  physics.
In 51, editor, *Journal of Astrophysics and Astronomy, 39 (2018). Proceeding of the workshop
  Advances in Astroparticle Physics and Cosmology, APCOS-2018 held at Saha Institute of
  Nuclear Physics, Kolkata, India; during 06 - 09 March, 2018.*, Aug 2018.


[**C**]
**Subhroneel Chakrabarti, Deepali Mishra***, **Yogesh K. Srivastava***, **and Amitabh**

**Virmani**[*].
Generalised Garfinkle-Vachaspati Transform With Dilaton.
*Classical and Quantum Gravity*, 2019.
arXiv:1901.09048 (Submitted).


[**Ch1**]
**Bhanu P. Bhowmik**[*], **Pinaki Chaudhuri, and Smarajit Karmakar**[*].
Effect of pinning on the yielding transition of amorphous solids.
2018.
arxiv:1808.09723 (Submitted).


[**Ch2**]
**Raffaela Cabriolu**[*], **Juergen Horbach**[*], **Pinaki Chaudhuri, and Kirsten Martens**[*].
Precursors of fluidisation in the creep response of a soft glass.
*Soft Matter*, **15**, 415, 2019.


[**Ch3**]
**Mohit Gupta**[*], **Pinaki Chaudhuri, Jeremie Bec**[*], **and Samriddhi S. Ray**[*].
Turbulent route to two-dimensional soft crystals.
*65532;*, 2018.
arXiv:1812.06487 (Submitted).


[**Ch4**]
**Ehsan Irani**[*], **Pinaki Chaudhuri, and Claus Heussinger**[*].
Discontinuous shear-thinning in adhesive dispersions.
2018.
arxiv:1809.06128 (Submitted).


[**Ch5**]
**Rituparno Mandal**[*], **Pranab J. Bhuyan**[*], **Pinaki Chaudhuri, Chandan Dasgupta**[*], **and Madan Rao**[*].
Extreme active matter at high densities.
2019.
arXiv:1902.05484 (Submitted).


[**Ch6**]
**Tanmoy Sarkar**[*], **Pinaki Chaudhuri, and Anirban Sain**[*].
Flow of polycrystals in rough channels.
2018.
arXiv:1809.02068 (Submitted).


[**J**]
**R. Janaki, Shakti N. Menon, Rajeev Singh, and Sitabhra Sinha**.
Lateral inhibition provides a unifying framework for spatiotemporal pattern formation in media comprising relaxation oscillators.
2019.
(Preprint: arXiv:1902.01163).

[**Jo**]
**J. P. Joy, S. N. Pathak**[*]**, and R. Rajesh**.
Shock propagation following an intense explosion: comparison between hydrodynamics and
  simulations.
2018.
ArXiv:1812.03638 (Submitted).


[**M**]
**Shakti N. Menon, V. Sasidevan, and Sitabhra Sinha**.
Emergence of cooperation as a non-equilibrium transition in noisy spatial games.
*Frontiers in Physics*, **6**, 34, 2018.


[**Mi1**]
**Tanmay Mitra, Shakti N. Menon, and Sitabhra Sinha**.
Emergent memory in cell signaling: Persistent adaptive dynamics in cascades can arise from
  the diversity of relaxation time-scales.
*Scientific Reports*, **8**, 13230, 2018.


[**Mi2**]
**Tanmay Mitra, Shakti N. Menon, and Sitabhra Sinha**.
Non-associative learning in intra-cellular signaling networks.
2018.
(Preprint: arXiv:1807.01243).


[**Mu1**]
**M V N Murthy, Matthias Brack**[*]**, and Rajat K. Bhaduri**[*].
On the asymptotic distinct prime partitions of integers.
2018.
arXiv:1904.02776 [math.NT] 22 March 2019 (Submitted to Phys.Rev E).


[**Mu2**]
**M V N Murthy, Matthias Brack**[*]**, Rajat K. Bhaduri**[*]**, and Johann Bartel**[*].
Semiclassical analysis of distinct square partitions.
*Physical Review E*, **98**, 052131, 2018.


[**N1**]
**Aritra Biswas, Sanjoy Mandal, and Nita Sinha**.
Searching for New physics in Charm Radiative decays.
*Int.J.Mod.Phys.*, **A33(32)**, 1850194, 2018.


[**N2**]
**Sanjoy Mandal, Manimala Mitra, and Nita Sinha**.
Probing leptoquarks and heavy neutrinos at the LHeC.
*Phys.Rev.*, **D98(9)**, 095004, 2018.


[**O**]
**Prafulla Oak and Balachandran Sathiapalan**.

Holographic beta functions for the generalized sine gordon theory.
*Physical Review D*, 2018.
arXiv:1809.10758 (To be published).


**[P]**
**Dhruv Pathak and Manjari Bagchi**.
Dynamical effects in the observed rate of change of the orbital and the spin periods of radio
  pulsars: Improvement in the method of estimation and its implications.
*The Astrophysical Journal*, **868(2)**, 123, 2018.


**[Pr]**
**V. V. Prasad, D. Das\*, S. Sabhapandit\*, and R. Rajesh**.
Steady state velocity distribution of driven granular gases.
2018.
arXiv:1804.02558 (Submitted).


**[R1]**
**D. Choudhury\*, A. Kundu\*, R. Mandal\*, and R. Sinha**.
$R_{K^{(*)}}$ and $R(D^{(*)})$ anomalies resolved with lepton mixing.
*Nucl Phys. B*, **933**, 433, 2018.


**[R2]**
**A. Karan\*, R. Mandal\*, and R. Sinha**.
Testing $ww\gamma$ vertex in radiative muon decay.
*Phys. Rev.*, **D99**, 033006, 2019.


**[R3]**
**R. Mandal\* and R. Sinha**.
Searching new physics with beauty mesons.
*Acta Phys. Polon.*, **B49**, 1371, 2018.


**[R4]**
**L. M. G. Martn\*, B. Jashal\*, F. M. Vidal\*, A. Oyanguren\*, S. Roy\*, R. Sain\*,
  and R. Sinha**.
Radiative $b$-baryon decays to measure the photon and $b$-baryon polarization.
arXiv:1902.04870 [hep-ph].


**[Ra1]**
**A. A. Jaleel\*, M. Ponmurugan\*, R. Rajesh, and S. V. Satyanarayana\***.
Phase transitions in a linear self-interacting polymer on FCC lattice using flat energy inter-
  acting growth walk algorithm.
*Journal of Statistical Mechanics*, **2018**, 113301, 2018.


**[Ra2]**
**Ashwij Mayya\*, Anuradha Banerjee\*, and R. Rajesh**.
Role of porosity and matrix behavior on compressive fracture of haversian bone using random

spring network model.
*Journal of the Mechanical Behavior of Biomedical Materials*, **83**, 108, 2018.


[**Rav1**]
**Neelima Agarwal, Pulak Banerjee, Goutam Das, Prasanna K. Dhani, Ayan Mukhopadhyay, V. Ravindran, and Anurag Tripathi**.
Resummed transverse momentum distribution of pseudo-scalar Higgs boson at $NNLO_a$+NNLL.
*JHEP*, **1812**, 105, 2018.
arXiv:1805.12553 [hep-ph]. 10.1007/JHEP12(2018)105.


[**Rav2**]
**A.H. Ajjath, Pulak Banerjee, Amlan Chakraborty, Prasanna K. Dhani, Pooja Mukherjee, Narayan Rana, and V. Ravindran**.
Two-loop QCD corrections to $b + \bar{b} \to H + H$ amplitude.
arXiv:1811.01853 [hep-ph].


[**Rav3**]
**Pulak Banerjee, Sophia Borowka, Prasanna K. Dhani, Thomas Gehrmann, and V. Ravindran**.
Two-loop massless QCD corrections to the $g + g \to h + h$ four-point amplitude.
*JHEP*, **1811**, 130, 2018.
arXiv:1809.05388 [hep-ph]. 10.1007/JHEP11(2018)130.


[**Rav4**]
**Pulak Banerjee, Amlan Chakraborty, Prasanna K. Dhani, V. Ravindran, and Satyajit Seth**.
Second order splitting functions and infrared safe cross sections in $\mathcal{N} = 4$ SYM theory.
*JHEP*, **1904**, 058, 2019.
arXiv:1810.07672 [hep-th]. 10.1007/JHEP04(2019)058.


[**Rav5**]
**Pulak Banerjee, Goutam Das, Prasanna K. Dhani, and V. Ravindran**.
Threshold resummation in the rapidity distribution for a colorless particle production at the LHC.
*PoS*, **LL2018**, 043, 2018.
arXiv:1807.04583 [hep-ph]. 10.22323/1.303.0043.


[**Rav6**]
**Pulak Banerjee, Goutam Das, Prasanna K. Dhani, and V. Ravindran**.
Threshold resummation of the rapidity distribution for Drell-Yan production at NNLO+NNLL.
*Phys.Rev.*, **D98(5)**, 054018, 2018.
arXiv:1805.01186 [hep-ph]. 10.1103/PhysRevD.98.054018.


[**Rav7**]
**Pulak Banerjee, Prasanna K. Dhani, and V. Ravindran**.

Gluon jet function at three loops in QCD.
*Phys.Rev.*, **D98(9)**, 094016, 2018.
arXiv:1805.02637 [hep-ph]. 10.1103/PhysRevD.98.094016.


[**S**]
**Balachandran Sathiapalan and Hidenori Sonoda**$^*$.
Holographic Wilson's RG.
*Nuclear Physics B*, 2019.
IMSc/2019/02/01 (Submitted).


[**Sh1**]
**Sayantan Sharma**.
Recent progress on the QCD phase diagram.
In *PoS, (LATTICE 2018) 009*, 2019.
1901.07190.


[**Sh2**]
**E.**$^*$ **Larsen, Sayantan Sharma, and E.**$^*$ **Shuryak**.
The topological objects near the chiral crossover transition in QCD.
*Phys. Letters B*, 2019.
1811.07914 (Submitted).


[**Sha**]
**Anupama Sharma, Shakti N. Menon, V. Sasidevan, and Sitabhra Sinha**.
Epidemic prevalence information on social networks mediates emergent collective outcomes
  in voluntary vaccine schemes.
*PLoS Computational Biology*, 2019.
(To be published).


[**Shr**]
**Shrihari Gopalakrishna and Arunprasath Velusamy**.
Higgs vacuum stability with vector-like fermions.
arXiv:1812.11303 [hep-ph]. (Submitted).


[**Si1**]
**A. Chakraborty, S. Easwaran, and Sitabhra Sinha**.
Deviations from universality in the fluctuation behavior of a heterogeneous complex system
  reveal intrinsic properties of components: The case of the international currency market.
*Physica A*, **509**, 599–610, 2018.


[**Si2**]
**V. Sasidevan, A. Kushal, and Sitabhra Sinha**.
When big data fails: Adaptive agents using coarse-grained information have competitive
  advantage.
*Physical Review E*, 98, 2018.

[**Si3**]
**A. Sharma, S. N. Menon, V. Sasidevan, and Sitabhra Sinha**.
Epidemic prevalence information on social networks can mediate emergent collective out-
  comes in voluntary vaccine schemes.
*PLOS Computational Biology*, **6**, 34, 2019.
(Accepted).


[**V**]
**N. Vigneshwar, D. Mandal, K. Damle**∗**, D. Dhar**∗**, and R. Rajesh**.
Phase diagram of a system of hard cubes on the cubic lattice.
2019.
ArXiv:1902.06408 (Submitted).

# 2.4   Theoretical Computer Science


## 2.4.1   Research Summary & Highlights


**Algorithms and Data Structures**


In  [**C**] a new framework is provided for in-place graph algorithms.

It is shown that a simple natural relaxation of Read-Only Memory model (ROM) enables implementations of fundamental graph search methods like BFS (breadth-first search) and DFS (depth-first search) more space efficiently than in ROM. By simply allowing elements in the adjacency list of a vertex to be permuted, it is shown that, on an undirected or directed connected graph G having $n$ vertices and $m$ edges, the vertices of G can be output in a DFS or BFS order using $O(\lg n)$ bits of extra space and $O(n^3 \lg n)$ time. Thus similar bounds for reachability and shortest path distance (both for undirected and directed graphs) are shown. With a little more (but still polynomial) time, one can also output vertices in the lex-DFS order. As reachability in directed graphs (even in DAGs) and shortest path distance (even in undirected graphs) are NL-complete, and lex-DFS is P-complete, these results show that our model is more powerful than ROM if $L! = P$.

En route, algorithms for another relaxation of ROM are developed, where the adjacency lists of the vertices are circular lists and one can modify only the heads of the lists. Here a linear time DFS implementation using $n + O(\lg n)$ bits of extra space is shown. Improving the extra space exponentially to only $O(lgn)$ bits, implementations of BFS and DFS albeit with a slightly slower running time are obtained. Both the models maintain the graph structure throughout the algorithm, only the order of vertices in the adjacency list changes.


In  [**R1**], a polynomial sized kernel is given for the following problem. Given an undirected graph with two designated vertices $s$ and $t$ whether all $s − t$ paths can be "tracked" by at most $k$ vertices. A set of vertices is said to track all $s − t$ paths if each $s$-$t$ path intersects the set in a unique sequence of vertices. This problem is related to the feedback vertex set problem, and the polynomial kernel also gives (the first) fixed-parameter tractable (FPT) algorithm for the problem.

In [**Pr**], we focus on lower bounds for data structures supporting orthogonal range querying on $m$ points in $n$-dimensions in the semigroup model. Such a data structure usually maintains a family of "canonical subsets" of the given set of points and on a range query, it outputs a disjoint union of the appropriate subsets. Fredman showed that in order to prove lower bounds in the semigroup model, it suffices to prove a lower bound on a certain combinatorial tradeoff between *two parameters*: (a) the total sizes of the canonical subsets, and (b) the total number of canonical subsets required to cover all query ranges. In particular, he showed that the arithmetic mean of these two parameters is $\Omega(m \log^n m)$. We strengthen this tradeoff by showing that the *geometric mean* of the same two parameters is $\Omega(m \log^n m)$. The *second result* in the paper is an alternate proof of Fredman's tradeoff in the one dimensional setting. The problem of answering range queries using canonical subsets can be formulated as factoring a specific boolean matrix as a product of two boolean matrices, one representing the canonical sets and the other capturing the appropriate disjoint unions of the former to output all possible range queries. In this formulation, we can ask what is an optimal data structure, i.e., a data structure that minimizes the sum of the two parameters mentioned above, and how does the balanced binary search tree compare with this optimal data structure in the two parameters? The problem of finding an optimal data structure is a non-linear optimization problem. In one dimension, Fredman's result implies that the minimum value of the objective function is $\Omega(m \log m)$, which means that at least one of the parameters has to be $\Omega(m \log m)$. We show that both the parameters in an optimal solution have to be $\Omega(m \log m)$. This implies that balanced binary search trees are near optimal data structures for range querying in one dimension. We derive intermediate results on factoring matrices, not necessarily boolean, while trying to minimize the norms of the factors, that may be of independent interest.

In [**J**], we explore the parameterized complexity of different variants of DOMINATING SET problem when parameterized by a class of parameters. Broadly our results are as follows.

- We consider the size of a cluster vertex deletion set as a parameter and provide $\mathcal{O}^*(3^k)$ time algorithm for DOMINATING SET, TOTAL DOMINATING SET, EFFICIENT DOMINATING SET and INDEPENDENT DOMINATING SET. Furthermore, we also prove that under Strong Exponential Time Hypothesis (SETH), there cannot exist any algorithm running in time $\mathcal{O}^*((2 - \epsilon)^k)$ for DOMINATING SET, TOTAL DOMINATING SET, and INDEPENDENT DOMINATING SET.

- We consider EFFICIENT DOMINATING SET parameterized by the size of a split vertex deletion set as the parameter. We provide an algorithm with running time $\mathcal{O}^*(1.732^k)$ for this problem.

- Furthermore, we provide an independent proof saying that EFFICIENT DOMINATING SET parameterized by the size of a given vertex cover cannot admit an algorithm with running time $\mathcal{O}^*(2^{o(k)})$ unless Exponential Time Hypothesis (ETH) fails.

In [**Maj1**], we explored kernelization spectrum of CYCLE PACKING problem in undirected graphs when pair of cycles are allowed to intersect. In other words, the cycles we want to pack are not necessarily pairwise vertex disjoint. The question is whether there are at least $k$ distinct cycles satisfying some intersection criteria among themselves. We consider two cycles to be distinct if they differ by at least one edge (or one vertex). The first relaxation is a global relaxation where every vertex of the graph is allowed to appear in at most $t$ of the $k$ cycles packed. When $t$ is $O(k^{1-\epsilon})$, then we show that this problem still has no polynomial

kernel unless $NP \subseteq coNP/poly$. When $t = k/c$ for some constant $c$, then we provide a polynomial kernel for this problem. More generally, we provide a spectrum of kernelization behavior under various values of $t$. The second relaxation is local relaxation. In this case, any two of the $k$ cycles can intersect in at most $t$ vertices. When $t = 1$, then we provide a polynomial kernel for this problem and when $t \geq 2$, we provide a polynomial compression for this problem.

In [**Maj5**], we provide polynomial kernels for VERTEX COVER with respect to two different parameters. – Size of a set $S$ whose deletion results in a graph with degree at most two. We call this as degree-two-modulator. We provide a kernel with $O(k^5)$ vertices for this problem. – Size of a set $S$ whose deletion results in a cluster graph such that each component of $G - S$ has at most $d$ vertices. We provide a kernel with $O(k^d)$ vertices for this problem. Finally we prove that a kernel with $O(k^{d-\epsilon})$ bits cannot exist unless $NP \subseteq coNP/poly$ for this case. – As a consequence of the above mentioned lower bound result, we have that when $S$ is a degree-two-modulator, then VERTEX COVER has no kernel with $O(k^{3-\epsilon})$ bits.

In [**Maj4**], we have explored alternate parameterizations of FEEDBACK VERTEX SET in a complete detail. One part of it is to provide parameterized algorithms and other part is about kernelization. In particular, we prove the following results. – FEEDBACK VERTEX SET is fixed-parameter tractable when parameterized by the number of vertices having degree more than three. This answers a question asked in an earlier paper. We also show that this problem has no polynomial kernel under complexity theoretic assumptions. – We provide parameterized algorithms for FEEDBACK VERTEX SET when parameterized by split vertex deletion set and cluster vertex deletion set. – Finally, we provide polynomial kernels for FEEDBACK VERTEX SET when parameterized by deletion distance to pseudo-forest and mock-d-forest. We also provide a lower bound for FEEDBACK VERTEX SET when parameterized by the size of a given set whose deletion results in a mock-d-forest.


## Automata, Logic and Concurrency

Since the 1960s, logic has been related to formal language theory. Fixing words or trees as models, definable sets can be seen as word or tree languages. Many mathematical questions can be stated in first-order logic, making it a natural descriptive formalism. Rabin (1970) showed that a large number of questions can be formulated in first-order logic on trees, and solved the problem whether a given sentence has a model. Meyer and Stockmeyer (1975) showed that the amount of memory used by the algorithm cannot be bounded by a fixed tower of exponentials. The answers connected logic to the theory of finite automata, and for the definability problem on words to algorithms based on the theory of finite algebras with an associative operation, developed by Schützenberger (1965). Kamp showed in his PhD thesis (1976) that every first-order sentence can be expressed using three variables. Meyer and Stockmeyer's lower bound applies to three-variable logic.
This raised the definability problem for two-variable sentences of first-order logic, which was solved by Thérien and Wilke (1998), forming part of Wilke's habilitation thesis (1998). Algebraic techniques developed by Schützenberger (1976) were used. Given a finite automaton description, definability in two-variable logic is decided by an algorithm using a polynomial amount of memory. Given a sentence of two-variable logic, whether it has a model is decided by a nondeterministic algorithm using an exponential number of steps. In practice this means using an exponential amount of memory.

In joint work with Krebs, Pandya and Straubing over two years, a logic on words was proposed by Kamal Lodaya of IMSc, extending two-variable logic by relations which specify that a letter occurs between two positions on the word. These are typical three-variable properties, the idea goes back to Hilbert (1899). An algebraic condition is found, using operations developed by Schützenberger around his (1976) paper, which solves the definability problem for this intermediate logic, deciding it by an algorithm as in the earlier work. In particular there are (infinitely many) languages in three-variable logic which are not definable in the intermediate logic. Given a sentence of the intermediate logic, whether it has a model is decided using an exponential amount of memory. These computational bounds are shown to be tight.

The two-variable logic on words proposed in (Krebs et al, 2016) specifies that a letter occurs between two positions on the word. An extension allows specifying that a factor occurs between two positions. Algebraic conditions are found which solve the definability problem for these logics in exponential space, and this bound is tight [**L1**, **L2**].

Modal and two-variable logics are proposed to describe and compare paths in graphs [**L3**].

A fragment of the unary interval logic of Halpern and Shoham (1991) is shown to be expressively complete for the two-variable logic with between relations of (Krebs et al, 2016) [**L4**].

in [**Ra**], parameterized complexity (hardness or FPT) results are obtained for some natural parameterizations of graph coloring and list coloring problems.

While modal logics are extensively used in verification of finite state systems, quantification is necessary for extension to infinite state systems. First order model logic is notoriously undecidable, and in [**P1**] we identify an interesting decidable fragment that *bundles* quantifiers with modalities, without placing any restrictions on quantification, variables, or relational vocabulary. In the context of term-modal logic, with applications to systems of unboundedly many agents, [**P3**] and [**P2**] offer interesting decidable fragments: the former controls free variables in the scope of a modality, the latter is variable-free. In the process, we also sharpen the undecidability results, thus getting a glimpse of the border between decidability and undecidability.

**Computational Complexity**

In [**Ma5**], bounded-depth $(\min, +)$ formulas computing the shortest path polynomial were studied. For depth $2d$ with $d \geq 2$, lower bounds were obtained parameterized by certain fan-in restrictions on $+$ gates except those at the bottom level. For depth 4, in two regimes of the parameter, these bounds are tight.

Strategy extraction is of paramount importance for quantified Boolean formulas (QBF), both in solving and proof complexity. It extracts (counter)models for a QBF from a run of the solver resp. the proof of the QBF, thereby allowing to certify the solvers answer resp. establish soundness of the system. So far in the QBF literature, strategy extraction has been algorithmically performed from proofs. In [**Ma1**], the first QBF system was devised

where (partial) strategies are built into the proof and are piecewise constructed by simple operations along with the derivation.

This has several advantages: (1) lines of the new calculus MergeRes have a clear semantic meaning as they are accompanied by semantic objects; (2) partial strategies are represented succinctly (in contrast to some previous approaches); (3) the new calculus has strategy extraction by design; and (4) the partial strategies allow new sound inference steps which are disallowed in previous central QBF calculi such as Q-Resolution and long-distance Q-Resolution.

The last item (4) was exploited to show an exponential separation between MergeRes and the previously studied reductionless long-distance resolution calculus, introduced to model QCDCL solving.

The new approach also naturally lifts to dependency QBFs (DQBF). It was shown in [**Ma1**] that MergeRes yields the first sound and complete CDCL-type calculus for DQBF, thus opening future avenues into DQBF CDCL solving.

Linear decision lists are decision lists where the queries are arbitrary linear threshold functions. In [**Ma3**], a lower bound technique for such lists was demonstrated. The technique was then used to prove an explicit lower bound by showing that any linear decision list computing the function $\mathsf{MAJ} \circ \mathsf{XOR}$ requires size $2^{0.18n}$, completely answering an open question posed by Turán and Vatan in 1997. It was also shown that the spectral classes $\mathsf{PL}_1, \mathsf{PL}_\infty$, and the polynomial threshold function classes $\widehat{\mathsf{PT}_1}, \mathsf{PT}_1$, are incomparable to linear decision lists.

Circuits with linear threshold functions as primitives are a natural model for computation in the brain. Small threshold circuits of depth two cannot compute most functions, but how do we prove such a statement? And how do we lay our hands on explicit functions that they cannot compute? The article [**Ma4**] gave an overview of the landscape.

In [**A2**] we develop an efficient procedure for computing a (scaled) Hadamard product for commutative polynomials. This serves as a tool to obtain faster algorithms for several algorithmic problems. The main results are: 1) Given an arithmetic circuit $C$ computing a multivariate polynomial and a parameter $k$, we give a deterministic algorithm of run time $O^*(n^{k/2+c\log k})$, for some constant $c > 0$, to compute the sum of the coefficients of multilinear monomials of degree $k$ in $f$, which answers a question asked by Koutis and Williams, 2) Given an arithmetic circuit $C$ computing a multivariate polynomial, and a parameter $k$, we give a randomized algorithm of run time $O^*(4.32^k)$ and polynomial space to check if $f$ contains a multilinear monomial of degree $k$, and 3) If the given circuit $C$ is a depth-three homogeneous circuit computing $f$ of degree $k$, we give a deterministic algorithm of run time $O^*(4^k)$ to detect degree $k$ multilinear terms, and an algorithm of run time $O^*(2^k)$ to compute the sum of their coefficients in $f$.

