

भारतीय विज्ञान शिक्षा एवं  
अनुसंधान संस्थान पुणे

वार्षिक प्रतिवेदन २०१९ - २०२०

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Indian Institute of Science  
Education and Research Pune  
Annual Report 2019 - 2020

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**On the Cover**

The image on the cover represents a quantum wavefunction of a chaotic system and its symmetry decomposition. The quantum energy level fluctuations inform us about the degree of chaos in quantum systems. Without this decomposition, fluctuations hide the symptoms of chaos in quantum dynamics.

Chaos is a dynamical property applicable to a range of situations, from the weather and solar system to even the stock market. Published in the journal *Physical Review Research* (2:032063(R)), this work from Prof. M.S. Santhanam's group studies chaos in quantum systems.

**Image Credit**

S. Harshini Tekur and M.S. Santhanam

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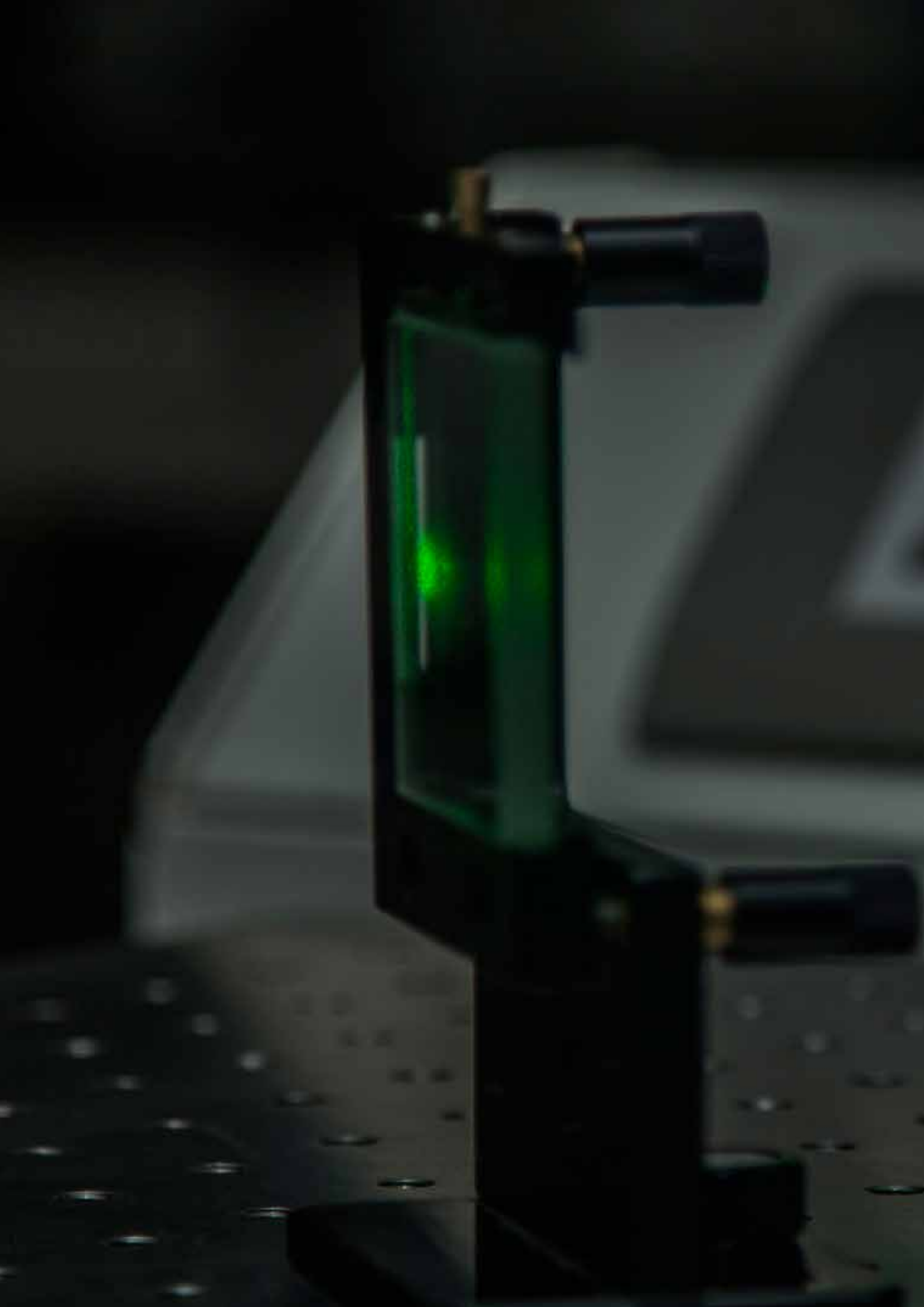
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भारतीय विज्ञान शिक्षा एवं अनुसंधान संस्थान पुणे  
वार्षिक प्रतिवेदन २०१९ - २०२०

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH PUNE  
Annual Report 2019-2020





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**Fostering a culture of excellence and expanding the frontiers of knowledge, IISER Pune is at the forefront of training the next generation of scientists and informed citizens.**

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IISER Pune is an autonomous teaching and research organisation of the Ministry of Human Resource Development (renamed as the Ministry of Education in August 2020), Government of India.

IISER Pune offers undergraduate and graduate programmes in Biology, Chemistry, Earth and Climate Science, Humanities and Social Sciences, Mathematics, and Physics. Researchers at the Institute investigate a wide spectrum of topics in the basic sciences as well as in applied areas of research.

The Institute is ranked 25 in the 2020 India Rankings of the National Institutional Ranking Framework (NIRF); 601-800 in the 2020 Times Higher Education (THE) World University Rankings; and is listed among the top 15 in India for research output by the 2020 Nature Index Tables.

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## FOREWORD

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We have been going through a surreal experience since the lockdown started in March. Our campus then became a ghost campus. With no students around us for the first time in our lives, with no substantive work possible, with apprehensions about our health, and with anxieties about our future, we just about managed to remain sane. But, as a community, we have to be proud that we kept the good health of all as the overriding priority. We can be proud that we were not selfish and gave precedence to our own individual needs. For the Institute to continue to flourish for many years to come, we must give primacy to what is good for our institute over our own individual desires. The pandemic may just about have taught us to do that.

We engaged ourselves in new activities, and there are lessons there too. A COVID-19 testing centre was set up on a completely voluntary basis by faculty, students and staff. This has re-emphasized to us the importance of having an active program in infectious disease research. Faculty members and staff developed a versatile ventilator. This made us realize that we could very well develop other essential medical devices and instruments if we put our minds to it. Research programs related to the treatment of COVID-19 have been started. We now realize that it is not enough to just advertise the potential benefits of the research, as we do to attract funding. Instead, having started such work, we have to advance it right through to the translational stage.

The COVID-19 Task Force has done a marvelous job in planning and overseeing our preparations for bringing back students. It has put in a lot of hard work, and it and the Academic Office have had to deal continually with the idiosyncrasies and demands of individual faculty members. But they will soon have the satisfaction, as we all will, of seeing our campus fully re-populated with PhD students, and with final year BS-MS students, by the end of October. In the past many months, our staff in administration and engineering, and in housekeeping, security, canteen and gardening, have managed, through their dedication and commitment, to give our functioning a semblance of normalcy. We will need the cooperation and vigilance of the entire community to make sure that the policies and rules framed by the Task Force are implemented, as well as followed, strictly and meticulously, for our students' and our own safety.

Online teaching is a poor substitute for classroom teaching. The latter makes it so much easier for faculty members to ensure and gauge the learning outcome and can be so

satisfying to both teacher and student. But we have no choice, and faculty members need to go out of their way to make online teaching as pleasant and fruitful an experience as possible for our students. With its requirement for good internet connections and proper devices, online teaching is a logistical challenge. Yet, it has to be done well. Its implementation must take into account the economic disparities in our society, as well as the poor electricity and internet connections in many parts of our country. Otherwise, the danger is that we will end up increasing the gap between the economically and socially privileged and unprivileged students. We must do all we can to ensure an equitable education for all. Looking at the brighter side of things, once our faculty members become more proficient in teaching online, it is likely that they will become more enthusiastic about developing online courses that will go beyond IISER to benefit the large multitude of students in the country.

Our students, both undergraduate and graduate, have been hit particularly hard by the pandemic. Our undergraduates were transiting through some of the most enjoyable years of their lives. Our PhD students were completing the toughest years of their education. For both, the future might look bleak with the long break in their education and training. As their teachers and mentors, faculty members need to continue to make sure that students see the light at the end of the tunnel. While their formal acquisition of knowledge had a temporary break, education is much more than that. The goal of education is to make us live our lives in a more meaningful, moral and enjoyable manner. In addition to learning through formal mentoring, our students must try and understand life better through self-learning not just science, but history, philosophy and the other humanities, and dare I say it, religion and spirituality. They must continue to sharpen the intellectual and technological skills that they require to enrich their own lives and the lives of those around them. And they can have fun through engaging with family and friends, through listening to music, through reading literature, and through enjoying nature. We need to make our students understand that all this is important to qualify as an educated individual.

**Jayant B. Udgaonkar**

Director, IISER Pune

October 6, 2020



## Director's Report

I am happy to present the Annual Report of the Institute for the duration April 2019 to March 2020.

IISER Pune continued to do well. In the 2020 India Rankings of the National Institutional Ranking Framework by the MHRD, which considers all universities and national institutes, IISER Pune is ranked at the 25<sup>th</sup> position.

We had nine new faculty members join the institute in the past year. They were Ashna Bajpai and Tarun Souradeep (Physics); Devapriya Chattopadhyay and Joy Merwin Monteiro (Earth and Climate Science); Sunish Kumar Radhakrishnan and Mridula Nambiar (Biology); and Bejoy K. Thomas, Chaitra Redkar, and Shalini Sharma (Humanities and Social Sciences). We wish them the best, and we are sure they will do very well, for themselves and for the Institute.

We now have 124 faculty members in our six departments. We also have 1511 students, with 973 BS-MS, 196 Integrated PhD, and 342 PhD students.

Our research output also grew. The total number of research publications since inception, from 2006 to 2019, is 2,845. Three patents were granted during the 2019 calendar year: U.S. patents to R. Vaidhyanathan

for metal-based splitting of water and to B. Sandanaraj for a process for the preparation of hydrophobin mimics; and an Indian patent to R.G. Bhat for synthesis of  $\alpha$ ,  $\beta$ -unsaturated carboxylic acids and esters.

Our faculty members continued to garner extramural funds. In the past year, the Institute managed a total of 172 extramural projects, and our faculty members secured 62 new projects.

Two inter-institutional collaborative projects, that IISER Pune is part of, were formally launched during the year: the Manav Human Atlas project, a collaboration between IISER Pune, Persistent Systems, and the National Centre for Cell Science (on May 10, 2019); and the Pune Biotech Cluster, a joint initiative between the IUCAA and IISER Pune (on August 23, 2019). The DST initiated the quantum enabled science and technology (QUEST) programme during the year and will fund 51 projects across India; two of these projects are led by research groups in the Physics department of the Institute.

IISER Pune was fortunate to be selected to house one of the first three supercomputers developed under the National Supercomputing Mission. The supercomputer, PARAM Brahma, which became functional in November

2019, will greatly facilitate computational research at the Institute and elsewhere.

The quality of research accomplishment at the Institute led to recognition in the form of prestigious awards to faculty members. S. Kayarat was awarded the Shanti Swarup Bhatnagar Prize in the area of Biological Sciences by the CSIR, and the S. Ramachandran National Bioscience Award for Career Development for 2019 from the DBT; S.S. Kamat was selected as an EMBO Young Investigator, received the INSA Young Scientist Medal for 2019, the Merck Young Scientist Award in Biological Sciences for 2019, and the UAA-ICT Distinguished Alumnus Award of Young Achievers for 2019; S. Rai was awarded the Naha Memorial Medal for 2019 by the INSA; S. Galande was awarded the J.C. Bose National Fellowship for 2019 by the DST; S.K. Ghosh was awarded the 2020 MRSI Medal and the 2019 India Research Excellence-Citation by Clarivate Analytics; A. Nag was awarded the 2020 MRSI medal; S.G. Srivatsan received the 2020 CRSI Bronze Medal for 2020 and the 2019 CDRI Award for Excellence in Drug Research in Chemical Sciences; P. Ghosh was selected as a Simons Associate of the Abdus Salam ICTP, Trieste; S. Chaudhury received a Young Scientist Award at the 2019 Chemical Frontiers event; and L.S. Shashidhara was elected as the President of the International Union of Biological Sciences.

Three students, BS-MS student Kumar Aanjaneya Ajay and Integrated PhD students Priya Batra and Rituparna Ghosh, were selected for the Prime Minister's Research Fellowship (PMRF) during the year. A team of undergraduate students, who competed at the international Genetically Engineered Machines (iGEM) Competition, won a silver medal at the Giant Jamboree held October 31 to November 4, 2019 in Boston, U.S.A. The team was led by Dr. Chaitanya Athale and co-supervised by Dr. Aurnab Ghose.

Institute faculty members organised 19 national and international conferences. These included the Workshop on Phase Separation in Genome Organization; Workshop on Bioluminescence: Advanced light microscopy; the GPU Application Hackathon 2019 (GAH – 2019); the Workshop on Parallel Programming; the Workshop on Thermodynamics in the Earth Sciences; a short

course on Physics and Mechanics of Rocks by Prof. Manika Prasad; the 9<sup>th</sup> International Conference of LASA India (LASACON 2019) on Laboratory Animals in Biomedical Research; the Indo-U.K. Researcher Links Workshop on New Electrochemical Technologies for sustainable fuels, chemicals and industrial processes; the 3<sup>rd</sup> National Post-doc Symposium; the IFCAM winter school on Graphs and Random Processes; the Winter School on Geometric Algorithms and their applications; the U.K.-India Newton-Bhabha Fund RSC Researcher Links workshop on Challenges of Tuberculosis; the National conference on aquatic ecosystems: Sustainability and conservation; Technology and Innovation in Mathematics Education (TIME) Conference 2019; the No Garland Neuroscience (NGN) 2019; the 5<sup>th</sup> Asia Pacific *Drosophila* Research Conference (APDRC5) and Indian *Drosophila* Research Conference; the Workshop on Data Science ecosystem tools; the International symposium on Cell Surface Macromolecules; and the Workshop on Parameterized Complexity 2019. The 5<sup>th</sup> Asia Pacific *Drosophila* Research Conference (APDRC5) and the Indian *Drosophila* Research Conference, held in Pune, brought two Nobel Laureates, Prof. Eric Wieschaus and Prof. Michael Rosbash, to our campus.

The Institute Colloquium series was an important new addition to our academic activities this year. It brought distinguished experts from various domains to the Institute. Open and free for the public, this series attempts to make science more accessible to society. The Institute hosted several special colloquia and named lectures during the year. These included 'The Cancer Genome Atlas: Getting to know the enemy' by Dr. Jean C. Zenklusen (The Cancer Genome Atlas (TCGA), NCI, NIH, U.S.A.); 'Water so common, so mysterious' by Prof. Richard N. Zare (Stanford University, U.S.A.); 'Wonder world seen with ultrashort light' by Prof. Tahei Tahara (RIKEN, Japan); Second K.S. Krishnan Memorial Lecture in Neuroscience 'Straighten up & fly right: Insect flight control from neurons to ecosystems' by Dr. Michael Dickinson (The California Institute of Technology, U.S.A.); the Sixth Annual Homi Bhabha Memorial Public Lecture 'Probing the Universe using Radio Waves: From Sir J.C. Bose to modern times' by Prof. Yashwant Gupta (National Centre for Radio Astrophysics (TIFR), Pune); and the Third Annual P.M. Mukhi Memorial Human

Rights Lecture 'The Technological Fix - and what it does to our rights and the rights of others' by human rights expert Usha Ramanathan.

The Institute signed MoUs with Florence University, Italy; University of Turku, Finland; University of Notre Dame Du Lac, U.S.A.; and Friedrich Schiller University Jena, Germany to support academic collaboration. A MoU with University of Manchester, U.K. will enable joint undertaking of graphene research and commercialisation projects for industries with involvement from the Graphene Engineering and Innovation Centre of the University of Manchester. The Institute signed an agreement with King Abdullah University of Science and Technology (KAUST), Saudi Arabia to implement a Visiting Student Research Program (VSRP). In this programme fully funded by KAUST, students from IISER Pune can carry out research work at KAUST for up to 1 year.

The Institute hosted two DST-INSPIRE Science Internship Camps for 11<sup>th</sup> standard school students during the year. Ten events related to teacher training were conducted by the Centre of Excellence in Science and Mathematics Education (CoESME). The Smt. Indrani Balan Science Activity Centre organised an open day as part of Children's Day, when more than 13,000 people visited. The Jigyasa Science Exhibition that the Centre, held in association with the Agasthya International Foundation, brought together school students and was attended by more than 2,200 visitors. The Science Media Centre at the institute conducted ten workshops, aimed to train participants in science communication through videos, writing, theatre, and illustration. The Institute also hosted an Indian Science Festival in January 2020.

IISER Pune hosted the eighth edition of the Inter IISER Sports Meet in December 2019. IISER Bhopal secured the 1<sup>st</sup> position, and IISER Pune stood in the 2<sup>nd</sup> position. IISER Pune students bagged 4 gold, 5 silver and 3 bronze medals in athletics, and the championship in Table Tennis Single (Men), Basketball (Men) and Basketball (Women). We congratulate our sportspeople.

With organisers from the student community taking the lead, IISER Pune hosted several student events including the annual cultural festival *Karavaan*, the inter-institutional pan-India science quiz event *Mimamsa*,

lectures on the occasion of the announcement of Nobel and Abel Prizes. *Disha* and *Prutha*, voluntary organisations at the Institute in the areas of education of the underprivileged and environmental issues, respectively, continued their important work.

The Institute continued its association with several partners and benefactors from foundations and companies. The construction of the Bajaj Auto Hall of Residence for Women, undertaken through an endowment from Bajaj Auto Ltd., was completed during the year and was inaugurated on January 11, 2020. With an occupancy of 756, this new hostel now allows the Institute to accommodate up to 2,000 students on the campus. Bajaj Auto also instituted three Chair Professorships and one Distinguished Visiting Professorship at the Institute.

The Cipla Foundation-IISER Pune Centre for Chemistry Education and Research was inaugurated on January 29, 2020. The in-class demonstration facilities and laboratories of international standards at this Centre enable a wide range of chemistry outreach activities including teacher and student training. The Centre will also serve as a platform for developing industry-academia interactions.

New partners also joined hands with us during the year to support academic and research activities at the institute. Praj Industries decided to support the *Mimamsa* inter-collegiate science quiz coordinated by students of the Institute. Support from Innoplexus Consulting Services Pvt. Ltd. will fund the IISER Pune-Innoplexus Travel Award to students, and a contribution from ZF Steering Gear (I) Ltd. will support research. Contributions from Delta Faucet Co. India Pvt. Ltd. and Scivic Engineering I. Pvt. Ltd. will support IISER Pune students at the upcoming 2020 edition of the international Genetically Engineered Machine (iGEM) Competition hosted at the Massachusetts Institute of Technology (MIT), Boston, U.S.A.

We were delighted to have Prime Minister Narendra Modi visit the Institute on the evening of December 07, 2019. He was on our campus for the Annual Meeting of the DGPs of Central and State Police forces from December 06 to 08, 2019, which the Institute had the privilege of hosting. The highlight of the Prime Minister's visit was his very lively interaction with ten faculty

members who made brief presentations of their work to him. The Prime Minister made incisive comments on the research, and we all obtained valuable insight into how knowledgeable he was on a range of scientific issues. The Prime Minister later interacted with a few students at the NMR laboratory and the newly installed PARAM Brahma supercomputer. We were later told that the Prime Minister left with a very positive impression of the Institute.

With our talented and enthusiastic faculty and students, with our dedicated and capable administration, engineering and technical staff, there is no reason why IISER Pune cannot become one of the best science education and research institutes in India and the world.

Finally, it is my pleasure to acknowledge the counsel and support of the members of the Board of Governors. They provided wise advice for the proper running of the Institute. I would like to specifically thank Dr. Shekhar Mande, who as the Acting Chairperson of our Board of Governors for a year from August 2019, helped steer the Institute out of a difficult period.