In [**A3**] we study graph properties that are invariant under the Weisfeiler-Leman procedure. The k-dimensional Weisfeiler-Leman procedure ($k$-WL) is a fruitful approach to the Graph Isomorphism problem. 2-WL corresponds to the original algorithm suggested by Weisfeiler and Leman over 50 years ago. 1-WL is the classical color refinement routine. Two graphs are known to be $k$-WL indistinguishable precisely when they are equivalent in $(k + 1)$-variable first-order logic with counting quantifiers. A graph property is invariant under this

equivalence iff it is definable in the $(k + 1)$-variable infinitary counting logic. Focusing on dimensions $k = 1, 2$, we investigate subgraph patterns whose counts are invariant graph parameters and whose presence is an invariant graph property. We also study a notion of "approximate invariance" of subgraph counts and other graph parameters.

The exact root finding (ERF) problem is to approximate the roots of a holomorphic function $f$ in an input box $B_0$ to within some desired input accuracy. We assume that $f$ and all its derivatives are represented by their "box"-versions, i.e., given a box $B$, we can compute an overestimation of the range $f(B)$; moreover, for a sequence of boxes monotonically converging to a point the error in the overestimation goes to zero. The ERF problem naturally generalizes the problem of approximating polynomial roots. However, not many algorithms are known in the literature for solving it. A complete algorithm for the root clustering problem (RCP) was presented by Yap-Sagraloff-Sharma, 2013. In [**S1**], we bound the complexity of this subdivision-based algorithm and obtain a generalisation of similar results for the case of polynomials. We establish a framework for developing uniform complexity results for RCP for holomorphic functions. We introduce some natural geometric parameters in the analysis of the algorithm. Our analysis shows that the algorithm by Yap-Sagraloff-Sharma, 2013, is exponential in the worst case, and more work needs to be done for developing an efficient algorithm.

## Graph Theory and Combinatorics

In [**Su3**], an inductively defined analogue $f()$ (based on immediate neighborhoods) of any increasing graph invariant $f()$ is introduced and studied. This inductive analogue simultaneously generalizes and unifies several known notions into a single generic notion. For any given increasing $f()$, this leads to several new invariants and many of which are increasing and are also interesting. It is also shown that $f()$ is the minimum (over all orderings) of a value associated with each ordering. Also studied in this work are the computational aspects of computing $f()$ (and a corresponding optimal vertex ordering) and identification of some pairs $(C, f())$ for which $f()$ can be computed efficiently for members of $C$. Further generalizationss of this new notion obtained by considering weighted graphs and also by considering $r$-neighborhoods for arbitrary but fixed $r \geq 1$, are also studied. Such a generalization is employed in designing efficient approximations of some graph optimization problems. Precisely, efficient algorithms for approximating optimal weighted induced $P$-subgraphs and optimal $P$-colorings (for hereditary $P$'s) within multiplicative factors of (essentially) $k$ and $k/(m-1)$ respectively, where $k$ denotes the inductive analogue (as defined in this work) of optimal size of an unweighted induced $P$-subgraph of the input and $m$ is the minimum size of a forbidden induced subgraph of $P$, are obtained. These results generalize the previous results on efficiently approximating independent sets and minimum colorings on a special class of graphs, to arbitrary hereditary classes $P$.

In [**Su1**], the problem of stochastic weighted independent sets (SWIS) under the probe-and-commit model is studied. In this model, a random induced subgraph $H$ (formed by active vertices) of a given vertex weighted graph $(G, w)$ where each vertex $u$ is active independently with probability $p_u$, is revealed through vertex probes. The problem is, given such a vertex weighted graph, to efficiently find (through vertex probes) an independent set in $H$. The goal is to design an efficiently realizable approximation to an optimal adaptive policy of probing vertices. This model generalizes some well-known stochastic optimization problems

studied in the literature. Efficient, non-adaptive policies approximating optimal adaptive ones with proven guarantees on the approximation factors are presented. As a consequence, one obtains efficient approximations for various special classes with "small' approximation factors. Applications of these results to also infer about efficient approximations for deterministic versions of a few optimization problems are also presented. Also presented in this work is a generalization of SWIS to a model of stochastic PIPs (SPIP) wherein the uncertainty is in the presence of a column of the matrix and obtain efficient approximations to general SPIPs under various special assumptions on the sparsity structure of the columns. Also presented are approximations to another model of stochastic PIPs (studied by others) where uncertainty is not in the presence/absence of a column or its cost (both choices are deterministic) but is in the actual values of these entries. The previous work on this model studies a special case (referred to as $k$-column sparse set packing) of columns being random $\{0, 1\}$-valued vectors with 1's in at most $k$ fixed positions for each column. It is shown that the proof arguments of this earlier result can be extended thereby obtaining that an efficient approximation is possible even when each column is allowed to be a random vector of non-negative reals but require it to be $k$-column sparse (that is, each column can have non-zero entries in at most $k$ fixed positions).

In [**Su2**], a model of the *Stochastic C-subgraph* problem ($C$ is an arbitrary hereditary class) under the *probe and commit with patience constraints* was defined and studied. The input is an undirected graph $G$ whose edges $e$ are active independently with probability $p_e$. The goal is to compute a $C$-subgraph of $G$ consisting of active edges by probing edges one by one subject to the constraints ($i$) edges found active upon probing be included as part of the solution, ($ii$) at most $t_u$ edges incident at $u$ can be probed, for each $u$. This problem generalizes the previously studied stochastic matching problem. In this work, a greedy policy for probing edges was proposed and analyzed and it was shown that it approximates the optimal policy within a multiplicative factor of $i_C(G) + 2$. $i_C(G)$ is a graph invariant introduced (in this paper) to analyze the greedy heuristic. This approach is extendable to the weighted graphs also. It is shown that for several hereditary classes forests, etc., this invariant is bounded by a constant. Hence, one obtains that greedy policy is a $O(1)$-factor approximation of optimal policies, for each of these classes.

**Popular Matching in Roommates Setting is NP-hard**

An input to the Popular Matching problem, in the roommates setting, consists of a graph G and each vertex ranks its neighbors in strict order, known as its preference. In the Popular Matching problem the objective is to test whether there exists a matching M* such that there is no matching M where more people are happier with M than with M*. In a recent paper the computational complexity of the Popular Matching problem was settled in the roommates setting by showing that the problem is NP-complete. This resolved an open question that has been repeatedly, explicitly asked over the last decade. This work was carried out by Saket Saurabh of IMSc with other collaborators.

**Minimum Spanning Trees**

Consider n nodes uniformly distributed in the unit square and let Kn be the complete graph formed by these nodes. Each edge is assigned a random edge weight that possibly depends on the location of the endvertices. We are interested in determining the weight of the minimum

spanning tree (MST) formed by these nodes and study its behaviour as the number of nodes goes to infinity.

We first use the martingale difference method to estimate the variance of the MST weight and then use the subsequence argument to obtain a.s. convergence. To use the martingale difference method, we obtain one node difference estimates that determines the change in MST weight upon shifting the location of a single node. This is done by first removing the nodes and obtaining a set of subtrees of the MST. We then shift the node to the desired location and glue back the trees via the new location to obtain a new spanning tree.

This kind of scenario frequently arises in wireless networks where terminals are located within a geographical area and some terminals have easy accessibility than the others (for example due to geographical reasons). Communication links to such terminals are typically low cost and it is of interest to determine the overall cost of setting up the network.

**Travelling Salesman Problem**

A related problem to that described above is that of the Travelling Salesman Problem (TSP) where the goal is to determine the minimum weight of the cycle containing all the nodes. As before, we first use the martingale difference method to estimate the variance and then use the subsequence argument to obtain a.s. convergence. The main difference here is that removing a node from a cycle only creates a path and therefore we use indirect edge weight counting arguments to obtain the desired one node difference estimate. As before, we then use subsequence arguments to obtain a.s. convergence.

**Random Access Networks with separable schemes**

In this problem, there are n users accessing a single channel, each with a goal of maximizing its throughput. Each user is assumed to be equipped with an infinite queue and we are interested in determining bounds on the stability region of the overall network. For the lower bound on the stability region, we let T denote the return time to zero of the queue length vector Markov chain. Using a Lyapunov stability type analysis to determine conditions under which the expected value of T is finite, we then obtain the lower bound on the stability region.

For the upper bound, we force all queues to have enough number of packets at the beginning (t=0). We then determine conditions that ensure that the queues of all the users are always non-empty with positive probability. Due to irreducibility of the Markov chain, this obtains the upper bound on the stability region.

For details on the relevant publications we refer to the publication section of the report[G].

## 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.

**[A1]**
**V. Arvind, Abhranil Chatterjee, Rajit Datta∗, and Partha Mukhopadhyay∗.**

Univariate ideal membership parameterized by rank, degree, and number of generators.
In Sumit Ganguly and Paritosh Pandya, editors, *Foundations of Software Technology and Theoretical Computer Science, FSTTCS 2018*, page 7:1. Dagstuhl Research Online Publication Server, Dec 2018.


[**A2**]
**V. Arvind, Abhranil Chatterjee, Rajit Datta**[\*], **and Partha Mukhopadhyay**[\*].
Fast exact algorithms using Hadamard Product of Polynomials.
In *CoRR arxiv*, page 1. 2018.
(Preprint: arXiv:1807.04496).


[**A3**]
**V. Arvind, Frank Fuhlbrueck**[\*], **Johannes Koebler**[\*], **and Oleg Verbitsky**[\*].
On Weisfeiler-Leman Invariance: Subgraph Counts and Related Graph Properties.
In *CoRR arxiv*, page 1. 2018.
(Preprint: arXiv:1811.04801).


[**A4**]
**V. Arvind, Pushkar Joglekar**[\*], **and Gaurav Rattan**[\*].
On the complexity of noncommutative polynomial factorization.
*Information and Computation*, **262(2)**, 22, 2018.


[**B1**]
**Niranka Banerjee, Varunkumar Jayapaul**[\*], **and Srinivasa Satti**[\*].
Minimum transactions problem.
In *COCOON 2018*, May 2018.


[**B2**]
**Niranka Banerjee, Venkatesh Raman, and Srinivasa R. Satti**[\*].
Maintaining chordal graphs dynamically: Improved upper and lower bounds. csr 2018: 29-40.
In *International Computer Science Symposium in Russia, CSR-Computer Science theory and applications*, page 29. Springer Verlag, Apr 2018.


[**C**]
**Sankardeep Chakraborty, Anish Mukherjee**[\*], **Venkatesh Raman, and Srinivasa R. Satti**[\*].
A framework for in-place graph algorithms.
In Yossi Azar, Hannah Bast, and Grzegorz Herman, editors, *Proceedings of the 26th Annual European Symposium on Algorithms (2018)*. LIPICS, Aug 2018.


[**G**]
**Ghurumuruhan Ganesan**.
Random access networks with separable schemes.
*IET Networks*, 2018.
(To be published).

[**J**]
**Dishant Goyal**[*]**, Ashwin Jacob, Kaushtubh Kumar**[*]**, Diptapriyo Majumdar, and Venkatesh Raman**.
Structural Parameterizations of Dominating Set Variants.
In Fedor V. Fomin and Vladimir V. Podolskii, editors, *13th International Computer Science Symposium in Russia (CSR)*, page 157. Springer, Jun 2018.


[**K1**]
**R. D. Krithika, Pranabendu D. Misra**[*]**, and Prafullkumar M. Tale**.
An fpt algorithm for contraction to cactus.
In *The 24th International Computing and Combinatorics Conference*, Jul 2018.


[**K2**]
**R. Krithika, Abhishek Sahu, Saket Saurabh, and Meirav Zehavi**[*].
The parameterized complexity of cycle packing: Indifference is not an issue.
In *13th Latin American Theoretical Informatics Symposium (LATIN 2018)*, Apr 2018.
(To be published).


[**L1**]
**Andreas Krebs**[*]**, Kamal Lodaya, Paritosh K. Pandya**[*]**, and Howard Straubing**[*].
An algebraic decision procedure for two-variable logic with a between relation.
In Dan Ghica and Achim Jung, editors, *Proc. 27th Computer Science Logic, Birmingham*, pages 28:1–28:17. Lipics volume 119, Sep 2018.


[**L2**]
**Andreas Krebs**[*]**, Kamal Lodaya, Paritosh K. Pandya**[*]**, and Howard Straubing**[*].
Two-variable logics with some betweenness relations.
*Arxiv*, pages 1–40, 2019.
1902.05905 (Submitted).


[**L3**]
**Kamal Lodaya**.
Via.
In G. Lee F. Liu R. Ramanujam S.M. Srivastava A. Tsuboi L. Yu B. Kim, J. Brendle, editor, *Proc. 14th and 15th Asian logic conferences*, pages 205–212. World Scientific, 2019.


[**L4**]
**Kamal Lodaya**.
Unary and two-variable interval logics.
In *Proc. 4th Asian philosophical logic workshop, Beijing*. Springer, 2019.
(Submitted).


[**M1**]
**Jayakrishnan Madathil, Saket Saurabh, and Meirav Zehavi**[*].
Max-cut above spanning tree is fixed-parameter tractable.
In *Proceedings of the 13th International Computer Science Symposium in Russia*, Jun 2018.

[M2]

**Akanksha Agrawal**[*]**, Grzegorz Guspiel**[*]**, Jayakrishnan Madathil, Saket Saurabh, and Meirav Zehavi**[*].
Connecting the dots (with minimum crossings).
In *Proceedings of The 35th International Symposium on Computational Geometry (SoCG), 2019*, Mar 2019.
(To be published).


[M3]

**Jayakrishnan Madathil, Fahad Panolan**[*]**, Abhishek Sahu, and Saket Saurabh**.
On the complexity of mixed dominating set.
In *Proceedings of The 14th International Computer Science Symposium in Russia (CSR), 2019*, Mar 2019.
(To be published).


[M4]

**Jayakrishnan Madathil, Saket Saurabh, and Meirav Zehavi**[*].
Fixed-parameter tractable algorithm and polynomial kernel for max-cut above spanning tree.
*Theory of Computing Systems*, **1432-4350**, 1, 2019.


[Ma1]

**Olaf Beyersdorff**[*]**, Joshua Blinkhorn**[*]**, and Meena Mahajan**.
Building strategies into QBF proofs.
In *36th Symposium on Theoretical Aspects of Computer Science (STACS)*, pages 14:1–14:18. LIPIcs, Mar 2019.


[Ma2]

**Olaf Beyersdorff**[*]**, Leroy Chew**[*]**, Meena Mahajan, and Anil Shukla**.
Understanding cutting planes for QBFs.
*Information and Computation*, **262**, 141–161, 2018.


[Ma3]

**Arkadev Chattopadhyay**[*]**, Meena Mahajan, Nikhil Mande**[*]**, and Nitin Saurabh**[*].
Lower bounds for linear decision lists.
2019.
(Preprint: ECCC TR 2019-007).


[Ma4]

**Meena Mahajan**.
Depth-2 threshold circuits: Provable limitations.
*Resonance*, **24(3)**, 371–380, 2019.


[Ma5]

**Meena Mahajan, Prajakta Nimbhorkar**[*]**, and Anuj Tawari**.
Shortest path length with bounded-alternation (min, +) formulas.
*International Journal of Advances in Engineering Sciences and Applied Mathematics. Special Issue on Theory of Computation.*, **11(1)**, 68–74, 2019.

[**Ma6**]
**Meena Mahajan and Nitin Saurabh**.
Some complete and intermediate polynomials in algebraic complexity theory.
*Theory of Computing Systems*, **62(3)(622–652)**, dx.doi/10.1007/s00224–016–9740–y, 2018.


[**Maj1**]
**Akanksha Agrawal∗, Daniel Lokshtanov∗, Diptapriyo Majumdar, Amer E. Mouawad∗, and Saket Saurabh**.
Kernelization of Cycle Packing with Relaxed Disjointness Constraints.
*SIAM Journal on Discrete Mathematics*, **32(3)**, 1619, 2018.


[**Maj2**]
**R. Krithika∗, Diptapriyo Majumdar, and Venkatesh Raman**.
Revisiting Connected Vertex Cover: FPT Algorithms and Lossy Kernels.
*Theory of Computing Systems*, **62(8)**, 1690, 2018.


[**Maj3**]
**Diptapriyo Majumdar, Rian Neogi, Venkatesh Raman, and S. Vaishali∗**.
Tractability of Konig Edge Deletion Problems.
2018.
(Preprint: arxiv:1811.04560).


[**Maj4**]
**Diptapriyo Majumdar and Venkatesh Raman**.
Structural Parameterizations of Undirected Feedback Vertex Set: FPT Algorithms and Kernelization.
*Algorithmica*, **80(9)**, 2683, 2018.


[**Maj5**]
**Diptapriyo Majumdar, Venkatesh Raman, and Saket Saurabh**.
Polynomial Kernels for Vertex Cover Parameterized by Small Degree Modulators.
*Theory of Computing Systems*, **62(8)**, 1910, 2018.


[**P1**]
**Anantha Padmanabha, R. Ramanujam, and Yanjing Wang∗**.
Bundled fragments of first-order modal logic: (un)decidability.
In Ganguly and Pandya, editors, *Proc. FSTTCS18*, pages 43:1–43. LiPICS, Dagshtul, Germany, Dec 2018.


[**P2**]
**Anantha Padmanabha and R. Ramanujam**.
Propositional modal logic with implicit modal quantification.
In Khan and Manuel, editors, *Proc. ICLA 2019, LNCS 11600, FoLLI Series*, page 1, Mar 2019.


[**P3**]
**Anantha Padmanabha and R. Ramanujam**.

The monodic fragment of propositional term modal logic.
*Studia Logica*, **107(1)**, 1, 2019.


**[Pr]**
**Swaroop N. Prabhakar and Vikram Sharma**.
Stronger tradeoffs for orthogonal range querying in the semigroup model.
In Sumit Ganguly and Paritosh K. Pandya, editors, *38th IARCS Annual Conference on Foundations of Software Technology and Theoretical Computer Science, FSTTCS 2018, December 11-13, 2018, Ahmedabad, India*, page 45:1. Schloss Dagstuhl - Leibniz-Zentrum fuer Informatik, Dec 2018.


**[R1]**
**Aritra Banik\*, Pratibha Choudhary\*, Daniel Lokshtanov\*, Venkatesh Raman, and Saket Saurabh**.
A polynomial sized kernel for tracking paths problem.
In Mosteiro M Bender M., Farach-Colton M., editor, *Proceedings of the Latin American Theoretical Informatics (LATIN)*, page 84. Springer, Apr 2018.


**[R2]**
**Timothy Chan\*, Ian Munro\*, and Venkatesh Raman**.
Selection and sorting in the "restore" model.
*ACM Transactions on Algorithms*, **14(2)**, 11:1, 2018.


**[R3]**
**Samuel Florini\*, R. Krithika\*, N. S. Narayanaswamy\*, and Venkatesh Raman**.
Approximability of clique transversal in perfect graphs.
*Algorithmica*, **80(8)**, 2221, 2018.


**[R4]**
**Neeldhara Misra\*, Fahad Panolan\*, Ashutosh Rai\*, Venkatesh Raman, and Saket Saurabh Saurabh**.
Parameterized algorithms for max colorable induced subgraph problem on perfect graphs.
*Algorithmica*, **81(1)**, 26, 2019.


**[Ra]**
**Pranav Arora\*, Aritra Banik\*, Vijay K. Paliwal\*, and Venkatesh Raman**.
Some (in)tractable parameterizations of coloring and list-coloring.
In Chen J. and Lu P., editors, *International Workshop on Frontiers in Algorithmics (FAW)*, page 126. Springer Verlag, May 2018.


**[S1]**
**Prashant Batra\* and Vikram Sharma**.
Complexity of a root clustering algorithm.
In *Fifteenth International Conference on Computability and Complexity in Analysis5-8 August 2018, Lake Kochel, Germany*, page 32, Aug 2018.

[**S2**]
**Ruben Becker∗, Sagraloff∗, Vikram Sharma, and Yap∗.**
A near-optimal subdivision algorithm for complex root isolation based on the pellet test and
 newton iteration.
*J. Symb. Comput.*, **86**, 51, 2018.


[**Su1**]
**C.R. Subramanian**.
On approximating stochastic pips and independent sets.
2018.
(Submitted).


[**Su2**]
**C.R. Subramanian**.
Analysis of greedy approximation of stochastic c-subgraphs.
2018.
(Submitted).


[**Su3**]
**C.R. Subramanian**.
Inductive analogues of graph invariants.
2018.
(Submitted).

# 2.5   Student Programmes


## 2.5.1   Degrees Awarded


**Doctoral Degrees Awarded during 2018 − 2019**


**Mathematics**

Name: **Arunkumar, G.**
Thesis Title: Root Multiplicities for Borcherds-Kac-Moody Algebras and Graph Coloring.
Thesis Advisor: Viswanath, S.
University: HBNI


Name: **Keshab Chandra Bakshi**
Thesis Title: On Intermediate Subfactors
Thesis Advisor: Sunder, V.S.
University: HBNI


**Physics**

Name: **Aritra Biswas**
Thesis Title: Phenomenology of the Charm decays
Thesis Advisor: Nita Sinha
University: HBNI


Name: **Atanu Bhatta**
Thesis Title: Holographic Conformal Partial Waves
Thesis Advisor: Nemani Venkata Suryanarayana
University: HBNI


Name: **Dhargyal**
Thesis Title: Phenomenological studies of the observed anomalies in the T sector
Thesis Advisor: Nita Sinha
University: HBNI


Name: **Madhusudhan Raman**
Thesis Title: Modular structures in superconformal field theories
Thesis Advisor: Sujay K. Ashok
University: HBNI


Name: **Minati Biswal**
Thesis Title: $Z\_N$ Symmetry and confinement-deconfinement transition in SU(N)+ Higgs theory
Thesis Advisor: Sanatan Digal
University: HBNI


Name: **Prasanna Kumar Dhani**
Thesis Title: Higher order corrections and soft gluon resummation in perturbative QCD
Thesis Advisor: Ravindran, V.
University: HBNI


Name: **Prosenjit Haldar**
Thesis Title: Study of quantum transport at the Metal-insulator transition in Falicov-Kimball Model within Alloy analogy
Thesis Advisor: Hassan, S.R.
University: HBNI


Name: **Pulak Banerjee**
Thesis Title: Higher order QCD corrections and resummation effects to the Drell-Yan process in the Standard Model and Beyond
Thesis Advisor: Ravindran, V.
University: HBNI


Name: **Rusa Mandal**
Thesis Title: Rare B decays as a probe to beyond standard model physics
Thesis Advisor: Rahul Sinha
University: HBNI

Name: **Sk. Jahanur Hoque**
Thesis Title: Physics of Gravitational Waves in presence of positive cosmological constant
Thesis Advisor: Date, G.
University: HBNI

**Theoretical Computer Science**

Name: **Anuj Tawari**
Thesis Title: Lower Bounds for Read-Once and Tropical Formulas
Thesis Advisor: Meena Mahajan, B.
University: HBNI

Name: **Diptapriyo Majumdar**
Thesis Title: Classical and Approximate Kernels for Structural Parameters of some graph parameters
Thesis Advisor: Venkatesh Raman
University: HBNI

Name: **Joydeep Mukherjee**
Thesis Title: Approximation Algorithms for Stochastic matchings and independent sets
Thesis Advisor: Subramanian, C.R.
University: HBNI

Name: **Ramanathan Thinniyam**
Thesis Title: Definability and Decidability in First Order Theories of Graph Order
Thesis Advisor: Ramanujam, R.
University: HBNI

**Doctoral Theses Submitted during 2018 – 2019**

**Physics**

Name: **Anvy M. Tom**
Thesis Title: Attractive interactions in similarly charged polyelectrolytes
Thesis Advisor: Rajesh, R.
University: HBNI

Name: **Arindam Mallick**
Thesis Title: Quantum Simulation of Neutrino Oscillation and Dirac Particle Dynamics in Curved Space-time
Thesis Advisor: Chandrashekar, C.M.
University: HBNI

**Theoretical Computer Science**

Name: **Swaroop N. Prabhakar**
Thesis Title: New Results in Bounds for Positiveness of Polynomials
Thesis Advisor: Vikram Sharma
University: IMSC, HBNI


**Masters Theses Awarded during 2018 − 2019**


**Mathematics**

Name: **Arghya Sadhukhan**
Thesis Title: General Linear Group and Symmetric Group : Commuting Actions and Combinatorics
Thesis Advisor: Amrithansu Prasad
University: HBNI


Name: **Jyothsnaa, S.**
Thesis Title: Lower bound for heights in abelian extensions and local metric estimates
Thesis Advisor: Sanoli Gun
University: HBNI


Name: **Mita Banik**
Thesis Title: Geodesic and horocycle flows on certain homogeneous spaces
Thesis Advisor: Parameswaran Sankaran
University: HBNI


Name: **Souvik Pal**
Thesis Title: Classification of Complex Semisimple Lie Algebras
Thesis Advisor: Viswanath, S.
University: HBNI


Name: **Subham Bhakta**
Thesis Title: Virtual characters on the theory of Artin $L$-functions
Thesis Advisor: Srinivas, K.
University: CMI, Chennai