Jayant B. Udgaonkar

*During the visit of Honourable Prime Minister of India Shri Narendra Modi to IISER Pune on December 07, 2019*



# GOVERNANCE

## BOARD OF GOVERNORS

**Acting Chairperson** (from 28/08/2019)

**Prof. Shekhar C. Mande**

*Director General, Council of Scientific and Industrial Research (CSIR), and Secretary, Department of Scientific and Industrial Research (DSIR)*

**Officiating Chairperson** (up to 27/08/2019)

**Shri. V.L.V.S.S. Subba Rao**

*Senior Economic Advisor, Ministry of Human Resource Development, New Delhi*

### **Members**

**Prof. Subhasis Chaudhuri**

*Director, Indian Institute of Technology Bombay, Mumbai*

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*Independent Management Consultant, Healthcare and Biotechnology, New Delhi*

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*Joint Secretary & Financial Advisor, Ministry of Human Resource Development, New Delhi*

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*Professor, IISER Pune*

**Dr. Janhavi Kedare**

*Psychiatrist, KEM Hospital, Mumbai*

**Shri. Amit Khare (IAS)**

*Secretary (Higher Education), Ministry of Human Resource Development, New Delhi (from 16/12/2019)*

**Prof. Anurag Kumar**

*Director, Indian Institute of Science, Bengaluru*

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*Chief Secretary, Government of Maharashtra, Mantralaya, Mumbai*

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*Professor, IISER Pune*

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*Secretary, Department of Biotechnology, New Delhi*

**Prof. Jayant B. Udgaonkar**

*Director, IISER Pune*

### **Secretary**

**Col. G. Raja Sekhar (Retd.)**

*Registrar, IISER Pune*

## FINANCE COMMITTEE

**Acting Chairperson** (from 28/08/2019)

**Prof. Shekhar C. Mande**

*Director General, Council of Scientific and Industrial Research (CSIR), and Secretary, Department of Scientific and Industrial Research (DSIR)*

**Officiating Chairperson** (up to 27/08/2019)

**Shri. V.L.V.S.S. Subba Rao**

*Senior Economic Advisor, Ministry of Human Resource Development, New Delhi*

### **Members**

**Ms. Darshana M. Dabral**

*Joint Secretary & Financial Advisor, Ministry of Human Resource Development, New Delhi*

**Shri. C.P. Mohan Kumar**

*Registrar, IISER Tirupati*

**Dr. R. Premkumar**

*Registrar, Indian Institute of Technology Bombay, Mumbai*

<b>Cmdr. Atul Kumar Sinha</b>	<i>Registrar, Defence Institute of Advanced Technology (DIAT), Pune (up to 30/09/2019)</i>
<b>Shri. V.L.V.S.S. Subba Rao</b>	<i>Senior Economic Advisor, Ministry of Human Resource Development, New Delhi</i>
<b>Prof. Jayant B. Udgaonkar</b>	<i>Director, IISER Pune</i>

### Secretary

<b>Col. G. Raja Sekhar (Retd.)</b>	<i>Registrar, IISER Pune</i>
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## SENATE

*List is as of March 31, 2020; changes during the year not shown here*

### Chairperson

<b>Prof. Jayant B. Udgaonkar</b>	<i>Director, IISER Pune</i>
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### Members (Institutional)

<b>Prof. V.G. Anand</b>	<i>Professor and Chief Vigilance Officer</i>
<b>Prof. Sudarshan Ananth</b>	<i>Professor</i>
<b>Prof. Anjan Banerjee</b>	<i>Professor</i>
<b>Prof. Bhas Bapat</b>	<i>Dean (Academics)</i>
<b>Dr. Chandrasheel Bhagwat</b>	<i>Associate Dean (Doctoral, Course Work and RAC Evaluations)</i>
<b>Prof. Ramakrishna G. Bhat</b>	<i>Professor</i>
<b>Dr. Arijit Bhattacharyay</b>	<i>Associate Dean (Graduate Studies)</i>
<b>Prof. R. Boomi Shankar</b>	<i>Professor</i>
<b>Prof. Harinath Chakrapani</b>	<i>Dean (International Relations and Outreach)</i>
<b>Dr. Srabanti Chaudhury</b>	<i>Associate Dean (Doctoral, Thesis and Fellowships)</i>
<b>Prof. Aloke Das</b>	<i>Professor</i>
<b>Prof. Sutirth Dey</b>	<i>Professor</i>
<b>Dr. Sourabh Dube</b>	<i>Associate Dean (International Relations and Outreach)</i>
<b>Prof. Sanjeev Galande</b>	<i>Dean (Research and Development)</i>
<b>Prof. Hosahudya N. Gopi</b>	<i>Chair, Chemistry</i>
<b>Nikita Gupta</b>	<i>Student Representative</i>
<b>Dr. Anirban Hazra</b>	<i>Associate Dean (Graduate, Curriculum and Scheduling)</i>
<b>Dr. Amit Hogadi</b>	<i>Chair, Mathematics</i>
<b>Prof. Srinivas Hotha</b>	<i>Professor</i>
<b>Prof. M. Jayakannan</b>	<i>Professor</i>
<b>Dr. Umeshreddy Kacherki</b>	<i>Librarian</i>
<b>Prof. T.S. Mahesh</b>	<i>Professor</i>
<b>Prof. Rama Mishra</b>	<i>Professor</i>
<b>Prof. Sunil Mukhi</b>	<i>Dean (Faculty)</i>
<b>Dr. Shivprasad Patil</b>	<i>Dean (Student Activities)</i>
<b>Dr. Thomas Pucadyil</b>	<i>Chair, Biology</i>
<b>Dr. Sohoni Pushkar</b>	<i>Chair, Humanities and Social Sciences</i>
<b>Prakash Panwaria</b>	<i>Student Representative</i>
<b>Prof. Mainak Poddar</b>	<i>Professor</i>
<b>Prof. A. Raghuram</b>	<i>Professor</i>
<b>Prof. M.S. Santhanam</b>	<i>Professor</i>
<b>Prof. L.S. Shashidhara</b>	<i>Professor</i>

<b>Prof. Tarun Souradeep</b>	<i>Chair, Physics</i>
<b>Prof. S.G. Srivatsan</b>	<i>Professor</i>
<b>Prof. Prasad Subramanian</b>	<i>Interim Chair, Earth and Climate Science</i>
<b>Prof. Pinaki Talukdar</b>	<i>Professor</i>

### **Members (External)**

<b>Prof. Dilip Dhavale</b>	<i>Professor, Chemistry, Savitribai Phule Pune University, Pune</i>
<b>Prof. Sonal Kulkarni-Joshi</b>	<i>Professor, Linguistics, Deccan College, Pune</i>
<b>Dr. Ashish Lele</b>	<i>Chief Scientist, CSIR-National Chemical Laboratory, Pune</i>

### **Secretary**

<b>Col. G. Raja Sekhar (Retd.)</b>	<i>Registrar, IISER Pune</i>
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## **BUILDING AND WORKS COMMITTEE**

### **Chairperson**

<b>Prof. Jayant B. Udgaonkar</b>	<i>Director, IISER Pune</i>
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### **Members**

<b>Shri. Sushant Baliga</b>	<i>Additional Director General (Retd), CPWD, Delhi (from October 2019)</i>
<b>Prof. Sanjeev Galande</b>	<i>Dean, Research and Development, IISER Pune</i>
<b>Shri. P.M. Kanvinde</b>	<i>Architect and Former Principal, Abhinav K.M. &amp; College of Architecture, Pune</i>
<b>Mr. S.M. Mane</b>	<i>Superintending Engineer, NCL, Pune</i>
<b>Shri. Balbir Singh</b>	<i>BARC, Mumbai (up to October 2019)</i>

### **Secretary**

<b>Col. G. Raja Sekhar (Retd.)</b>	<i>Registrar, IISER Pune</i>
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# 01

## Research Activities and Achievements

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# RESEARCH REPORT

Research at IISER Pune is carried out under six departments and aims to reach a fundamental understanding of how the physical world works. Recognising that several complex systems and problems require multi-pronged approaches, many research areas pursued in IISER Pune combine the expertise and ideas from people with diverse training.

IISER Pune has performed consistently in terms of obtaining research publications from work carried out at the Institute. Institute faculty members have secured 3 patents during 2019. A new Centre for Artificial Intelligence and Data Science (CAIDS) at the Institute is being organised around a core group of faculty members.

Our researchers continue to push the boundaries of knowledge in basic as well as applied sciences. The Institute supports them in this endeavour and facilitates academic and industrial partnerships within and outside India for better research outcomes.

## DEPARTMENT-WISE NUMBER OF PUBLICATIONS DURING 2019

## PUBLICATIONS IN 2019: 505



**84**  
BIOLOGY



**139**  
CHEMISTRY



**16**  
EARTH AND  
CLIMATE SCIENCE



**08**  
HUMANITIES AND  
SOCIAL SCIENCES



**30**  
MATHEMATICS



**228**  
PHYSICS

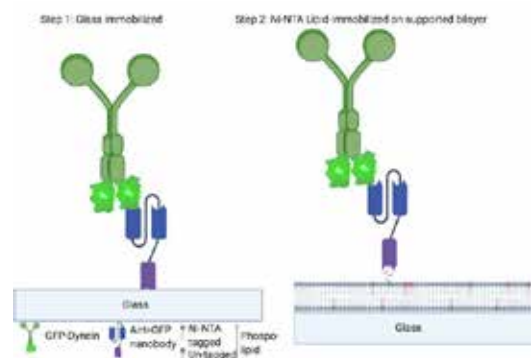


## 1.1 Biochemistry and Biophysics

### Self-organisation and cell morphogenesis

The work in Dr. Chaitanya Athale's group in the past year has focused on the role of collective motor-microtubule (MT) mechanics in the process of transport of MT filaments. This work has some relevance for the mechanobiology of intracellular processes, vital in understanding cell division, differentiation and intracellular physiology. The molecular players in such cellular processes are important for understanding diseases ranging from cancer, developmental defects to viral infections. The progress in the current year has involved extending the work described in an earlier study of the *in vitro* reconstitution of molecular motor driven transport by dyneins (Jain et al. 2019 *Soft Matt.*). This takes two directions: (1) In order to improve the control over molecular numbers of the motor proteins on the surface, they aim to immobilise an anti-GFP nanobody (Katoh et al. 2015 *J. Cell Sci.*) on the glass slide and on a supported bilayer with Ni-NTA and 6xhis tag chemistry. (2) The group is attempting an *ex-vivo* assay of nuclear transport using yeast nuclei with dynein from the native system. Recent work in the lab to develop a DIC object tracking (DICOT) image analysis workflow has resulted in results on the intracellular streaming movement of cytoplasm in *C. elegans* (Chaphalkar et al. in prep.). Synthetic biology work in the lab has concluded with an improved theoretical model based on a reduced 6-equation model of the genetic oscillator based on a dual feedback loop (Joshi, Jawale & Athale (2020) *Phys. Rev. E*).

**Figure 1:** Specific immobilisation of GFP-dynein on a coverless surface using an anti-GFP nanobody either on the glass coverslip or a supported lipid bilayer with Ni-NTA tagged lipids and a 6-histidine tagged nanobody (Dr. Chaitanya Athale's Group)

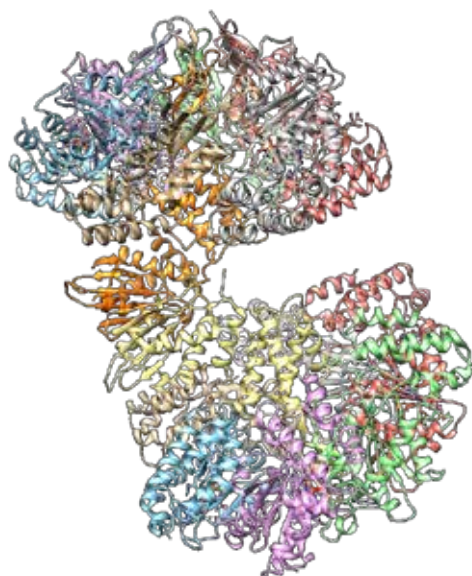


### Biological mechanisms of lipid signalling pathways

The advent of genome sequencing technology has resulted in an explosion of available protein sequences. Concomitant with the rising number of sequences, the propagation of annotation errors or lack of annotation, have become more prominent throughout databases that rely heavily on high-throughput computational predictions of protein function without much experimental support. Understanding the genetic basis for rare hereditary human disorders has also greatly benefited from tremendous advances in DNA sequencing technologies. Human genome mapping projects and sequencing have, to date, facilitated determination of the genetic basis for over 4,000 inherited diseases, with additional pathogenic mutations still being discovered. However, it is also becoming apparent that as a greater number of disease-causing mutations are being mapped, many of the affected genes encode unannotated proteins. Thus, assigning biochemical and cellular functions to such proteins is critical to achieve a deeper mechanistic understanding of these pathological disorders and for identifying potential therapeutic interventions for them. In this regard, Dr. Siddhesh Kamat's group is pursuing the following projects: (1) understanding the biochemical basis for the pathophysiology of the human neurological disorder PHARC, (2) mapping lipid pathways in mammalian cells and tissues under oxidative stress, and (3) functional annotation of orphan lipases and acyltransferases from the metabolic serine hydrolase enzyme class.

### Mechanisms of nucleotide-dependent restriction enzymes

The entry of foreign DNA, such as the bacteriophage genome, pathogenicity islands or antibiotic resistance genes, are tightly regulated by nucleotide-dependent restriction enzymes, a prominent bacterial defence system. Dr. Saikrishnan Kayarat's laboratory deciphered the cryo-EM structure of one such defence machinery, McrBC from *Escherichia coli*, revealing the blueprint of the machinery and the molecular mechanism of its action (Nirwan et al., *Nature Commun.*, 2019). This is the first high-resolution cryo-EM structure to be reported from India. The laboratory also uncovered the significance of motor driven enzyme translocation along DNA for activation of certain types of nucleotide-dependent restriction enzymes (Chand et al., *Nucleic Acids Res.*, 2020).



**Figure 2:** Cryo-EM structure of McrBC complex (Dr. Saikrishnan Kayarat's Group)

### Cell motility and bacterial cytoskeleton

Dr. Gayathri Pananghat's research focus is to understand the molecular mechanism of motility and cell shape determination based on the bacterial cytoskeleton using *Myxococcus xanthus* and *Spiroplasma* as model systems. The group utilises the techniques of structural biology (mainly X-ray crystallography and electron microscopy) and complementary biochemical and biophysical characterisation to study the structure and dynamics of assembly of the macromolecular complexes involved in motility. In the reporting year, (1) The group has identified a novel Walker B motif in a prokaryotic small Ras-like GTPase MglA; (2) Structures of FtsZ from the cell wall less organism *Spiroplasma* have been determined and will help in understanding mechanism of cell division in a cell wall less bacteria; (3) Structure determination and membrane-binding characterisation of the cytoskeletal proteins of *Spiroplasma* and their visualisation using cryotomography is in progress.

### Understanding protein machines that catalyse membrane fission

Cell membranes are spontaneously formed by the self-assembly of lipids into a 5-nm thin bilayer sheet. They have unique mechanical properties. Foremost among them is their ability to resist rupture. This property lies at the heart of evolution choosing lipids as the material to contain life within membrane-bound compartments. But cells have also evolved mechanisms to compartmentalise the cytoplasm into vesicles and organelles and pathogens and viruses have evolved mechanisms to enter cells enveloped inside vesicles. The formation of vesicles and division of organelles requires active bending and fission of the membrane, which are processes that are managed by specialised protein machines. Research in Dr. Thomas Pucadyil's group focuses on identifying such protein machines and understanding where and how they function in cells. Using

arrayed membrane nanotubes that represent a facile read-out for membrane fission, along with methods to determine proteins that bind membranes they discover, analyse and establish the physiological relevance of such protein machines. For more details, please see Kamerkar et al. (2019) *Biochemistry* 58:65-71; Jose et al. (2020) *Traffic* 21: 297-305 (US patent in process).

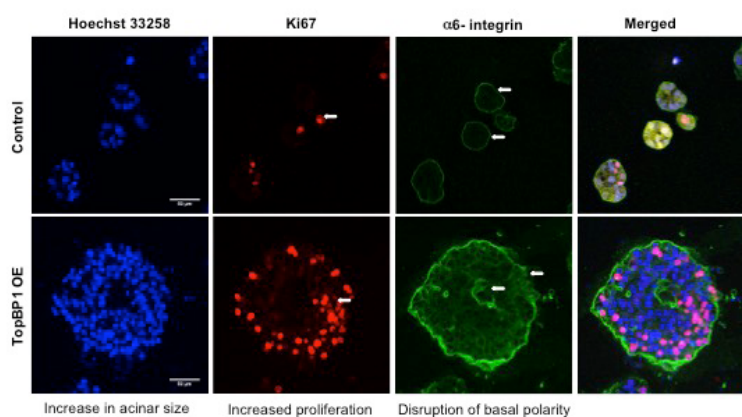
### Emergence of information-containing polymers in prebiotic Earth

One of the greatest scientific mysteries pertains to understanding how life would have originated on Earth. In this regard, discerning the processes relevant to emergence of informational polymers, and the earliest compartments, have fundamental implications for understanding how chemistry transitioned to biology on the early Earth. In the aforesaid context, Dr. Sudha Rajamani's lab is characterising plausible prebiotic precursors that would have resulted in the formation of primitive informational molecules of a pre-RNA World, prior to the emergence of an RNA World; a time when RNA facilitated information processing and catalytic activity. They are also investigating nonenzymatic oligomerisation of cyclic nucleotides by evaluating this, both, in laboratory-simulated and early Earth analogous conditions. Finally, they have also been exploring the landscape of prebiotic amphiphiles to discern how composition of primitive membranes would have impinged on their survival under then harsh conditions. The group is also delineating how environmental constraints would have shaped their evolution by acting as important selection pressures.

## 1.2 Cell and Developmental Biology

### DNA damage and maintenance of genome integrity

Dr. Mayurika Lahiri's group has been investigating the process by which DNA deregulation or lipid mediators in the microenvironment can lead to cellular transformation of breast epithelial cells using three-dimensional breast acini as a model system. Recent studies have shown that when Api5, an anti-apoptotic protein or TopBP1, a key checkpoint regulator, on deregulation led to cellular transformation in the breast spheroids. Currently the molecular mechanism of such a transformation is being dissected out. In order to understand whether any of these proteins can be used as bio-markers for the Indian population, Dr. Lahiri's laboratory collaborates with Prashanti Cancer Care Mission (PCCM), Pune to use patient blocks to study the expression level of the proteins in the Indian population. The other research projects include investigating the post-translational modifications of Api5, microtubule stability following DNA damage as well as investigating the role of the lipid mediator, PAF in breast cancer initiation, progression and promotion.



**Figure 3:** TopBP1 over-expression leads to increase in acinar size, proliferation and disruption of basal polarity in MCF10A acini (Dr. Mayurika Lahiri's Group)

**Cell adhesion and regulation of membrane trafficking by cell adhesion**

Dr. Nagaraj Balasubramanian investigates how integrin mediated adhesion regulates the trafficking and plasma membrane localisation of raft microdomains to control anchorage dependent signalling. Integrin endocytosis is regulated by caveolae and its phosphorylation at the tyrosine-14 residue (pY14Cav1) and exocytosis through the RalA-Arf6-exocyst complex. Ongoing studies use the AURKA-RalA crosstalk in Ras-dependent and independent cancers using nanovesicle encapsulated Alisertib (MLN8237) to target anchorage-independent signalling. The group is further studying the role and regulation of pY14Cav-1 in regulating adhesion dependent signalling across 2D and 3D microenvironments of varying stiffness. The lab is also aiming to understand how adhesion dependent signaling regulates organelle function, focusing on the Golgi, ER and mitochondria. The group's studies have revealed integrin mediated adhesion to dramatically alter Golgi organisation and function, suggesting a role for this regulation in anchorage-independent cancers. The group is also using their expertise in 3D cell culture and imaging to develop and use an assay to understand cellular behaviour around implant surfaces.

**Molecular signature of an ancient organizer regulated by Wnt/ $\beta$ -catenin signalling during primary body axis patterning in *Hydra***

Multiple studies have contributed significant insights into the molecular mechanisms imparting organizer function. However, the complete repertoire of the molecular players associated with organizer phenomenon was not clear. Prof. Sanjeev Galande's lab focused on unravelling the molecular signature of *Hydra* head organizer and gain insight into the evolution of a primary body axis since *Hydra* belongs to the earliest divergent phylum Cnidaria with a definitive body axis. Wnt signalling has been shown to play a critical role in *Hydra* head organizer and systemic activation of this signalling turns entire polyp to a head-like phenotype. The group has exploited this phenotype to comprehensively study the gene expression changes that occur upon activation of Wnt signalling and knockdown of  $\beta$ -catenin.

This approach facilitated the systematic identification of the genes that are regulated by Wnt signalling in a  $\beta$ -catenin-dependent manner. The group then demonstrated the direct binding of  $\beta$ -catenin on the promoter of the *Hydra* Margin homolog by using chromatin immunoprecipitation. Loss of function analyses of two novel homeodomain-containing transcription factors HvMargin and Gorget demonstrated the functional significance of these transcription factors in body axis patterning, especially in oral pole fate determination. Similar observations were recorded in the gain of function studies using zebrafish, a heterologous vertebrate model system. Expression of the master regulatory transcription factors involved in neurogenesis and head formation in bilaterians such as Otx, Otp, Margin, Arx and Nkx from the study suggests that the oral pole of *Hydra* shares more similarity with the bilaterian head (Reddy et al., *Comms. Biol.* 2019). The group's study argues in favour of the hypothesis stating that the cnidarian oral pole is similar to the bilaterian head (anterior).