**Theoretical Computer Science**

Name: **Divyarthi**
Thesis Title: An improved Dynamic Algorithm for Maximum b-Matching
Thesis Advisors: Vikram Sharma
University: HBNI


Name: **Jayakrishnan**
Thesis Title: Data Structure Lower Bounds Using Communication Complexity
Thesis Advisors: Vikram Sharma & Sayan Bhattacharya

University: HBNI

## 2.5.2  Lecture Courses During 2018 – 2019.

The following **lecture courses** were offered during 2018 – 2019

| Course Title | Period | Lecturer |
|---|---|---|

**Mathematics**

| | | |
|---|---|---|
| Algebra II | Jan-Apr 2018 | Raghavan, K. N. |
| Topology 2 | Jan-Apr 2018 | Venugopalan, Sushmita |
| Algebra I | Aug-Dec 2018 | Viswanath, Sankaran |
| Measure Theory | Aug-Dec 2018 | Mohari, Anilesh |
| Floer theory | Jan-Apr 2019 | Venugopalan, Sushmita |

**Physics**

| | | |
|---|---|---|
| Advanced Particle Physics . | Jan-May 2018 | Murthy, M.V.N. , Ravindran V., Sayantan Sharma & Shrihari Gopalakrishna |
| Classical Field Theory | Jan-Apr 2018 | Date, G. |
| General Relativity and Cosmology | Jan-Apr 2018 | Mukhopadhyay, Partha |
| Nonlinear Dynamics | Jan-May 2018 | Sinha, Sitabhra |
| Quantum Field Theory II | Jan-Apr 2018 | Sathiapalan, Balachandran |
| Statistical Field Theory (Reading course) | Jan-Apr 2018 | Sathiapalan, Balachandran |
| Statistical Mechanics | Jan-Apr 2018 | Vemparala, Satyavani |
| Systems Biology | Jan-May 2018 | Sinha, Sitabhra |
| Classical Mechanics | Aug-Dec 2018 | Mukhopadhyay, Partha |
| Electrodynamics | Aug-Nov 2018 | Sharma, Sayantan |
| Mathematical Methods I (half) | Aug-Dec 2018 | Ashok, Sujay K. |
| Statistical Mechanics II | Aug-Dec 2018 | Rajesh, R. |
| Particle Physics - I | Aug-Dec 2018 | Nita Sinha |
| Quantum Field Theory -II | Jan-May 2019 | Shrihari Gopalakrishna |
| Classical Field Theory | Jan-Apr 2019 | Ashok, Sujay K. |
| Quantum Mechanics II | Mar-Mar 2019 | Sharma, Sayantan |
| Systems Biology | Jan-May 2019 | Sinha, Sitabhra |

**Theoretical Computer Science**

| | | |
|---|---|---|
| Advanced Parameterized Complexity | Jan-Apr 2018 | Saurabh, Saket |
| Integer Linear Programming | Jan-Apr 2018 | Sharma, Vikram |
| Design and Analysis of Algorithms | Aug-Dec 2018 | Subramanian, C.R. & Venkatesh Raman |
| Discrete Mathematics | Aug-Dec 2018 | Sharma, Vikram |
| Mathematical Logic | Aug-Dec 2018 | Ramanujam, R. |
| Computational Complexity | Jan-Mar 2019 | Arvind, V. |

| | | |
|---|---|---|
| Game theory | Jan-May 2019 | Ramanujam, R. |
| Parameterized Complexity | Jan-Apr 2019 | Raman, Venkatesh |
| Proof Complexity | Jan-May 2019 | Mahajan, Meena B. |
| Theory of Computation (through video for IIT-Jodhpur BTech) | Jan-Apr 2019 | Subramanian, C. R. |

**Computational Biology**

| | | |
|---|---|---|
| Biology 1 | Aug-Nov 2018 | Samal, Areejit |

In addition, the following **lecture courses** were offered during 2018 – 2019 by IMSC faculty in the National Undergraduate programme of the Chennai Mathematical Institute.

| Course Title | Period | Lecturer |
|---|---|---|

**Physics**

| | | |
|---|---|---|
| Classical Dynamics | Aug-Nov 2018 | Murthy, M.V.N. |

# 2.6   Honours and Awards

**Ravindran, V** was awarded Fellow of the Indian National Science Academy, for 2018, by the Indian National Science Academy.

**Samal, Areejit** was awarded Research Ambassador , for 2018, by the Deutscher Akademischer Austauschdienst (DAAD) for to promote bilateral cooperation between Germany and India. This appointment is for the period 2018-2022.

**Sankaran, Parameswaran** was awarded Fellow of the Indian National Science Academy, for 2018, by the Indian National Science Academy.

**Saurabh, Saket** was awarded SwarnaJayanti Fellowship, for 2018, by the DST, India.

**Sharma, Sayantan** was awarded Ramanujan Fellowship, for 2018, by the SERB, DST, Government of India.

**IMSc bags two SPARC grants for international collaboration**

Sanoli Gun and Amritanshu Prasad of IMSc received two separate grants under the Scheme for Promotion of Academic Research Collaboration (SPARC) of the Ministry of Human Resource Development. Prof. Gun's proposal on Arithmetical aspects of the Fourier coefficients of modular forms is for collaboration with Prof. Yuri Bilu of the University of Bordeaux,

France. Prof. Prasad's proposal in Representation zeta functions is for collaboration with Prof. Uri Onn of the Australian National University.

# Chapter 3

# Other Professional Activities

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

**Arvind, V.**

Member of Academic Council, Homi Bhabha National Institute.

**Bagchi, Manjari**

Reviewer of GMRT observation proposals during Aug 2016 – Feb 2019.

Reviewer of NASA Post-doctoral Program during Aug 2016 – Nov 2018.

Lecture at The Institute for Ocean Management, Anna University, Chennai, on May 18, 2018. Delivered an invited lecture "Talking to the stars" at the DST Vigyan Jyoti residential program titled "Empowering girl students: success through motivational guidance in science, technology and culture" held during 16th May to 5th June 2018.

Resource person of Physics Olympiad Resource Generation Camp, Homi Bhabha Centre for Science Education (HBCSE-TIFR), Mumbai, India during Sep 25 – Sep 27, 2018.

Convener of Local Organising Committee for The Stellar Legacy of Prof. Meghnad Saha: from Society to the Cosmos held at IMSc during Jan 3 – Jan 4, 2019.

**Chaudhuri, Pinaki P.**

Convener of International Organising Committee for Entropy, Information and Order in Soft Matter held at ICTS Bangalore during Aug 27 – Oct 31, 2018.

Convener of Local Organising Committee for Mechanics of Complex Matter: Criticality, intermittency and collective behaviou held at IMSc during Mar 4 – Mar 7, 2019.

**Gun, S.**

Editor of JRMS during Mar 2017 – Dec 2018.

Editor of PMSC during Jan – Dec, 2018.

**Mahajan, Meena B.**

Member of Programme Committee of 38th Foundations of Software Technology and Theoretical Computer Science Conference (FSTTCS) during Jun – Dec, 2018.

Convener of International Organising Committee for CAALM: Complexity, Algorithms, Automata, Logic Meeting 2019 held at Chennai Mathematical Institute during Jan 21 – Jan 25, 2019.

Chairperson of Steering Committee for FSTTCS Conference, Jul 2018 to Jun 2019.

**Prasad, Amritanshu**

Contributing Editor of Bhavana during Jan 2018 – Mar 2019.

Convener of Local Organising Committee for Summer school for MSc students held at IMSc during May 28 – Jun 15, 2018.

Member of International Organising Committee for Algebras, Combinatorics, and Representation Theory held at IISER Thiruvananthapuram during Dec 5 – Dec 8, 2018.

**Raghavan, K. N.**

Convener (Southern Region) of NBHM Library Committee

Member of NCM Programme Committee of TEW and IST

Associate Editor of Indian Journal of Pure and Applied Mathematics

Member of Steering Committee of the Talent Nurture Programme of Kerala School of Mathematics

Member of Board of Studies in Mathematics, Cochin University of Science and Technology (CUSAT)

Member of Board of Studies in Mathematical Sciences, HBNI

Secretary of Forum D'analystes

Convener of National Organising Committee for Tenth Summer Training Programme in Mathematics held at Ramanujan Institute for Advanced Study in Mathematics, Madras University during May 16 – Jun 5, 2018.

Convener of Local Organising Committee for Nagarajfest held at IMSc during Jul 10 – Jul 12, 2018.

Mentor at DST INSPIRE camp for school children at VelTech University, Chennai on Aug 3, 2018. Lectured to and interacted with school children

Convener of National Organising Committee for Science Academies' Lecture Workshop on Algebra held at Bharatidasan University, Trichy during Aug 16 – Aug 18, 2018.

Lecture on mathematics to engineering students at Nanda College of Technology, Erode on Oct 3, 2018.

Mentor at DST INSPIRE camp for school children at Nandha Arts and Science College on Oct 3, 2018. Lectured to and interacted with school children

Mentor at DST INSPIRE camp for school children at K L University, Guntur on Nov 12, 2018. Lectured to and interacted with school children

Member of National Organising Committee for Algebras, Combinatorics, and Representation Theory held at IISER Thiruvananthapuram during Dec 5 – Dec 8, 2018.

Member of Local Organising Committee for National Mathematics Day: NCM lecture held at P S Senior Secondary School on Dec 22, 2018.

Ramanujan Day Celebrations at S.A. Engineering College on Dec 20, 2018. Gave lecture as a resource person

Mentor at DST INSPIRE camp for school children at University of Madras, Guindy Campus on Dec 26, 2018. Lectured to and interacted with school children.

Mentor at DST INSPIRE camp for school children at University of Madras, Guindy Campus on Jan 4, 2019. Lectured to and interacted with school children

Convener of Local Organising Committee for Science at the Sabha held at Madras Music Academy on Feb 24, 2019.

Mentor at DST INSPIRE camp for school children at Anurag Group of Institutions, Hyderabad on Mar 19, 2019. Lectured to and interacted with school children

**Raman, Venkatesh**

Member of Board of Studies in Computer Science at Stella Maris College, Chennai during

Apr 2017 – Mar 2019.

Convener of Local Organising Committee for ACM-India Summer School on Graph Theory and Algorithms held at PSG College of Technology, Coimbatore during May 21 – Jun 8, 2018.

## Ramanujam, R.

Member of Governing board of TARK during Jun 2015 – Jun 2018.

Member of Advances in Modal Logic 2018 Program Committee during Aug 2017 – Jul 2018.

Member of Progam Committee of TIME 2018, International Symposium on Temporal Representation and Reasoning during Dec 2017 – Oct 2018.

Member of Program Committee, Strategic Reasoning 2018 during Jan – Sep, 2018.

Member of FSTTCS 18 Program Committee during Feb – Dec, 2018.

Speaker in conference on Integrating Science and Society at Jadavpur University, Kolkata on Dec 16, 2018. Gave a talk on "Processes in the science classroom"

## Samal, Areejit

Advanced Research In Germany & DAAD Funding! at IMSc, Chennai, India on Oct 22, 2018.

Nominated to play the role of a research ambassador by DAAD, the German Academic Exchange Service, for the period 2018-2022.

Organized a DAAD information session on funding for research stays in Germany, especially, Sandwich PhD, Postdoctoral and Faculty exchange visits.

Nominated to play the role of a research ambassador by DAAD, the German Academic Exchange Service, for the period 2018-2022.

DAAD Information Session at IIT Madras, Chennai, India on Feb 13, 2019. Participated in the DAAD Information Session on research opportunities in Germany

## Sankaran, Parameswaran

Member, IASc, Bangalore of Science Education Panel, The Science Academies of India during Apr 2018 – Feb 2019.

Member of Mathematics Section Committee, Indian Academy of Sciences during Apr – Dec,

2018.

Chief Editor of Proceedings, Mathematical Sciences, Indian Academy of Sciences, Bangalore during Jan – Mar, 2019.

### Sharma, Sayantan

Member of American Physical Society during Apr – Dec, 2018.

Convener of Local Organising Committee for The Stellar Legacy of Prof. Meghnad Saha: from Society to the Cosmos held at IMSc during Jan 3 – Jan 4, 2019.

### Sharma, Vikram

Program Committee Member of International Congress on Mathematical Software during Mar – Jul, 2018.

### Siddharthan, Rahul

Convener of International Organising Committee for India—EMBO Symposium on Regulatory Epigenomics: From Large Data to Useful Models held at MGM Beach Resorts, Muttukadu, Chennai during Mar 10 – Mar 13, 2019.

### Sinha, Sitabhra

Speaker in "Science at the Sabha", Chennai on Feb 24 2019 on *"The whole is more than the sum of its parts"*

Speaker in "Jagadis Bose National Science Talent Search" scholars meeting in Kolkata, March 31, 2019 "The whole is more than the sum of its parts: An exploration of complex systems"

### Srinivas, K.

Member of Board of Studies, Central University of Tamilnadu

Speaker at Pie Mathematics Association, Chennai on Apr 10, 2018. Pie Mathematics association conducts programmes to remove math phobia among students. Delivered two talks (10th and 19th April 2019) to BSc/MSc students on understanding mathematical concepts.

Guest Editor of Editorial Board of Hardy Ramanujan Journal

Member of EC of Ramanujan Mathematical Society

Convener of NCM-TEW Committee

Member of Board of Studies, NIT Rourkela

Convener of Local Organising Committee for Teacher's Enrichment Workshop held at IMA, Bhubaneswar during Jun 18 – Jun 23, 2018.

Speaker at Pune University, Pune on Oct 3, 2018. Delivered a popular talk in Riemann Hypothesis. The audience consisted of students, teachers and some other mathematics enthusiasts from Pune.

Convener of Local Organising Committee for Teacher's Enrichment Workshop held at IMSc during Nov 26 – Dec 1, 2018.

Convener of Local Organising Committee for Teacher's Enrichment Workshop held at Andhra University, Visakhapatnam during Jan 7 – Jan 12, 2019.

**Subramanian, C. R.**

Member of Programme Committee of CALDAM-2019 during Apr 2018 – Feb 2019.

**Venugopalan, Sushmita**

Organizer, Speaker at IMSc, Chennai on Jul 5, 2018. FACETS, an outreach programme for college students

# Chapter 4

# Colloquia

## 4.1 Conferences/Workshops Held at IMSc

### 4.1.1 Summer school for MSc students (May 28 – Jun 15, 2018)

This workshop helped MSc students from colleges and universities in Chennai to strengthen their foundation in mathematics. It was attended by about 50 students. Courses were taught by students and postdoctoral fellows of IMSc (Snehajit Mishra, Biplab Paul, Ujjal Das, Oorna Mitra, R Jayakumar, C G Karthick Babu, Balesh Kumar Pandey) and Prof. K Srinivas and Prof. Vijay Kodiyalam.

### 4.1.2 Nagarajfest (Jul 10 – Jul 12, 2018)

This was a conference on algebraic geometry. There were 14 research talks in all given by leading experts in the subject (7 from TIFR, Mumbai, 4 from CMI, 1 each from Emory University, ISI Bangalore, and IIT Madras). Apart from the invited speakers, there were about 25 registered delegates (some on special invitation). More information is available at https://sites.google.com/site/nagarajfestatimsc/

### 4.1.3 The Stellar Legacy of Prof. Meghnad Saha: from Society to the Cosmos (Jan 3 – Jan 4, 2019)

This two-day event at IMSc was organized by Manjari Bagchi and Varuni P. to celebrate the 125th birth anniversary of Meghnad Saha. It consisted of a conference and a day of lectures aimed at school students. Researchers working on modern topics of astrophysics and cosmology, were invited to give scientific talks. It was followed by a half day outreach event where students from nearby schools were invited. This conference and outreach was jointly funded by IMSc and the National Academy of Sciences, India (NASI).

Eminent speakers from various institutes (IIA, TIFR, IUCAA, UC-Berkeley, and KIPAC-Stanford) presented their research work. Around 100 school children participated. Website: https://www.imsc.res.in/outreach/MSaha2019/

### 4.1.4 Mechanics of Complex Matter: Criticality, intermittency and collective behaviour (Mar 4 – Mar 7, 2019)

A workshop on "Mechanics of Complex Matter: Criticality, intermittency and collective behaviour" was organized by Pinaki Chaudhuri and Purusattam Ray at IMSc during March 04-07, 2019. It is the seventh such workshop in the Fracmeet series of meetings that has been held at IMSc since 2012.

The objective of the workshop would be to provide graduate students and researchers with an exposure to the current developments in understanding how various materials, both soft and hard, in crystalline and amorphous forms, respond to mechanical perturbations of various kinds leading to plasticity, fracture, flow etc. As we know, an insight into the underlying processes involves physical descriptions and modelling across large length-scales, bringing forth researchers, from theory and experiments, across disciplines with varying expertise to develop a common understanding.

This year, the workshop featured speakers from India, France, Spain, and Singapore, both theorists and experimentalists, signifying the need for an interdisciplinary approach to develop a common understanding across a wide range of materials, both hard and soft. The workshop also had strong participation of scientists from IGCAR, thus providing a scope for increased contact and exploration of possible collaborations between IMSc and IGCAR on the physics of materials.

## 4.2 Other Conferences/Workshops Organized by IMSc

### 4.2.1 ACM-India Summer School on Graph Theory and Algorithms (May 21 – Jun 8, 2018)

This is an annual summer school organized by ACM-India targeting bright pre-final year students. Organized the entire academic program and gave several lectures.

### 4.2.2 Tenth Summer Training Programme in Mathematics (May 16 – Jun 5, 2018)

K.N. Raghavan, of IMSc helped to convene the meeting, and also was a resource person (delivered lectures and conducted tutorials).

### 4.2.3 Science Academies' Lecture Workshop on Algebra (Aug 16 – Aug 18, 2018)

K.N. Raghavan, of IMSc was academic convener of this workshop, and also was a resource person.

### 4.2.4 Entropy, Information and Order in Soft Matter (Aug 27 – Oct 31, 2018)

Entropy is a central and fundamental concept in statistical mechanics, but considerations of entropy remain far from routine, and exhibit non-trivial and surprising aspects, particularly in soft matter phenomena. Soft matter self-assembly is replete with subtle and fascinating entropic effects. Moving away from the conventional view of entropy as a measure of disorder, current trends in soft matter self assembly increasingly have focused on the connection to information and algorithmic complexity as relevant aspects. Whether organizational principles in non-equilibrium systems may be built around entropy like concepts is an unresolved open question. Transitions in disordered matter such as the glass transition and jamming centrally involve entropy. The nature of order present in seemingly amorphous structures have been explored with concepts of entropy and information. These are some themes that will be explored in the program.

The goal of the program is to bring together researchers investigating these diverse aspects of the non-trivial role of entropy in both equilibrium and non-equilibrium phenomena in soft matter, and in related fields, and to facilitate cross fertilization of ideas among the different themes. We envisage the program as broadly organized among, but not limited to, the following four themes:

1) Entropic considerations in self-assembly, 2) Entropic considerations in understanding glassy behavior, 3) Entropy considerations in out of equilibrium systems: granular matter, active matter, and biological systems, and 4) Entropic measures of structural patterns.

### 4.2.5 National Mathematics Day: NCM lecture (Dec 22, 2018)

The lecture was delivered by Professor S. Kesavan and sponsored by the NCM.

### 4.2.6 Algebras, Combinatorics, and Representation Theory (Dec 5 – Dec 8, 2018)

A conference jointly funded by IMSc and IISER Thiruvananthapuram, held at IISER Thiruvananthapuram. The conference was organized by T Geetha and S Mohanty from IISER Thiruvananthapuram and Amritanshu Prasad, K N Raghavan and S Viswanath from IMSc. The program consisted of 13 invited talks and 12 contributed talks.
http://conference.iisertvm.ac.in/acr/

### 4.2.7 CAALM: Complexity, Algorithms, Automata, Logic Meeting 2019 (Jan 21 – Jan 25, 2019)

The workshop CAALM (Complexity, Algorithms, Automata and Logic Meet) took place at the Chennai Mathematical Institute (CMI) - Chennai (India) between January 21 - January 25, 2019. It was organised under the aegis of the CNRS Indo-French joint research unit

UMI-ReLaX, which has four participating institutes: LSV at ENS Paris-Saclay and LaBRI at Bordeaux in France, and CMI and IMSc in India.

CAALM was envisaged as a continuation of the ACTS (Automata, Concurrency and Timed Systems) series with the added track on Algorithms and Complexity. In the past years, the ACTS workshops have brought together leading researchers in Automata-Logic and have been quite successful in creating a vibrant environment for exchange of ideas. It was hoped that the CAALM workshop would additionally foster interaction between the two communities. The workshop amply met this hope.

The scientific organizers of the workshop were Paul Gastin (LSV, ENS Paris-Saclay, France), Meena Mahajan (IMSc, Chennai, India), Alessia Milani (LaBRI, Bordeaux, France), and B Srivathsan (CMI, Chennai, India).

The workshop had two parallel sessions - Track A: Complexity and Algorithms, and Track B: Automata and Logic, and also some joint sessions. The joint sessions had survey-style talks with an emphasis on reaching out to a broader audience, while some of the parallel session talks were more focussed. There was ample time outside the talks for discussion among participants. There were 9 talks in the joint sessions, and 24 talks in the parallel sessions. About 125 researchers, including 35 from outside India, participated in the workshop. A full list of talks, titles, and other details can be found at https://www.cmi.ac.in/ sri/CAALM2019 .

## 4.2.8 India-EMBO Symposium on Regulatory Epigenomics: From Large Data to Useful Models (Mar 10 – Mar 13, 2019)

Understanding the functioning of genome-wide regulatory networks that control cell identity and cell fate decisions remains one of the key challenges in molecular biology. With the advent of various NGS methodologies for quantitatively characterizing the internal states of cells genome-wide, many large-scale epigenomic datasets have become available in recent years, and there is an urgent need for developing new computational analysis methods for integrating such data into predictive models of regulatory networks. The main objective of this EMBO India Symposium was to bring together a collection of top international and Indian researchers from interdisciplinary backgrounds that are leaders in this field, to discuss the key current biological and methodological questions, to foster new interdisciplinary collaborations with Indian researchers from quantitative backgrounds, and to inspire young Indian researchers and students to enter this field and pioneer new methods. This EMBO India Symposium focused on all aspects of gene regulatory dynamics from analysis of regulatory sequence motifs, transcription factor-DNA interaction, local chromatin dynamics and epigenetic modifications, RNA dynamics at the level of transcription and post-transcriptional processing, to 3D dynamics of chromatin and the resulting gene regulatory dynamics on daily and development time scales.

The event was funded by European Molecular Biology Organization (EMBO) and DBT-Wellcome India Alliance (IA), and featured 19 speakers including 11 international speakers, and about 70 participants, mostly from India. It is one of three symposia funded by EMBO and IA annually in India.

Rahul Siddhartan was one of four organizers and the "local organizer". IMSc provided institutional support.

## 4.3 IMSc Outreach Activities

### 4.3.1 Zero Shadow Day (24th April 2018)

Kamal Lodaya, Varuni P and Vijay Ravikumar (CMI) designed a poster to explain the astronomical phenomena called Zero Shadow Day which occurs twice a year when the sun is directly overhead at each latitute in the tropics. The poster received much attention on social media and was even covered in the science section of the Indian Express. (https://indianexpress.com/article/explained/zero-shadow-day-how-shadows-played-hide-seek-with-chennai-kids-5156463/).

Kamal Lodaya, Varuni P and Vijay Ravikumar (CMI) also conducted a session for students at Pudiyador (Urur Kuppam) on 24th April at local noon to observe the phenomena.

### 4.3.2 Summer School Students Workshop (8th - 17th May 2018)

IMSc organized a Mathematics and Science workshop for high school students.We were delighted by the overwhelming number of applicants for the program! IMSc hosted 70 students from classes X  XI for the program. The workshop consisted of activity sessions, lectures and research talks in a range of topics from microscopy to astronomy. Participants also worked on projects and presented them on the last day of the workshop. Sessions: Ajjath AH, Aparna Sankar, Anantha Padmanabha, Arivnd Gupta (Arvind Gupta Toys), G. Baskaran, K. A. Chandrashekar, Digjoy Paul, Pinaki Chaudhuri, Indumathi D. Jayashree (HBCSE), Kamal Lodaya, Madhusudan Raman, M.V.N. Murthy, Oorna Mitra, Pandu Rangan (IITM), S. Pavitra, Pooja Mukherjee, R. Ramanjuam, Semanti Dutta, R. Shankar, Sreevidya T S, Sushmita Venugopalan, Varuni P.