**Figure 4:** Novel TFs in the Wnt regulatory network of *Hydra* head. The figure depicts the expression pattern of HvWnt3a (panels 1,2) and two novel TFs reported in the study by the group, Margin (3,4) and Gorget (5,6), in normal adult *Hydra* polyps and upon activation of Wnt signalling (Prof. Sanjeev Galande's Group)

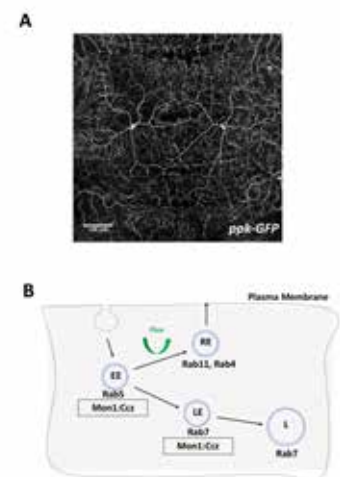
### Chromosomal segregation during cell division

Dr. Mridula Nambiar's research focuses on understanding the molecular mechanisms that underly errors in chromosomal segregation during cell division. She uses the genetically tractable fission yeast *Schizosaccharomyces pombe* as a model system to investigate the role of DNA recombination in generating such segregation errors during meiosis. Her lab is interested in exploring the molecular interactions between the ring-shaped protein complexes known as cohesins that hold the sister-chromatids together after replication and the heterochromatin proteins, especially at the centromeres. These interactions are essential to maintain accurate chromosomal segregation fidelity both in meiosis as well as during mitosis in cancer cells. Her research uses a combination of yeast genetics, cell and molecular biology, proteomics and biochemical approaches to decipher the mysteries of meiotic recombination and chromosomal segregation.

### Molecular principles underlying animal development and disease

Dr. Girish Ratnaparkhi's group utilises *Drosophila melanogaster* as a model organism to study evolutionarily conserved molecular principles underlying animal development and disease. During 2019–20, the group, working in collaboration with Dr. Anuradha Ratnaparkhi's group at Agharkar Research Institute (ARI), Pune, has uncovered novel roles for the Rab7 convertor Monensin Sensitive 1 (Mon1) in animal development (Dhiman et. al., 2019; Harish et. al., 2019). They find that octopaminergic-tyraminerigic (OPN) neurons in the brain can synapse with cell bodies of insulin producing neurons and that Mon1 activity in OPN neurons can regulate, non-autonomously, the vitellogenic maturation of egg chambers in the ovary via insulin signalling (Dhiman et. al., 2019). They also find that modulation of Mon1 activity in the dendritic arbors of class IV sensory neurons can dictate the complexity of dendritic branching and mechanistically this phenomenon appears to incorporate modulation of endocytic flux in the secretory Rab5/Rab11 pathway (Harish et. al., 2019).

**Figure 5:** Mon1 regulates dendritic arborisation of sensory neurons. (A) Highly branched 'arbors' of class IV multi-dendritic sensory neurons of *Drosophila larva* visualised by expression of GFP, driven by a pickpocket promoter. (B) Modulation of Mon1 activity can modulate degree of branching via the Mon1/Rab11 based recycling endocytic (RE) pathway. Increase in Mon1 activity (or decrease in Rab11 activity) decreases complexity of branching while decrease in Mon1 activity (or increase in Rab11 activity) increases branching complexity. The group hypothesises that this is a result of change of endocytic flux in the RE pathway, which affects the secretion of macromolecules required for determining dendritic architecture. EE, Early endosome; LE, Late endosome; L, Lysosome. (Dr. Girish Ratnaparkhi's Group)



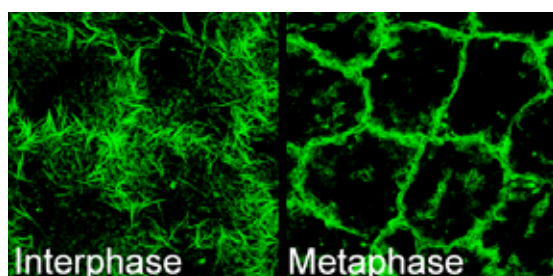
### Regulatory processes that govern growth and development in bacteria

The primary focus of Dr. Sunish Kumar Radhakrishnan's group is to understand the fundamental regulatory processes that govern growth and development in bacteria. Recent work from the group has helped to understand the signalling mechanism that bacteria utilise to ensure the inheritance of flagella by the newly born daughter cells. Most bacteria, having free-living, symbiotic or pathogenic lifestyles, possess a unique "tail-like" organelle called flagella that allows them to swim and move. This process helps the bacteria to find new nutrient-rich niches or host cells. The flagellum is effectively a

molecular nanomachine and is built from several proteins that have to be assembled from the inside to the outside of the cell, traversing the cell envelope. Previous studies have indicated that improper assembly of the flagellum slows down the production of new daughter cells by inhibiting cell division. However, the underlying mechanism that couples flagellar development to cell division remained unknown. Through a combination of genetic and imaging-based approaches, the group has identified the long-sought-after signalling principle, and the underlying mechanism, that couples cell division to flagellar development in bacteria. Furthermore, their studies have uncovered common regulatory molecules linking two pivotal developmental events in bacteria, which can indeed be exploited as potential antimicrobial targets.

### Cell biology of development and differentiation

The first morphologically distinct cell type to form during metazoan embryogenesis is an epithelial cell. *Drosophila* embryogenesis shows the formation of epithelial-like plasma membrane domains organised as a polygonal array in cortical syncytial division cycles. Studies in Dr. Richa Rikhy's group have found that the actin rich caps above each nucleus in syncytial division cycles expand on enrichment of actomyosin at their periphery. Protrusions observed at the apical surface by TIRF and STED microscopy in interphase are absent in metaphase (Figure). Lateral furrows form during prophase in between adjacent caps. Lateral furrows show the presence of cytoskeletal and polarity proteins that are responsible for their extension. Onset of polygonal architecture occurs when it reaches beyond a threshold length in each cortical syncytial division cycle. The distribution of polarity proteins on the furrow stabilises hexagon dominated plasma membrane organisation.



**Figure 6:** Actin rich protrusions visualised by STED super resolution microscopy are enriched in apical caps in interphase (left) and not seen in metaphase (right) of the syncytial division cycle. Actin is enriched at cap edges in metaphase. (Dr. Richa Rikhy's Group)

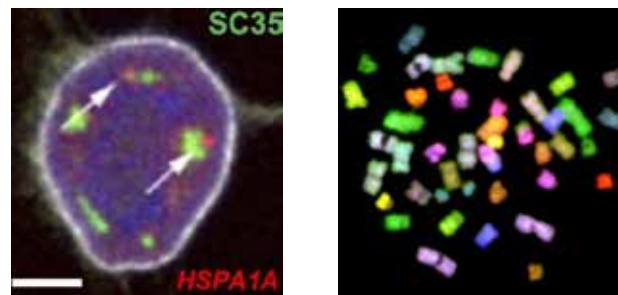
## 1.3 Chromosome Biology and Epigenetic Regulation

### Epigenetics and transcriptional regulation in *Plasmodium falciparum*

The malaria parasite has a complex life cycle exhibiting phenotypic and morphogenic variations in two different hosts. Phenotypic cell-to-cell variability can be an important determinant of cellular adaptation, stress tolerance and immune evasion in the host. To investigate cellular heterogeneity, Dr. Krishanpal Karmodiya's group performed single cell RNA-sequencing (scRNA-seq) of synchronised *Plasmodium* cells in control and under temperature stress condition (phenocopying the cyclic bouts of fever experienced during malarial infection). They identified a subset of parasites primed for gametogenesis and stress adaptation. The group also identified a rare population of cells, which is only emerged during the stress condition, showing the reactive state of the pathogen. Interestingly, genes associated with the gametogenesis, chaperon activity and maintenance of cellular homeostasis showed maximum heterogeneity. Thus, their study suggests that the variability and versatility of the maintenance of cellular homeostasis should enable cells to survive under different stress conditions and may act as an important stimulator of development of drug-resistance in *Plasmodium falciparum*.

## Chromosome biology

Dr. Kundan Sengupta's group studies the mechanistic underpinnings of genome organisation and function in cancer cells. The group showed that nuclear envelope proteins - Lamin-Emerin and their interaction with Nuclear Myosin I (NM1- a motor protein), modulates chromatin dynamics selectively at the nuclear interior. Furthermore, nuclear lamin A/C regulates the dynamics and expression of the HSPA1A gene locus (that encodes for the Hsp70 heat shock protein), and its proximity to the nuclear speckle protein - SC35, in a Nuclear Myosin I (NM1) dependent manner, highlighting a collective role for the LaminA/C-Emerin-NMI sub-complex in regulating chromatin organisation and function in the interphase nucleus. They also studied the relay of external mechanical signals into the nucleus in cells exposed to softer substrates. In another study, they found an increase in chromosomal instability upon the induction of Epithelial to Mesenchymal Transitions (EMT) in cancer cells.



**Figure 7:** (Left) SC35\_HSPA1A – A representative image of a single nucleus (blue) showing heatshock gene loci (HSPA1A -red) in close proximity (arrow) to the nuclear speckles SC35 (green). Lamin B1 demarcates the border (white) of the nucleus, Scale bar: ~5  $\mu$ m. (Right) SKY HCT116: A representative spectral karyotyping (SKY) image derived from the human colorectal cancer cell line (HCT116), showing each human chromosome in a unique colour. (Dr. Kundan Sengupta's Group)

## 1.4 Ecology and Evolution

### Population dynamics

Dr. Sutirth Dey's group worked on two different research questions, namely, effects of population size on microbial evolution and modelling the dynamics of laboratory populations of *D. melanogaster*. Larger populations generally adapt faster to their existing environment. However, it is unknown if the population size experienced during evolution influences the ability to face sudden environmental changes. To investigate this issue, the group subjected replicate *Escherichia coli* populations of different sizes to experimental evolution. The group found that, quantitative differences in population size can lead to qualitative differences (decay/enhancement) in the fate of a character during adaptation to identical environments. Furthermore, larger populations can have inferior fitness upon sudden exposure to alternative stressful environments. The dynamics of stage-structured populations facing stage-specific variability in resource availability remains poorly understood. The group addressed these issues using a stage-structured individual-based model that incorporates life-history parameters common to many holometabolous insects. The model was calibrated using time-series data from a 49-generation experiment on laboratory populations of *Drosophila melanogaster*, subjected to four different combinations of larval and adult nutritional levels. The model was able to capture multiple qualitative and quantitative aspects of the empirical time series across three independent studies.

## 1.5 Neurobiology and Computational Biology

### *Structural plasticity of neuronal circuits*

The key questions Dr. Aurnab Ghose's group addresses are the mechanisms underlying neural connectivity and the integration of physiological information in neural circuits in order to generate behaviours. The neuronal cytoskeleton comprises of different subsystems whose activities are dynamically coordinated. The group has identified new regulatory modalities coupling the actin and microtubule cytoskeletons during neuronal pathfinding and arborisation. Additionally, they have explored new components in the mechanochemical signalling necessary for neuronal motility. New studies have been initiated to identify mechanisms that encode nutritional states in the brain to influence behaviours like risk-taking, learning and memory and innate fear. The group's work is aimed to not only help understand how the brain is wired and how it responds to physiological states, but also to inform on underlying deficits resulting in neurodevelopmental disorders, affective states and innate purposive behaviours.

### *Olfactory information processing and decision-making*

Dr. Nixon Abraham's group is investigating different questions related to olfactory information processing and decision-making using mouse as the model system. The group combines state-of-the-art methods in molecular biology, automated behavioural training and optogenetic neural control to answer the basic questions in olfactory decision-making.

While addressing the basic questions using rodent models, the group is studying the human olfactory perception and decision-making in normal subjects using an "olfactory-action meter" they developed in the lab. In one of the projects, they have investigated the multimodality in executing the pheromone-mediated behaviours. The aim was to discern if animals can actively associate the pheromones with the shape and sizes of the entities on which they are sprayed upon. Can these associations be facilitating the long-term memory formation of scent marks?

In order to investigate this, the group designed a novel 'multimodal pheromonal learning' behavioural paradigm which lets the female mice use sensory information processed by main olfactory bulb, accessory olfactory bulb and the whisker subsystems to associate a location presented with opposite sex pheromones over a location holding the neutral stimulus, water. This paradigm allowed the animals to sense pheromonal volatiles through holes of specific diameter, thus, allowing us to probe the role of whiskers and microvibrissae present on the snout in learning and memorising the pheromone locations.

### *Computational neurobiology*

Information is processed and stored in the hippocampus region of the brain in the form of changes in the strength of connections of local synapses. Connections that encode information get stronger until their synaptic strengths saturate. We have a limited resource of synapses; however, synapses with saturated strengths are useless, as new information cannot be encoded in these anymore. Dr. Suhita Nadkarni's group showed how synapses with saturated strengths could be brought back into the game of encoding information via an intracellular mechanism that modulates calcium signalling.

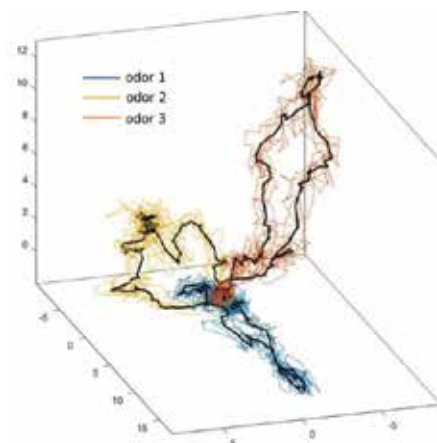
The human brain that makes up about 2% of the bodyweight uses about 25% of the total energy budget of the body. Within that, signal transmission at the synapses alone is an energetically expensive process and consumes more than 50% of the total energy used by the brain. If every electrical impulse generated in the brain were transmitted

to the connected synapses, the brain would approximately need 5 times more energy. The CA3-CA1 synapse in the hippocampus is a crucial component of the neural circuit associated with learning. As it turns out, synaptic connections here display a notoriously low fidelity and only about 1 out of 5 impulses get transmitted. This suggests a possible design to lower the energy consumption of synaptic transmission. However, an unreliable transmission can lead to massive loss of information.

The team used information transmission and energy utilisation, fundamental constraints that govern the neural organisation, to gain insights into the relationship between form and function of this synapse. The group showed that unreliable neurotransmitter release and its activity-dependent enhancement (short-term plasticity), a characterising attribute of this synapse, maximises information transmitted in an energetically cost-effective manner. Their analysis reveals that synapse-specific quirks ensure information rate is independent of the release probability; thus, even as ongoing long-term memory storage continues to fuel heterogeneity in synaptic strengths, individual synapses maintain robust information transmission. Alzheimer's Disease is a catastrophic disease that initially affects memory and cognition. Some of these changes are reflected in modified brain activity patterns that represent important functions. What are the underlying neural mechanisms that lead to the pathology? Using computational modelling, the group found the causal link to an aberrant signalling cascade to modified brain activity. The group showed that the lowered presence of pacemaker channels called the HCN makes activity that is otherwise robust, more unreliable, and trigger plaque formation in Alzheimer's disease.

### Form and function in neuronal networks

In Neuroscience, the structure of a circuit has often been used to intuit function – an inversion of Louis Kahn's famous dictum, 'Form follows function'. However, different brain networks may utilise different network architectures to solve the same problem. Dr. Collins Assisi's lab looked at the olfactory circuits of two insects, the locust, *Schistocerca americana*, and the fruit fly, *Drosophila melanogaster*, that serve the same function – to identify and discriminate odours. However, the neural circuitry that achieves this goal shows marked differences in the two insects. By simulating these circuits using detailed computational models, the group showed that *Drosophila* and locust circuits lie at different ends of a continuum where the *Drosophila* gives up on the ability to resolve similar odours to generalise across varying environments, while the locust separates odour representations but risks misclassifying noisy variants of the same odour. Other work in the lab has looked at different facets of the relationship between form and function in neuronal networks found in the olfactory system and in the hippocampal formation..



**Figure 8:** Odours are represented in the insect brain as transient patterns of activity in ensembles of neurons. The figure shows the activity of a simulated network of 900 neurons in the antennal lobe of a locust. This 900-dimensional spatiotemporal pattern was projected into three dimensions. Each trace shows the spatiotemporal evolution of an odour. (Dr. Collins Assisi's Group)

### *Improving blood insulin in diabetes with antioxidant supplementation*

Dr. Pranay Goel recently concluded a clinical study that addresses a long-standing question of whether antioxidants are beneficial in chronic diseases, in particular, in type 2 diabetes. Together with the lab of Prof. Saroj Ghaskadbi, Dr. Uma Divate, MD, Jehangir Hospital, and other colleagues, Dr. Goel investigated whether oral glutathione (GSH; a potent antioxidant) supplementation is of help in diabetes therapy. They found that GSH is substantially improved in the blood, indicating its successful assimilation in the body. A particularly interesting finding was that in patients older than age 55 years plasma insulin was found to be significantly increased. This suggests that oral GSH supplementation may serve to complement existing diabetes treatment for improving glucose control.



## 2. CHEMISTRY RESEARCH REPORT



### *Peroxide synthesis using metal catalyst*

Rearrangements impart a skeletal reorganisation in synthetic chemistry which led to the synthesis of many complex organic molecules. To achieve the functionalised substituted-2H-benzo[b][1,4]oxazin-3(4H)-one derivatives, Dr. Gnanaprakasam's research group developed in situ conversion of tert-butyl 2-oxindole peroxy compounds into highly reactive peresters using external esters, which then underwent the ring-expansion process. Transient carbocation was then trapped with the various alcohol residue generated from the esters. Peroxide synthesis and scale-up are one of the challenges in chemical production. In this direction, his research group reported the modern smart technology i.e., continuous-flow approach for the synthesis of 2-oxindole peroxide using Fe-magnetic nanoparticle as a catalyst. Furthermore, Dr. Gnanaprakasam's research group developed a transition-metal-free approach for the exclusive synthesis of Z-3-(aminobenzylidene/aminoalkylidene)indolin-2-ones efficiently from 2-oxindole and aryl/alkyl nitrile using LiOtBu and 2,2'-bipyridine system. Another interesting synthetic methodology developed by the group involves  $sp^3$  C-H alkylation of 9H-fluorene using alcohol and a Ru catalyst via the borrowing hydrogen concept. This approach demonstrates the broad reaction scope with different alcohols, utilising both primary and secondary alcohols as non-hazardous and greener alkylating agents with the formation of environmentally benign water as a byproduct.

### *Extracellular matrix (ECM) glycopeptides for cell surface markers*

The aberrant expression of endocytic epidermal growth factor receptors (EGFR) on cancer cells has emerged as a key target for therapeutic intervention. Dr. Raghavendra Kikkeri's group has developed a broad synthetic heparan sulfate (HS)-tetrasaccharide library to evaluate binding affinity with EGFR specific growth factors and thereby develop the HS-nanovehicle to target cancer cells in tumour model. ELISA binding assay of structurally well-defined HS oligosaccharides shows that 6-O-sulfation (6-O-S) and 6-O-phosphorylation (6-O-P) of HS-tetrasaccharides significantly enhances EGFR cognate growth-factor binding. To highlight the oncogenic activities, synthetic HS-tetrasaccharides are conjugated on multivalent fluorescent gold nanoparticles and measured the phenotypic cancer-cell-uptake mechanism. Hierarchical clustering of the cellular uptake assay with different degrees of EGFR-expressed cancer cells

shows native 6-O-S residues of HS as powerful scaffold in EGFR mediated nanovehicle delivery. Finally, the 6-O-S HS-conjugated nanovehicle shows selective homing of the nanoparticles in cancer cells in 3D-co-culture spheroids, thus providing a novel target for cancer therapy and diagnostics in tumour microenvironment.

### Macromolecular engineering

Further development of MAPLab technology: Dr. Britto Sandanaraj's group extended the scope of the MAPLab technology by designing novel protein-dendron bioconjugates. Custom design of protein-dendron amphiphilic macromolecules is at the forefront of macromolecular engineering. Macromolecules having this architecture are very interesting because of their ability to self-assemble into various biomimetic nanoscopic structures. However, to date, there are no reports based on this concept due to the technical challenge associated with chemical synthesis. Towards that end, the group developed a novel chemical methodology for the modular synthesis of a suite of monodisperse facially amphiphilic "protein-dendron" conjugates.