### 4.3.3 Teacher's Enrichment Workshop (21st - 26th May 2018) : Algebra, Analysis and Topology of p-adic numbers

IMSc hosted a week long workshop aimed at mathematics teachers in Arts and Science colleges, to enable them to revisit and update content knowledge. Discussion hours offered opportunities to get doubts cleared and work out exercises (both routine and advanced). About 60 teachers were selected from about 200 applicants. This program was part of IMSc's Enriching Collegiate Education (ECE) series of workshops as an effort to facilitate interactions between research mathematicians and college teachers. The workshop was held as a Teachers Enrichment Workshop, a series co-sponsored by the National Centre for Mathematics (NCM). Speakers: Anirban Mukhopadhyay, D. S. Nagaraj, P. Sankaran, Sanoli Gun

### 4.3.4 Teacher's Enrichment Workshop (18th – 23rd Jun 2018)

The Institute of Mathematics and Applications (IMA), Bhubaneswar organized the NCM sponsored TEW programme in the month of June 2018. This was locally coordinated by Prof. A. K. Mishra, Director, IMA and the academic part was handled by Prof. K. Srinivas of IMSc. About 35-40 teachers attended the programme. The topics were real, complex and functional analysis which were delivered by Prof. Tarakanta Nayak, IIT, Bhubaneswar, Prof. K. Srinivas, IMSc,Chennai, Prof. Sudhanshu S Rout and Prof. A. K. Mishra from IMA.

### 4.3.5 Facets: (5th - 6th July 2018) Mathematics program for college students

This was the 2018 edition of the institute's outreach program for advanced undergraduate (BSc third year) and postgraduate (MSc) students of mathematics.

The speakers are - Amritanshu Prasad, IMSc, Aaloka Kanhere, Homi Bhabha Centre for Science Education (Mumbai), Balaji K, Adobe Research (Bangalore), Nemani Suryanarayana, IMSc, Rahul Siddharthan, IMSc, Sivaguru R, TIFR Centre For Applicable Mathematics (Bangalore), and Sushmita V, IMSc.
About 180 students participated in this program.

### 4.3.6 IMSc Open Day: (15th Sept 2018)

A day of fun mathematics and science talks and activities for school children
The program was intended for students of 8th - 10th standards. The program comprised of lectures and demonstrations in a range of topics by students and professors of the institute. Sharing the curiosity and excitement that we have for mathematics, science and research with the school students is the focus of this program.

### 4.3.7 Enriching Mathematics Education: (4th - 5th Oct 2018)

This was the 7th edition of IMSc's outreach program for school teachers of classes XI and XII. This year, the workshop was hosted by PS Secondary School, Mylapore. The program included ideas about new ways to teach syllabus topics and different approaches to problem solving. 70 teachers attended the workshop. Speakers: Athmaraman R. (Retired Headmaster), P. Sankaran, Sushmita V., R. Ramanujam, S. Viswanath, Varuni P.

### 4.3.8 Kanita-Kaanakam (26th Oct 2018)

IMSc conducted kaNita-kAnakam, an outreach program in Tamil for children of classes VIII to XII on 26th October 2018. The program was attended by 150 students from 15 corporation schools in Chennai. Mathematical ideas were analyzed through hands-on activities such as modular origami, analyzing bicycle tracks, kolams (tamil-style rangoli), and games

of strategy, conducted mostly in Tamil. An underlying theme was the pervasive role of mathematical thought in all aspects of modern life. The event received coverage in the local press with a detailed article in Dina Malar's Pattam (https://www.imsc.res.in/outreach/KK2018/pattam_29102018.pdf).

Speakers: R. Ganesh, Roopika Jayaram, R. Ramanujam, Vijay Ravikumar (CMI)
Photos: https://ekalavya.imsc.res.in/node/3708


### 4.3.9 Vigyan Pratibha Chennai Region Teachers Workshop (15th - 16th Nov 2018)

This was the 1st edition of IMSc's teachers regional workshop for Vigyan Pratibha, a Government of India program to nurture of talent in Science and Mathematics among VIII - X students. The workshop was attended by 30 mathematics and science teachers from KV and AECS schools from Chennai, Kalpakkam and Puducherry.

Speakers: Chaitanya Ursekar (HBCSE), Jayashree S. (HBCSE), Niruj Mohan Ramanujam (ASIPOEC), R. Ramanujam, Reema Mani (HBCSE), Varuni P.
Photos: https://ekalavya.imsc.res.in/node/3719


### 4.3.10 Teacher's Enrichment Workshop (26th Nov – 1st Dec 2018): Workshop for mathematics teachers of Engineering colleges

IMSc has been organizing TEWs as part of its outreach activities since last few years. This particular event is for teachers of engineering colleges in and around Chennai area. About 45 teachers participated in this workshop. This programmed was financially supported by NCM and co-sponsored by IMSc.
This week-long workshop was aimed at mathematics teachers in Engineering colleges, to enable them to revisit and update content knowledge. About 50 teachers were selected from about 200 applicants. This program was part of IMScs Enriching Collegiate Education (ECE) series of workshops as an effort to facilitate interactions between research mathematicians and college teachers. The workshop was held as a Teachers Enrichment Workshop, a series co-sponsored by the National Centre for Mathematics (NCM).

Speakers: Phoolan Prasad (IISc), T. N. Shanmugam (Anna University), S. Viswanath
Photos: https://ekalavya.imsc.res.in/node/3728


### 4.3.11 Teacher's Enrichment Workshop ( 7th – 12th Jan 2019)

NCM sponsored TEW programme was organized in the department of mathematics, Andhra University. Prof. Anuradha and Prof. Murty were the local coordinaters and Prof. Srinivas handled the academic coordination. About 40 teacher's attended the programme. The topics were chosen from algebra, real analysis and complex analysis. The resource people were Prof. R. Tandon from Hyderabad University, Prof. A. Singh from IIT Madras and Prof. K. Srinivas from IMSc.

### 4.3.12 UN International Day for Girls and Women in Science: 11th Feb 2019

IMSc hosted about 180 girls from local schools to celebrate the UN International Day for Girls and Women in Science. The program included lectures by young women in science and mathematics: Shanti Bhattacharya (IITM), Prajakta Nimbhorkar (CMI) and Satyavani Vemparala (IMSc). IMSc students organized a series of demonstrations. In association with Nandita Jayaraj (TLoS) and the American Counsulate (Chennai), a screening was organized and the film "Hidden Figures" (2016), the story of a team of female African-American mathematicians who served a vital role in NASA during the early years of the U.S. space program was screened.

### 4.3.13 Science at the Sabha (Feb 24, 2019)

This year, Science at the Sabha, IMSc's flagship outreach program, was held at the Music Academy on Sunday, 24 February. The talks are aimed at anyone with an interest in science, irrespective of age or background. Science at the Sabha is free and open to all. This year the speakers were: Sandhya Koushika (TIFR), Vijay Shenoy (IISc), Harini Nagendra (APU) and Sitabhra Sinha (IMSc).
This event was attended by about 1200 people. https://www.imsc.res.in/triveni/2019/

**From Learning to Doing: Science, Education and Public Service in Chennai**

This panel exhibition was unveiled at Science at the Sabha, highlighting Chennai's traditions in science, mathematics, education and public service, along with the people and institutions that helped to define them. Science at the Sabha and the accompanying exhibition received extensive press coverage:
https://www.thehindu.com/sci-tech/science/fourth-edition-of-science-at-sabha/article26365816.ece
https://timesofindia.indiatimes.com/city/chennai/science-at-the-sabha-educates-youngsters-and-enthrals-old/articleshow/68143474.cms
website: https://www.imsc.res.in/triveni/2019/
photos: http://ekalavya.imsc.res.in/node/3782

### 4.3.14 Indian Women in Science Exhibit display (February - March 2019)

IMSc in collaboration with The Life of Science (TLoS) produced a poster exhibition on Indian Women in Science and premiered it at last year's Science at the Sabha (2018). It consisted of 13 posters highlighting the life and work of women scientists of the country. The exhibition was displayed at Women's Christian College, Chennai, (25th Feb – 1st March, 2019) and Stella Maris College (2nd March – 7th March, 2019)
Photos: - https://photos.app.goo.gl/1zRSUeVH9avQwmix8
https://photos.app.goo.gl/tC5cwGyoKT2Dgdu76

Figure 4.1: Zero Shadow Day, April 24th 2018



Figure 4.2: Summer School Students Workshop: 8th - 17th May 2018

Figure 4.3: kaNita-kAnakam: 26th Oct 2018



Figure 4.4: News Article on 'Dinamalar Student Edition' - Pattam, 11, dt.30.10.2018 (A Tamil Newspaper, Chennai).

Figure 4.5: Vigyan Pratibha Chennai Region Teachers Workshop: 15th - 16th Nov 2018



Figure 4.6: Teacher's Enrichment Workshop: 26th Nov - 1st Dec 2018

Figure 4.7: Science at the Sabha : 24th Feb 2019



Figure 4.8: From Learning to Doing: Science, Education and Public Service in Chennai, Science at the Sabha, 24th Feb 2019

Figure 4.9: Indian Women in Science Exhibit display: February - March 2019



Figure 4.10: UN International Day for Girls and Women in Science: 11th Feb 2019

Figure 4.11: UN International Day for Girls and Women in Science: 11th Feb 2019

## 4.4 Seminars

| Date | Speaker Affiliation | Title |
|------|---------------------|-------|
| 03-04-2018 | Ramanathan IMSc | Logic |
| 04-04-2018 | Nivedita Chatterjee Sankara Nethralaya | Biology-2 Course |
| 04-04-2018 | Pranendu Darbar IMSc, Chennai | char bigger than 5 case. |
| 04-04-2018 | Bhal Chandra Joshi NCRA-TIFR | The hunt for the nano-Hz gravitational waves using Pulsar Timing Arrays and the Indian participation |
| 09-04-2018 | IMSc members IMSc | Institute Seminars |
| 10-04-2018 | First Year Students IMSc | Research Methodology Talks |
| 10-04-2018 | Nivedita Chatterjee Sankara Nethralaya | Biology-2 course |
| 10-04-2018 | Nilanjana Kumar SINP | Confronting LHC data with composite Higgs theories |
| 10-04-2018 | Gayatri Panicker IIT, Guwahati | If-then-else over the algebra of conditional logic |
| 10-04-2018 | Mr. Ganesh Sankaralingam Director, LatentView Analyics | Rise of Artificial Intelligence: Should Humans be Worried? |
| 11-04-2018 | First Year Students IMSc | Research Methodology Talks |
| 11-04-2018 | Akhilesh P. CMI, Chennai. | Char 3 case. |

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| 11-04-2018 | A.P. Balachandran<br>Syracuse University | The Gauss Law : A Tale |
| 12-04-2018 | Saket Saurabh<br>IMSc | Quasipolynomial Representation of Transversal Matroids with Applications in Parameterized Complexity |
| 12-04-2018 | Peter Bouwknegt<br>Australian National University | Spherical T-duality and M-geometry |
| 13-04-2018 | Xerxes Tata<br>University of Hawaii | Supersymmetry: Aspirations and Prospects |
| 16-04-2018 | IMSc members<br>IMSc | Institute Seminars |
| 16-04-2018 | Xavier Viennot<br>LABRI, Bordeaux | Trees and tableaux: the Loday-Ronco algebra of binary trees |
| 17-04-2018 | Mrigendra Singh Kushwaha<br>IMSc | Kostant module and KPRV Refinement |
| 17-04-2018 | Ramanathan<br>IMSc | Logic |
| 19-04-2018 | Aditya Banerjee<br>Harish Chandra Research Institute | A model for three dimensional fractionalised gapless states from stacking of quantum Hall liquids |
| 19-04-2018 | Xavier Viennot<br>LABRI, Bordeaux | Trees and tableaux: alternative trees, non-ambiguous trees and beyond |
| 24-04-2018 | Bishal Deb<br>CMI | Some Enumerative and Bijective Results Related to Non Ambiguous Trees |
| 24-04-2018 | Ramanathan<br>IMSc | Logic |
| 25-04-2018 | G. Baskaran<br>IMSc/ Perimeter Institute | From Simplicity to Quantum Complexity |
| 26-04-2018 | Yash Uday Deshmukh<br>CMI | Construction of symplectic cobordisms |

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| 01-05-2018 | Ramanathan<br>IMSc | Logic |
| 02-05-2018 | Biplab Paul<br>IMSc | On arithmetic behavior of Hecke<br>eigenvalues of cusp forms |
| 02-05-2018 | Abhishek T Bharadwaj<br>CMI, Chennai. | The case of characteristic 2 |
| 07-05-2018 | Jyothsnaa S.<br>IMSc | On existence of Euclidean ideal classes<br>in certain number fields |
| 08-05-2018 | Ramanathan<br>IMSc | Logic |
| 09-05-2018 | S. Sahu<br>CMI | Points of small height in certain<br>nonabelian extensions |
| 09-05-2018 | Rahul Dandekar<br>IMSc | Higher-order correlators in the<br>Random Average Process |
| 09-05-2018 | Subham Bhakta<br>CMI Chennai | Virtual Characters on the theory of<br>Artin $L$-functions |
| 10-05-2018 | C. Jebarathinam<br>SN Bose Center, Kolkota | Simultaneous correlations in<br>complementary bases as quantitative<br>resource for quantum steering |
| 15-05-2018 | Ramanathan<br>IMSc | Logic |
| 15-05-2018 | Narayan Rana<br>DESY, Zeuthen, Germany | Three loop QCD corrections to heavy<br>quark form factors |
| 16-05-2018 | Richa Tripathi<br>Discipline of Physics, IIT<br>Gandhinagar, Gandhinagar | Applying Machine Learning in<br>Network Epidemiology: Identifying<br>key topological and disease spreading<br>parameters from data |
| 17-05-2018 | Nivedita Chatterjee<br>Sankara Nethralaya | Neuroscience Module of Biology-2<br>Course |

| 17-05-2018 | B. Prasanna Venkatesh<br>Institute for Quantum Optics<br>and Quantum Information,<br>Innsbruck | Cooperative Effects in Closely Packed<br>Quantum Emitters with Collective<br>Dephasing |
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| 18-05-2018 | Narasimha Kumar<br>IIT Hyderabad | Simultaneous behavior of the Fourier<br>coefficients of two Hilbert modular<br>cusp forms |
| 18-05-2018 | Govind Krishnaswami<br>CMI, Chennai | On a dual to the 2d principal chiral<br>model and its mechanical reduction |
| 18-05-2018 | Vasudharani Devanathan<br>IISER Tirupati | Biology-2 Course |
| 22-05-2018 | Nivedita Chatterjee<br>Sankara Nethralaya | Neuroscience Module of Biology-2<br>Course |
| 28-05-2018 | Krishna B. S. Swamy<br>Institute of Molecular Biology,<br>Academia Sinica, Taipei,Taiwan. | Genes and Speciation: What can we<br>learn from yeast |
| 28-05-2018 | Ronak Soni<br>TIFR | BRST v/s EPR in Maxwell |
| 29-05-2018 | DC Meeting | Abhranil Chatterjee |
| 30-05-2018 | Alakh Dhruv Chopra<br>CMI | Ordinal Analysis using Provability<br>Logics |
| 30-05-2018 | A.P. Balachandran<br>IMSc | Phases of Non-Abelian Gauge<br>Theories |
| 31-05-2018 | Krishanu Roy<br>IMSc | Weyl Orbits of System in Kac-Moody<br>Algebras |
| 31-05-2018 | Md. Manirul Ali<br>National Tsing Hua University,<br>Taiwan | Dynamics of non-Markovian open<br>quantum systems and nonequilibrium<br>quantum thermodynamics |
| 01-06-2018 | Anuj Tawari<br>IMSc, HBNI | Lower bounds for read-once and<br>tropical formulas |

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| 01-06-2018 | Dhiraj Hazra<br>Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Bologna | Decoding cosmic fingerprints: constraining the generation and evolution of primordial fluctuations |
| 04-06-2018 | Dhiraj Hazra<br>Istituto Nazionale di Fisica Nucleare (INFN), Sezione di Bologna | The standard model of cosmology and beyond: constraints and forecasts |
| 05-06-2018 | Sridhar P Narayanan<br>IMSc | Insertion algorithms for shifted tableaux |
| 05-06-2018 | Ronak M Soni<br>TIFR, Mumbai | BRST v/s EPR in Maxwell - continued |
| 05-06-2018 | Sankha S. Basu<br>IIIT, Delhi | The Muchnik topos |
| 06-06-2018 | Govind Krishnaswami<br>CMI, Chennai | On a dual to the 2d principal chiral model and its mechanical reduction – continued |
| 07-06-2018 | NP Swaroop<br>IMSc, HBNI | New Results in Bounds for Positiveness of Polynomials |
| 07-06-2018 | Subramanya Hegde<br>IISER, Trivendrum | New multiplets in four dimensional N=2 conformal supergravity |
| 07-06-2018 | Dilpreet Kaur<br>IISER Pune | z-classes and rational conjugacy classes of alternating groups |
| 12-06-2018 | Wolfgang Slany<br>Technische Universitaet Graz, Austria | Design your own app! |
| 19-06-2018 | Anosh Joseph<br>ICTS, Bengaluru | Exact Lattice Supersymmtery |
| 19-06-2018 | Anindya S Chakrabarti<br>Indian Institute of Management (IIM) Ahmedabad | Multivariate analytics of economic and social data |

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| 20-06-2018 | Anindya S Chakrabarti<br>Indian Institute of Management<br>(IIM) Ahmedabad | Multivariate analytics of economic and social data |
| 21-06-2018 | Multiple Speakers | A morning of combinatorics |
| 21-06-2018 | Anindya S Chakrabarti<br>Indian Institute of Management<br>(IIM) Ahmedabad | Multivariate analytics of economic and social data |
| 22-06-2018 | Anindya S Chakrabarti<br>Indian Institute of Management<br>(IIM) Ahmedabad | Multivariate analytics of economic and social data |
| 25-06-2018 | Rahul Saladi<br>University of Illinois<br>Urbana-Champaign. | Algorithms and Data Structures for Geometric Intersection Query Problems |
| 27-06-2018 | Priyotosh Bandyopadhyay<br>IIT Hyderabad | Higgs and higgsinos in extended supersymmetric Standard Model at the LHC |
| 28-06-2018 | Kajal Das<br>Weizmann Institute of Science | Invariance of conformal dimension under $L^p - OE$ for a class of hyperbolic coxeter groups |
| 04-07-2018 | R. Sivaguru<br>TIFR CAM | Holomorphic extension of CR functions |
| 04-07-2018 | Venkata Sathish Akella<br>IIT Madras | Self-propulsion by Marangoni forces |
| 06-07-2018 | Rajeev Singh<br>Department of Physics, Indian<br>Institute of Technology (BHU),<br>Varanasi | Many-body localization and its signatures in quantum quenches |
| 06-07-2018 | R Rajaraman<br>JNU, Delhi | The Kim-Trump Singapore Summit – before and after |
| 10-07-2018 | G. Subrahmanya VRK Rao<br>Cognizant | Cybersecurity in Quantum Era, ACM India Chennai Chapter Expert Lecture |

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| 11-07-2018 | Sambaran Banerjee<br>Argelander-Institut fur<br>Astronomie, University of Bonn | Star clusters: a versatile laboratory<br>for astrophysical phenomena |
| 16-07-2018 | Jayanta Bhattacharjee<br>IACS, Kolkata | Scales and scaling in hydrodynamic<br>turbulence |
| 16-07-2018 | Shamik Banerjee<br>IOP Bhubaneswar | Null-Infinity and Unitary<br>Representation of The Poincare<br>Group. (1/3) |
| 17-07-2018 | Digjoy Paul<br>IMSc | Feasible degree sequences for graphs<br>with bounded real weights |
| 17-07-2018 | Jayanta Bhattacharjee<br>IACS, Kolkata | Scales and scaling in hydrodynamic<br>turbulence |
| 17-07-2018 | Abhishek Roy<br>Institute for Theoretical Physics,<br>Cologne | The chiral Haldane phase with SU(N)<br>symmetry |
| 18-07-2018 | Jayanta Bhattacharjee<br>IACS, Kolkata | Scales and scaling in hydrodynamic<br>turbulence |
| 18-07-2018 | Shamik Banerjee<br>IOP Bhubaneswar | Null-Infinity and Unitary<br>Representation of The Poincare<br>Group. (2/3) |
| 19-07-2018 | Shuchita Goyal<br>IIT Bombay | Absence of Strm-Hurewicz model<br>structure on the category of graphs |
| 19-07-2018 | Jayanta Bhattacharjee<br>IACS, Kolkata | Scales and scaling in hydrodynamic<br>turbulence |
| 19-07-2018 | Subinoy Das<br>Indian Institute of Astrophysics | Cosmology: A lamp post of particle<br>dark matter search |
| 20-07-2018 | Raman Sundrum<br>University of Maryland | Primordial Anisotropies in the<br>Gravitational Wave Background from<br>Cosmological Phase Transitions - Part<br>I |

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| 20-07-2018 | Shamik Banerjee<br>IOP Bhubaneswar | Null-Infinity and Unitary Representation of The Poincare Group. (3/3) |
| 23-07-2018 | Vani Vemparala<br>IMSc | Simulation Techniques in Biology |
| 23-07-2018 | K P Mohanan<br>IISER Pune (Retd) and ThinkQ | The Value of Math for Non-math Folks |
| 23-07-2018 | Raman Sundrum<br>University of Maryland | Primordial Anisotropies in the Gravitational Wave Background from Cosmological Phase Transitions - Part II |
| 24-07-2018 | Marcin Chrzszcz<br>LHCb, CERN | Anomalies in Physics |
| 25-07-2018 | Vani Vemparala<br>IMSc | Simulation Techniques in Biology |
| 25-07-2018 | Susmita Ghosh<br>IMSc | Development of a New Class of Enhanced Kinetic Sampling Methods for Biomolecular Simulations. |
| 26-07-2018 | Lalit Kumar Saini<br>Delhi University | $Spin - 0^+/$ - portal induced Dark Matter |
| 26-07-2018 | Kunal Dutta<br>INRIA Sophia Antipolos | On the Randomized Incremental Construction of Delaunay Triangulations of Epsilon-nets |
| 27-07-2018 | Venkat Guruswami<br>CMU | Polymorphic inquiries: (Promise) constraint satisfaction, fine-grained complexity, and more |
| 30-07-2018 | Rati Sharma<br>Dept. of Physics,, Harvard University | Signal response studies during cell polarization and external stress |
| 30-07-2018 | Vani Vemparala<br>IMSc | Simulation Techniques in Biology |
| 30-07-2018 | Dharmesh Jain<br>SINP | Lecture(s) on Localization |

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| 31-07-2018 | Vinodchandran Variyam<br>University of Nebraska, Lincoln | Testing Distributions for Uniformity |
| 01-08-2018 | Vani Vemparala<br>IMSc | Simulation Techniques in Biology |
| 01-08-2018 | Balesh Kumar<br>IMSc, Chennai | On discriminant conjecture |
| 01-08-2018 | Dharmesh Jain<br>SINP | Lecture(s) on Free Energy |
| 03-08-2018 | Avijit Nath<br>IMSc | On generalized Dold manifolds |
| 03-08-2018 | Venkat Guruswami<br>Carnegie Mellon University,<br>USA. | Constraint Satisfaction Problems and<br>Polymorphisms |
| 03-08-2018 | Dharmesh Jain<br>SINP | Relating Supersymmetric Theories<br>across Dimensions |
| 06-08-2018 | Vaidy Sivaraman<br>University of Amsterdam,<br>Amsterdam, The Netherlands | Detecting odd holes |
| 06-08-2018 | Vani Vemparala<br>IMSc | Simulation Techniques in Biology |
| 06-08-2018 | Areejit Samal<br>IMSc, Chennai | Bio-2 course Exam |
| 06-08-2018 | Chandrasekhar Chatterjee<br>Keio University, Japan | Vortices in non-Abelian gauge theories |
| 06-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 07-08-2018 | Dibyendu De<br>University of Kalyani | Topological and combinatorial van der<br>Waerden theorem |

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| 07-08-2018 | Balaraja Battu<br>Centre of Behavioural and<br>Cognitive Sciences (CBCS),<br>University of Allahabad,<br>Allahabad | Does the bounded rationality of<br>agents help to establish conditional<br>cooperation? |
| 07-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 08-08-2018 | Vani Vemparala<br>IMSc | Simulation Techniques in Biology |
| 08-08-2018 | Various<br>IMSc | Combinatorics Group Meetings |
| 08-08-2018 | Dibyendu De<br>University of Kalyani | Topological and combinatorial<br>Hales-Jewett Theorem |
| 08-08-2018 | Chandrasekhar Chatterjee<br>Keio University, Japan | Obstructions in non-Abelian vortices<br>and BPS Alice strings |
| 08-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 09-08-2018 | Rahul Singh<br>Northeastern University | Conormal Varieties on Cominuscule<br>Grassmannians |
| 09-08-2018 | Dibyendu De<br>University of Kalyani | Polynomial IP van der Waerden<br>Theorem for Nilpotent Groups |
| 09-08-2018 | Rakesh Venkat<br>Hebrew University, Israel | Graph Partitioning for Low<br>Threshold-Rank and Semi-Random<br>Instances |
| 09-08-2018 | Chandrasekhar Chatterjee<br>Keio University, Japan | Obstructions in non-Abelian vortices<br>and BPS Alice strings |
| 09-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 10-08-2018 | Venkat Guruswami<br>Carnegie Mellon University,<br>USA. | Constraint Satisfaction Problems and<br>Polymorphisms |