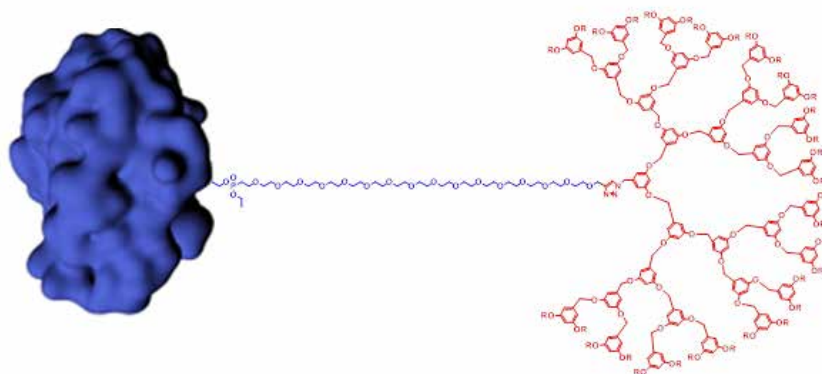
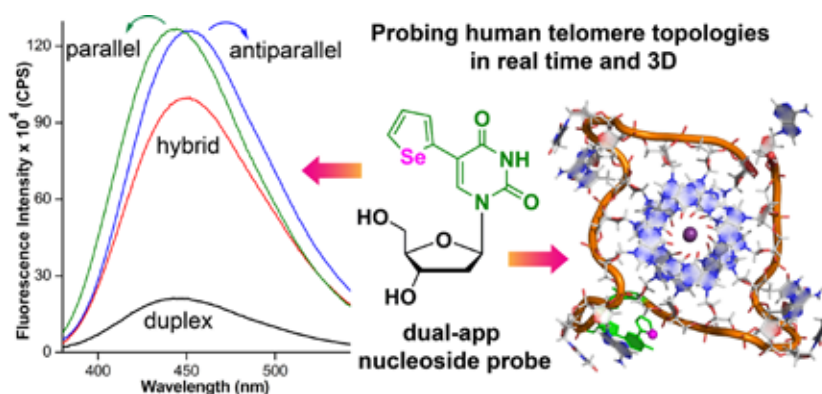


Figure 9: Protein-dendron bioconjugate (Dr. Britto Sandanaraj's Group)

Development of Activity-based Reporter Gene Technology (AbRGT): Imaging of an active protease with an exquisite specificity in highly homologous proteins within a living cell is a very challenging task. The group developed a new method called "Activity-based Reporter Gene Technology" (AbRGT). This method provides an opportunity to study the function of "active protease" with unprecedented specificity. As a proof-of-concept, they have applied this method to study the function of individual caspase protease in both intrinsic and extrinsic apoptosis signalling pathways. The versatility of this method is demonstrated by studying the function of both the initiator and effector caspases, independently. The modular fashion of this technology provides the opportunity to non-invasively image the function of cathepsin-B in a caspase-dependent cell death pathway. As a potential application, this method is used as a tool to screen compounds that are potent inhibitors of caspases and cathepsin-B proteases. The fact that this method can be readily applied to any protease of interest opens up huge opportunities for this technology in the area of target validation, high-throughput screening, in vivo imaging, diagnostics, and therapeutic intervention.

Prof. Seergazhi G. Srivatsan's group is developing biophysical platforms to understand the structure-function relationship of nucleic acids in cell-free and cellular environments. His group is also developing multifunctional nucleolipid conjugates that could self-assemble into nanofibres, nanotubes and gels (*Nanoscale* 2019). Recently, his group has successfully developed multifunctional nucleoside analogues that can be used to study nucleic acid structure and recognition properties in real time by fluorescence, in solid state by X-ray crystallography and in cells by NMR. Some of the nucleoside analogues have been successfully used in studying the bacterial ribosomal decoding site RNA-antibiotic interaction and non-canonical nucleic acid structural motifs such G-quadruplexes and i-motif in real time, cell models, 3D and live cells by using combinations of fluorescence, NMR and X-ray crystallography techniques (*Nucl. Acid. Res.* 2019, *Org. Lett.* 2019). His group has recently developed practical chemical labelling and imaging methods for cellular RNA by using chemo-selective reactions (*Methods Mol. Biol.* 2019, in press).



**Figure 10:** Probing G-quadruplex nucleic acid structure of human telomeric overhang in real time and in 3D by using fluorescence and X-ray crystallography techniques (*Nucl. Acid. Res.* 2019, 47:6059) (Prof. Seergazhi G. Srivatsan Group)

## 2.2 Inorganic and Materials Science

Dr. Nirmalya Ballav's research primarily focuses on interfacial materials chemistry, from fundamentals to applications, upon exploring solid-solid and solid-liquid interfaces. Research platforms include coordination polymers, conducting polymers, two-dimensional materials, magnetic semiconductors, and thin films.

Thin films of a coordination polymer (CP) comprised of Cu(II) ion and benzenetetracarboxylic acid (BTEC) ligand were successfully fabricated on functionalised Au substrate by employing a layer-by-layer (LbL) method. Interestingly, open-metal Cu(II) sites generated during LbL in the thin film were susceptible to activation by molecular dopant molecules such as tetracyanoquinodimethane (TCNQ). As a consequence, significant enhancement in in-plane electrical conductivity and an unheralded cross-plane current rectification ratio (exceeding 105 both at room temperature and at an elevated temperature – resembling commercial Si diodes) were achieved in TCNQ doped Cu-BTEC thin film. Dr. Ballav's group has attributed this phenomenon to the formation of an electronic heterostructure in the molecularly doped thin film. A deeper understanding of the electronic heterostructure is required.

### Synthetic inorganic chemistry: Materials applications

Materials exhibiting ferroelectric and piezoelectric properties are of immense attention due to their promising applications in energy and electronics. Dr. R. Boomishankar's group is interested in the synthesis of organic and hybrid organic-inorganic salts with ferroelectric properties and use them as mechanical energy harvesters. By judiciously designed ammonium and phosphonium cations, the group was able to obtain novel examples of ferroelectric salts with various polarization values that impacts the output performance of devices based on them. Moreover, incorporation of these ferroelectric salts in non-piezoelectric polymers such as poly(dimethyl siloxane) (PDMS) and thermoplastic poly-urethane (TPU) have proved to be advantageous in terms of achieving the desired flexibility and superior energy harvesting and storage attributes.

### Hydrolytic and chemical stability of MOFs

Metal-organic polyhedra (MOP) are a promising class of crystalline porous materials with multifarious potential applications. Although MOPs and metal-organic frameworks (MOFs) have similar potential in terms of their intrinsic porosities and physicochemical properties, the exploitation of carboxylate MOPs is still rudimentary because of the lack of systematic development addressing their chemical stability. Prof. Sujit K. Ghosh and team have developed chemically robust carboxylate MOPs via outer-surface functionalisation as an a priori methodology, to stabilise those MOPs system where metal-ligand bond is not so strong. Fine-tuning of hydrophobic shielding is key to attaining chemical inertness with retention of the framework integrity over a wide range of pH values, in strong acidic conditions, and in oxidising and reducing media. These results are further corroborated by molecular modelling studies. Owing to the unprecedented transition from instability to a chemically ultra-stable regime using a rapid ambient-temperature gram-scale synthesis (within seconds), a prototype strategy towards chemically stable MOPs is reported.

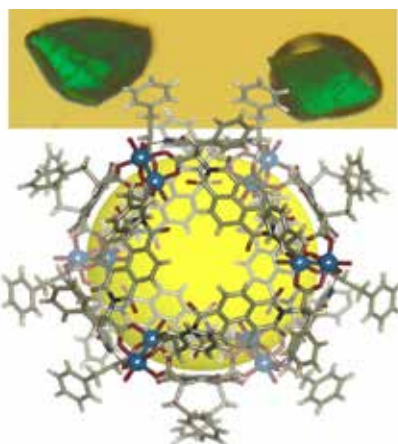


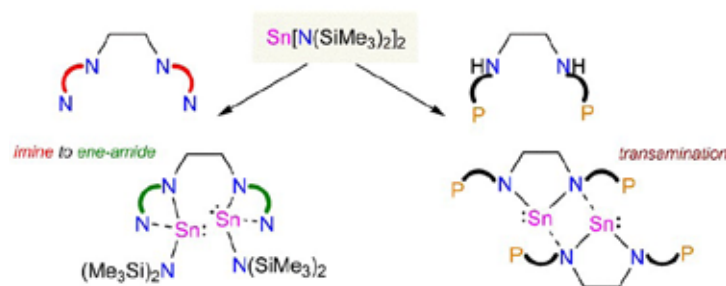
Figure 11: A chemically stable Metal-Organic polyhedra (MOP) (Prof. Sujit K. Ghosh's Group)

### Silylene as a ligand in homogeneous catalysis

The advent of N-heterocyclic silylenes (NHSis) and their ability to activate small molecules led to envisage that they could be the alternative ligands to NHCs. Dr. Shabana Khan's group is exploring silylene  $[\text{PhC}(\text{NtBu})_2\text{SiN}(\text{SiMe}_3)_2]$  as a ligand to prepare Cu(I), Ag(I), and Au(I) complexes which are being utilised for further catalytic applications. They have demonstrated the supremacy of Si(II)-Cu complexes over NHC-Cu complexes in Click reactions. The group is also developing some NHC supported Fe-based catalysts for water splitting reactions.

## Main-group and transition metal compounds for catalysis

Dr. Moumita Majumdar's group's research focuses on the fundamental exploits and prospective applications of low-valent Group 14 elements. They have explored the chemistry of polystannylene (where stannylene is the Sn analogue of carbene) within redox-active bis( $\alpha$ -iminopyridine) or diminodiphosphine ligand units (*Dalton Trans.* 2019). The conversion of stannylene to Sn(II) dication with potential nucleophilic behaviour has been studied. The s-p hybridisation has been introduced on the Sn(II) centre by judicious molecular geometry manipulations. The preferential sequestration using polystannylene has also been studied (manuscript submitted).

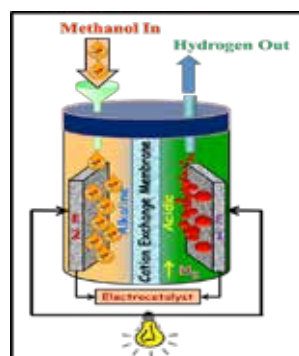


**Figure 12:** Syntheses of Bis-stannylenes (Dr. Moumita Majumdar's Group)

The group has developed an easily implementable chemical strategy and large-scale solution-phase coherent production of amalgamated Ge-graphitic nanocomposites (*Chem. Asian J.* 2020). This colloidal synthetic route to germanium nanocrystals embedded on N-doped graphenic nanosheets Ge/NG is free of any template or catalyst and involves easy purification techniques. The Ge/NG/C obtained after carbonization has been explored for anode performance in Lithium ion battery.

## Electrochemistry

Embracing 'hydrogen economy' or sustainable production and utilisation of hydrogen will be truly rejuvenating for our planet; when the entire life on it is threatened by myriad of problems than ever before due to inconsiderate human activities. Ironically, the prime challenges in realising 'hydrogen economy' seed from molecular hydrogen itself; with its peculiar physico-chemical properties posing serious safety, storage and transportation issues. Emergence of short-chain aliphatic alcohols as hydrogen-carrier molecules although have rekindled hope in hydrogen economy, the incompetence of state-of-the-art alcohol reforming techniques for sustainable hydrogen production is unmistakably visible from its high temperature (>200°C) and pressure (>25 bar) requirements and carbonization of the hydrogen fuel stream which prevents its direct utilisation in fuel cells.



**Figure 13:** Schematics of Alcohol Reforming Fuel Cell (ARFC) for spontaneous hydrogen fuel production. E1 and E2 are Pt based electrocatalysts (Dr. Muhammed Mustafa's Group)

Dr. Muhammed Mustafa's group has formulated a room-temperature alcohol reforming fuel cell (ARFC) uniquely integrating electric power generation with spontaneous hydrogen production in high purity and volume through the inter-conversion of neutralisation energy as electromotive force, which eventually redefines the role of fuel cells from simple fuel utilisation devices to the overall root of hydrogen economy. This

fundamentally different approach of alcohol reforming involves decarbonisation with CO<sub>2</sub> capture and fuel generation in distinct half cells which enable inherent purification of hydrogen fuel stream and consequently its direct utilisation in fuel cells. The ARFC offers an unprecedented route for reviving hydrogen economy from its twilight as CO<sub>2</sub> is simultaneously captured and electric power is harnessed during hydrogen fuel production as well as its utilisation.

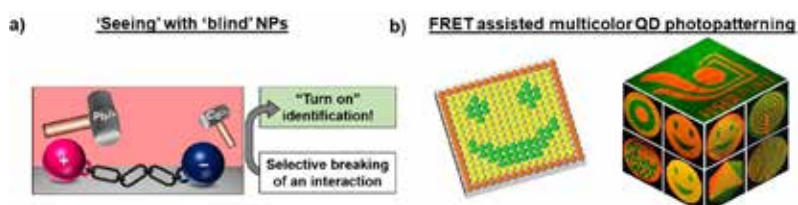
### Electronic dimensionality of layered perovskite

Layered hybrid metal halide perovskites are interesting optoelectronic materials. Since 1990s, layered perovskites like (BA)<sub>2</sub>PbI<sub>4</sub> (BA = C<sub>4</sub>H<sub>9</sub>NH<sub>3</sub>) are considered to be electronically 2D, where electrons and holes are confined in atomically thin two 2D Pb-I inorganic layers. In the 3<sup>rd</sup> dimension, the inorganic layers are electronically separated by the insulating organic layers.

Dr. Angshuman Nag's group found that the 2D electronic model does not explain their optical spectroscopic data obtained from single crystals of ~20 such layered perovskites. Correlating their spectroscopic data with the existing 2D model was one of the major focuses of the work during the last one year. The experimental findings suggest the presence of electronic interaction between the inorganic layers in some parts, predominantly at the edges of the single crystals. This finding that the parts of the best quality of layered hybrid perovskites are not strictly electronically 2D is critical for understanding the electronic, optical and optoelectronic properties of these technologically important materials.

### Functional nanomaterials

One of the main research themes of Dr. Pramod Pillai's group is to control the interplay of forces to improve various optoelectronic properties of hybrid nanomaterials. In this direction, the group demonstrated a fundamentally unique identification strategy to impart selectivity to a traditionally and inherently nonselective carboxylate-functionalized gold nanoparticles ([-] AuNPs), without the aid of any analyte specific ligands. The approach was to use the abilities of various divalent ions to break a thermodynamically stable inter-nanoparticle precipitates containing [+] and [-] AuNPs, as the means of identification. Importantly both [+] and [-] AuNPs, independently, were 'blind' in terms of selectivity towards divalent ions. Remarkably, a hybrid-system composed of such nonselective nanoparticles was able to discriminate between the hard-to-distinguish pair of Pb<sup>2+</sup> and Cd<sup>2+</sup> ions. In another effort, they have demonstrated a robust and simple tool for the fabrication of reusable multicolor luminescent photopatterns using a single Quantum Dot (QD) nanohybrid system. This is in stark contrast to the existing techniques where different sized QDs are required to achieve different luminescent colours. The photopatterning approach of the group relies on the photoregulation of Förster resonance energy transfer (FRET) process in a QD - dye donor-acceptor film. This led to the generation of high-contrast multicolor luminescent patterns comprising of at least three distinctly different colours: orange, yellow and green.



**Figure 14:** Regulation of nanoscale interactions a) impart selectivity to an inherently nonselective AuNP system, and b) create multicolor luminescent patterns on a single QD nanohybrid film (Dr. Pramod Pillai's Group)

## 2.3 Spectroscopy, Theoretical and Computational Chemistry

### *Dynamics of polymer translocation*

Dr. Srabanti Chaudhury's group has worked specifically on two major projects: one is in the field of polymer physics and another one is in the field of single event statistics.

The group has studied the dynamics of a folded linear polymer translocating through a nanopore by a pulling force using the molecular dynamics simulations and provided a quantitative theory based on the iso flux tension propagation theory. This model is relevant in the context of experiments on double-strand DNA translocation using silicon oxide nanopores.

The group proposed a theoretical method to investigate the dynamics of chemical reactions on catalytic particles with multiple active sites. It is based on a discrete-state stochastic description that allows us to explicitly evaluate dynamic properties of the system. The theoretical method proposed by the group provides a way to quantify the molecular mechanisms of processes on nanocatalysts.

### *Protein-RNA interactions*

Many double-stranded RNA-binding domains (dsRBDs) interact with topologically distinct double-stranded RNAs (dsRNAs) in crucial biological pathways that are pivotal to viral replication, causation and propagation of cancers, and neurodegenerative diseases. Dr. Jeetender Chugh's group hypothesised that the adaptability of dsRBDs is essential to target the pool of dsRNA substrates; thus, it is imperative to comprehend this adaptability for better understanding of such biological pathways. Dr. Chugh's lab is engaging model dsRBDs to understand the shape-dependent dsRNA recognition phenomenon employed by the dsRBDs. In this direction, the lab has established that the thermodynamic signature of the dsRNA-dsRBD interaction depends on the shape of the target dsRNA, which is also reflected in NMR-based studies. They have observed presence of intrinsic microsecond timescale motions in RNA-binding sites that relay to residues that are in close proximity upon RNA-binding. Dr. Chugh's lab is carrying out dynamics studies on a series of such dsRNA-binding domains to come to a general understanding on how dsRBDs sense dsRNAs.

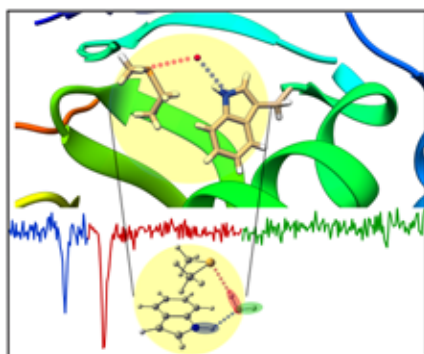
Another area of interest is the applicability of NMR to metabolomics where they collaborate with biology labs across India to find various problems that can be addressed by NMR. In this direction, they have recently shown that o-phosphocholine to UDP-N-acetylglucosamine ratio may act as a potential biomarker in glucotoxic/lipotoxic/glucolipotoxic conditions in pancreatic  $\beta$ -cells. Similar results have been observed in diabetic population from Pune region. They have also discovered the metabolic reprogramming in *Mycobacterium smegmatis* that allows it to adapt to various environmental stresses including oxidative stress, nutrient-deprivation stress, and acidic stress. In a recent study, lab has studied metabolic perturbations in a variety of potato cultivars upon cold-storage.

### *Studying weak non-covalent interactions*

The major focus of Dr. Alope Das's research group is on molecular level understanding of various weak non-covalent interactions which govern the structures as well as the functions of biomolecules and materials. They employ isolated gas phase laser spectroscopy techniques combined with quantum chemistry calculations to obtain intrinsic knowledge on the physical nature, strength, and binding motifs of these weak interactions. In-depth knowledge on various aspects of the non-covalent interactions

is extremely important for designing drugs, catalyst, etc. of optimal activity as well as functional materials or supramolecular assemblies.

Recently, the group is interested in modulating the strength of weak  $n \rightarrow \pi^*$  interaction which has been demonstrated to play significant role in the structures of proteins. They have reported the conformational preference of phenyl acetate governed by steric effect and  $n \rightarrow \pi^*$  interaction using conformation-specific electronic and IR spectroscopy combined with quantum chemistry calculations. They have found the effect of methyl substitution on the strength of the  $n \rightarrow \pi^*$  interaction, steric repulsion, and hyperconjugation in phenyl acetate. Their research demonstrates that the introduction of a bulkier substituent can induce steric as well as electronic control to reduce conformational heterogeneity of a molecular system. It has been concluded that understanding the effect of bulkier substituents to promote defined conformations having specific non-covalent interactions may have implication in better perception of optimum structure and function of biomolecules as well as recognition of drugs by biomolecules.

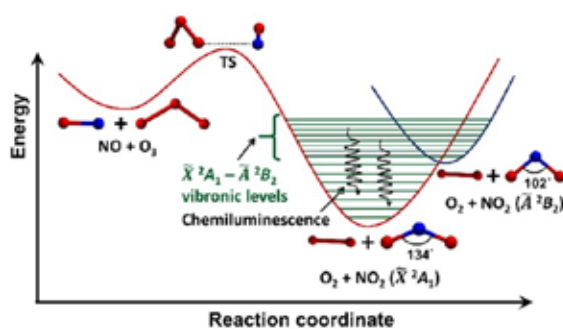


**Figure 15:** PDB structure showing single water-mediated Se hydrogen bonding between tryptophan and selenomethionine residues as well as IR spectrum of cyclic bridge structure of indole... H<sub>2</sub>O...dimethyl selenide complex (Dr. Alope Das's Group)

Dr. Das's group is also exploring unconventional hydrogen-bonding interactions involving weakly electronegative atoms (S, Se etc.) as hydrogen bond donor as well as acceptor. They have investigated single water-mediated selenium hydrogen-bonding interactions between amino acid residues in proteins through extensive PDB analysis coupled with gas phase spectroscopy study of a model complex consisting of indole, dimethyl selenide, and water. Their results demonstrate that the most stable structure of the model complex observed in the IR spectroscopy mimics single water-mediated selenium hydrogen-bonded structural motifs present in the crystal structures of proteins.

### *Study of excited state phenomena in molecules using quantum chemical tools*

Molecules in their excited electronic states are responsible for a variety of interesting natural phenomena like photosynthesis, vision and bioluminescence, and are the basis for numerous technological applications. Using quantum chemical methods, Dr. Anirban Hazra's group seeks fundamental understanding of a wide range of excited state phenomena. The group has recently obtained new insights on the mechanism of chemiluminescence in the reaction of nitric oxide with ozone. This reaction is routinely used commercially for quantitative determination of NO<sub>x</sub> (NO and NO<sub>2</sub>) in gas mixtures. It also plays a crucial role in the atmospheric ozone budget. The group's study suggests that chemiluminescence in the NO+O<sub>3</sub> reaction is due to emission from the NO<sub>2</sub> vibronic states associated with the ground ( $X^2A_1$ ) and first excited ( $\tilde{A}^2B_2$ ) electronic states, which are populated in the nascent NO<sub>2</sub> produced in the reaction. This mechanism is very different from that in cycloperoxides, the only other type of chemiluminescent system explored in-depth up to now, and the results provide fundamental new insights on the phenomenon of chemiluminescence.



**Figure 16:** Mechanism of chemiluminescence in the reaction of nitric oxide with ozone to produce nitrogen dioxide and oxygen  
(Dr. Anirban Hazra's Group)

### Photophysics of biologically important molecules

Dr. Partha Hazra's group is trying to explore the lyotropic liquid crystalline (LLC) system, which has tremendous application in the biomedical field.

The group has used two molecules exhibiting an excited state intramolecular proton transfer (ESIPT), fisetin and 3-hydroxyflavone, to determine the hydrogen bond donating and accepting parameters of the LLC water molecules. Using fluorescence spectroscopic technique they have found that despite a reported general alcohol like polarity of the LLC nanochannels, the hydrogen bonding behaviour of the water molecules is similar to that of moderately polar aprotic solvents, such as acetonitrile. Moreover, using pico-second and femtosecond time-resolved fluorescence techniques, they have noticed that the ESIPT rates, which are ultrafast (~20 ps) in neat polar protic and aprotic solvents, get slowed down dramatically by almost 15 times inside the LLC phases.

In the field of biophysics, the group has developed i-motif DNA sensor, which shows light up property upon selective detection of various i-motif DNA (including intermolecular and intramolecular) based on the recognition between hemi-protonated cytosine–cytosine (C<sup>+</sup>–C) base pairing and negative functionality of coumarin 343.

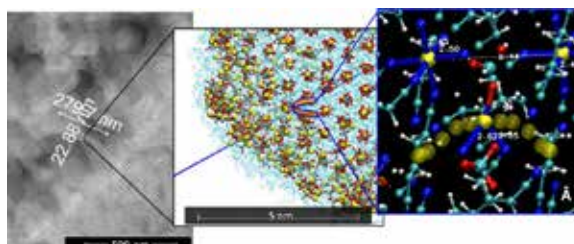
Presently, Dr. Hazra's group is working on (i) the self-assembly driven tunable copper nano-cluster formation and its application towards catalytic activity, and (ii) design, synthesis and photophysics of novel thermally activated delayed fluorescent (TADF) and solid state multi-stimuli responsive organic luminogens.

### Understanding properties of materials through simulation methods

Dr. Arun Venkatnathan's research focuses on computational investigation of battery electrolytes, polymer electrolyte membrane fuel cells and carbon capture. The research employs application of Molecular dynamics (MD) simulation methods with all atom force fields to compute structural and dynamical properties in various polymer membranes environments; thermal stability, interactions and ion conduction in battery electrolytes and mechanism of carbon dioxide absorption in amino acid ionic liquids. The reaction mechanisms using density functional theory (DFT) calculations for proton transport in fuel cell electrolytes and for CO<sub>2</sub> capture in an amino acid-based absorbent have also been investigated. Further with experimentalists at Temple University, the group also collaborate on the design, characterisation and modelling of novel co-crystalline electrolytes for alkali metal (Li/Na) batteries.

A combined experimental and theoretical work have resulted in the synthesis of new alternatives for battery electrolytes and innovative approaches to model complex chemical processes like mechanism of ion conduction and thermal stability of electrolytes. Co-crystals composed of NaClO<sub>4</sub> and adiponitrile solvent in 1:3 stoichiometric ratio-

$\text{NaClO}_4(\text{ADN})_3$  show potential battery applications. The group studied its thermal stability and ion conduction pathways from MD simulations and DFT calculations. A molecular simulation model predicts stable  $\text{Na}^+$  ion-solvent interactions which plays an important role in thermal stability and thus enable melt-casting of the electrolyte. Further, vacuum-interface modelling predicts a highly conductive layer of solvent at the surface which facilitates transport of ions between small grains of electrolyte- grain boundary conduction. Using the plane-wave DFT method, a mechanism of  $\text{Na}^+$  ion migration in the crystalline phase was explored where anion-solvent assisting the path of  $\text{Na}^+$  ions was observed. The approach of using several computational methods based on the system size and time scales of various physical and chemical phenomena have led to a better understanding of a novel domain of energy materials, and is expected to further the design of co-crystal battery electrolyte with improved material properties.



**Figure 17:** Multi-scale modeling of electrolyte for  $\text{Na}^+$  ion battery where structure from SEM (small grains)  $\rightarrow$  MD simulation (surface of crystals)  $\rightarrow$  DFT (ion migration path) are shown from left to right. (Dr. Arun Venkatnathan's Group)



### 3. EARTH AND CLIMATE SCIENCE RESEARCH REPORT



#### 3.1 Earth Surface Processes, Climate

##### *Weathering and erosion*

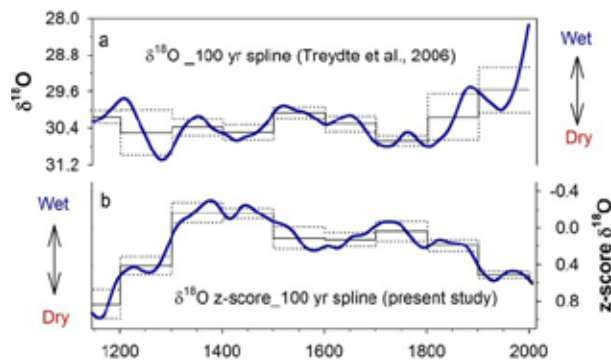
Reconstruction of past rainfall pattern can provide useful clues about monsoon physics, which in turn can help its better future prediction. However, there exists limited paleoclimatic records from the core monsoon zone to establish natural variability of the Indian summer monsoon (ISM). Dr. Gyana Ranjan Tripathy has investigated oxygen isotopic ( $\delta^{18}\text{O}$ ) composition of a U-Th dated speleothem from the Gupteswar cave, Odisha. The rain-water  $\delta^{18}\text{O}$  from this region shows a strong anti-correlation with rainfall amount with  $\sim 1.5\%$  isotopic depletion being observed for 100 mm increase in rainfall. This amount effect has been used to reconstruct past ISM variation during the speleothem growth period ( $\sim 4,000$ - $9,000$  yr BP) with an average time-resolution of  $\sim 5$  yrs. The time-series  $\delta^{18}\text{O}$  data indicates that the ISM was steadily declining during the mid-Holocene period and it shifted towards a drier phase since  $\sim 5.2$  kyr. A broad anti-phase between south-west and north-east rainfall was observed during 9.0-5.2 kyr. A comparison of global climatic and the present ISM data reveals influence of surface temperature of the North Atlantic Ocean on the ISM variability during the mid-Holocene.

##### *Stable isotope geology*

Understanding the effect of climate change on the glaciers in High Mountain Asia is important as it influences the discharge of important rivers such as the Indus and Ganga. The glaciers from the Karakoram region are in balance or thickening while most from the other regions are thinning, the "Karakoram anomaly". It represents important

and intriguing hydroclimatic change that is occurring in High Mountain Asia. Whether this contrasting glacier response is the result of regionally varying climate trends or regionally varying glacier responses to the same climate forcing was not clear. Dr. Shreyas Managave's group reconstructed past climate variability using oxygen isotope records ( $\delta^{18}\text{O}$ ) of trees from the Lahaul-Spiti region. This reconstruction was found to be contrasting to the similar reconstruction from the Karakoram regions over the past millennium. As trees-ring  $\delta^{18}\text{O}$  and glaciers mass balance records respond in a similar way to the changes in the climate, they suggest that the "Karakoram Anomaly" is the result of regionally varying climate trends.

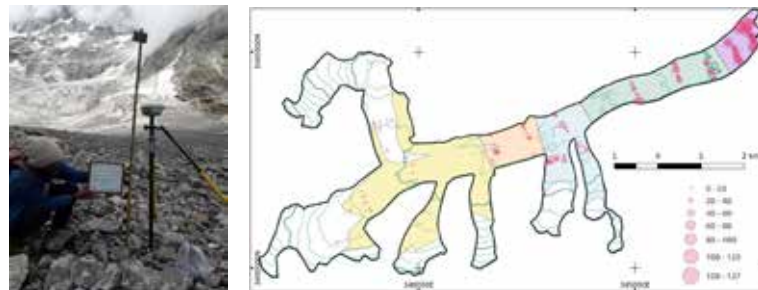
*Installation of Isotope Ratio Mass Spectrometer (IRMS):* Dr. Managave was involved in the procurement and installation of an IRMS and helped in operationalizing it for the use by the IISER community.



**Figure 18:**  $\delta^{18}\text{O}$  records of Junipers from the Karakoram region (a) and from Lahaul-Spiti (b) (Dr. Shreyas Managave's Group)

### Himalayan glaciers

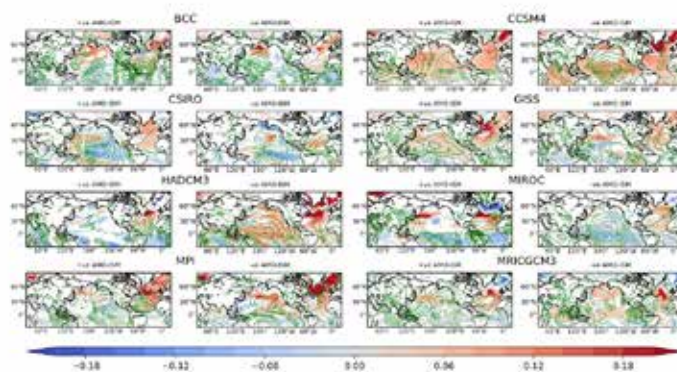
Estimation of glaciological balance utilises point-scale data at a few ablation stakes that are usually regressed as a function of elevation and summed over the glacier area. However, in debris-covered glaciers, a spatially variable supraglacial debris layer strongly influences the ablation. Dr. Argha Banerjee's group developed a new method to compute sub-debris ablation where stake data are interpolated as a function of debris-thickness alone and averaged over the local debris-thickness distribution. They apply this method on Satopanth Glacier located in the Central Himalaya where they performed ~1000 ablation measurements with a network of 50+ stakes during 2015–2017. The estimated mean sub-debris ablation ranges between  $1.5 \pm 0.2$  to  $1.7 \pm 0.3$  cm/day. They show that the debris-thickness-dependent regression describes the spatial variability of the sub-debris ablation better than the elevation dependent regression.



**Figure 19:** Measurement of surface mass balance of Satopanth Glacier: (Left) A field photo of an ablation stake where measurement is being performed. (Right) A map of the glacier showing all the stakes with circles whose size denote the debris-thickness there (Dr. Argha Banerjee's Group)

### Weather prediction and understanding natural variability

The Atlantic Multidecadal variability (AMV) has been established as one of the major drivers of the multidecadal variability of Indian summer monsoon seasonal rainfall (ISM). In Climate Model Intercomparison Project (CMIP5) historical simulations, only ~16% of the models could reproduce the observed statistically significant relationship between AMV and ISM. The uncertainties in model simulations lead to a major question, whether the observed relationship of AMV and ISM may be specific to the current observation period. Dr. Neena Joseph Mani's group focuses on understanding the teleconnections between the Atlantic and the Pacific with the ISM on decadal and longer timescales.



**Figure 20:** Linear regression pattern of normalised AMO index with sea surface temperature anomalies in the different models. Correlations which are more than 90% significant (based on *t* test for slope values and *F* test for goodness of fit) are only shown. (Dr. Neena Joseph Mani's Group)

The group analysed the Last millennium (LM) simulations from eight climate models participating in Paleo climate Modeling Intercomparison Project phase 3 (PMIP3), which are forced with historical reconstructions of total solar irradiance, volcanic aerosols, land use/land cover and evolution of trace gases. Three plausible physical mechanisms through which the AMV can modulate the monsoon were tested in the climate model simulations viz., a) AMV modulating the monsoon through the summer time North Atlantic Oscillation b) AMV modulating the monsoon through upper atmospheric circulation responses c) Via modulating the Pacific variability which is strongly linked to ISM variability. Most of the models indicate a strong SST response in the North Pacific, indicating that the teleconnection via the Pacific pathway might be a major player in modulating the ISM multidecadal variability.

### Organisation of tropical convection

Dr. Suhas Ettammal's group has studied the initiation of the monsoon low-pressure system (LPS) over the Bay of Bengal. It contributes to more than half of the rainfall over a highly populated Gangetic plains of India. Despite their importance in the regional hydrological cycle, the exact genesis mechanisms by which these storms form are still elusive. It has been known for a long time that there are two types of LPS - those that form due to local processes (in situ) over the Bay of Bengal and those triggered by propagating atmospheric disturbances from the West Pacific (downstream amplification). Previous studies indicate that about 85% of the LPS form by downstream amplification. Their analyses of four decades of LPS data show that 68% of the LPS forms in situ and 32% by downstream processes. The storms formed by both the mechanisms have the same dynamical and thermodynamical characteristics. The group also show that there is a decreasing trend in the LPS formed by the downstream processes.

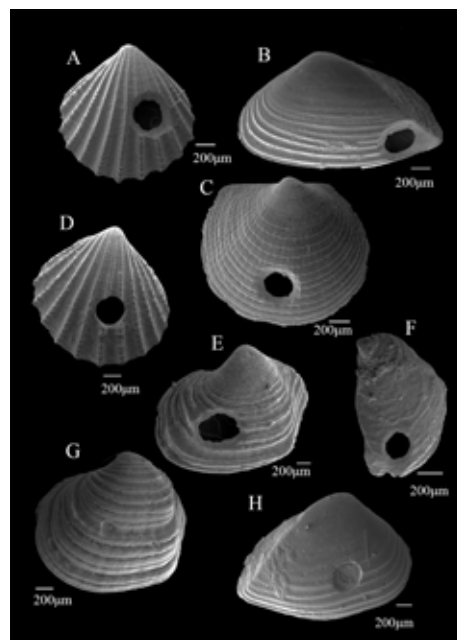
**Understanding organic carbon mobilisation in a young volcanic basin and its impact on climate change**

The scientific understanding of the fluid plumbing system at the passive continental margin is highly relevant for society. The continental margin marine sediments store substantial natural gas, that can meet the society's energy demand. The sedimentary environment at the margin is dynamic. Both thermohaline circulation and sediment-laden gravity currents influence margin sedimentation. Dr. Sudipta Sarkar's group probed into the Cenozoic evolution of the sedimentary system at the western North Atlantic. They analysed several multichannel seismic reflection datasets that were collected during the Eastern North American Margin Community Experiment (ENAM). The scientists characterised the evolution of the continental margin and discovered gas hydrate. The new results extend the previously found gas hydrate occurrence. A buried submarine landslide was discovered on the continental slope. The discovery of this landslide provides a unique perspective on how the sedimentary wedge on the continental slope can fail. Such landslide may trigger tsunami waves and could prove to be fatal for coastal communities.

### 3.2 Response of ecosystems

**Ancient and recent marine ecosystems**

Dr. Devapriya Chattopadhyay addresses a wide range of questions related to the nature of faunal response to physical and biological triggers in ancient and recent marine ecosystems. Areas of particular interest include individual response to biotic interaction, effect of local environment on shallow-marine benthos diversity and ecologic response to climate change. In addition to studying fossils in the field, her group also works on modern organisms using under-water observations, conduct laboratory experiments in aquariums, and use statistical modelling. After joining IISER Pune last year, Dr. Chattopadhyay is in the process of setting up the Paleontology and Marine Ecology Research Laboratory. In their recent work using marine micromolluscan fossil assemblage of Miocene age (~20 my) from Kerala in comparison to the global record, they have established that the small-size of the prey can act as an effective defence against predation and such "negative size refugia" explains the evolutionary trend of micromorphy observed in tropical marine biota.



**Figure 21:** Predation marks on micromolluscan fossils (Dr. Devapriya Chattopadhyay's Group)



## 4. HUMANITIES AND SOCIAL SCIENCES RESEARCH REPORT



### 4.1 History of science, architecture, material culture

#### *History of architecture and material culture*

Dr. Pushkar Sohoni's research over the past year included preparation of a major two-volume reference work (to be published independently in Marathi and English) titled *महाराष्ट्रातील वास्तुकला: परंपरा आणि वाटचाल* [Maharashtraatil vaastukala: parampara ani vatchaal] in collaboration with architects Narendra Dingle, Chetan Sahasrabuddhe, and Minal Sagare. The publication has been commissioned by the Maharashtra Rajya Sahitya Sanskriti Mandal.

In a project funded by the Science and Heritage Research Initiative (SHRI) of the Department of Science and Technology (DST), Dr. Sohoni has commenced work related to investigating historic mortars.

A systematic study of Yadava temples is underway to try and understand the unique architectural contributions in the realm of temple-building in this period. Along with colleagues from Deccan College Post-Graduate and Research Institute, a research project will soon be initiated.

### 4.2 Literature

#### *Fictional worlds and their analyses*

Dr. Pooja Sancheti is currently working on two minor and two major projects. The minor projects include (1) Examining the figure of the robot in Helen O'Loy (1938) and Ex Machina (2014), with focus on the figure of the female robot, male desire/male gaze, and the unyielding trope of the femme fatale; (2) The novels of Cyrus Mistry, especially looking at representations of a minority community (i.e. the Parsis), subjectivised historiography, and the influence of majoritarian cultures on minority cultures.

The major projects include (1) Women characters in the novels of Amitav Ghosh, with a focus on foreignness, cultural imbalances, sexual violence, and gendered identities; (2) Contemporary English novelists of the Indian subcontinent, with an emphasis on the conversation between the West and the East, as well as between the various countries of the subcontinent, the politics of English writing and narrativisation, and gender, cultural and historical specificities. The project also explores transnationalism, postcolonialism, and world literature as potential frameworks that may only partially satisfy a sustained reading of such a literary body.

### 4.3 Humanities

#### *Water and environmental change*

Dr. Bejoy K. Thomas has been working on water resources management and livelihoods in peri-urban and agrarian settings using a combination of field research and desk reviews. Specifically, he looks at policies and practices around groundwater management, water use efficiency in agriculture and wastewater reuse. His research speaks to Sustainable Development Goals 2 (hunger and food security) and 6 (clean water, sanitation and sustainable water use), focusing on the interactions between them and the policy implications. In addition, he has been analysing the trade-offs between climate action

and development goals and the potential unintended negative effects of climate action interventions.

*Political ideas in modern India, Gandhian studies, gender studies*

Dr. Chaitra Redkar has worked broadly in three areas, namely, Political Ideas in Modern India, Social Movement Perspective on Indian politics and Gender in Indian Politics. She has been exploring the political discourse of Gandhians in the post-independent period. Her work on J.C. Kumarappa, Gandhi's economist, was published by SAGE in 2019 (Gandhian Engagement with Capital: Perspectives of J. C. Kumarappa). At present, she is focusing on the Gandhian experiments in participatory democracy, rural development and education. With reference to the other two areas of her research, she has recently completed a monograph on 'Women and State Politics in Maharashtra'.



## 5. MATHEMATICS RESEARCH REPORT



### 5.1 Algebra and Number Theory

*Special values of L-functions associated to automorphic forms*

Dr. Baskar Balasubramanyam's research during the last year has focused on the study of special values of L-functions and p-adic interpolation of such L-functions. Some of the problems he studied are: Asai L-values, p-adic adjoint L-functions for Hilbert modular forms and Rankin triple product L-values.