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| 10-08-2018 | Ananth Shankar<br>MIT | Exceptional splitting of reductions of abelian surfaces |
| 10-08-2018 | Chandrasekhar Chatterjee<br>Keio University, Japan | Topological defects in the Georgi-Machacek model: Domain walls, topological EW strings |
| 10-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 13-08-2018 | Vani Vemparala<br>IMSc | Simulation Techniques in Biology |
| 13-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 14-08-2018 | N D Hari Dass<br>TIFR-TCIS Hyderabad. | Gauge Symmetry is an oxymoron, and Spontaneous breaking of gauge symmetry is a double oxymoron. |
| 14-08-2018 | G. Baskaran<br>IMSc. | Theory of Confined High Tc Superconductivity in Monovalent Metals |
| 14-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 15-08-2018 | Vani Vemparala<br>IMSc | Simulation Techniques in Biology |
| 15-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 16-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 17-08-2018 | Venkat Guruswami<br>Carnegie Mellon University, USA. | Constraint Satisfaction Problems and Polymorphisms |
| 17-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |

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| 17-08-2018 | Niruj Mohan Ramanujam<br>Public Outreach and Education<br>Committee, Astronomical<br>Society of India | The 150th anniversary of<br>fingerprinting the Universe - the<br>discovery of Helium from Andhra<br>Pradesh |
| 20-08-2018 | Vani Vemparala<br>IMSc | Simulation Techniques in Biology |
| 20-08-2018 | Venkat Guruswami<br>Carnegie Mellon University,<br>USA. | Constraint Satisfaction Problems and<br>Polymorphisms |
| 22-08-2018 | Sharmistha Majumdar<br>IIT Gandhinagar | The evolution of a transposase: why<br>do some genes jump? |
| 22-08-2018 | Amitabh Joshi<br>JNCASR, Bangalore | Experimental Ecology and Evolution<br>in the Laboratory |
| 23-08-2018 | Simulation Techniques | Simulation Techniques |
| 24-08-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 24-08-2018 | Prakash Saivasan<br>T U Braunschweig, Germany | Regular abstractions with applications<br>to Infinite state verification |
| 27-08-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 27-08-2018 | M. Muthukumar<br>University of Massachusetts,<br>Amherst, USA | Topologically Frustrated Dynamics of<br>Charged Macromolecules in Crowds |
| 27-08-2018 | Areejit Samal<br>IMSc, Chennai | Biology-1 Course |
| 27-08-2018 | Alok Laddha<br>CMI, Chennai | Classical Limit of Soft Graviton<br>Theorem and the memory effect |
| 30-08-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 30-08-2018 | Meena Mahajan<br>IMSc | Locating Linear Decision Lists within<br>$TC^0$ |

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| 30-08-2018 | Sam Paul | Induced-fit drug docking in proteins using mutually orthogonal Latin squares (MOLS) |
| 03-09-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 05-09-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 05-09-2018 | P Sankaran<br>IMSc | Topics in group theory |
| 06-09-2018 | Amit Chakraborty<br>KEK, Japan | Monojet Signatures from Heavy Colored Particles: Theoretical Uncertainties and Future Collider Sensitivities |
| 10-09-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 12-09-2018 | Daciberg Lima Goncalves<br>Institute of Mathematics and Statistics, University of Sao Paulo, Brazil | Automorphisms of the fundamental group of a 3-dimensional Sol-manifold |
| 12-09-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 12-09-2018 | P Sankaran<br>IMSc | Topics in group theory |
| 13-09-2018 | Shraddha Srivastava<br>IMSc | Structure constants of alternating Schur algebras |
| 14-09-2018 | Arunima Banerjee<br>IISER-Tirupati | Origin of low surface brightness galaxies: A dynamical study |
| 14-09-2018 | Rahul Srivastava<br>Valencia, Spain | Neutrino, Dark Matter and Higgs Portals for New Physics |
| 17-09-2018 | S Chakraborty<br>IACS, Kolkota | Action Principle for Gravity, Null Surfaces and Thermodynamic Consequences |
| 18-09-2018 | Ankit Agrawal<br>IMSc Chennai | Nuclear Architecture from Chromosomes to Motifs |

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| 19-09-2018 | Anilatmaja Aryasomayajula<br>IISER Tirupati | Bergman kernels and cusp form |
| 19-09-2018 | P Sankaran<br>IMSc | Topics in group theory |
| 19-09-2018 | Suvrat Raju<br>ICTS-TIFR, Bengaluru | The Black Hole Interior and the<br>Information Paradox in Holography |
| 20-09-2018 | Suvrat Raju<br>ICTS-TIFR, Bengaluru | Toy models of the information<br>paradox in empty space |
| 20-09-2018 | Seethalakshmi K<br>IISER Pune | Ehrhart functions |
| 20-09-2018 | Tanmay Mitra<br>IMSc Chennai | Adaptive dynamics of intra- and<br>inter-cellular networks: Emergence of<br>memory and learning in cell-signaling<br>and immune systems |
| 20-09-2018 | Dipramit Majumdar<br>IIT Madras | Order of cuspidal subgroup and index<br>of Eisenstein ideal |
| 21-09-2018 | Raghuram Murtugudde<br>University of Maryland | A Threefold increase in Widespread<br>Floods over India |
| 24-09-2018 | G. Arunkumar<br>IISER Mohali | Root Multiplicities for<br>Borcherds-Kac-Moody Algebras and<br>Graph Coloring (Ph.D thesis defence) |
| 24-09-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 25-09-2018 | Dhruv Ranganathan<br>Cambridge | The tropical geometry of Hurwitz<br>numbers |
| 26-09-2018 | Soumyadeep Chaudhuri<br>ICTS-TIFR, Bangaluru | Probing Out-of-Time-Order<br>Correlators |
| 26-09-2018 | Bidesh Kumar Bera<br>Physics and Applied<br>Mathematics Unit, Indian<br>Statistical Institute, Kolkata | Synchronization and chimera states in<br>static and time-varying networks |

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| 26-09-2018 | P Sankaran<br>IMSc | Topics in group theory |
| 27-09-2018 | Dani P Rajiah<br>Department of Atomic Energy,<br>Mumbai | DAE Experience on Patenting |
| 27-09-2018 | Srivatsa N S<br>Max Planck Institute for the<br>Physics of Complex Systems,<br>Dresden | Excitonic collective modes in Weyl<br>semi-metals |
| 27-09-2018 | Vani | Simulation Techniques in Biology |
| 27-09-2018 | Venkatesh Raman<br>IMSc | Turing Award Lecture |
| 28-09-2018 | Debajyoti Sarkar<br>University of Bern | Some recent progress on spacetime<br>reconstruction from CFT |
| 01-10-2018 | Diptapriyo Majumdar<br>IMSc | (Thesis Defence) Classic and<br>approximate kernels for some<br>structural parameters of some covering<br>problems |
| 03-10-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 03-10-2018 | Arnab Pal<br>Tel Aviv University, Israel | First Passage Under Restart |
| 03-10-2018 | P Sankaran<br>IMSc | Topics in group theory |
| 04-10-2018 | Shraddha Srivastava<br>IMSc | Combinatorics group meeting |
| 05-10-2018 | Vani Vemparala | Simulations techniques in Biology |
| 08-10-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 08-10-2018 | Thomas F. Icard III<br>Stanford University, USA | Probabilistic Chomsky hierarchy |

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| 09-10-2018 | Rajesh Viswanathan<br>Biology and Chemistry, IISER<br>Tirupati | Genome-Enabled Molecular Synthesis<br>Unraveling New Natural Product<br>Pathways in Cyanobacteria and<br>Marine Actinomycetes |
| 10-10-2018 | P Sankaran<br>IMSc | Topics in group theory |
| 11-10-2018 | Steven Dale Cutkosky<br>University of Missouri | Local uniformization and generating<br>sequences of valuations |
| 12-10-2018 | S. Anirudh Reddy<br>RRI, Bangalore | Entropy and Geometry of Quantum<br>States |
| 13-10-2018 | Classes for CMI students | Classes for CMI students |
| 15-10-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 16-10-2018 | Anvy Moly Tom<br>IMSc | (Synopsis Talk)Aggregation of flexible<br>polyelectrolytes: Phase diagram and<br>dynamics |
| 16-10-2018 | Shiv Prakash Patel<br>IIT Delhi | Regular represayions and Whittaker<br>models |
| 17-10-2018 | Hema Srinivasan<br>University of Missouri | Gorenstein Monomial Curves |
| 17-10-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 17-10-2018 | P Sankaran<br>IMSc | Topics in group theory |
| 22-10-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 22-10-2018 | Ramij Rahaman<br>Department of Mathematics,<br>Presidency University, Kolkata | Detection of true multipartite<br>entanglement and its applications in<br>secured communication |
| 24-10-2018 | Biplab Paul<br>IMSc | Arithmetic of Hecke eigenvalues of<br>Siegel modular forms |
| 24-10-2018 | Vani Vemparala | Simulation Techniques in Biology |

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| 24-10-2018 | Sagnik Chakraborty<br>IMSc | Pre-synopsis submission seminar |
| 25-10-2018 | Subhroneel Chakrabarti<br>IMSc | Pure Spinor Superstrings: Massless States |
| 26-10-2018 | Subhroneel Chakrabarti<br>IMSc | Pure Spinor Superstrings: Massive States |
| 29-10-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 31-10-2018 | Priyamvad Srivastav<br>IMSc | Alternate Vaughan's identity in the ternary Goldbach problem |
| 31-10-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 01-11-2018 | Vani Vemparala | Simulations Techniques in Biology |
| 01-11-2018 | Madhav Reddy Bagannagari<br>ISI Kolkata | On free type rigid $C^*$-tensor categories and their annular representations |
| 02-11-2018 | Satyajit Seth | Higgs+n-gluon one-loop amplitude: an analytical approach |
| 02-11-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 05-11-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 07-11-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 07-11-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 08-11-2018 | Madhav Reddy Bagannagari<br>ISI Kolkata | Rigid $C^*$ tensor categories and annular representations |
| 09-11-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 12-11-2018 | Vani Vemparala | Simulation Techniques in Biology |

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| 12-11-2018 | Dhruv Pathak<br>IMSc | The dynamical contributions in the rate of change of the orbital and the spin periods of radio pulsars |
| 14-11-2018 | Sohan Lal Saini<br>IMSc | On multiplications coming from tangles |
| 14-11-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 14-11-2018 | Santanu Mondal | Moments of pion distribution amplitude using OPE on the lattice |
| 15-11-2018 | Madhav Reddy Bagannagari<br>ISI Kolkata | Rigid $C^*$-tensor categories and annular representations |
| 16-11-2018 | Sohan Lal Saini<br>IMSc | Topics in planar algebras and their presentations |
| 16-11-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 16-11-2018 | T. Jayaraman<br>Tata Institute of Social Sciences, Mumbai | The IPCC SR15 Report and Its Implications for Future Climate Action |
| 18-11-2018 | Tamil Nadu Science Forum | Nobelprizes in Physics and Climate Change/Economics |
| 19-11-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 19-11-2018 | Roji Pius<br>UC, Davis | Introduction to closed superstring field theory: Lecture 1 |
| 20-11-2018 | Roji Pius<br>UC, Davis | Quantum spacetime from quantum entanglement |
| 21-11-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 21-11-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 22-11-2018 | Madhav Reddy Bagannagari<br>ISI Kolkata | Rigid $C^*$ tensor categories and annular representations |

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| 22-11-2018 | Roji Pius<br>UC, Davis | Introduction to closed superstring field theory: Lecture 2 |
| 22-11-2018 | Apoorva Khare<br>Indian Institute of Science and Analysis Probability Research Group (Bangalore) | The history of matrix positivity preservers |
| 23-11-2018 | Dhruv Ranganathan<br>Cambridge University | Tropical and analytic geometry |
| 23-11-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 26-11-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 26-11-2018 | Roji Pius | Introduction to closed superstring field theory: Lecture 3 |
| 27-11-2018 | Justin R. David<br>IISc, Bangalore | Applications of moonshine in string compactifications and black holes |
| 28-11-2018 | Justin R. David<br>IISc, Bangalore | Quantum black holes, wall-crossing and mock-modular forms |
| 28-11-2018 | Vani Vemparala | Simulation Techniques in Biology |
| 28-11-2018 | A. Sankaranarayanan<br>TIFR, Mumbai | Riemann Hypothesis and some more conjectures |
| 28-11-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 29-11-2018 | Madhav Reddy Bagannagari<br>ISI Kolkata | Rigid $C^*$ tensor categories and annular representations |
| 29-11-2018 | Rajaram Nityananda<br>Azim Premji University, Bengaluru | Thermal physics revisited |
| 30-11-2018 | Roji Pius<br>UC, Davis | Introduction to closed superstring field theory: Lecture 4 |

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| 30-11-2018 | V. S. Sunder<br>IMSc | Hypergroups and subfactors |
| 30-11-2018 | Nikhil Ramesh<br>BITS Pilani Goa Campus | Dynamics of Gene Regulation<br>Networks: The Role of Structural<br>Balance and Frustration |
| 30-11-2018 | Kaarthik Sivakumar<br>Principal engineer,Cisco,<br>Bangalore | Security and Trust |
| 03-12-2018 | Anantha Padmanabha<br>IMSc | Bundled Fragments of First Order<br>Modal Logic: (Un)decidability |
| 03-12-2018 | Roji Pius<br>UC, Davis | Introduction to closed superstring field<br>theory: Lecture 5 |
| 05-12-2018 | Roji Pius<br>UC, Davis | Introduction to closed superstring field<br>theory: Lecture 6 |
| 06-12-2018 | Massimo Warglien<br>Universit Ca Foscari, Venezia,<br>Italy | Filtering Biotech: detecting the<br>organizational building blocks of the<br>emergent Biotech industry<br>(1972-1981) through network filtration |
| 10-12-2018 | Prajwal Nandekar<br>Center for Molecular Biology<br>(ZMBH), Heidelberg University,<br>Germany | Understanding the differences in<br>Rabbit and Plasmodium actin<br>filament dynamics: Implications for<br>antimalarial drug design |
| 11-12-2018 | Anirban Chakraborti<br>SCIS, JNU, Delhi | Predicting the unpredictable: A case<br>study of financial market crashes |
| 11-12-2018 | Swagatika Sahoo<br>Department of Chemical<br>Engineering, IIT Madras,<br>Chennai | Mathematical modeling of human<br>metabolism |
| 12-12-2018 | Celestine Preetham Lawrence<br>University of Twente, the<br>Netherlands | Neuroevolution in a small-world<br>dynamical system: Experiments on<br>nanoparticle networks, their<br>computational capacity and<br>simulations based on a mean-field<br>model |

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| 14-12-2018 | Karan Fernandes<br>CMI, Chennai | Gauge theories on black hole spacetimes |
| 14-12-2018 | Aradhana Singh<br>IMSc Chennai | Partially bipartite networks are infra-small world |
| 17-12-2018 | Narayan Rana<br>INFN Milan | Three loop QCD corrections to massive form factors and its asymptotic behaviour |
| 17-12-2018 | Thorsten Heidersdorf<br>Max Planck Institute, Bonn. | Tensor product decomposition for the general linear supergroup GL(m—n) |
| 18-12-2018 | Nivedita Bhaskhar<br>UCLA, USA. | On Serre's question and norm principles |
| 18-12-2018 | K. Srinivas Rao, Senior (Retd.),<br>IMSc<br>IMSc, Retd Faculty | Generalized Hypergeometric Functions: Transformations and group theoretical methods |
| 18-12-2018 | Ravi Kunjwal<br>Perimeter Institute for<br>Theoretical Physics | Hypergraph framework for Spekkens contextuality applied to Kochen-Specker scenarios |
| 19-12-2018 | Alessandro Vicini<br>University of Milan | Precision EW measurements at hadron colliders |
| 20-12-2018 | Jean Renault<br>Universit d'Orlans | Generalised Bratteli diagrams and Markov chains |
| 20-12-2018 | E V Sampathkumaran<br>TIFR, Mumbai | Possible evidence for exotic spin-glass features due to geometrical frustration in metallic kagome lattices, R3Ru4Al12 |
| 21-12-2018 | Antonio di Nola<br>University of Salerno, Italy. | On the prime spectrum of MV algebras |
| 22-12-2018 | National Mathematics Day<br>IMSc | National Mathematics Day |
| 22-12-2018 | M. Ram Murty<br>Queen's University | The Ramanujan Tau Function |

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| 24-12-2018 | C.S. Stalin<br>Indian Institute of Astrophysics | Narrow line Seyfert 1 galaxies: A new class of gamma-ray emitting AGN |
| 26-12-2018 | Dieter Suter<br>Technical University, Dortmund, Germany | The second quantum revolution and its impact on information technology |
| 28-12-2018 | P Pavan Kumar<br>IIITDM, Kurnool | Retrieval of Mathematical Expressions |
| 31-12-2018 | G.V. Ravindra<br>UMSL, USA | Vector bundles on hyperrsurfaces |
| 02-01-2019 | Pranabendu Misra<br>University of Bergen | Parameterized Complexity of Network Design Problems |
| 02-01-2019 | R. P. Malik<br>Banares Hindu University | BRST, anti-BRST and Dark Objects |
| 03-01-2019 | Samrat Chatterjee<br>THSTI, Faridabad | Revealing the significance of calcium dynamics in normal cardiac functioning using mathematical models |
| 03-01-2019 | Krishnendu Gongopadhyay<br>IISER Mohali | Conjugation orbits of semisimple pairs in rank one |
| 04-01-2019 | S Lakshmivarahan<br>University of Oklahoma, USA. | Topologies of Complex Networks : Models and Properties |
| 04-01-2019 | Moitri Sen<br>Department of Mathematics, National Institute of Technology (NIT) Patna | Effect of non-local interactions in a prey-predator system |
| 07-01-2019 | Vasavi Sundaram<br>EMBL-EBI, Hinxton, UK | Junk DNA - its role in transcription regulation in normal and diseased tissues |
| 07-01-2019 | Ajit C Balram<br>Niels Bohr Institute, Copenhagen | Parton paradigm for the fractional quantum Hall effect in the second Landau level |

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| 07-01-2019 | T V H Prathamesh<br>University of Innsbruck, Austria | Towards a verified tool for the<br>first-order theory of left-linear and<br>right-ground term rewriting systems |
| 07-01-2019 | S Lakshmivarahan<br>University of Oklahoma, USA. | Dynamics in Networks : Part-I |
| 07-01-2019 | Atish Dabholkar<br>ICTP, Trieste | Quantum Black Holes: An encounter<br>between Hawking and Ramanujan |
| 08-01-2019 | Atish Dabholkar<br>ICTP, Triste | Quantum Black Holes |
| 08-01-2019 | Gautami Bhowmik<br>University of Lille | The Goldbach Problems and zeros of<br>the Riemann zeta functions |
| 08-01-2019 | P. Poulose<br>IIT, Guwahati | Anomalous couplings of Top Quark |
| 08-01-2019 | Atish Dabholkar<br>Abdus Salam International<br>Centre for Theoretical Physics,<br>Trieste | Science and Superstitions |
| 09-01-2019 | Atish Dabholkar<br>ICTP, Triste | Quantum Black Holes |
| 09-01-2019 | Venkat Guruswami<br>CMU | Solving a linear system with a global<br>congruency constraint |
| 09-01-2019 | Sumithra Sankaran<br>CES, IISc, Bangalore | Local interactions, spatial patterns<br>and ecosystem stability |
| 09-01-2019 | Kamalakshya Mahatab<br>NTNU, Norway | Large values of Hardy's Z function |
| 09-01-2019 | Krishnan Rama<br>The School of Good Shepard | Fully constrained neutrino mass<br>matrices and how to model them. |
| 09-01-2019 | S Lakshmivarahan<br>University of Oklahoma, USA. | Dynamics in Networks : Part-I |
| 10-01-2019 | Shankha Banerjee<br>Durham | Constraining certain Higgs couplings<br>at the HL-LHC and beyond. |

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| 10-01-2019 | Marc Bourdon<br>University of Lille | Quasi-isometric invariance of continuous group $L^p$ - Cohomology and applications |
| 11-01-2019 | Sruthy Murali<br>IMSc | Planar algebras, quantum inormation theory and subfactors |
| 11-01-2019 | Mehedi Masud<br>IFIC, Valencia | Exploring Lorentz Invariance Violating (LIV) parameters at DUNE and its impact on octant studies. |
| 16-01-2019 | Ashish Mishra<br>Universidade Federal do Para | On representation theory of partition algebras for complex reflection groups |
| 16-01-2019 | Arunprasath<br>IMSc | Polarization of a vector boson produced in decay of a heavy fermion in an arbitrary frame |
| 16-01-2019 | Mandira Mondal<br>Chennai Mathematical Institute | Basics of toric varieties |
| 16-01-2019 | Dhivya Manogaran<br>IISc Bangalore | Water as a Solvent through Static Dynamic Calculations - A Theoretical Perspective |
| 16-01-2019 | Anupam H<br>IMSc | Generalised Coherent states in Yang-Mills Theory and Asymptotic Symmetries |
| 16-01-2019 | Anirbit Mukherjee (Johns Hopkins University, USA)<br>Johns Hopkins University, USA | Special lecture in the Machine Learning Course: Deep neural circuits |
| 17-01-2019 | Sruthy Murali<br>IMSc | Planar algebras, quantum information theory and subfactors |
| 17-01-2019 | Chiranjib Mukhopadhyay<br>HRI–Allahabad | Turn on a quantum switch for improved quantum technology |
| 18-01-2019 | Naqueeb Warsi<br>NUS Singapore | Building blocks for communication over noisy quantum networks |
| 18-01-2019 | C. Jebarathinam<br>S. N. Bose National Centre for Basic Sciences | Remote state preparation using correlations beyond discord |

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| 21-01-2019 | S Krishnaswamy<br>IMSc | Bio-2 Lecture |
| 22-01-2019 | S Krishnaswamy<br>IMSc | Bio-2 Lecture |
| 23-01-2019 | S Krishnaswamy<br>IMSc | Bio-2 Lecture |
| 23-01-2019 | Arghya Chattopadhyay<br>IISER, Bhopal | Emergent Phase Space Description of<br>Unitary Matrix Model |
| 24-01-2019 | Sruthy Murali<br>IMSc | Planar algebras, quantum information<br>theory and subfactors |
| 24-01-2019 | S Krishnaswamy<br>IMSc | Bio-2 Lecture |
| 24-01-2019 | Arghya Chattopadhyay<br>IISER, Bhopal | Consequences of Integrable<br>Representations on Chern-Simons<br>Theory |
| 29-01-2019 | N. Saradha<br>CBS, Mumbai | Rational points on Erdős Selfridge<br>superelliptic curve and its variants. |
| 29-01-2019 | Arghya Chattopadhyay<br>IISER, Bhopal | Matrix models |
| 29-01-2019 | S Krishnaswamy<br>IMSc | Bio-2 course |
| 30-01-2019 | S Krishnaswamy<br>IMSc | Bio-2 course |
| 31-01-2019 | Sohan Lal Saini<br>IMSc | Topics in planar algebras and their<br>presentations |
| 31-01-2019 | S Krishnaswamy<br>IMSc | Bio-2 course |
| 01-02-2019 | Anuj Tawari<br>IMSc, HBNI | (PhD Thesis Defense) Lower bounds<br>for read-once and tropical formulas |

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| 01-02-2019 | Joydeep Mukherjee<br>IMSc, HBNI | (PhD Thesis Defense) Approximation Algorithms for Stochastic Matchings and Independent Sets |
| 01-02-2019 | S Krishnaswamy<br>IMSc | Bio-2 course |
| 01-02-2019 | Miguel Campiglia<br>University of Montevideo,<br>Uruguay | Asymptotic Charges in QED: Moving beyond tree level |
| 04-02-2019 | Thomas B. Bahder<br>US Army Research Office, Asia<br>Pacific Region, Tokyo - Japan | Topological Quantum Sensors |
| 04-02-2019 | Subramanya Hegde<br>IISER, Trivendrum | A new N=2 density formula in four dimensions with applications to Real Scalar/Tensor Multiplet |
| 05-02-2019 | Nishant Chandgotia<br>Einstein Institute of<br>Mathematics | Universal models in ergodic theory |
| 05-02-2019 | Thomas B. Bahder<br>U. S. Army Research Office,<br>Tokyo - Japan | Army Research Office (ARO) Overview and Physics Division Objectives in Asia-Pacific |
| 06-02-2019 | Aradhita Chattopadhyaya<br>IISc, Bangalore | Applications of Mathieu Moonshine in N=4 supersymmetric theories |
| 06-02-2019 | Subrata Dev<br>SNBNCBS, Kolkata | Effect of extra-cellular nutrient environment and intra-cellular biochemical conditions on the chemotactic performance of E. coli |
| 06-02-2019 | Tathagata Ghosh<br>U Hawaii | Complementarity between Higgs searches at the LHC and Gravitational Waves signals |
| 07-02-2019 | J. Sivaraman<br>IMSc | On Euclidean ideal classes |
| 07-02-2019 | Ranjani Seshadri<br>IISc Bangalore | "Cornering" the electrons on a topological insulator - Higher order topological insulators |