*Arithmetic geometry and automorphic forms*

Let  $X$  be a modular curve. Recall the definition of Eisenstein classes in the modular symbols:

Definition 1. We call Eisenstein classes corresponding to a divisor  $D$  to be the element  $\varepsilon_D \in H_1(X, \partial(X_r), \mathbb{R})$  such that  $\int \varepsilon_D \omega = 0$  for all  $\omega \in H^0(X, \Omega^1)$  and  $\delta(\varepsilon_D) = D$ . The Eisenstein cycles are paths in the Eisenstein classes corresponding to  $D$ .

In a paper with Loic Merel in the *Journal of the London Mathematical Society*, Dr. Debargha Banerjee wrote down these Eisenstein classes for the principal congruence subgroups.

In another work (joint with Loic Merel), they wrote down these classes for any subgroup of finite index. The classical Manin-Drinfeld Theorem asserts that the class of a divisor  $D$  of degree zero supported on  $\partial(X_r)$  is torsion in the Jacobian  $Jac(X_r)$  for the modular curve associated to the subgroup  $\Gamma = \Gamma(N)$ . If  $\Gamma$  is not a congruence subgroup, the cuspidal subgroup may or may not be finite.

In fact, Manin-Mumford conjecture (Raynaud's theorem) implies that there are subgroups of finite index for which the cuspidal groups are not necessarily finite. Scholl and Murty-Ramakrishnan gave a criteria for a divisor to be torsion or not for any subgroups of finite index in terms of Fourier co-efficients of Eisenstein series; that in turn can be computed using Ramanujan sums. According to the criteria, finiteness of the divisor class for the cuspidal subgroup can be detected by the rationality of all Fourier co-efficients of Eisenstein series or by evaluating infinite number of quantities involving Ramanujan sums.

The team showed that the checking a particular divisor  $D$  is of finite order in the cuspidal group depends on the rationality criteria of the value of a certain explicit real valued function at finitely many cusps. Although it seems that we need to know all the Fourier co-efficients to write down the function but these are harmonic conjugate of Eisenstein series of weight zero associated to the divisor and hence can be written directly from this Eisenstein series. The function is written without writing down all the Fourier co-efficients.

In a paper with Tathatagata Mandal, Dr. Banerjee wrote down the local Brauer classes of the endomorphism algebras of motives attached to non-CM primitive Hecke eigenforms for the supercuspidal prime  $p=2$ . The same for odd supercuspidal primes are determined by Bhattacharya-Ghate. They also treat the case of odd unramified supercuspidal primes of level zero also removing a mild hypothesis of them. As an intermediate step, they write down a description of the inertial Galois representation even for  $p=2$  generalising the construction of Ghate-Mézard. Some numerical examples using Sage and LMFDB are provided supporting some of our theorems.

### *Whitehead group of general orthogonal modules*

Dr. Rabeya Basu's work has deduced a graded-local global principle (LGP) for traditional classical groups over graded rings and discussed its applications. Her work has also established a relative version of the LGP which is very much useful for stabilization problems and also otherwise.

### *L-functions and zeta functions*

In a joint work with Prof. A. Raghuram, IISER Pune, Dr. Chandrasheel Bhagwat has proved a theorem which gives a certain rationality result for the ratios of successive critical values of degree- $2n$  Langlands L-functions associated to the group  $GL_1 \times O(2n)$  over  $F$ .

### *Analytic number theory and arithmetic of modular forms*

A primary theme in Dr. Kaneenika Sinha's research programme focuses on distribution properties of special arithmetic sequences and families with a focus on zeta zeroes of curves over finite fields, Fourier co-efficients of modular forms and eigenvalues of families of Ramanujan graphs.

These distribution properties include asymptotic distribution measures for above sequences, the rate of convergence of sequences to their distribution measures, fluctuations in the rate of convergence among families of sequences and local spacing statistics among uniformly distributed sequences.

## **5.2 Analysis and Applicable Mathematics**

### *Elliptical particle differential equations*

In a joint work with former PhD student D. Mukherjee, Dr. Mousomi Bhakta studied  $(p,q)$  fractional Laplacian type equations with concave-critical nonlinearities in bounded domain  $\Omega$ . They obtained multiplicity results for nonnegative solutions and proved the problem admits at least  $\text{cat}_p(\Omega)$  number of nonnegative solutions. In another joint project with D. Mukherjee, Dr. Bhakta worked in nonlocal scalar field equations and proved existence of solution and established various qualitative properties of the solution. They also characterised the asymptotic profile of solution when the vanishing parameter goes to zero in all the three cases of nonlinearities: critical, subcritical and super critical.

In another joint project with D. Mukherjee and S. Santra, Dr. Bhakta studied asymptotic profile of positive solutions of nonlocal equations (in bounded domain in  $\mathbb{R}^N$ ) with critical and supercritical exponents in presence of a small parameter which goes to 0. They also studied asymptotic uniqueness of positive solution.

In a joint project with Phuoc Tai Nguyen (from Czech Republic), they proved existence, multiplicity, regularity properties of positive solutions of system of equations with fractional Laplace operator and with power type nonlinearities and measure source term/boundary trace.

### **Probability theory and control theory**

Dr. Anup Biswas worked on developing a PDE theory for nonlocal operators, in particular, maximum principles, eigenvalue value theory, symmetry property, overdetermined property, etc. He has also been active in extending the theory of risk-sensitive control. Jointly with Ari Arapostathis and Luis Caffarelli, he has been able to resolve a question on uniqueness of sub-critical viscous equation. They have developed the policy iteration method for risk-optimisation problem and also trying to extend our results for switching diffusions.

### **Moduli of curves**

Arakelov geometry of moduli of elliptic curves: In collaboration with Debargha Banerjee and Diganta Borah from IISER Pune, Dr. Chitrabhanu Chaudhuri computed an asymptotic expression for the Arakelov self-intersection number of the relative dualising sheaf of Edixhoven's minimal regular model for the modular curve  $X_0(p^2)$  over  $\mathbb{Q}$ . In the second paper they first give explicit descriptions of semi-stable models of modular curves  $X_0(p^2)$  for odd primes  $p > 3$ . Using these models and the results of the first paper they are able to compute the Arakelov self-intersection numbers of the relative dualising sheaves for these models. They gave two arithmetic applications of their computations. In particular, they proved an effective version of the Bogomolov conjecture following the strategy outlined by Zhang and find the stable Faltings heights of the arithmetic surfaces corresponding to these modular curves.

Gromov-Witten theory of genus 1 curves: In collaboration with Ritwik Mukherjee and Nilkantha Das from the Mathematics department of NISER Bhubaneswar, Dr. Chaudhuri obtained a formula for the number of genus one curves with a variable complex structure of a given degree on a del-Pezzo surface that pass through an appropriate number of generic points of the surface. This is done using Getzler's relationship among cohomology classes of certain codimension 2 cycles in  $\overline{M}_{1,4}$  and recursively computing the genus one Gromov-Witten invariants of del-Pezzo surfaces. Using completely different methods, this problem has been solved earlier by Bertram and Abramovich, Ravi Vakil, Dubrovin and Zhang and more recently using Tropical geometric methods by M.~Shoval and E.~Shustin. They also subject our formula to several low degree checks and compare them to the numbers obtained by the earlier authors. They have implemented an algorithm to calculate the recursive formula as a C programme.

### **Mathematical finance**

Dr. Anindya Goswami, along with research students, has started building an adaptive AI system for early detection of instability in Indian financial market. This study relies on detection of mispricing in derivative market without any theoretical assumption on market dynamics. This is important, as fair pricing is at the heart of the market stability.

The group has determined how to tune an AI system which learns market's perception on

right option price for a given asset price data. When trained with a large amount of data from a particular economy, the AI produces, based on no theoretical model, the price of CE(European Call) options corresponding to any given asset price time-series data. That enables us to testify (AI perceived) market perception by contrasting with simulated asset price data which has a unique fair price of CE. If the mismatch in AI perceived right price and the theoretical fair price is found to be biased in one particular direction and the amplitude of the bias is more than a statistical significance level that would point out presence of mispricing of derivatives.

This AI system would then be configured in an adaptive mode, so that it reflects more on recent market perception than on distant past. Therefore, this dynamic AI system would devise an early warning system - which can identify signatures of irrationality within recent trading activities. This problem is otherwise mathematically intractable in its full generality. The group has developed both XGBoost and ANN models.

## 5.3 Geometry and Topology

### *Low-dimensional topology*

Any two PL-triangulations of a PL manifold are related by a sequence of local combinatorial changes to the triangulations called Pachner Moves. A basic question in combinatorial topology is the following: Given the combinatorial description of two triangulations, when do they determine the same manifold? One way to answer this question is to bound the number of Pachner moves needed to relate any two triangulations of the same manifold. In work with student Advait Phanse, Dr. Tejas Kalelkar has obtained such a bound for hyperbolic, spherical and Euclidean manifolds of any dimension. Their work last year focused on showing that any two such geometric triangulations are in fact related by geometric Pachner moves (upto derived subdivisions), so that the intermediate triangulations are also geometric in nature. Their ongoing work is to extend these results to hyperbolic knot complements.

In a work with student Ramya Nair, Dr. Kalelkar has given a characterisation of Seifert fibre spaces in terms of the existence of a special prism complex structure. This gives a discrete version of the fibration structure of the manifold.

### *Toric vector bundles and tensor triangular geometry*

In a joint work with Dr. Umesh Dubey, Dr. Vivek Mallick has a computation for the K-theory of a G-equivariant tensor-triangulated category. This provides analogues formulae proved by Vistoli-Vezzosi for K-theory of G-equivariant schemes, and by Tabuada for universal additive functors for dg-categories in the tensor-triangulated world.

In another work with Jose Ignacio Burgos Gil, they studied the structure of toric vector bundles with applications to Arakelov geometry in mind.

The third project is regarding the study of multihomogeneous projective spaces with Dr. Mallick's student Kartik Roy. These spaces are generalisations of projective spaces in which any scheme embeds. They have some description of line bundles on it, and the team is studying resolution property over such spaces. With Dr. Samarpita Ray, Dr. Mallick is studying structures on derived categories of group schemes.

### *Toric vector bundles*

The study of toric vector bundles has yielded rich dividends, perhaps best exemplified by Klyachko's work on Horn's conjecture about eigenvalues, which is a beautiful fusion of

Linear Algebra, Algebraic Geometry, Representation Theory and Differential Geometry. Prof. Mainak Poddar's research is broadly aimed at improving the understanding of the more general category of toric principal bundles. This year, the group has completed a project on developing a Tannakian description of this category with I. Biswas and A. Dey. They have also made significant progress on developing a Lie theoretic description of the same with IISER postdoctoral fellows, J. Dasgupta and B. Khan. Besides these, they have introduced a notion of toric co-Higgs vector bundle and proved a classification theorem on it with I. Biswas, A. Dey and S. Rayan. The group has also used toric vector bundles to construct interesting examples of higher dimensional SKT manifolds with H. Coban and C. Haciyusufoglu. Moreover, with A. Dey and V. Mallick, Prof. Poddar has investigated the existence of toric structure on rank two vector bundles over projective spaces, a topic which is closely related to a famous conjecture of Hartshorne.

### Representation theory of $p$ -adic groups

Bernstein decomposition realises the category of smooth representations of a  $p$ -adic group as a product of indecomposable subcategories called Bernstein blocks. Moy-Prasad theory associates a number called depth to each Bernstein block. Depth-zero blocks have been well understood. In an earlier work (Crelle, 2019), Dr. Manish Mishra had established that Bernstein centre of supercuspidal block is isomorphic to the Bernstein centre of a depth-zero supercuspidal block of some suitable subgroup. Greatly generalising this work, in a recent joint work with Jeffrey Adler (arXiv:1909.09966), Dr. Mishra established this isomorphism for most Bernstein blocks (more precisely 'regular' Bernstein blocks). As an application of this, they proved the 'ABPS conjecture' in many new cases.

In a work in progress, along with student Basudev, Dr. Mishra generalised a result of Chan and Savin (*Math. Z.*, 2018) from unramified principal series block to an arbitrary principal series block.



## 6. PHYSICS RESEARCH REPORT



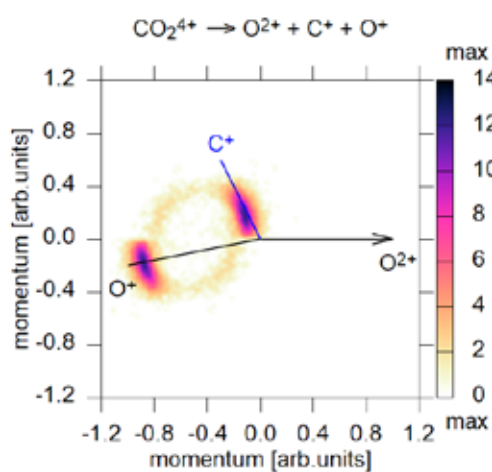
### 6.1 Atomic and Molecular Physics, Optics, and Quantum Information

#### Atomic collisions and molecular fragmentation

Does the absence of spherical symmetry in a molecule lead to a dependence of the ionization probability on the orientation of the molecule in swift collisions with a charged particle? Prof. Bhas Bapat's group confirmed this experimentally and further showed that the dependence is not merely a geometric alignment effect, but is also a function of the specific orientation and the nature of the atomic constituents.

Collisions between molecules and slow, highly charged ions may lead to significant transient changes in the potential energy surfaces of the molecule and resonant transfer of electrons from specific shells of the molecule to the ion. The changes can be discerned through the kinematics of ionization. A recent grant from DST-SERB has been used to procure a high-charge, low energy ion source and accelerator for such

studies. Initial results show that the ionization and fragmentation features are drastically affected by the choice of ion charge and velocity.



**Figure 22:** A fragmenting molecule: A  $\text{CO}_2$  molecule is ionised by the impact of Argon ion projectiles.  $\text{CO}_2$  loses 4 electrons and fragments into its atomic constituents. The two images show how the fragments  $\text{O}^{2+}$ ,  $\text{C}^+$ ,  $\text{O}^+$  arising from the fragmentation emerge from the molecule. The three fragments almost always move apart promptly along the directions shown (intense areas in the map). In addition to this, there is also a delayed fragmentation as evidenced by the circular trace: The  $\text{O}^{2+}$  ion separates first, the transient intermediate entity  $\text{CO}_2^{4+}$  rotates before separating into  $\text{C}^+$  and  $\text{O}^+$ . (Prof. Bhas Bapat's Group)

Collaborating with IIT Hyderabad and TCIS Hyderabad, the group studied the behaviour of small molecules in laser fields of strengths approaching the strength of the nuclear field, and pulse widths that are comparable to rotational time scales. These extreme conditions permit alignment and manipulation of the ionization yield and electron emission characteristics of molecules. While alignment of a dissociating molecular ion with the laser field is known, they found it may also anti-align, under suitable conditions.

Collaborating with PRL, Ahmedabad, the group has built the Solar Wind Ion Spectrometer for analysing solar wind particles. It will help investigate the anisotropy in the energy distribution of solar wind particles and the correlations between the changes in the relative abundance of protons to alpha particles and solar events. The payload is nearly ready to be integrated with ISRO's Aditya-L1 mission.

### Light-matter quantum systems

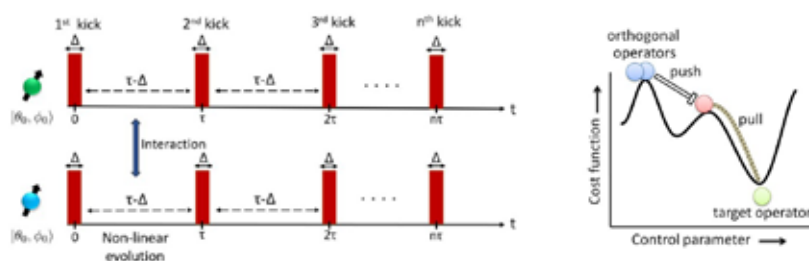
Dr. Bijay Kumar Agarwalla's research is focused on investigating the quantum dynamics and steady-state properties of non-equilibrium systems. During 2019-20, the group worked on the theoretical bounds of non-equilibrium fluctuations, also known as thermodynamic uncertainty relation (TUR) and investigated conditions under which such bounds can be observed/violated. The group exemplified this work in the context of both charge and energy currents. They demonstrated experimentally, in collaboration with Prof. T.S. Mahesh's group at IISER Pune, the validity of exchange fluctuation symmetry for heat transport in NMR setup and in the same setup analysed the transient version thermodynamic uncertainty relation. The group also recently experimentally tested the steady state TUR for atomic junctions in collaboration with Dvira Segal's group at the University of Toronto, Canada and Oren Tal's group at the Weizmann Institute of Science, Israel.

In another research direction, the group is working on understanding non-equilibrium light-matter quantum systems to investigate the coherent optical signal and incoherent charge current signals. Through theory, they have showed the potential of a simple double-quantum dot setup working as a maser. In collaboration with A. Sharma's group at IISER Bhopal, the group has worked on quantifying quantum entanglement in non-equilibrium setups.

## Quantum information processing

Realising non-Markovian dynamics: Prof. T.S. Mahesh's group experimentally emulated the non-Markovian dynamics of a pure dephasing spin-boson model at zero temperature. They used a randomised set of external radio-frequency fields to engineer a desired noise power spectrum to effectively realise a non-Markovian environment for a single NMR qubit. Using filter function formalism, they designed optimised DD sequences that maximise coherence protection for non-Markovian environments and studied their efficiencies experimentally.

Two-qubit kicked top: Quantum chaotic kicked top (QKT) model is implemented experimentally in a two-qubit system comprising of a pair of spin-1/2 nuclei using nuclear magnetic resonance techniques.



**Figure 23:** (Left) Simulating QKT with two qubits; (Right) Push-pull optimisation scheme (Prof. T.S. Mahesh's Group)

The essential nonlinear interaction was realised using indirect spin-spin coupling, while the linear kicks were realised using radio-frequency pulses. Intermittent quantum state tomography enabled the study of correspondence with classical phase space as well as probing distinct features of quantum chaos, such as symmetries and temporal periodicity in the two-qubit kicked top.

Push-pull optimisation of quantum controls: Optimisation of quantum controls to achieve a target process is centred around an objective function comparing the realised process with the target. The group proposed an objective function that incorporates not only the target operator but also a set of its orthogonal operators whose combined influence leads to an efficient exploration of the parameter space, faster convergence, and extraction of superior solutions. The group described adopting the push-pull optimisation for gradient based and variational-principle based approaches. They also demonstrated it for preparing a long-lived singlet order in a two-qubit system using NMR techniques.

## Plasmon enhanced Raman and fluorescence scattering in Fourier space

Dr. G.V. Pavan Kumar's group has furthered the development of Fourier plane optical microscopy towards nonlinear light scattering. Individual plasmonic nanowires were studied using spatially resolved nonlinear optical microscopy. The group initiated a new project on combining ideas of plasmonics with soft-matter physics. Colloidal assembly in the presence of optothermal fields were initiated. Initial studies of liquid crystal droplets and their generation and visualisation were performed.

## Ultra cold dipolar gases and Rydberg atoms

This work from Dr. Rejish Nath's group has been done in collaboration with Prof. Luis Santos and his team from University of Hannover and Prof. Subhasis Sinha from IISER Kolkata.

Over the last year, the group has studied dipolar atoms in both a lattice and continuum limit. In the context of dipolar Bose-Einstein condensates (BEC), they proposed a new class of BEC, so-called doubly DBEC (DDBEC) of atoms possessing both electric and magnetic dipole moments. In this system, they found a dimensional cross-over from a cigar-shaped to pancake-shaped self-bound droplets. In the lattice model, they considered both dipolar and Rydberg dressed atoms in a two-dimensional square lattice. For dipolar atoms, the group studied the quantum phases such as superfluid, Mott insulator, both checkerboard and stripe supersolids and density wave states. In the Rydberg admixed case, they looked at the quenched dynamics, and predicted universal behaviour for the dynamical evolution of the superfluid parameter.

In a different context, associated with the coherent control of the quantum states, they have analysed the population dynamics in a two-atom setup in which each atom is driven independently by different light fields, but coupling the same Rydberg state. They found a novel phenomenon, and termed it as Rydberg biased freezing. The latter will find applications in the context of quantum technologies.

### *Computational study of correlated quantum systems*

Dr. Sreejith G.J.'s group worked on algorithm development for computational study of correlated quantum systems. They made progress in developing local technical expertise in advanced numerical methods (MPS/DMRG methods). These were successfully tailored to study quantum critical dynamics in complex spin chains. The group is in the process of tailoring these methods to study what are called out-of-time-ordered correlators. In another direction, the group has demonstrated, using cleverly designed numerical algorithms, the nature of topological order in certain FQH states called parton states.

Along with collaborators from France, progress has been made in designing efficient computing algorithms to probe constrained quantum dynamics wherein quantum degrees of freedom move about under local constraints. The algorithms are being fine-tuned and will be used to explore complex phases exhibited in gauge+matter theories.

## **6.2 Condensed Matter, Statistical Physics, Materials**

### *Statistical physics of mesoscopic systems, analogue gravity and Bose-Einstein condensate*

In the area of research on statistical physics, Dr. Arijit Bhattacharyay's group is focusing on establishing two major aspects as a general physical outcome which are - (a) Establishing the fact that the equilibrium distribution of a Brownian particle is a modified Boltzmann distribution in a space where its diffusivity is coordinate dependent and (b) There can exist ratcheting, i.e., a directed motion of a symmetry broken dimer, under equilibrium conditions. The group has shown new results in this respect, which also includes proposing a novel ratcheting mechanism in nano-fluidic systems.

In another area of physics, the group's work involves spinor BEC where they have shown the existence of a unified way of understanding spin domains within Thomas-Fermi approximation. They have extended the work to include variational corrections over Thomas-Fermi approximation recently.

### *Soft condensed matter*

Dr. Apratim Chatterji's group has studied generic interactions resulting in helical structure of polymers. Generic interactions e.g., the Coulomb or other long ranged radially symmetric repulsive interactions between monomers of bead-spring model of

a semi-flexible polymer induce instabilities in a initially straight polymer chain to form long-lived helical structures. This mechanism can explain the spontaneous emergence of helices in stiff (bio-)polymers as effective charge of the chain increases. The helix formation is independent of the chemistry and torsional potentials are not used. So this method can be used to synthesise helical springs at length scales of nm-10 $\mu$ .

### Active matter, glass transition and plasticity

Research in Dr. Vijayakumar Chikkadi's group studies active matter, glass transition and plasticity of amorphous and ordered solids and uses confocal microscopy and optical tweezer techniques. The group aims to develop a miniaturised rheometer by incorporating a force measuring device in a shear cell. The force measuring techniques would be developed in collaboration with Prof. Shivprasad Patil. One of the PhD students in the lab is developing microrheology techniques for investigating rheology of bacterial suspensions. This project is running in collaboration with Prof. Umakant Rapol (Physics) and Prof. Chaitanya Athale (Biology). The active matter projects using colloidal models are being developed in collaboration with Dr. Antina Ghosh.

### Optoelectronics

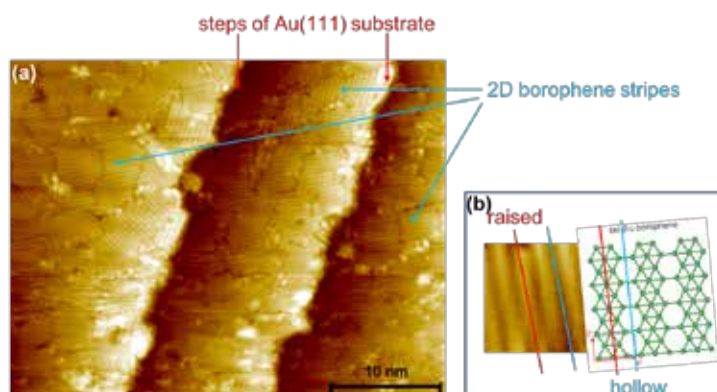
Dr. Shouvik Datta's group showed how coherent resonant tunneling in a quantum coupled heterostructure can probe the 'elusive' momentum-space narrowing of Bose-Einstein condensation (BEC) of electron-hole pairs or 'excitons' inside a solid. Drastic increase of indirect exciton densities inside zero-dimensional (0D) InAs quantum dots and two-dimensional (2D), triangular GaAs quantum-well based heterostructure below 70 Kelvin indicates a density-driven phase transition. This revealed that excitonic wave functions anchored with neighbouring InAs quantum dots can laterally overlap across a wide region around 200  $\mu$ m to create the macroscopic quantum state of excitonic BEC. This helps understand why similar 0D-2D heterostructures can be a better choice than the standard 2D-2D bilayers and/or coupled quantum wells frequently used to study excitonic BEC in the past. Interference between spatially separated excitonic BEC form quantum beats in photocapacitance which indicates long-range quantum coherence. They explain their observations in terms of Hadamard Gate like quantum operations on macroscopic quantum 'qubits' of excitonic BEC.

The group has undertaken dual measurements of both temporal and spatial coherence of light using a single Michelson interferometer. Other members of the group have studied facile synthesis of multi-shelled NiO hollow-microspheres as bifunctional material for electrochromic smart window and non-enzymatic glucose sensor. They have also studied temperature tunable optical transmission by IR based 1-D Photonic Crystals of VO<sub>2</sub> nanostructures (Dipti Umed Singh et al 2020 *J. Phys. D: Appl. Phys.* 53:245106).

### Matter at the atomic scale

Graphene, the two-dimensional (2D) form of carbon, isolated from three-dimensional (3D) graphite in 2004 led to the genesis of the field of 2D materials that continues to grow unravelling novel 2D materials as well as properties uniquely tied to their dimensionality. One new entrant in this arena is borophene – the 2D form of the element boron. In a collaboration, with 2D sheets of borophene synthesised by wet chemistry by Dr. Prashant Kumar at IIT Patna, Dr. Aparna Deshpande's group has been imaging these sheets at the atomic scale to see how these sheets adhere on a single crystal gold (Au(111)) surface using scanning tunneling microscopy (STM) in ultra high vacuum (UHV) environment at low temperature, i.e., 77K. The group observed that the sheets align in

small but well-organised domains. They form nanoscale ridges that can be potential templates for a wide range of applications. Efforts are on to understand the electronic structure of these 2D borophene sheets using scanning tunneling spectroscopy (STS) in UHV at 77K.



**Figure 24:** Figure (a) is an STM image showing 2D borophene sheets spin-coated on Au(111), (b) shows the schematic structure of the stripes in green (from Wikipedia) made of boron atoms that appear as raised ridges and hollow trenches in the STM image next to the schematic. (Dr. Aparna Deshpande's Group)

### Phase transitions, sorting dynamics

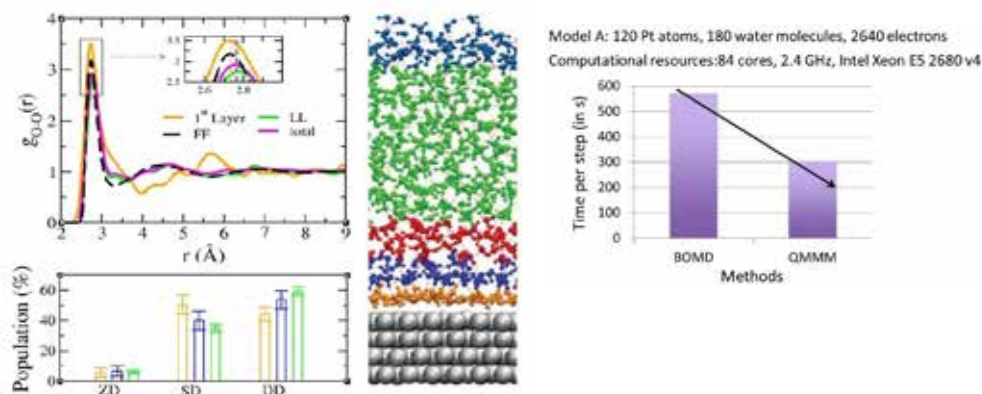
Prof. Deepak Dhar has been studying phase transitions in a system of hard particles. Different shapes of particles, and different models in one and three dimensions were studied. Also, some improved bounds for first passage percolation velocities were determined. Collaborators on Prof. Dhar's work include S. Saryal (IISER Pune), T. Sadhu (TIFR Mumbai); J. Klamser (ENS, Paris); S. Sabhapandit (RRI), S. Das (RRI), and Aanjaneya Kumar (IISER Pune).

### Computational materials science

Dr. Prasenjit Ghosh's group works on different areas of materials science with applications towards catalysis, thermoelectrics, layered materials, etc. In a recent work, they have shown that using hybrid quantum-mechanics-molecular-mechanics (QMMM) based simulations, one can study solid-liquid interfaces that are relevant towards energy storage and application at significantly cheaper computational costs. The work has been published in *Physical Chemistry Chemical Physics* and has been selected as 2019 PCCP Hot Article. A brief description of the work is given below:

Solid-liquid interfaces have been of immense interest in the field of energy storage and conversion. Studying this interface using both experimental and theoretical tools is challenging. On the theoretical front, typically one uses classical Molecular Dynamics (MD) simulations to handle large system sizes or time scales while for a more accurate quantum mechanical description Born Oppenheimer MD (BOMD) is typically used. The latter is limited to smaller system sizes and time scales. In this study using QMMM, they have performed atomistic MD simulations to have a microscopic understanding of the structure of the Pt–water interface using a system size that is much larger than that accessible when using BOMD simulations. In contrast to recent reports using BOMD simulations, their study reveals that the water molecules typically form two distinct layers above the Pt-surface before they form bulk like structures. Further, the group found that a significant fraction of the water molecules at the interface are pointed towards the surface thereby disrupting the H-bond network. Consistent with this observation, the layer resolved oxygen–oxygen radial distribution function for the water molecules belonging to the solvating water layer shows a high density liquid like behaviour even

though the overall water behaves like a low density liquid. A charge transfer analysis reveals that this solvating water layer donates electrons to the Pt atoms in contact with it thereby resulting in the formation of an interface dipole that is pointing towards the surface. These results suggest that, using QMMM-MD, on one hand it is possible to study more realistic models of solid-liquid interfaces that are inaccessible with BOMD, while on the other hand one also has access to information about such systems that is not obtained from conventional classical MD simulations.



**Figure 25:** The left panel of the figure shows the layer resolved  $g_{O-O}(r)$ , population of hydrogen bond donors and post-equilibration structure of Pt–water interface. The right panel shows the reduction of the computational cost as one studies the interfaces using QMMM simulations, compared to that with BOMD simulations. (Dr. Prasenjit Ghosh's Group)

### Ferromagnetism in graphene

Inducing a robust long-range magnetic order in diamagnetic graphene remains a challenge. While nitrogen-doped graphene is reported to be a promising candidate in this regard, the corresponding magnetic exchange mechanism remained unclear, which is essential to tune and manipulate magnetism further. Dr. Mukul Kabir's group has systematically addressed this issue within quantum mechanical calculations and investigated the local moment formation and the concurrent interactions between various nitrogen-containing defect complexes. They have also quantified the importance of adatom diffusion on the differential defect abundance and consequences on the overall magnetism. The magnetic interaction between the defect complexes are shown to depend on the concentration, complex type, sublattice, separation, and orientation. The group proposed that the direct exchange mechanism between the delocalized magnetic moment originating from the itinerant  $\pi$  electron at the prevalent graphitic complexes to be responsible for the observed ferromagnetism. Present results will motivate new experiments to produce robust magnetism following the proposed synthesis strategy.

## 6.3 Cosmology, Particle Physics, and Gravity

### Gravity and Yang-Mills

Yang-Mills theories play a central role in the Standard Model of Particle Physics. The richness of structure in these theories continues to surprise us after decades of investigation. There exists an entirely different approach to Yang-Mills theory that is likely to yield novel insights. The underlying premise is intriguing: what appears to be a purely bosonic gauge theory is actually a more involved supersymmetric gauge theory. A concrete example is the Nicolai map. This formalism allows us to study supersymmetric gauge theories without any use of anti-commuting variables. Dr. Sudarshan Ananth's group has used this approach, in the past year, to (re) examine a number of interesting directions. For example, they used it to prove that supersymmetric Yang-Mills theories

are consistent only in  $D=3,4,6$  and 10 dimensions (Ananth et al, *J. Phys. A* (Invited contribution)).

### Ultra-relativistic heavy-ion collisions

Prof. Rajeev Bhalerao's work showed how to relate eccentricity fluctuations to energy density fluctuations in heavy-ion collisions. The magnitude of anisotropic flow is determined by the density field,  $\rho(x,y,z)$ , created right after the collision occurs. Specifically, elliptic flow,  $v_2$ , and triangular flow,  $v_3$ , are proportional to the eccentricities  $\epsilon_2$  and  $\epsilon_3$ , which are functionals of  $\rho$ . They expressed the mean and the variance of  $\epsilon_2$  and  $\epsilon_3$  in terms of the 1- and 2-point functions of  $\rho$ . They applied their results to the colour glass condensate effective theory, using the recently derived expression of the 2-point function.

They further showed that experimental data on cumulants of anisotropic flow probe the non-Gaussian statistics of the energy density field. They carried out a perturbative expansion of the initial anisotropies of the system in terms of its density fluctuations, and argued that the correlation between the magnitudes of elliptic flow and triangular flow, dubbed  $sc(3,2)$ , is generically of the same sign and order of magnitude as the kurtosis of triangular flow in a hydrodynamic picture. This work throws light on the primordial non-Gaussianity in heavy-ion collisions.

### Experimental high energy physics

Dr. Sourabh Dube's group continued the analysis of data collected by the CMS experiment in 2016, 2017, and 2018. A search was performed for vector-like leptons (VLLs) using data collected in 2016 and 2017, with the addition of channels with hadronically decaying taus. In addition, data of all three years was used to search for Type-III seesaw fermions, and for a light scalar resonance. These results were published in *Phys. Rev. D* 100, 052003 (2019) and *J. High Energy Phys.* 2020, 51 (2020), respectively. With a master's thesis student, Dr. Dube has begun to explore applying machine learning techniques, such as convoluted neural networks, to the problem of identifying events with high momentum particles.

### Conformal field theory

Prof. Sunil Mukhi studied a conjecture to describe the characters of large families of Rational Conformal Field Theories (RCFT) in terms of contour integrals of Feigin-Fuchs type and developed a simple algorithm to determine the modular  $S$ -matrix for arbitrary numbers of characters as a sum over paths. This provides valuable new insight into the computation of these characters and the associated partition functions. The existence and role of quasi-characters in the classification of RCFT was investigated. Using modular differential equations, a study of the three-character case was initiated. Several infinite families of quasi-characters were conjectured and it was shown in examples that their linear combinations can generate admissible characters with arbitrarily large Wronskian index. Using even unimodular lattices, some explicit three-character CFT were constructed that correspond to the new admissible characters.

### Diffusion in nano-confinement

In a recent paper in the journal *Review of Scientific Instruments*, Dr. Shivprasad Patil's group reported the development of a novel instrument to measure diffusion under nano-confinement. They analysed data on diffusion in typical electrolytes used in Li-ion batteries. The analysis has shown interesting properties of battery electrolytes under high ion concentrations. The group's research on single molecules showed that dissipation involved in single macromolecule stretching using Atomic Force Microscope

(AFM) is immeasurably low. Their new approach of directly measuring stiffness of unfolding molecules has revealed that for single macromolecules of Polyethylene Glycol (PEG), the persistence length matches well with other equilibrium measurements. The work now explains unreasonably low persistence lengths of some polymer chains using AFM and possibly shows a way of using non-equilibrium measurements to estimate free energies with faster convergence compared to certain developments such as using Jarzynski's estimator.

### *Cosmology with the Cosmic Microwave Background*

Since joining IISER Pune in August 2019, Prof. Tarun Souradeep has continued his work in the field of Cosmology with the Cosmic Microwave Background (CMB). The work of his group and collaborators has addressed pressing issues in the field such as, early universe implications of the tension in the global and local measurements of the expansion rate of the universe, understanding of the Galactic foreground emission that screens out the prized signal of primordial gravitational waves from the earliest moments of the Universe.

Prof. Souradeep is also lead in the proposal to ISRO for a comprehensive CMB space mission submitted by CMB-Bhārat consortium of Indian cosmologists forged in early 2018. He continues his leadership role in the LIGO-India mega-science project as the Spokesperson (Science) and Member-Secretary of the Scientific Management Board.

### *Probing new physics*

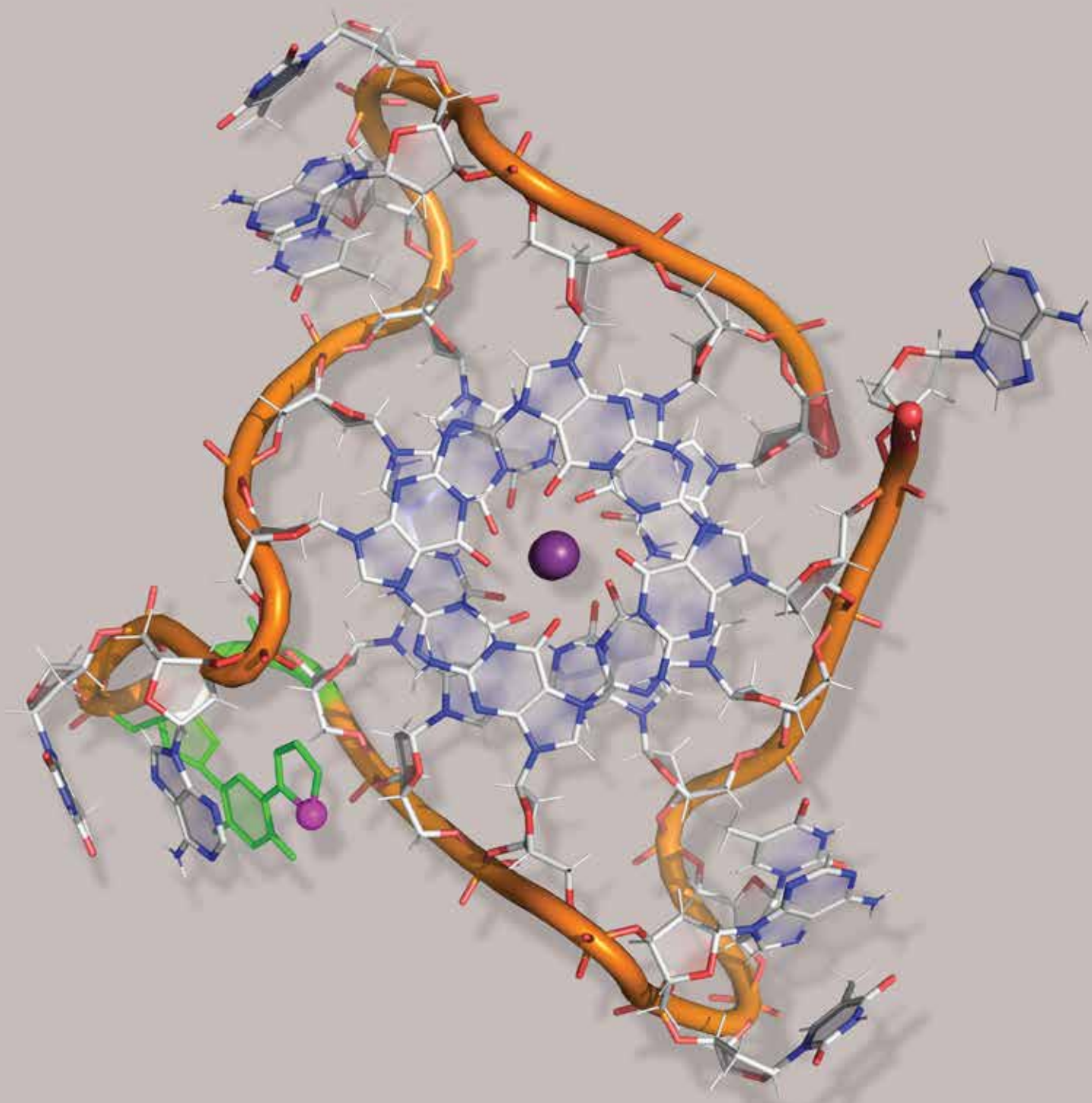
Dr. Arun Thalapillil's work focused on completing a study on heavy sterile neutrino searches at the Large Hadron Collider, using jet substructure techniques, and on investigating the effects of millimagnetic monopoles on continuous gravitational waves from neutron stars.

### *Gravitation and mathematical physics*

Dr. Suneeta Vardarajan's group's research has focused on two themes, the large Dimension (D) limit of General relativity (GR) and its applications, and the instability of anti-de Sitter (AdS) spacetime.

Large D limit of GR: Recently, the large dimension limit of GR has been used to analyse black holes and black strings, and the black hole-black string phase transition. In a recent paper, Dr. Vardarajan's group has analysed the semiclassical stability of the Schwarzschild AdS black hole in the Euclidean partition function approach. They performed this computation in the large D limit and focused on scalar perturbations. They obtained the equations for non-spherically symmetric scalar perturbations in a simple form and ruled out large classes of instabilities. The group also analysed the spherically symmetric perturbations and demonstrated the appearance of an unstable mode for small black holes in the large D limit. They obtained an expression for the eigenvalue corresponding to the unstable mode to next to leading order in a  $1/D$  expansion. This is work done jointly with former PhD student Dr. Amruta Sadhu.