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| 07-02-2019 | Tathagata Ghosh<br>U Hawaii | Probing Squeezed Bino-Smuon Spectra with the Large Hadron Collider |
| 08-02-2019 | Aradhita Chattopadhyaya<br>IISc, Bangalore | Applications of moonshine symmetry in string theory |
| 08-02-2019 | Amit Mukherjee<br>IMSc | Unextendible k-separable bases and different inequivalent multipartite entangled subspace |
| 08-02-2019 | String theory group meeting<br>IMSc | NA |
| 11-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 11-02-2019 | Juergen Horbach<br>University of Duesseldorf | On the yielding of solids |
| 11-02-2019 | Sunil Mukhi<br>IISER, Pune | Towards a classification of two-character conformal field theories |
| 11-02-2019 | Alain Finkel<br>LSV, CNRS  ENS Paris-Saclay, France | What is thinking in mathematics and computer science ? |
| 12-02-2019 | Ramanathan S Thinniyam<br>IMSc, HBNI | Definability and decidability in the first order theory of graph order |
| 12-02-2019 | Nishad Kothari<br>University of Campinas | Pfaffian Orientations and Conformal Minors |
| 12-02-2019 | Sunil Mukhi<br>IISER, Pune | Towards a classification of two-character conformal field theories |
| 12-02-2019 | Supratik Chakraborty<br>Indian Institute of Technology, Mumbai | Knowledge Compilation for Boolean Functional Synthesis |
| 12-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 12-02-2019 | Florian Sprung<br>Arizona State University | Elliptic Cruves and the Birch and Swinnerton-Dyer Conjecture |

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| 13-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 14-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 14-02-2019 | Jaikrishnan Janardhanan<br>IIT Madras | Holomorphic mappings into the<br>symmetric product of a Riemann<br>surface |
| 15-02-2019 | Madhusudhan Raman<br>TIFR, Mumbai | Aspects of Hecke symmetry |
| 15-02-2019 | Kajari Gupta<br>Indian Institute of Science<br>Education and Research (IISER)<br>Pune | Emergent Dynamics of Slow and Fast<br>Systems on Complex Networks |
| 15-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 15-02-2019 | G Baskaran<br>IMSc, Chennai | Private Funding for Basic Sciences in<br>India |
| 18-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 19-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 19-02-2019 | Ashutosh Rai<br>International Institute of<br>Physics, Federal University of<br>Rio Grande do Norte, Natal,<br>Brazil | Geometry of the Quantum Set on<br>No-Signaling Faces |
| 20-02-2019 | Aarti Jajoo<br>Baylor College of Medicine,<br>Houston, USA | Computational Mathematics in<br>Biomedical Sciences |
| 20-02-2019 | Najimuddin Khan<br>IISc, Bengaluru | Sensitivity of TeV scale new physics<br>on electroweak metastability |
| 20-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |

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| 21-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 21-02-2019 | Xavier Viennot<br>CNRS, France | Proofs without words: the example of the Ramanujan continued fraction |
| 21-02-2019 | Tanmoy Paul<br>IACS, Kolkata | The inflationary universe in F(R) gravity with antisymmetric tensor fields and their suppression during the universe evolution |
| 22-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 22-02-2019 | Shreyansh Shankar Dave<br>IMSc | Magneto-hydrodynamics for Relativistic Heavy-ion Collisions |
| 25-02-2019 | W. Kohnen<br>University of Heidelberg | On the Ramanujan-Petersson conjecture for modular forms of half-integral weight |
| 25-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 26-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 course |
| 27-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 course |
| 27-02-2019 | A. Gopakumar<br>TIFR, Mumbai | Blazar OJ287 and its nano-Hertz GW emitting massive BH binary central engine |
| 28-02-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 course |
| 28-02-2019 | Abhimanyu Susobhanan<br>TIFR | Ready-to-Use Timing Residuals from Relativistic Eccentric Black Hole Binaries |
| 01-03-2019 | Joshua Blinkhorn<br>Friedrich-Schiller University,<br>Jena, Germany | Building strategies into QBF proofs |

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| 01-03-2019 | Thomas E. Browder<br>University of Hawaii at Manoa | Belle II and SuperKEKB: New Physics and the Next Generation |
| 05-03-2019 | Krishanu Roy<br>IMSc | Maximal closed subroot systems of affine root system |
| 06-03-2019 | Jayakumar<br>IMSc | Hopf algebras |
| 06-03-2019 | Richa Tripathi<br>Department of Physics, IIT Gandhinagar | Characterizing functional brain networks and emotional centers for different 'rasas' in Indian natyasastra |
| 06-03-2019 | Indranil Das<br>Saha Institute | Heavy quark measurements with ALICE at the LHC |
| 07-03-2019 | Abhishek Sankaran<br>Dept. of Computer Science, University of Cambridge | Hereditariness in the finite and prefix classes of first order logic |
| 07-03-2019 | Eduard Vives<br>University of Barcelona | Avalanche dynamics in First-Order Phase Transitions |
| 08-03-2019 | Abhiram Kaushik<br>IISc, Bengaluru | Probing the gluon Sivers function (GSF) at RHIC |
| 11-03-2019 | IMSc members<br>IMSc | Institute Seminar Day |
| 12-03-2019 | Jilmy P. Joy<br>Institute of Mathematical Sciences | Shock propagation in dilute inelastic and elastic media (Pre-synopsis seminar) |
| 13-03-2019 | Punyabrata Pradhan<br>SN Bose National Centre for Basic Sciences, Kolkata | Characterizing fluctuations in driven many-body systems |
| 14-03-2019 | S. K. Khanduja<br>Indian Institute of Science Education and Research, Mohali, India. | On integrally closed domains and their applications in Number Theory. |
| 14-03-2019 | Shouvik Datta<br>UCLA | Modular invariance in 2d quantum field theories |

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| 15-03-2019 | Pranendu Darbar<br>IMSc | Correlation of multiplicative functions. |
| 15-03-2019 | Dipanjan Mandal<br>Institute of Mathematical<br>Sciences | Entropy driven phase transitions in<br>hard core lattice gases (Pre-synopsis<br>seminar) |
| 15-03-2019 | Sanjoy Mandal<br>IMSc | Search for sterile neutrinos at colliders |
| 15-03-2019 | Shouvik Datta<br>UCLA | Aspects of the TTbar deformation |
| 15-03-2019 | Shashikant Singh Kunwar<br>IIT Madras/Zhejiang University | Combined effect of interactions and<br>spin-dependent disorder in the two<br>dimensional Hubbard model |
| 18-03-2019 | IMSc members<br>IMSc | Institute Seminar Day |
| 19-03-2019 | Shibananda Biswas<br>IISER Kolkata | Reducing submodules of Hilbert<br>modules with an invariant kernel and<br>analyticChevalley-Shephard-Todd<br>Theorem |
| 19-03-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 20-03-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 20-03-2019 | Hridis Pal<br>IIT Bombay | New Surprises in Quantum<br>Oscillations |
| 21-03-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |
| 21-03-2019 | Om Prakash<br>University of Lucknow | Computations for observation of<br>impact/ response of small molecule in<br>in-vitro, in-vivo and theoretical<br>bio-systems for therapeutic purposes |
| 22-03-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 Course |

| 22-03-2019 | Dharmesh Jain<br>SINP, Kolkata | Twisted Indices of 3d N=2<br>Affine-ADE Quivers |
|---|---|---|
| 25-03-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 |
| 26-03-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 |
| 26-03-2019 | Avijit Nath<br>IMSc | Topology of Dold manifolds |
| 26-03-2019 | Chirag Dhara<br>First Post | Contrasting effects of greenhouse and<br>solar radiative forcing on the climate<br>and hydrologic sensitivity: an analysis<br>using simple climate models. |
| 27-03-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 |
| 27-03-2019 | Chirag Dhara<br>Firstpost | Climate change |
| 28-03-2019 | N. D. Hari Dass<br>TIFR-TCIS, Hyderabad | Topology and Geometry of Yang Mills<br>configuration space |
| 28-03-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 |
| 28-03-2019 | Sathish K Sukumaran<br>Yamagata University | Entanglements in Polymer Liquids:<br>From monodisperse melts to binary<br>blends |
| 29-03-2019 | Parameswaran Sankaran<br>IMSc | Topology of 3-manifolds |
| 29-03-2019 | S Krishnaswamy<br>IMSc, Chennai | Biology-2 |
| 29-03-2019 | Hiranmaya Mishra<br>Physical Research Laboratory | Color superconductivity in magnetized<br>quark matter |

# Chapter 5

# External Interactions

## 5.1 Collaborative Projects with Other Institutions

### 5.1.1 Indian Pulsar Timing Array (InPTA) experiment

Pulsar Timing Array (PTA) uses an ensemble of pulsar clocks in an attempt to detect Gravitational Waves (GW) from a stochastic background resulting from a superposition of an ensemble of super-massive black hole binary systems (BSMBH). The Indian PTA (InPTA) experiment is going on since 2015 using the Giant Metrewave Radio Telescope (GMRT) and the Ooty Radio Telescope (ORT). Observations and data analysis is going on. The preliminary results were presented in the 2016 Meeting of International Pulsar Timing Array in South Africa. Presently 10 people are involved in this project, members are affiliated to NCRA-TIFR Pune, TIFR Mumbai, IIT-Hyderabad, West Virginia University (USA), ASTRON (The Netherlands), IMSC Chennai (Manjari Bagchi, Dhruv Pathak). IMSc faculty M. Bagchi is a member (out of three) of InPTA steering committee. M. Bagchi is also the chair of the scientific organising committee of the meeting of the Interrnational Pulsar Timing Array to be held in June 2019 in Pune.

### 5.1.2 Indo-U.S Joint R&D Networked Joint Center Programme: Emergence and Re-modeling of force chains in soft and Biological Matter

A R& D Networked joint Center involving partners at Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, India, (Srikanth Sastry), Brandeis University, Waltham, MA, USA, (Bulbul Chakraborty), National Centre for Biological Sciences, Bengaluru, (Madan Rao), Institute of Mathematical Sciences, Chennai, (Pinaki Chaudhuri) and Northeastern University, Boston, (Dapeng Bi), to pursue theoretical and computational research on the localization of pathways by which stress propagates in disordered, soft matter and biological systems, and their implications for the propagation of dynamical correlations, and information, in these systems, and in the latter context, their implications for biological function.

### 5.1.3   Max Planck Partner Group in Mathematical Biology

In the partner group, we are employing concepts from geometry to develop and apply methods based on edges rather than nodes in graphs for differential or comparative analysis of condition-specific biological networks. We are developing general methods that can compare condition-specific networks irrespective of their mathematical representation, and thus, will be applicable to labeled or unlabeled graphs, unweighted or weighted graphs, and undirected or directed graphs. In collaboration with Prof. Jürgen Jost, our partner and host in MPIMIS Leipzig, we have recently introduced an edge-based measure, Forman-Ricci curvature, for the geometrical characterization of complex networks which is applicable to unweighted or weighted graphs and undirected or directed graphs. Forman-Ricci curvature is a concept inspired from Riemannian and polyhedral geometry which quantifies the extent to which the network spreads out at the ends of edges in a complex network. Forman-Ricci curvature is simple to compute in large networks, and its statistics capture global network properties better than more traditional node-based measures in both model and real-world networks. Moreover, the associated Forman-Ricci flow is also a concept inspired by deep results in geometry that offers an elegant scheme for denoising networks. Forman-Ricci curvature also presents a natural method to quantify the difference between multiple networks, via so-called Wasserstein distance, inspired by optimal transport theory. In the partner group, we want to further develop this scheme in collaboration with the group of Prof. Jürgen Jost, and explore its potential applications in a systematic manner to different types of biological networks.

### 5.1.4   Mechanism of Active Intracellular Transport:  Connecting Theory and Experiment

This DAE-Plan project attempts to combine experimental investigations, using fluorescence microscopy, of the motion of vesicle in axons of touch neurons of C. elegans with theoretical models. Smooth axonal transport is crucial for the healthy functioning of nerve cells and impairment of this transport is often seen in neurodegenerative disease. We plan to closely link the theory and experimental observations to come up with a detailed simulation of axonal transport mechanisms which can then be compared to experiments.

### 5.1.5   Modeling Soft Glass flow from micro to macro scale (CE-FIPRA Project No 5604-1)

The project, funded via CEFIPRA, is a collaboration between Dr. Kirsten Martens, Laboratoire interdisciplinaire de Physique, Universit Grenoble Alpes, Grenoble, and Pinaki Chaudhuri, IMSc, starting from December 2016, for a period of three years. The aim of this project is to understand the complex dynamical features during the yielding and subsequent flow of dense soft disordered materials, via a multi-scale approach, using computational and analytic techniques. Such an approach is necessary in linking macroscopic experimental observations to material's properties at micro-scale, thereby leading to designing new materials. To develop valid descriptions across the scales involved, we start from the scale of individual particles, grains or bubbles, which are modeled using molecular dynamics simulations. Based on these microscopic studies, we aim at coarse-graining the dynamics to stochastic lattice models on the scale of plastic rearrangements. These simpler models are the ideal

starting point for a statistical approach to derive stochastic evolution equations for the probability distributions of local observables, relevant for the yielding process. The originality in this bottom up approach, bridging different scales, is the combination of consistent simultaneous studies on the micro and the meso-scale to ensure the validity of the assumptions made for the simplified scenarios, which can thereafter be used to predict effects on larger length-scales.

### 5.1.6 Representation Zeta Functions

Scheme for Promotion of Academic and Research Collaboration project in collaboration with IISc Bangalore, and the Australian National University, Canberra.

### 5.1.7 Size Matters: Predicting personalized risk of SGA

An 18-month project, part of "Grand Challenges India: Maternal and Child Health", funded by BIRAC, DBT and Bill and Melinda Gates Foundation. The project seeks to use in-house data from collaborators, and data from the Gates Foundation "knowledge integration" initiative to build models to predict the risk of babies being born "small for gestational age" (SGA). Investigators are Leelavati Narlikar of CSIR-NCL Pune (PI), Gautam Menon and Rahul Siddharthan of IMSc, all of whom bring modelling and machine-learning expertise; and Uma Ram of Seethapathy Clinic, Chennai, and P Saravanan of University of Warwick, UK, who are both medical professionals. LN and RS attended a "Gates Grand Challenges Partners" meeting in New Delhi on March 14-16, 2019.

### 5.1.8 Survey for Pulsars and Fast Transients with the upgraded GMRT : A Pilot Study

A pilot survey to discover new for pulsars and radio transients using the upgraded GMRT (uGMRT) is ongoing. More than 100 hours of observations have been performed and data analysis is ongoing. So far, two new pulsars have been discovered. The results have been presented at various national conferences by various team members.

Members of this project are affiliated to various Indian and foreign Institutes, like NCRA-TIFR Pune, IMSc Chennai (Manjari Bagchi) SINP Kolkata, IUCAA Pune, RRI Bangalore, NISER Bhubaneswar, University of California Berkeley (USA), and ASTRON (The Netherlands), etc. GMRT is operated by NCRA-TIFR, Pune.

## 5.2 Institute Associateships

## 5.3 Conference Participation and Visits to Other Institutions

**Arvind, V.**

Participated in *International Conference on recent trends in Graph Theory and Combinatorics (ICRTGC-2018)* held at Cochin University of Science and Technology during Apr 26 – Apr 29, 2018.

Participated in *Algebraic Methods in Computational Complexity* held at Schloss Dagstuhl, Leibniz-Zentrum fuer Informatik, Germany during Sep 23 – Sep 28, 2018.

Participated in *Ramanujan Math and IT Conference, RMIT 2018* held at International Institute of Information Technology, Bangalore during Oct 30 – Oct 31, 2018.

Participated in *Algebraic Methods (Lower Bounds in Computational Complexity)* held at Simon's Institute for the Theory of Computing, Berkeley University, USA during Dec 3 – Dec 7, 2018.

**Ashok, Sujay K.**

Visited Department of Physics,INFN, Torino during Apr 15 – Jul 11, 2018. Collaboration on the physics of surface operators in 4d gauge theories

Participated in *Quantum fields, geometry and representation theory* held at ICTS, Bengaluru during Jul 16 – Jul 27, 2018. Invited speaker

Participated in *Indian Strings Meeting* held at IISER-Trivandrum during Dec 15 – Dec 21, 2018. Student presented work at International strings meeting

**Bagchi, Manjari**

Visited National Centre for Radio Astrophysics - TIFR, Pune, India during Jul 12 – Aug 12, 2018. Performed pulsar observations using the upgraded GMRT telescope, as well as had lots of collaborative discussions.

Visited National Centre for Radio Astrophysics - TIFR, Pune, India during Nov 15 – Nov 25, 2018. Performed pulsar observations using the upgraded GMRT telescope and had intensive collaborative discussions.

Participated in *Probing Relativistic Gravity in the SKA Era Workshop* held at Chiang Mai, Thailand during Jan 26 – Jan 28, 2019. Given a lecture on "Pulsars as Neutron Stars" to to participants (undergraduate students from various universities/colleges in Thailand, India, Nepal, and China).

Participated in *Second Asia SKA Initiative On Neutron Stars (ASIONS)* held at Chiang Mai, Thailand during Jan 29 – Jan 30, 2019. The conference was organised by The National Astronomical Institute of Thailand. Given an invited talk "Eliminating dynamical effects from the observed rate of change of the periods of the pulsars".

Visited Department of Physics and Astronomy, West Virginia Univeersity, USA during Feb 25 – Feb 28, 2019. Discussed collaborative projects. Gave a seminar "Understanding and eliminating external dynamical effects from the observed rate of change in the periods of pulsars".

## Chakrabarti, Subhroneel

Participated in *Indian Strings Meeting-2018* held at IISER-Thiruvananthapuram during Dec 16 – Dec 21, 2018.

Visited Chennai Mathematical Institute during Jan 30 – Feb 20, 2019. Gave a series of lectures titled "Introduction to string perturbation theory"

Participated in *Stringy Days-IV* held at IISER-Pune during Mar 2 – Mar 4, 2019.

## Chaudhuri, Pinaki P.

Participated in *CECAM workshop "Dynamic phenomena at interfaces"* held at Freie Universitt, Berlin during Oct 4 – Oct 6, 2018. Talk on "Cavitation in amorphous solids"

Participated in *6th Indian Statistical Physics Community Meeting* held at ICTS Bangalore during Feb 14 – Feb 16, 2019. Talk on "Residual stress in amorphous solids"

## Gopalakrishna, Shrihari

Participated in *XXIII DAE-BRNS High Energy Physics Symposium*, held at Indian Institute of Technology Madras(IITM), Chennai, during Dec 10 – Dec 14, 2018.

Participated in *International meeting on High energy Physics (IMHEP 2019)*, IOP Bhubaneswar, during Jan 17 – Jan 22, 2019.

Participated in  *Workshop on "Is SUSY still the best bunker to hide in, in light of experimental data?"*, IISc Bengaluru, during May 10 – May 13, 2018. **Jacob, Ashwin**

Participated in *The 13th International Computer Science Symposium in Russia* held at National Research University Higher School of Economics, Moscow, Russia during Jun 6 – Jun 10, 2018. Presented the paper "Structural Parameterizations of Dominating Set Variants"

**Jakhar, Anuj**

Participated in *ICM 2018* held at Rio de Janeiro, Brazil during Aug 1 – Aug 9, 2018.

Participated in *6th Heidelberg Laureate Forum* held at Heidelberg, Germany during Sep 23 – Sep 28, 2018.

Participated in *International Conference on Class Groups of Number Fields and Related Topics 2018* held at HRI Allahabad during Oct 8 – Oct 11, 2018.

Visited Indian Institute of Science Education and Research (IISER-M) Mohali during Nov 13 – Nov 22, 2018.

Participated in *International Conference in Number Theory* held at IISER Thiruvananthapuram during Mar 11 – Mar 13, 2019.

**Lodaya, Kamal**

Participated in *27th Computer Science Logic conference* held at University of Birmingham during Sep 4 – Sep 7, 2018. Presented the paper "An algebraic decision procedure for two-variable logic with a between relation".

Visited Peking University on Oct 16, 2018. Gave a talk on "Logic, automata and algebra".

Participated in *4th Asian philosophical logic workshop* held at Tsinghua University, Beijing during Oct 20 – Oct 21, 2018. Gave an invited talk on "Unary temporal logics, points and intervals".

Visited TIFR Mumbai during Nov 25 – Nov 28, 2018.

Participated in *38th FSTTCS conference* held at Ahmedabad University during Dec 10 – Dec 13, 2018.

Participated in *7th Indian School on Logic and Applications, Part 2* held at IIEST, Shibpur during Dec 17 – Dec 19, 2018. Gave a course of lectures on "Finite automata, behaviour and structure".

**Mahajan, Meena B.**

Visited CSE Dept, IIT Bombay on Apr 17, 2018. Gave a talk titled "Lower bound techniques for QBF proof systems".

Visited University of Paris-Diderot, Paris, France during Jul 1 – Jul 6, 2018. Gave a talk titled "Linear decision lists and depth-2 threshold circuits" on 3 July 2018.

Participated in *Workshop on Proof Complexity, in FLoC (Federated Logic Conference)* held at Oxford University during Jul 7 – Jul 8, 2018. Gave an invited talk titled "Lower Bound Techniques in QBF Proof Systems" in a joint session of this workshop and the workshop *Quantified Boolean Formulas and Beyond*.

Participated in *Workshop on Boolean Devices, part of the semester program on Lower Bounds in Computational Complexity* held at Simons Institute for the Theory of Computing, University of California at Berkeley, USA during Sep 10 – Sep 14, 2018. gave a talk titled "Locating Linear Decision Lists within $TC^0$".

Visited Friedrich-Schiller University, Jena, Germany, during Sep 16 – Sep 22, 2018. Research collaboration

Participated in *Dagstuhl Seminar on Algebraic Methods in Computational Complexity* held at Leibniz Centre for Informatics, Dagstuhl, Germany during Sep 23 – Sep 28, 2018. Gave a talk titled "Locating Linear Decision Lists within $TC^0$".

Participated in *Workshop on Algebraic Methods, part of the semester program on Lower Bounds in Computational Complexity* held at Simons Institute for the Theory of Computing, University of California at Berkeley, USA during Dec 3 – Dec 7, 2018.

Participated in *FSTTCS* held at Ahmedabad University during Dec 11 – Dec 13, 2018.

Participated in *CSA50-Pratiksha Trust Workshop on Theoretical Computer Science* held at IISc, Bangalore during Jan 2 – Jan 3, 2019. Give an invited talk titled "Short proofs in QBF expansion".

Visited Tata Institute of Fundamental Research on Feb 15, 2019. Gave a talk titled "Building strategies into QBF proofs" in the STCS colloquium series.

Participated in *Symposium on Theoretical Aspects of Computer Science STACS* held at Technical University, Berlin, Germany. during Mar 13 – Mar 16, 2019. A paper titled "Building Strategies into QBF Proofs" was presented (by a co-author).

Participated in *Dagstuhl Seminar on Computational Complexity of Discrete Problems* held at Leibniz Centre for Informatics, Dagstuhl, Germany during Mar 17 – Mar 22, 2019. Gave a talk titled "Building strategies into QBF proofs"

Participated in *Workshop on Algebraic Complexity Theory* held at ICTS, Bengaluru, India during Mar 25 – Mar 29, 2019.

**Menon, Shakti N.**

Participated in *ANZIAM 2019* held at Nelson, New Zealand during Feb 3 – Feb 7, 2019. Presented a talk entitled "A unified mechanism for spatiotemporal patterns in somitogenesis"

**Mukhopadhyay, Partha**

Participated in *Indian Strings Meeting 2018* held at IISER Thiruvananthapuram during Dec 16 – Dec 21, 2018.

**Murthy, M.V.N.**

Participated in *Lecture workshop on "Quantum Information and Quantum Computing"* held at St. Philomena's College, Mysore during Aug 18 – Aug 20, 2018, (Supported by the three National Academies). Course Director

Participated in *National workshop on High Energy Physics* held at Sree Sankara College, Kalady during Oct 29 – Oct 31, 2018. Delivered 5 lectures as Resource person.

Participated in *Refresher Course on "Quantum Mechanics for Nuclear and Particle Physics".* held at BCM College,Kottayam,Kerala during Dec 1 – Dec 15, 2018 (Supported by the three National Academies). Delivered 13 lectures on Introduction to Particle Physics as well as being Course Director.

Participated in *Refresher Course on "Quantum Mechanics towards Nuclear and Particle Physics". (Supported by the three academies IAS, NAS and INSA).* held at St. Philomena's College, Mysore during Dec 17 – Dec 31, 2018. Delivered 12 Lectures on "Relativistic Quantum Mechanics and Particle Physics".

**Pathak, Dhruv**

Visited NCRA, Pune during Dec 20 – Dec 31, 2018. PTA Observations at GMRT

Participated in *30th meeting of the Indian Association for General Relativity and Gravitation (IAGRG)* held at BITS Pilani, Hyderabad Campus during Jan 3 – Jan 5, 2019. Gave a talk on "Dynamical contributions in the rate of change of the period of radio pulsars"

Visited TIFR, Mumbai during Jan 28 – Feb 2, 2019. Gave seminar talk on "Dynamical contributions in the rate of change of the period of radio pulsars"

Visited ICTS-TIFR, Bengaluru during Feb 25 – Feb 28, 2019. Gave seminar talk on "Dynamical contributions in the rate of change of the period of radio pulsars"

Participated in *2019 URSI Asia-Pacific Radio Science Conference (AP-RASC 2019)* held at India Habitat Centre, New Delhi during Mar 9 – Mar 15, 2019. Gave a talk on the topic "The Indian Pulsar Timing Array" on behalf of the India Pulsar Timing Array Group.

Visited NCRA, Pune during Mar 22 – Mar 28, 2019. PTA Observations at GMRT

## Prasad, Amritanshu

Visited IIT Bombay during Jul 23 – Jul 24, 2018. Gave seminar talk

Visited IIT Madras on Aug 30, 2018. Mathematics colloquium

Participated in *Pysangamam 2018* held at IIT Madras during Sep 7 – Sep 8, 2018.

Participated in *Workshop on group theory* held at IISER Pune during Feb 22 – Feb 23, 2019. Invited speaker.

## Jayakumar, R.

Participated in *Annual Foundation School - III (2018) - Kozhikode* held at Kerala School of Mathematics,Kozhikode, Kerala, India. during Jul 2 – Jul 28, 2018. Conducted 16 hours of tutorials in Algebraic topology and 8 hours of tutorial in Algebra in Annual Foundation School-III (2017).

Participated in *AIS Lie Algebras (2018)* held at Harish Chandra Research Institute, Allahabad, India during Dec 10 – Dec 29, 2018. Gave a talk titled "Quiver Representation and Gabriel's Therorem" on the 27-12-2018.

Visited IIT Madras on Feb 25, 2019. Gave two talk on "Quiver Representation and Gabriel's Therorem" on the following dates. First talk on 25-02-2019 and second talk delivered on 04-03-2019.

Visited IIT Madras on Mar 19, 2019. Gave two talk titled "The Kadison Singer problem and Anderson's Paving conjecture" on the following dates. First talk on 19-02-2019 and second talk delivered on 26-03-2019.

## Raghavan, K. N.

Visited NISER, Bhubaneswar on Apr 7, 2018. HBNI Board of Studies (Mathematical Sciences) meeting

Participated in *Teachers' Enrichment Workshop on Complex Analysis and Galois Theory* held at St. Berchmans College, Chenganacherry, Kerala during May 2 – May 4, 2018. Delivered lectures and conducted tutorials as resource person.

Participated in *Science Academies' Refresher Course in Topology* held at Ramanujan Institute for Advanced Study in Mathematics, Madras University during May 7 – May 11, 2018. Delivered lectures and conducted tutorials as resource person

Participated in *10th Summer Training Programme in Mathematics* held at Ramanujan Institute for Advanced Study in Mathematics during Jun 1 – Jun 5, 2018. Resource person

Participated in *Joint meeting of the Canadian and Indian Member Councils of the Shastri Indo-Canadian Institute* held at India Habitat Centre, Delhi during Jun 9 – Jun 11, 2018. Participated as IMSc representative

Visited Indian Statistical Institute during Jun 12 – Jun 13, 2018. Gave a colloquium talk

Participated in *ATM Workshop on Combinatorial Commutative Algebra* held at IIT Bombay during Jun 18 – Jun 23, 2018. Gave six lectures as resource person.

Participated in *Mid-year meeting of the Indian Academy of Sciences* held at Infosys Campus, Mysuru during Jun 29 – Jun 30, 2018.

Participated in *Science Academies' Lecture Workshop on Algebra* held at Bharatiyar University, Coimbatore during Jul 17 – Jul 18, 2018. Resource person

Visited BARC on Jul 25, 2018. Meeting at HBNI office

Visited HBCSE on Sep 8, 2018. NBHM Library Committee Meeting

Participated in *A discussion on linear algebra and its applications* held at VIT, Vellore on Sep 10, 2018. Gave two lectures to participants of the meeting

Visited KSOM, Kozhikkode on Sep 29, 2018. Meeting of the steering committee of the KSOM's Nurture programme

Visited University of Mysore during Oct 26 – Oct 27, 2018. Meeting related to Karnataka State Eligibility Test

Visited Indian Institute of Science on Nov 8, 2018. Eigenfunction seminar speaker

Visited Meenakshi College for Women, Chennai on Nov 14, 2018. Review committee meeting

Participated in *7th Refresher Course in Mathematical Science* held at UGC-HRDC University of Mysore during Nov 19 – Nov 20, 2018. Resource person

Participated in *Indian Mathematical Society 84th Annual Conference* held at SMVDU, Jammu during Nov 27 – Nov 30, 2018. Delivered the V. Ramaswamy Aiyer Memorial Award Lecture

Visited Indian Academy of Sciences on Dec 10, 2018. Meeting regarding Summer Research Fellowship

Visited Ramanujan Institute for Advanced Study in Mathematics on Dec 21, 2018. Gave a lecture on the occasion of National Mathematics Day

Visited Annamalai University on Jan 19, 2019. Mathematics departmental meeting

Visited Indian Institute of Science on Feb 12, 2019. NBHM Library Committee Meeting

Visited IISER Kolkata during Feb 15 – Feb 17, 2019. Invited speaker at Mathematics and Statistics Departmental Day

Visited Periyar University, Salem during Feb 26 – Feb 27, 2019. Lectured to Masters and PhD students

Participated in *National Conference on Pure and Applied Mathematics* held at Ramanujan Institute for Advanced Study in Mathematics on Mar 6, 2019. Invited speaker

## Raman, Venkatesh

Participated in *Summer School on Theoretical Computer Science* held at IIIT Bangalore on Jun 22, 2018. Gave a talk on 'Exact Exponential Algorithms'

Participated in *Dagstuhl Workshop on "Synergies between Adaptive Analysis of Algorithms, Parameterized Complexity, Compressed Data Structures and Compressed Indices".* held at Schloss Dagstuhl, Germany during Jul 8 – Jul 13, 2018.

Participated in *Turing Award Lectures* held at IMSc Chennai on Sep 27, 2018. Organised by ACM Chennai Chapter. Gave a talk on Contributions of John Hopcroft and R. E. Tarjan

Visited Indraprastha Institute of Information Technology (IIIT) Delhi on Oct 11, 2018. Gave a talk on 'Models and Algorithms for Space Efficient Computation'

Participated in *ACM Compute Conference* held at Chitkara University, Chandigarh during Oct 12 – Oct 14, 2018.

Participated in *Faculty Development Programme in Computer Science* held at Vysya College, Salem during Nov 16 – Nov 17, 2018. Organised by Periyar University, Salem. Gave three talks on Algorithms and NP-completeness

Participated in *International Conference on Discrete mathematics and Theoretical Computer Sciene* held at SSN College, Chennai on Dec 5, 2018. Gave a talk on 'A tractable parameterization of graph coloring'.

Participated in *10th International Conference on Advanced Computing (ICoAC) 2019* held at Anna University, MIT Campus, Chennai during Dec 13 – Dec 15, 2018. Gave a keynote talk on 'Space Efficient Data Structures'

Visited PSG College of Technology, Coimbatore on Dec 21, 2018. Gave a talk on 'Crown Decomposition and its Applications'

## Ramanujam, R.

Participated in *FSTTCS 2018* held at Ahmedabad University during Dec 10 – Dec 13, 2018. A paper on fragments of first order modal logic.

Participated in *Indian School on Logic and Applications* held at IIEST, Shibpur, Kolkata during Dec 17 – Dec 22, 2018. Gave a set of lectures on the Automata – Logic connection.

**Ravindran, V.**

Visited LAPTH, Annecy, France. Visited CP3, Louvern, Belgium.

**Samal, Areejit**

Participated in *Ethnoveterinary Practices in livestock and poultry* held at TANUVAS, Chennai, India on Apr 11, 2018. Invited Talk

Participated in *Summer School on Drug Design and Development* held at PRIST University, Thanjavur, India during Jul 16 – Jul 20, 2018. Invited Talk

Participated in *Workshop on Network Science for Humanities* held at Max Planck Institute for Mathematics in the Sciences, Leipzig, Germany during Sep 5 – Sep 7, 2018. Invited Talk

Visited IISER, Tirupati on Sep 26, 2018. Invited Talk

Participated in *Back to Future II* held at SCIS, JNU, Delhi, India on Sep 29, 2018. Invited Talk

Visited Department of Physics and Astrophysics, University of Delhi, India on Oct 3, 2018. Invited Talk

Participated in *Young Scientists Conference (YSC) of the India International Science Festival (IISF) 2018* held at Lucknow, India during Oct 4 – Oct 7, 2018. Invited talk and awarded First Prize in Digital India Theme

Visited SINP, Kolkata on Oct 29, 2018. Invited Talk

Participated in *4th Workshop of the Initiative for Biological Systems Engineering (IBSE)* held at IIT Madras, Chennai, India on Nov 15, 2018. Invited Talk

Participated in *87th Annual meeting and Conference of Society of Biological Chemists (India)* held at MAHE, Manipal, India during Nov 25 – Nov 27, 2018. Invited Talk

Participated in *Training program on diversity, documentation, gene banking and database for medicinal plants for Indian Ocean Rim Association (IORA) countries* held at CSIR-CIMAP, Lucknow, India during Nov 25 – Nov 30, 2018. Keynote Talk

Participated in *Workshop on Geometry and Applications* held at ORT Braude College, Israel during Dec 19 – Dec 20, 2018. Invited talk

## Sankaran, Parameswaran

Visited IISER Bhopal during Jan 29 – Jan 31, 2019. Gave two lectures on 'Topology of surfaces and 3-folds'.

Visited Instituto de Matemática e Estatistica, Universidade de São Paulo, São Paulo, Brazil, during Feb 16 – Feb 28, 2019.

Participated in *National Conference on Pure and Applied Mathematics.* held at Ramanujan Institute, University of Madras, Chennai during Mar 6 – Mar 8, 2019. Gave a talk on "Topology of three-manifolds"

Visited Vellore Institute of Technology, Vellore, on Mar 20, 2019. Gave two talks on linear algebra and its applications

## Sathiapalan, Balachandran

Visited Raman Research Institute on Feb 18, 2019. PhD Exam as the external examiner

## Sharma, Sayantan

Visited Bielefeld University and the Helmholtz Institute, Johannes Gutenberg University, Mainz during May 14 – Jul 20, 2018. Research collaboration

Participated in *DAE-BRNS Symposium on High Energy Physics* held at IIT Madras during Dec 10 – Dec 14, 2018. Gave a mini-review talk on "The QCD Equation of State at finite density from lattice"

Visited TIFR Mumbai during Dec 18 – Dec 31, 2018. Research Collaboration, gave a talk titled "Topological objects near the chiral crossover transition in QCD"

Visited Indian Association for the Cultivation of Science during Feb 4 – Feb 8, 2019. Research Collaboration, gave a talk titled "Non-equilibrium phenomena on the lattice"

## Sharma, Vikram

Visited Chinese Academy of Sciences during Jun 30 – Jul 18, 2018. Research collaboration and gave a talk

Participated in *FSTTCS 2018* held at Ahmedabad University, Ahmedabad, Gujarat during Dec 10 – Dec 14, 2018. Attended the conference.

**Sinha, Nita**

Invited to participate and present a talk at Neutrino Physics workshop, held at IIT Mumbai, from Dec. 14th -18th2018.

Invited to participate and present a talk at the International meeting on High energy Physics (IMHEP 2019) which was held at IOP, Bhubaneswar, during the time period 17-22 January, 2019.

Invited Plenary speaker at the the 3rd, Heavy Flavour Meet, at IIT Indore, held from 18-20 March 2019.

**Sinha, Rahul**

Participated in 16th International conference on Flavor Physics and CP Violation (FPCP 2018), University of Hyderabad, July 14 – 18, 2018, Hyderabad, India.

Participated in XXIII DAE-BRNS High Energy Physics Symposium, Indian Institute of Technology Madras(IITM), Chennai, India, Dec 10 – 14, 2018.

**Sinha, Sitabhra**

Participated in *ICTS Workshop on Dynamics of Complex Systems* at ICTS Bangalore, June 26-30, 2018. Gave invited talk on "Emergence of voluntary vaccination behavior in a population of rational agents" and co-organized a session on "Medicine and Public Healt: A Complex Systems Approach?"

Participated in *Workshop organized by CPEPA*, Calcutta University, July 9-13, 2018. Gave lectures on "Statistical analysis of data using MATLAB"

Participated in *National Conference on Mathematical Biology* (NCMB 2018) at National Institute of Technology, Patna, July 7-8, 2018. Gave invited talk on "Strong community organization of populations can promote long-term recurrence of epidemic diseases"

Visited Central University of Rajasthan, Bandarsindri, Sept 6-8, 2018. External member of selection committee and gave seminar talk on pattern formation.

Visited National Institute of Immunology, New Delhi, Sept 12-15, 2018. Several lectures to graduate students on use of statistics for biological research.

Visited Department of Physics, IIT-BHU Varanasi, Oct 27-Nov 1, 2019. Gave a seminar talk on "Patterns, Broken Symmetries and Computation"

Participated in *Network Science Conference*, IIM Ahmedabad, Dec 19-21, 2018. Gave invited talk on "Can structural changes in networks of interactions in financial markets reflect onset

of systemic crises?"

Participated in *DST-SERB School on Nonlinear Dynamics*, Guru Nanak Dev University Amritsar, Dec 21-23, 2018. Gave a series of lectures on spatio-temporal dynamics and pattern formation

Visited ThoughtWorks Engineering for Research. Participated in *Symposium on Science and Engineering of Complex Systems* at ThoughtWorks, Pune on Jan 19, 2019 Gave invited talk on "Networked, Nonlinear and Far-from-equilibrium: Modeling complex reality"

Participated in *1st RBCDSAI Web Science Sysmposium*, IIT Madras, Feb 24-25,2019 Gave invited talk on "How representative is our democracy?"

Participated in *Symposium on Machine Learning Approaches in Bioinformatics*, Department of Bioinformatics, SASTRA University, Thanjavur, March 16, 2019. Gave invited talk on "Cancer Module-omics")

## Sivaraman, Jyothsnaa

Participated in *The mathematics of Artins conjectures* held at Yerevan state university, Armenia during May 21 – May 25, 2018. Participant

Participated in *Workshop on modular forms* held at Kerala School of Mathematics during Oct 12 – Oct 14, 2018. Delivered a talk on "Artin's primitive root conjecture: parallels and ramifications".

Participated in *Diophantine approximation, Transcendence, Topological Dynamics and topics in related areas of Number Theory and Combinatorics* held at RKMVERI, Kolkata during Jan 3 – Jan 13, 2019. Delivered a talk on "Primitive roots for Pjateckii-Sapiro primes".

## Srinivas, K.

Participated in *RMS Annual Conference* held at Delhi University, Delhi during Jun 1 – Jun 2, 2018. Delivered an invited talk with the title 'Zeros of Epstein zeta function'.

Visited IISER, Pune during Sep 6 – Sep 9, 2018. Delivered a colloquium talk on Lindelof hypothesis and its consequences.

Visited Pune University, Pune during Oct 1 – Oct 12, 2018. Delivered a mini-course of lectures on Primality testing and Integer factorization.

Visited IIIT, Bhubaneswar during Oct 29 – Oct 30, 2018. Invited as an external expert to conduct Ph D viva.

Participated in *Advanced Foundational School (AFS)* held at Bhaskaracharya Pratishthana, Pune during Dec 10 – Dec 15, 2018. Delivered a course of 6 lectures in complex analysis.

Visited NIT, Rourkela during Jan 26 – Jan 30, 2019. Attended Curriculum Review meeting, delivered a talk in the mathematics department.

Visited Sambalpur University during Jan 31 – Feb 2, 2019. Delivered 2 talks in the school of mathematics, Sambalpur University.

Visited IMA, Bhubaneswar on Feb 4, 2019. Delivered a talk in the Institute.

## Subramanian, C. R.

Visited Indian Institute of Technology, Jodhpur during Nov 12 – Nov 23, 2018. Visited the CSE department of IIT-Jodhpur and gave lectures of an Algorithms course for undergraduate students.

Visited Indian Institute of Technology - Jodhpur during Mar 24 – Mar 31, 2019. Visited the CSE department of IIT-Jodhpur and gave lectures of Theory of Computation course for undergraduate students.

## Venugopalan, Sushmita

Visited Rutgers University during May 21 – Jun 1, 2018. Research Collaboration

Participated in *Georgia Topology Conference* held at Athens, Georgia, USA during Jun 6 – Jun 10, 2018.

Participated in *ATM workshop on symplectic and contact geometry* held at IISER, Bhopal during Dec 10 – Dec 14, 2018. Gave a series of 5 lectures.

Visited TIFR, Mumbai during Jan 3 – Jan 17, 2019. Research Collaboration

## Viswanath, Sankaran

Participated in *Algebras, Combinatorics and Representation Theory* held at IISER Thiruvananthapuram during Dec 5 – Dec 8, 2018.

## Vivek Ananth

Visited The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy during Aug 4 – Sep 15, 2018. Visited as a Simons visitor for attending "The CODATA-RDA Research Data Science Summer School and Advanced Workshop on Bio-informatics" and for academic interactions with research scientists at ICTP.

Participated in The CODATA-RDA Research Data Science Summer School and Advanced Workshops on Bio-informatics held at The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy during Aug 5 – Aug 24, 2018.

Participated in 87th Annual Meeting and Conference of Society of Biological Chemists (India) (SBCI-2018) held at Manipal Academy of Higher Education, Manipal during Nov 25 – Nov 27, 2018.

Presented a poster on "Systems modeling of protein secretion system in model filamentous fungus".

## 5.4 Visitors

### 5.4.1 Faculty Visitors

| | | |
|---|---|---|
| **Johannes Kobler** | 7.3.18 - 3.5.18 | Humboldt University |
| **Anirban Banerjee** | 3.4.18 - 7.4.18 | IISER, Kolkata |
| **Ramakrishnan, B** | 1.4.18 - 31.7.18 | HRI, Allahabad |
| **Sayan Bhattacharya** | 8.4.18 - 13.4.18 | Univ of Warwick, UK |
| **Dileep Jatkar** | 8.4.18 - 14.4.18 | HRI, Allahabad |
| **Xerxes Tata** | 12.4.18 - 18.4.18 | Univ. of Hawaii |
| **Xavier Viennot** | 14.4.18 - 23.4.18 | Labri Bordeaux |
| **Purabi Mukherjee** | 19.4.18 - 30.4.18 | INSA |
| **Krishnaswamy, S** | 9.4.18 - 20.4.18 | IMSc Visiting Professor |
| **Hari Dass, N.D** | 11.5.18 - 15.5.18 | TIFR, Hyderabad |
| **Venkateswaran, T.V.** | 14.5.18 - 21.5.18 | Vigyan Prasar, DST, NewDelhi |
| **Golam Mortuza Hossain** | 26.4.18 - 29.4.18 | IISER, Kolkata |
| **Rohit Dhir** | 6.6.18 - 15.6.18 | SRM, Kattankulathur |
| **Kanishka Rawat** | 22.5.18 -7.6.18 | College of women, Chandigarh |
| **Sandipan Sengupta** | 26.4.18 - 29.4.18 | IISER, Kolkata |
| **Balachandran V.** | 28.3.18 - 31.3.18 | GSI, Retd |
| **Venkateswaran, T.V.** | 9.6.18 - 13.6.18 | Vigyan Prasad, DST, NewDelhi |
| **Sourav Tarafder** | 2.6.18 - 16.6.8 | Xavier College, Kolkata |
| **Sasidevan V.** | 12.6.18 - 16.6.18 | University of Sciences Tech., Kolkata |
| **Priyotosh Bandyopadhyay** | 14.6.18 - 30.6.18 | IIT, Hyderabad |
| **Steven Spallone** | 17.6.18 - 22.6.18 | IISER, Pune |
| **Anindya S Chakrabarti** | 18.6.18 - 24.6.18 | IISER, Pune |
| **Aritra Banik** | 10.6.18 - 24.6.18 | NISER, Bhubaneswar |
| **Pushkar Joglekhar** | 3.6.18 - 6.7.18 | Vishwakarma Institute of Tech, Pune |
| **Ragavendran, K.** | 4.6.18 - 30.6.18 | Kalasalingam University, Krishnankovil |
| **Ranjitha, K.** | 25.6.18 - 4.7.18 | Samhram Institute of Technology |
| **Ramij Rahaman** | 20.6.18 - 27.6.18 | Allahabad University |
| **Dibyendu Das** | 2.7.18 - 4.7.18 | IIT, Bombay |
| **Mithun Mitra** | 2.7.18 - 31.7.18 | IIT, Bombay |
| **Parimala Raman** | 2.7.18 - 31.7.18 | Emory University USA |
| **Rajeev Singh** | 5.7.18 - 7.7.18 | IIT Bhubaneswar, Varnasi |
| **Venkateswaran, T.V.** | 19.6.18 - 21.6.18 | Vigyan Prasar, DST, NewDelhi |
| **Jayanta Bhattacharya** | 16.7.18 - 20.7.18 | IACS |
| **Marcin Chrzaszcz** | 19.7.18 - 25.7.18 | CERN |
| **David, S** | 1.11.17 - 31.8.18 | University of Paris |
| **Subinoy Das** | 18.7.18 - 21.7.18 | IIA, Bangalore |
| **Shivchaitanya K.V. S** | 23.7.18 - 25.7.18 | BITS, Pilani |

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|---|---|---|
| Shamik Banerjee | 15.7.18 - 21.7.18 | Institute of Physics, Bhubaneswar |
| Venkat Guruswami | 15.7.18 - 21.8.18 | Carneqie Mellon University, USA |
| Pradeesha Ashok | 16.7.18 - 25.7.18 | IIT, Bangalore |
| Raman Sundram | 16.7.18 - 25.7.18 | University of Maryland, USA |
| Anirban Banerjee | 31.7.18 - 2.8.18 | IISER, Kolkata |
| Kumar Murty | 30.7.18 - 10.8.18 | University of Toronto |
| Manickam M. | 6.8.18 - 10.8.18 | KSOM, Kozhikode |
| Vaidy Sivaraman | 6.8.18 - 7.8.18 | University of Central, Florida |
| Sinnakaruppan S. | 13.7.18 - 20.7.18 | INO Project |
| Matteo Paris | 7.8.18 - 20.9.18 | University of Milan, Italy |
| Subinoy Dasgupta | 7.8.18 - 12.8.18 | University of Calcutta |
| Anilatmaja | 22.8.18 - 22.8.18 | IISER, Thirupathi |
| Manickam M. | 22.8.18 - 29.8.18 | KSOM, Kozhikode |
| Venkatasubramanian C.G. | 22.8.18 - 22.8.18 | IISER, Thirupathi |
| Krishnaswamy, S | 6.8.18 - 22.8.18 | Madurai |
| Muthukumar, M | 27.8.18 - 28.8.18 | USA |
| Peter Ngai-sing | 23.8.18 - 4.9.18 | Bates College, USA |
| Daciberg Goncalves | 21.8.18 - 17.9.18 | University of Sao, Brazil |
| Kumar M. C. | 21.8.18 - 17.9.18 | IIT, Guwahati |
| Haridass N. D. | 13.8.18 - 18.8.18 | TIFR, Hyderabad |
| Narasimha Kumar | 17.9.18 - 21.9.18 | IIT, Hyderabad |
| Anilatmaja Arya Samayajuta | 18.9.18 - 18.9.18 | IISER, Tirupati |
| Prakash Mathews S. | 4.9.18 - 13.9.18 | Saha Institute of Nuclear Physics, Kolkata |
| Suvrat Raju | 19.9.18 - 20.9.18 | TIFR, Bengaluru |
| Paritosh Pandya | 28.9.18 - 5.10.18 | TIFR, Mumbai |
| Guruprasad Kar | 14.10.18 - 23.10.18 | ISI, Kolkata |
| Kasi Viswanadham | 15.10.18 - 22.10.18 | IISER, Odisa |
| Ramij Rahaman | 14.10.18 - 23.10.18 | Presidency University |
| Samir Kunkri | 14.10.18 - 27.10.18 | Mahade Bananda Maha Vidhyalaya, West Bengal |
| Shiv Prakash Patel | 15.10.18 - 20.10.18 | IIT, Delhi |
| Oliver Ramare | 15.10.18 - 22.10.18 | University of Marseille |
| Dilip Kumar Maiti | 19.10.18 - 9.11.18 | Vidyasagar University |
| Saumia P.S | 22.10.18 - 2.11.18 | Institute of Nuclear physics, Dubai |
| Mayakh Nilay | 22.10.18 - 21.12.18 | University of Illinois, USA |
| Nirmalendu Ganai | 28.10.18 - 3.11.18 | Vidyasagar University |
| Venkateswaran T. V. | 6.8.18 - 8.8.18 | Vigyan Prasad, New Delhi |
| Sasidevan V. | 5.11.18 - 8.11.18 | CUSAT, Kochi |
| Hidenori Sonoda | 9.11.18 - 24.11.18 | Kobe University |
| Sunil Simon | 12.11.18 - 17.11.18 | IIT, Kanpur |
| Giovanni Landi | 22.11.18 - 24.11.18 | University of Trieste |
| Ragavendran K. | 20.11.18 - 20.12.18 | Kalasalingam Academy of Research and Education, Krishnan Koil |

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|---|---|---|
| Waldschmidt | 24.11.18 - 29.11.18 | Emeritus Prof, Paris |
| Sankaranarayan | 25.11.18 - 1.12.18 | TIFR, Mumbai |
| Aparna Baskaran | 12.10.18 - 31.12.18 | Brandeis University |
| Justin David | 26.11.18 - 28.11.18 | IISC, Bangalore |
| Inderasan Naidoo | 2.12.18 - 4.12.18 | University of South Africa, Johannesburg |
| Jayaraman T | 15.12.18 - 19.12.18 | TIFR, Mumbai |
| Araniza Gyangiren-Valencia | 8.12.18 - 18.12.18 | Valencia |
| Deshpande N.G | 6.12.18 - 14.12.18 | University of Oregon |
| Gyan Prakash | 4.12.18 - 9.12.18 | HRI, Allahabad |
| Anirban Kundu | 11.12.18 - 12.12.18 | University of Calcutta |
| Allesandro Vicini | 13.12.18 - 21.12.18 | University of Milano |
| Thorsten Heidersof | 16.12.18 - 18.12.18 | MPI Bonn |
| Adhikari S.D. | 15.12.18 - 21.12.18 | RKMVERI, Belur |
| Antonio Di Nola | 15.12.18 - 21.12.18 | University of Saleno, Italy |
| Ram Murty | 15.12.18 - 23.12.18 | Queens University |
| Kumar Murty | 15.12.18 - 23.12.18 | University of Toronto |
| Manickam M | 19.12.18 - 22.12.18 | KSOM, Kozhikode |
| Philopon | 16.12.18 - 30.12.18 | CNRS, France |
| Venkateswaran T.V. | 5.7.18 - 10.7.18 & 13.7.18 - 22.7.18 | Vigyan Prasad, New Delhi |
| Mohan Chintamani | 24.12.18 - 30.12.18 | University of Hyderabad |
| Paran Kumar | 28.12.18 - 28.12.18 | IIITDM, Kurnal |
| Krishnendu. G | 23.12.18 - 5.1.19 | IISER, Mohali |
| Malick R.P. | 30.12.18 - 2.1.19 | BHU, Varanasi |
| Ravindran G.V. | 30.12.18 - 31.12.18 | UMSL, USA |
| Lakshmi Varahan S | 1.1.19 - 12.1.19 | Univ of Oklahaoma, Norman |
| Shiv Chaitanya K.V.S | 1.1.19 - 5.1.19 | BITS, Hyderabad |
| Moitri Sen | 31.12.18 - 6.1.19 | NIT, Patna |
| Srinivasa Rao, S. | 2.1.19 - 12.1.19 | Seoul, South Korea |
| Surya Ramana D | 28.12.18 - 27.1.19 | HRI, Allahabad |
| Venkatesan Guruswami | 2.1.19;7.1.19;& 9.1.19 | Carneqie Mellon University |
| Gautami Bhowmik | 6.1.19 - 12.1.19 | University of Lille, France |
| Mare Bouroon | 6.1.19 - 12.1.19 | University of Lille, France |
| Pruisken A.M.M. | 4.1.19 - 25.1.19 | University of Amsterdam |
| Parimala Raman | 3.1.19 - 31.5.19 | Emory University, USA |
| Gyan Prakash | 9.1.19 - 22.1.19 | HRI, Allahabad |
| Jean- Marc Deshouillers | 14.1.19 - 19.1.19 | University of Bordeaux |
| Xavier Viennot | 14.1.19 - 19.1.19 | CNRS, Bordeaux |
| Sheik Abdullah | 20.1.19 - 22.1.19 | Thiagarajar College of Engineering |
| Ramdian Mawia | 20.1.19 - 22.1.19 | ISI, Kolkata |

## 5.4.2 Post Doctoral Visitors

| | | |
|---|---|---|
| Ratnadeep, A. | 1.4.18 - 30.6.18 | ISI, Kolkata |
| Neelam Dhanda | 2.4.18 - 8.4.18 | IIT, Delhi |
| Nilanjana Kumar | 9.4.18 - 15.4.18 | SINP, Kolkata |
| Gourav Narain | 12.4.18 - 17.4.18 | Institute of Theo. Physics, China |
| Gayatri Panickar | 2.4.18 - 20.4.18 | IIT, Guwahati |
| Jai D More | 20.5.18 - 25.5.18 | IIT, Mumbai |
| Arup Roy | 23.4.18 - 3.5.18 | ISI, Kolkata |
| Arjit Dutta | 8.5.18 - 16.5.18 | KIAS, Seoul |
| Narayan Rana | 12.5.18 - 26.5.18 | DESY, Germany |
| Prasanna Venkatesh | 16.5.18 - 18.5.18 | Institute of Quantum optics, Innsbruck |
| Krishna B.S. Swamy | 27.5.18 - 29.5.18 | IMB, Taiwan |
| Manirul Ali | 31.5.18 - 6.6.18 | National Tsing University, Taiwan |
| Dhiraj Hazra | 31.5.18 - 6.6.18 | INFN, Italy |
| Dilpreet Kaur | 3.6.18 - 11.6.18 | IISER, Pune |
| Anosh Joseph | 17.6.18 - 20.6.18 | TIFR, Bangalore |
| Nikhil Ramesh | 2.7.18 - 10.12.18 | BITS, Goa |
| Sandipan De | 26.6.18 - 29.6.18 | ISI, Bangalore |
| Kajal Das | 24.6.18 - 30.6.18 | Institute of Science, Israel |
| Balaraju Battu | 5.7.18 - 5.10.18 | CBCS, Allahabad |
| Sambaran Banerjee | 9.7.18 - 14.7.18 | University of Bonn |
| Shashikant Singh Kunwar | 15.7.18 - 15.10.18 | IIT, Madras |
| Abhishek Roy | 16.7.18 - 20.7.18 | University of Cologne |
| Dharmesh Jain | 30.7.18 - 10.8.18 | SINP, Kolkata |
| Prasad V. V. | 30.7.18 - 10.8.18 | Institute of Sciences, Isreal |
| Amit Chakraborty | 5.9.18 - 8.9.18 | IPNS, Japan |
| Sumanto Chanda | 16.8.18 - 16.11.18 | SN Bose Center For Basic Centre,Kolkata |
| Rahul Srivastava | 11.9.18 - 16.9.18 | IFIC, Spain |
| Minati Biswal | 8.9.18 - 21.9.18 | Institute of Physics, Bhubaneswar |
| Sumanta Chakraborty | 14.9.18 - 16.9.18 | IACS, Kolkata |
| Debajyoti Sarkar | 26.9.18 - 2.10.18 | ITPAC University |
| Arun Kumar | 21.9.18 - 27.9.18 | IISER, Mohali |
| Arnab Pal | 2.10.18 - 5.10.18 | Aviv University, Isreal |
| Diptapriyo Majumdar | 24.09.18 - 6.10.18 | IMSc, Chennai |
| Anirudh Reddy | 7.10.18 - 6.11.18 | Ramar Research Institute, Bangalore |
| Sumanta Pal | 7.10.18 - 6.11.18 | University of Coimbra, Portugal |
| Rishu Kumar Singh | 8.10.18 - 11.10.18 | IIT, Mumbai |
| Shashikant Singh Kunwar | 15.10.18 - 31.10.18 | IIT, Madras |
| Minati Biswas | 22.10.18 - 6.11.18 | IOP, Bhubaneswar |
| Soumyajyoti Biswas | 24.10.18 - 6.11.18 | Max Planck Inst. |
| Santanu Mondal | 21.10.18 - 20.1.19 | Univ. Of Taiwan |

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|---|---|---|
| Kuntal Nayek | 11.11.18 - 10.2.19 | SINP, Kolkata |
| Satyajit Seth | 1.11.18 - 3.11.18 | IPPP, Durban, UK |
| Fahad Panolan | 19.11.18 - 12.1.19 | University of Bergen, Norway |
| Vishwas Venkatesh | 19.11.18 - 12.1.18 | University of Creneble |
| Kabir Ramola | 19.11.18 - 12.1.18 | Brandeis University |
| Chandan Maity | 15.10.18 - 9.12.18 | ISI, Delhi |
| Roji Pius | 17.11.18 - 6.12.18 | University of California |
| Gaurav Rattan | 25.11.18 - 7.12.18 | University of Germany |
| Prajwal Nandekar | 9.12.18 - 11.12.18 | Heidelberg University |
| Maguni Mahakhud | 4.1.19 - 9.1.19 | Saha Institute of Nuclear Physics |
| Anirudh Reddy | 7.11.18 - 7.12.18 | RRI, Bangalore |
| Ravi Kunjwal | 17.12.18 - 23.12.18 | Perimeter Institute, Canada |
| Nivedita Bhaskar | 18.12.18 - 19.12.18 | UCLA, USA |
| Subramani, M | 19.12.18 - 31.12.18 | HRI, Allahabad |
| Pranabendu Misra | 6.12.18 - 20.1.19 | University of Bergen, Norway |
| Krishnan Rama | 7.1.19 - 11.1.19 | Trivandrum |
| Ajit Coimbatore Balram | 6.1.19 - 8.1.19 | Niel's Bohr Institute |
| Prathamesh T.V.H | 31.1.18 - 8.1.19 | University of Innstruct |
| Srimoy Bhattacharya | 7.1.19 - 24.1.19 | IIT, Guwahati |
| Sumithra Sankaran | 9.1.19 - 9.1.19 | Institute of Science, Bangalore |
| Kamalakshya Mahatab | 6.1.19 - 12.1.19 | NTNU, Norway |
| Mehedi Masud | 10.1.19 - 11.1.19 | Valencia, Spain |
| Celestine Preetham Lawrence | 16.1.19 - 15.4.19 | Netherlands |

### 5.4.3 Doctoral Student Visitors

| | | |
|---|---|---|
| Gayathri, B | 28.3.18 - 27.6.18 | Pondicherry university |
| Suryarao Bethapudi | 2.4.18 - 7.4.18 | IIT, Hyderabad |
| Sathish Kumar, P | 15.3.18 - 15.6.18 | University of Madras |
| Suchetana Goswami | 25.3.17 - 25.4.18 | S.N. Bose Center for Basic Sciences |
| Mahashweta Patra | 3.4.18 - 11.4.18 | IISER Kolkata |
| Aditya Banerjee | 3.4.18 - 11.4.18 | HRI, Allahabad |
| Nimisha Pahuja | 16.4.18 - 20.4.18 | IISC Bangalore |
| Gayathri Panicker | 16.4.18 - 20.4.18 | IIT, Guwahati |
| Meena, T | 5.5.18 - 4.8.18 | Idhaya College of Women |
| Vijay Kumar Paliwal | 24.4.18 - 29.4.18 | IIT Jodhpur |
| Richa Tripathi | 25.4.18 - 18.5.18 | IIT Gandhinagar |
| Rusa Mandal | 1.5.18 - 30.6.18 | *IMSc* |
| Manish Kumar Pandey | 4.5.18 - 10.6.18 | HRI, Allahabad |
| Asweel Ahmed | 8.5.18 - 9.5.18 | Pondicherry University |
| Anup Kumar Singh | 8.5.18 - 8.6.18 | HRI Allahabad |
| Harshit Rajgadia | 10.5.18 - 9.7.18 | IIT, Gawahati |

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|---|---|---|
| Asweel Ahmed | 16.5.18 - 17.5.18 | Pondicherry University |
| Priyanka, J | 20.5.18 - 1.11.18 | PSG College Of Technology |
| Sonika | 20.5.18 - 26.5.18 | IIT, Ropor |
| Lalit Vaishya | 24.5.18 - 10.6.18 | HRI Allahabad |
| Arpan Das | 15.5.18 - 1.6.18 | Institute of Physics |
| Jyothsna | 10.6.18 - 15.12.18 | PSG College of Technology |
| Jyotirmoy Ganguli | 18.6.18 - 22.06.18 | IISER Pune |
| Seethalakshmi, K | 18.6.18 - 22.06.18 | IISER Pune |
| Gopalakrishnan | 1.6.18 - 28.07.18 | IIT Bangalore |
| Mitali Thatte | 15.5.18 - 28.02.19 | IISER Pune |
| Neha Malik | 18.6.18 - 22.06.18 | IISER Pune |
| Gopinath Mishra | 11.6.18 - 22.06.18 | ISI, Kolkata |
| Sukanya Pandey | 8.6.18 - 1.03.19 | IISER Pune |
| Mrinalini Ranjan | 15.6.18 - 15.07.18 | IISST |
| Anmol Agrawal | 10.6.18 - 24.07.18 | Shankaracharya Group of Institute |
| Dhamapurkar Shyam Surykant | 19.6.18 - 29.06.18 | University of Pune |
| Pratibha Choudhary | 14.6.18 - 1.07.18 | IIT, Jodhpur |
| Gunda Spoorthy | 17.6.18 - 17.08.18 | IISER, Pune |
| Ankit Sihi | 1.7.18 - 16.07.18 | IIT, Mumbai |
| Pratyush Kumar | 28.5.18 - 20.07.18 | BITS, Goa |
| Sreekanth K. Manikandan | 23.7.18 - 24.07.18 | Slockholm University |
| Abdul Majith | 23.7.18 - 24.07.18 | University of Rome |
| Meena, T | 5.8.18 - 4.11.18 | University of Rome |
| Sumit Shaw | 1.8.18 - 29.10.18 | CMI, Chennai |
| Richa Tripathi | 4.8.18 - 17.08.18 | IIT, Gandhinagar |
| Fahad, P | 20.8.18 - 20.11.18 | Cochin University |
| Lalit Kumar Saini | 16.6.18 - 31.7.18 | University of Delhi |
| Nidhi Gujar | 3.9.18 - 4.9.18 | IBB, Pune |
| Arindam Mallick | 9.8.18 - 7.9.18 | Kolkata |
| Tamilmaran, C | 11.9.18 - 10.12.18 | Tamilnadu Agricultural University |
| Tanmay Mitra | 5.9.18 - 5.10.18 | IMSC |
| Dilnavas Roshan | 15.9.18 - 22.9.18 | CUSAT, Cochin |
| Richa Tripati | 17.9.18 - 28.9.18 | IIT, Gandhinagar |
| Srimoy Bhattacharya | 16.9.18 - 14.12.18 | IIT, Guwahati |
| Aniruddha Vidyadhar Shirsat | 18.9.18 - 16.12.18 | IISER, Pune |
| Narendra Hegade | 10.9.18 - 9.12.18 | NIT, Silchar |
| A.V.S.D. Bharadwaj | 17.9.18 - 26.11.18 | ISI, Bangalore |
| Shilpa Jangid | 17.9.18 - 16.10.18 | IIT, Hyderabad |
| Atanu Bhatta | 1.8.18 - 26.9.18 | IMSc |
| Bidesh Kumar Bera | 23.9.18 - 28.9.18 | ISI, Kolkata |
| Soumyadeep Chaudhuri | 25.9.18 - 27.9.18 | TIFR, Bangalore |
| Shivesh Kumar Roy | 31.8.18 - 30.6.19 | IIT, Patna |
| Theerthagiri, L. | 5.10.18 - 5.1.19 | IMSc |
| Ajay, K | 8.9.18 - 31.10.18 | IISER, Thiruvananthapuram |

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|---|---|---|
| **Kushal, A** | 5.11.18 - 8.11.18 | IISC, Bangalore |
| **Hrushikesh Gore** | 5.11.18 - 9.11.18 | University of London |
| **Sabareeswaran** | 24.10.18 - 31.12.18 | Bharathidasan University |
| **Mrunal Kamble** | 1.11.18 - 31.1.19 | College of Engineering, Pune |
| **Dilnavas Roshan** | 5.11.18 - 5.2.19 | CUSAT, Cochin |
| **Sohan Lal Saini** | 11.11.18 - 18.11.19 | College of Engineering, Naland |
| **Nithin, R** | 20.11.18 - 31.3.19 | Anna University |
| **Rajesh, G** | 20.11.18 - 31.3.19 | Anna University |
| **Sudipta Das** | 12.10.18 - 11.11.19 | IISER, Mohal |
| **Magali Le Goff** | 10.11.18 - 30.11.18 | University of France |
| **Swati** | 10.11.18 - 31.12.18 | HRI Allahabad |
| **Kruttika Bhat, G** | 1.12.18 - 31.3.18 | IIITDM, Kanchipuram |
| **Sudharshan, A** | 1.12.18 - 31.3.18 | Anna University |
| **Kiran Sharma** | 7.12.18 - 14.12.18 | JNU, Delhi |
| **Sivakamameenakshi. P** | 13.12.18 - 31.12.18 | Sastra University |
| **Madhav Sankaranarayanan** | 10.12.18 - 5.1.19 | ISI, Kolkata |
| **Richa Tripathi** | 12.12.18 - 23.12.19 | IIT Gandhinagar |
| **Kavyaa, K** | 17.12.18 - 30.4.19 | Bharathidasan University |
| **Dipayan Chakraborty** | 10.12.18 - 6.1.19 | University of Calcutta |
| **Prabir Kumar Dey** | 10.12.18 - 6.1.19 | University of Calcutta |
| **Adwait Sengar** | 14.12.18 - 23.12.18 | Australia National University |
| **Subramanya Bhat. K.N** | 16.12.18 - 15.3.19 | University of Karnataka |
| **Arunima Bhattacharya** | 4.12.18 - 9.1.19 | Institute of Nuclear Physics |
| **Balachander, N** | 26.12.18 - 25.3.19 | Anna University |
| **Kiran, D** | 1.12.18 - 31.12.18 | IISER, Bhopal |
| **Rahul, B.S.** | 16.12.18 - 10.1.19 | BITS, Pilani |
| **Fahad, P** | 21.11.18 - 20.2.19 | University of Cochin |
| **Pratibha Choudhary** | 22.12.18 - 7.1.19 | IIT, Jodhpur |
| **Spoorthy Gunda** | 15.12.18 - 30.4.19 | Pune |
| **Dhamapurkar Shyam Surykant** | 15.12.18 - 15.5.19 | University of Pune |
| **Nikhil Ramesh** | 7.1.19 - 15.5.19 | KK Birla Campus, Goa |
| **Roopesh Mangal** | 7.1.19 - 6.4.19 | IISC, Bangalore |
| **Anirbit Mukherjee** | 16.1.19 - 17.1.19 | Johns Hopkins University, USA |
| **Kushal, A** | 14.1.19 - 16.1.19 | NCBS, Bangalore |
| **Arindam Mallick** | 31.12.18 - 12.1.19 | Former Student at IMSc |
| **Dhruba Bora** | 10.1.19 - 25.11.19 | IISER, Pune |

### 5.4.4   Non Doctoral Student Visitors

| | | |
|---|---|---|
| **Davood Bashir Dar** | 8.6.18 - 8.7.18 | Aligarh Muslim University |
| **Pavithra Elumalai** | 25.6.18 - 30.11.18 | PSG College of Technology |
| **Harish, K** | 2.7.18 - 31.7.18 | UIUC |

| | | |
|---|---|---|
| **Sudharsan . A** | 9.7.18 - 30.11.18 | Sree Sasta Institute of Tech, Chennai |
| **Arnab Acharya** | 16.8.18 - 30.8.18 | IISER, Kolkata |
| **Madhav Reddy. B** | 27.8.18 - 26.11.18 | ISI, Kolkata |
| **Vaishali Suria-narayanan** | 1.12.18 - 1.6.19 | PSG College of Technology |
| **Nidhi Gujar** | 1.1.19 - 30.4.19 | IBB, Pune |
| **Sarvesh Srinivasan** | 19.12.18 - 20.1.19 | BITS, Pilani |
| **Yashwanth S Prabhu** | 3.1.19 - 30.4.19 | SV National Institute, Surat |
| **Smith Sen** | 2.1.19 - 6.7.19 | SV National Institute, Surat |
| **Anupama. B** | 1.1.19 - 31.3.19 | Amrita School of Engg, Coimbatore |
| **Murali T.S.** | 28.1.19 - 30.4.19 | SSN College of Engg., Chennai |
| **Komal Dilip** | 14.1.19 - 31.3.19 | IISER, Pune |
| | | |
| **Divya Chopra** | 1.1.19 - 30.4.19 | Central Univ. of Rajasthan |
| **Arun Karthiheyan** | 1.1.19 - 31.3.19 | Pacchaiappa's College |

# Chapter 6

# Infrastructure

## 6.1 Computer Facilities

### Enhancement of Computer Facility during 2018-19

- New laptops were issued to newly joined faculty and to those faculty requested replacement of laptops which are older than 4 years. MacBook Pro 13" , Dell XPS , MacBook Pro 15" , Mac Air 13" , Lenovo Yoga L380 laptops were distributed.

- Two new EPSON LCD projectors, two BENQ DLP projectors were installed in the library conference hall and other locations.

- Two Dell Power Edge R740xd servers were installed for data backup purposes. The JEST server was upgraded to higher specification as required.

- Three A3 Laserjet MFP, one A3 Colour laserjet MFP, Three A4 laserjet MFP Kyocera model printers enabled with access control system using RFID card reader connecting the LDAP server under Linux in the LAN were deployed by replacing obsolete printers. Also, three HP Laserjet MFP A4 laserjet printers were replaced in the campus.

- The existing 42 Mbps Internet bandwidth service was renewed for one more year through the service provider M/s. Bharti Airtel.

- Obsolete LAN switches were replaced and additional LAN Switches were deployed for the new library building. OFC redundant back-bone was established for the LAN services in the IMSc campus. Additional WiFi access-points and controller were installed in the campus to cover-up the black spots.

- Maple software was upgraded to 2018 version and Intel PCL Parallel Studio XE cluster edition was installed in the HPC Cluster.

- Central Computer Facility room was refurbished with Access Control System using RFID reader integrated with LDAP server under Linux O/S.

- About 500 hrs of class room video lectures were recorded and uploaded in the media portal page
  (http://ekalavya.imsc.res.in/) after editing and also in IMSc's YouTube channel the

"matsciencechannel". Frequent video conferencing activities were handled with DAE units, national and international institutions and also handled. Remote class-room lectures for IIT Jodhpur and other institutions were also handled.

- On successful completion of PoS billing system of cash-less transaction for the canteen using the IMSc ID(RFID) card under OpenERP(ODOO), the automation of "IMSc visitor form" is under testing phase and HR/Payroll module customization are under process.

**Activities :**

A two day training session on E-Procurement(E-Tender process) via the "Central Public Procurement Portal" under NIC, Government of India, was organized at IMSc during 30-31 October 2018 with the DSC tokens for the Officers involved in the tender activities.

Mr.B. Raveendra Reddy, Scientific Officer-F attended the meeting of the Computer and Information Security Advisory Group (CISAG) on 24 April 2018 at BARC, Mumbai.

Ms. T.V. Hari Priya, Administrative Assistant(Systems) and Ms. P.K. Sreelakshmi, Technical Assistant(ERP) attended a training program on "Linux Security and Network programming in C-language", during 19-21 November 2018 conducted by SETS, Chennai.

## 6.2 The Library

The Institute Library holds a total collection of 74775 books and bound periodicals as on March 31, 2019. This includes an addition of 995 volumes during the current year April 2018 - March 2019. The NBHM has recognized this Institute library as the Regional Library for Mathematics. An average of about 5000 outside users in a year from colleges, universities and research institutions from different parts of the country make use of the library facilities for their academic and research information needs.

The library has a well balanced collection both print and online on the major subject areas of research such as Theoretical Physics, Mathematics and Theoretical Computer Science. The library subscribes to over 350 national and international journals.

The library has access to over 3500+ online journals from major publishers such as Elsevier, American Mathematical Society, American Physical Society, Springer Verlag, World Scientific, Institute of Physics, Wiley, etc.

Library has also access to Nature online, Science Online, ACM Digital Library, SIAM Journals Archive, Duke Mathematical Journal, and JSTOR Full digital archive. It has also perpetual online access to backfile collection of journals contents from Volume 1 from some of the major publishers like Elesevier under DAE consortium, Springer, World Scientific, Wiley, deGruyter, Cambridge University Press, Turpion, IOP Publishing and Annual Reviews Electronic Backvolume collection.

Access to online journals is restricted to members of the Institute.

**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. The Koha software has been customised in-house to support all the library operations including online request for acquisition of books and status of borrowings, serials management, inventory management etc. Library has implemented RFID based system for self check-in and check-out 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.

As a result of library building expansion under 12th five year plan, library has now more space available for the users and collections. New furnitures are also being added to provide a comfortable user experience. The new expanded library is being made as more inviting with better ambience to support researchers to use more time in the library.

Library has a website dedicated to host all the online 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.