AdS instability: It was discovered in 2011 that AdS spacetime was nonlinearly unstable to scalar field perturbations. This is in part believed to be due to the confining box-like boundary conditions for fields in AdS spacetime. With student Dhanya Menon, Dr. Vardarajan has studied gravitational perturbations of confined geometries in weakly nonlinear perturbation theory. One example is Minkowski spacetime with a spherical Dirichlet wall where they predict nonlinear stability. Another problem nearing completion is gravitational perturbations of AdS in arbitrary dimension.



A dual-app fluorescence and X-ray probe prepared by Prof. S.G. Srivatsan's group to study the structure of nucleic acids

*Image Credit: Ashok Nuthanakanti*

*Nucl. Acid. Res. (2019) 47, 6059–6072*

# PUBLICATIONS AND PATENTS

## PUBLICATIONS

IISER Pune has published a total of 2845 papers since inception to the end of 2019. During 2019, institute members published 505 research papers, 08 book chapters and 02 books.

The list of publications from IISER Pune members in the 2019 calendar year is given in the Appendix section of this report.

### DEPARTMENT-WISE NUMBER OF PUBLICATIONS, 2006-2019

Numbers in parenthesis are for the calendar year 2019

**TOTAL: 2845** (505)



**468** (84)  
BIOLOGY



**967** (139)  
CHEMISTRY



**54** (16)  
EARTH AND CLIMATE SCIENCE



**30** (8)  
HUMANITIES AND SOCIAL  
SCIENCES



**149** (30)  
MATHEMATICS



**1177** (228)  
PHYSICS

## PATENTS

IISER Pune has filed a total of 30 patent applications. Among them, 04 patents have been granted. Numbers are since inception and as of March 31, 2020. In the 2019 calendar year, 13 patents were filed for and 3 patents were granted.

- 1) **Chakrapani, Harinath** and **Malwal, Satish Ramesh** Thiol mediated/activated prodrugs of sulfur dioxide ( $\text{SO}_2$ ) having anti-bacterial activity. US Patent 9,079,870B2, 2015.
- 2) **Britto, Sandanaraj S.; Reddy, Mullapudi Mohan; Bhandari, Pavankumar Janardhan** and **Rao, Kasuladevu Jagannadha** Hydrophobin mimics: Process for preparation thereof. US Patent 10,188,136B2, 2019.
- 3) **Ramanathan, Vaidhyanathan; Mullangi, Dinesh** and **Nandi, Shyamapada** Covalent organic frameworks as porous supports for non-noble metal based water splitting electrocatalysts. US Patent 10,301,727B2, 2019.
- 4) **Bhat, Ramakrishna Gopalkrishna** and **Mohite, Amar Ramchandra** Synthesis of  $\alpha$ ,  $\beta$ -unsaturated carboxylic acids and esters. India Patent 328495, 2019.

# EXTRAMURAL GRANTS

**IISER Pune faculty members have been consistently securing competitive research funds from various government science and technology departments. In the 2019–20 financial year, the institute has received Rs. 41.49 crores of research funds for 172 research projects.**

*The list of new extramural grants sanctioned during the 2019–20 financial year is given in the Appendix section of this report.*



## NEW PROJECTS SANCTIONED IN 2019–20

In the 2019–20 financial year, 62 new research projects have been initiated. Some of the high value projects initiated in the 2019–20 financial year include

Plasmofluidics in k space: Raman and Mie scattering studies- Swarnajayanti Fellowship: Awardee Dr. G.V. Pavan Kumar; funded by the DST

FIST Program – ECS: Awardee Dr. Prasad Subramanian; funded by the DST

Quantum information technologies with ion trap and optical lattice devices of Interdisciplinary Cyber Physical Systems (ICPS) Division of DST - Cluster Proposal: Awardee Dr. Umakant Rapol; funded by the DST

Quantum information technologies with nitrogen vacancy and magnetic resonance of Interdisciplinary Cyber Physical Systems (ICPS) Division of DST - Cluster Proposal: Awardee Dr. T.S. Mahesh, funded by the DST

Pilot programme of India Innovation Competency Enhancement Program (IICEP): Awardee Dr. Harinath Chakrapani; this programme is also funded separately by the DST and by Tata Technologies Ltd.

## FURTHER HIGHLIGHTS

Dr. Mousomi Bhakta was awarded SERB Woman Excellence Research grant for a period of 3 years (2020-23).

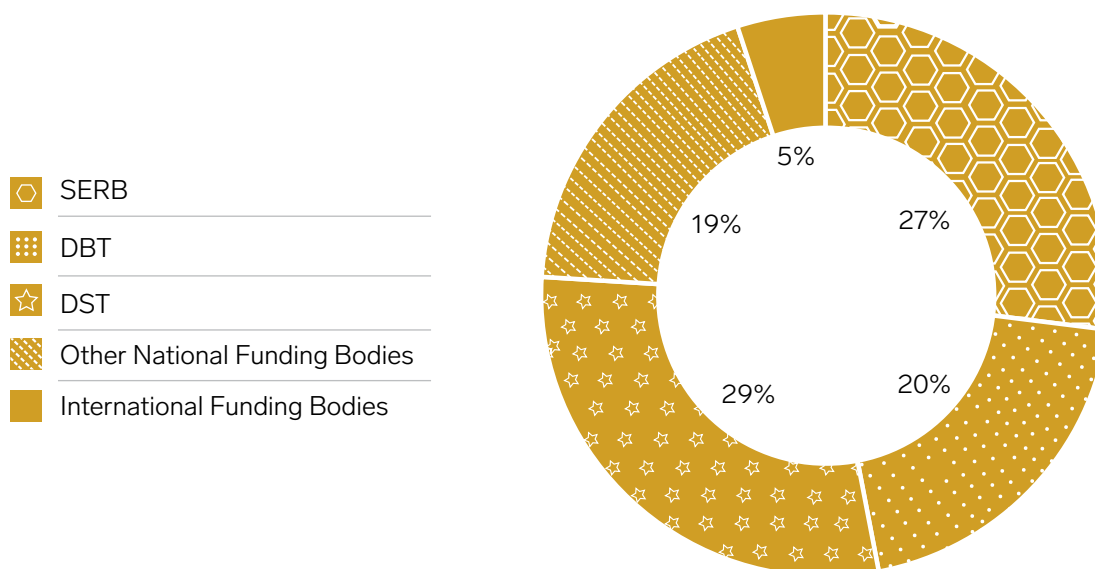
**Atal Incubation Center (AIC)** Awardee Prof. Sanjeev Galande; Incubator Grant funded by the NITI Aayog

IISER Pune has received approval in November 2019 for setting up an incubation centre through the Atal Incubation Mission (AIM) of the NITI Aayog. The incubator is envisaged to provide support to all startups and researchers that allow for co-creation approach integrating the research and innovation processes. The domain areas of operation for the Incubator will be Artificial Intelligence and Data Analysis, Biotechnology and Healthcare, and Energy and Materials Science.

**Two inter-institutional collaborative projects** that IISER Pune is part of, were formally launched during the year by the DBT Secretary Dr. Renu Swarup: the Manav Human Atlas project, a collaboration between IISER Pune, Persistent Systems, and the National Centre for Cell Science (NCCS) (on May 10, 2019); and the Pune Biotech Cluster, a joint initiative between the NCCS and IISER Pune (on August 23, 2019).

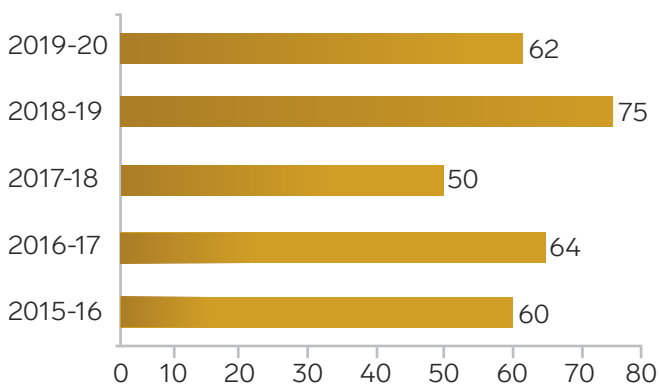
## SOURCES OF EXTRAMURAL GRANTS, 2019–20

Majority of the funds received through extramural grants have been from government bodies, with research funds from DST contributing to 29%, followed by SERB (27%) and DBT (20%), of the research funds received (in 172 projects) in 2019–20. Funding from other Indian funding bodies (Wellcome Trust-DBT India Alliance, IFCPAR, CSIR, UGC, DAE, AOARD, etc) has contributed to 19% of funds for research in sectors such as education, defense, atomic energy, etc. The international funding bodies (HHMI, IUSSTF, Rufford, Max Planck, etc) have contributed to 5% of the total research funds.



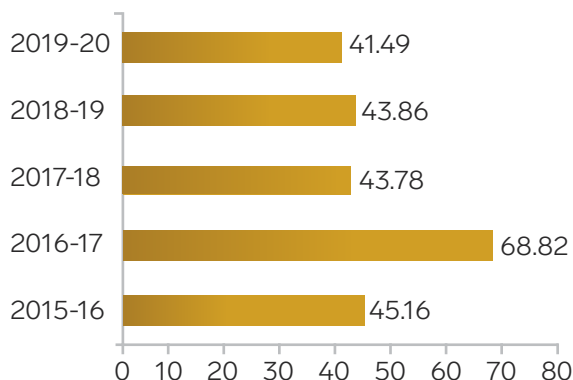
## NUMBER OF NEW EXTRAMURAL GRANTS SANCTIONED

Data is as per the last 5 financial years



## EXTRAMURAL FUNDS RECEIVED

Data is as per the last 5 financial years; Amount is in crore rupees





# AWARDS AND HONOURS



**Dr. Srabanti Chaudhury**

*Associate Professor*

Received Young Scientist Award at the 2019 Chemical Frontiers event organised by IIT Bombay and JNCASR, Bengaluru in Goa



**Prof. Sujit K. Ghosh**

*Professor*

Awarded the 2020 Materials Research Society of India (MRSI) Medal; Awarded the 2019 India Research Excellence-Citation Award for Young Researcher by Clarivate Analytics



**Prof. Sanjeev Galande**

*Professor*

Awarded J.C. Bose National Fellowship for 2019 by the DST's Science and Engineering Research Board (SERB)



**Dr. Siddhesh S. Kamat**

*Associate Professor*

Selected as EMBO Young Investigator (January 2020 – December 2023); Received Merck Young Scientist Award in Biological Sciences (2019); Indian National Science Academy (INSA) Young Scientist Medal (2019); and UAA-ICT Distinguished Alumni Award in the Young Achiever category (2019)



**Dr. Prasenjit Ghosh**

*Associate Professor*

Selected as Simons Associate of the Abdus Salam ICTP Trieste from January 2020 to December 2025



**Dr. Saikrishnan Kayarat**

*Associate Professor*

Awarded Shanti Swarup Bhatnagar Prize in the area of Biological Sciences by the Council of Scientific and Industrial Research (CSIR) India; Received S. Ramachandran National Bioscience Award for Career Development for 2019 from the Department of Biotechnology (DBT)



**Dr. Angshuman Nag**

*Associate Professor*

Awarded the 2020 Materials Research Society of India (MRSI) Medal



**Prof. L.S. Shashidhara**

*Professor*

Elected as President of the International Union of Biological Sciences (IUBS)



**Prof. Shyam Rai**

*Emeritus Professor*

Awarded the Naha Memorial Medal for 2019 by the Indian National Science Academy (INSA)



**Prof. S.G. Srivatsan**

*Professor*

Received the 2020 Chemical Research Society of India (CRSI) Bronze Medal for 2020

# MEMBERSHIPS AND AFFILIATIONS

**Nixon Abraham** Review Editor, *Frontiers in Neuroscience* (Neuroanatomy) (since June 2018)

**Bijay Kumar Agarwalla** Visiting Scientist in Dvira Segal's group, University of Toronto, May 15–June 15, 2019 • Visiting Scientist under the Max Planck India Mobility Grant Fellowship, Max Planck Institute for the Science of Light, June 30–July 30, 2019 • Visiting Professor, State Key Laboratory of Precision Spectroscopy, East China Normal University, December 01–11, 2019

**V.G. Anand** International Advisory Board Member, *Macroheterocycles*

**Sudarshan Ananth** Founder Member, Indian National Young Academy of Science (IN-YAS) of INSA • Member, National Academy of Sciences India (NASI)

**Chaitanya Athale** Member and IISER Pune Coordinator of Biophysics Paschim (now a student chapter of the Biophysical Society of U.S.A.)

**Nagaraj Balasubramanian** Adjunct Faculty, Department of Microbiology, Savitribai Phule Pune University (since July 2019)

**Nirmalya Ballav** Visiting Scientist, Paul Scherrer Institute (ETH Domain), Switzerland

**Argha Banerjee** Scientific Editor, *Journal of Glaciology*

**Mousomi Bhakta** Invited Member, Indian Society of Industrial and Applied Mathematics (ISIAM)

**Anup Biswas** Invited Member, Indian Society of Industrial and Applied Mathematics (ISIAM) • Associate Editor, *Annals of Applied Probability* • Associate Editor, *Pure and Applied Functional Analysis*

**Harinath Chakrapani** Editorial Board Member, *Scientific Reports*

**Srabanti Chaudhury** Associate Editor, *Frontiers in Physics* (Biophysics section)

**Jeetender Chugh** Executive Committee Member, Indian Biophysical Society (IBS), India, 2019–2022 • Executive Committee Member, National Magnetic Resonance Society (NMRS), India, 2019–2022 • Selected as first President of

the India-Sakura Science Club Alumni Association (ISAA)

**Aloke Das** Member, Executive Council, Indian Society for Radiation and Photochemical Sciences (2018–2020)

**Sutirth Dey** Editorial Board Member, *Dialogue: Science, Scientists and Society* • Founding Member and Member of the Executive Council, Indian Society of Evolutionary Biologists

**Deepak Dhar** Editorial Board Member, *Journal of Statistical Physics*, *Journal of Statistical Mechanics* • Fellow, Indian Academy of Sciences, Bengaluru • Fellow, Indian National Science Academy, New Delhi • Fellow, National Academy of Sciences India, Allahabad • Fellow, The World Academy of Sciences (TWAS)

**Sourabh Dube** Member, India-CMS Collaboration • Member, CMS Collaboration CERN, Geneva • Chief Editor, *Physics Education* (since January 2020)

**Sanjeev Galande** Honorary Associate, Sydney Medical School, Sydney, Australia 2013–19 • Fellow, Indian Academy of Sciences, Bengaluru • Fellow, Indian National Science Academy, New Delhi • Fellow, National Academy of Sciences India, Allahabad • Member, Guha Research Conference • Visiting Professor, Academy of Finland, Turku Centre for Biotechnology (2018–2020) • Editorial Board Member, *Genes and Genetic Systems* • Editor, *Zoology*

**Aurnab Ghose** Member, Asia-Pacific Regional Committee (APRC) of the International Brain Research Organization (IBRO) • Editorial Board Member, *Journal of Biosciences* • Review Editor, *Frontiers in Molecular Neuroscience* • Review Editor, *Frontiers in Cell and Developmental Biology* • Executive Council Member, Indian Subcontinent Branch of the International Neuropeptide Society (ISBINPS)

**Prasenjit Ghosh** Simons Associate of the Abdus Salam ICTP Trieste (from January 2020 to December 2025)

**Sujit K. Ghosh** International Advisory Board of *Chem PlusChem*

**Partha Hazra** Editorial Board Member, *Scientific Reports* (since January 2017)

**Krishanpal Karmodiya** Member, Malaria Research and Reference Reagent Resource Center (MR4) • Editorial

Board Member, *Scientific Reports*

**Shabana Khan** Editorial Advisory Board, *Organometallics*

**M.S. Madhusudhan** Editorial Board Member, *Biology Direct*

**Mayurika Lahiri** Editorial Board, *Experimental and Therapeutic Medicine* • Review Editor, Editorial Board, *Human Genomics* [Frontiers Genetics]

**Sunil Mukhi** Editor, *Journal of High Energy Physics* (Springer-IoP) • Adjunct Professor, Tata Institute of Fundamental Research, Mumbai • Fellow, Indian Academy of Sciences, Bengaluru • Fellow, Indian National Science Academy, New Delhi • Fellow, The World Academy of Sciences (TWAS)

**Suhita Nadkarni** Reviewing Editor *Frontiers in Cellular Neuroscience - Cellular Neurophysiology* • Member, 'Sanket', Open Neuro Signaling Consortium, India

**Angshuman Nag** Editorial Advisory Board Member, *Nano Letters* • Editorial Advisory Board Member, *Chemistry of Materials*

**A.A. Natu** DAAD Research Ambassador • Editorial Board Member, *Indian Drugs*

**Satishchandra Ogale** Fellow, Indian Academy of Sciences, Bengaluru • Fellow, National Academy of Sciences India, Allahabad • Editorial Advisory Board *Energy and Environmental Science; Sustainable Energy and Fuels; ACS Applied Materials & Interfaces; Scientific Reports*

**Venketeswara Pai** Founding Member (selected by INSA Council), Indian National Young Academy of Science (INIAS), 2015, New Delhi

**G.V. Pavan Kumar** Elected Senior Member, Optical Society of America

**Shyam Rai** Fellow, Indian Academy of Sciences, Bengaluru • Fellow, Indian National Science Academy, New Delhi • Fellow, National Academy of Sciences India, Allahabad

**A. Raghuram** Fellow, Indian Academy of Sciences • Editorial Board Member, Newsletter, Mathematics Teacher's Association (India)

**Sudha Rajamani** Editorial Board Member, *Life* • Adjunct Faculty, Dr. Vikram Sarabhai Institute of Cell & Molecular Biology, MSU, Baroda

**Umakant Rapol** Editorial Board Member, *EPJ Quantum Technology*

**Girish Ratnaparkhi** Subject Editor, Biochemistry & Genetics, *Current Science* (since November 2019) • Board Member, Asia-Pacific *Drosophila* Board (since January 2020)

**Richa Rikhy** Editor, *Scientific Reports* • Editor, Special Issue on Mitochondria and Stem cells, *Frontiers in Cell and Developmental Biology*

**M.S. Santhanam** Editorial Board Member, *Physics Education*

**Seema Sharma** Member, India-CMS Collaboration • Member, CMS Collaboration CERN, Geneva

**L.S. Shashidhara** Fellow, Indian National Science Academy, New Delhi • President, International Union of Biological Sciences (IUBS) (since 2019) • Fellow, Indian Academy of Sciences, Bengaluru • Fellow, National Academy of Sciences India, Allahabad • Associate Editor, *Current Science* • Editorial Board Member, *Scientific Reports*

**S. Sivaram** Fellow: Indian National Science Academy, New Delhi; Indian Academy of Sciences, Bengaluru; National Academy of Sciences India, Allahabad; Indian National Academy of Engineering; Academy of Sciences for the Developing World (TWAS); International Union of Pure and Applied Chemistry (IUPAC); Royal Society of Chemistry • Distinguished Adjunct Professor, Institute of Chemical Technology, Mumbai, India, 2019–21; Honorary Professor, Indian Institute of Science Education and Research, Mohanpur, Kolkata; Chair Professor of Eminence in Polymer Science, Somaiya College of Science and Commerce, Mumbai, India, 2018–; Visiting Professor, Center for Rapid and Sustainable Product Development, Polytechnico de Leiria, Marinha Grande, Leiria, Portugal, 2018–22; Distinguished Visiting Professor, The King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, 2019

**Sudipta Sarkar** Associate Member, European Association of Geoscientists and Engineers (EAGE)

**Kundan Sengupta** Associate Editor, *Journal of Biosciences* • Handling Editor, *Science Matters*, Bahnhofstrasse, Zürich

**Pushkar Sohoni** Associate Editor, *South Asian Studies* (journal of the British Association of South Asian Studies; since 2016)

**Tarun Souradeep** Editorial Board, *Current Science* • Fellow, International Society on General Relativity and Gravitation • Fellow, Indian Academy of Sciences, Bengaluru • Fellow, National Academy of Sciences, Allahabad • Spokesperson (Science) and Member-Secretary of the Scientific Management Board, LIGO-India

**Jayant Udgaonkar** Fellow, Indian National Science Academy, New Delhi • Fellow, The World Academy of Sciences (TWAS) • Fellow, Indian Academy of Sciences, Bengaluru • Associate Editor, *Biochemistry*

**S.G. Srivatsan** Editorial Advisory Board Member, *ACS Bioconjugate Chemistry* (since January 2019)

**R. Vaidyanathan** Editorial Board Member, *ACS Materials Letters*; *Scientific Reports*

**Suneeta Vardarajan** Editorial Board Member, *Geometric flows (de Gruyter)*

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In addition, several of our faculty members serve on committees and boards of educational/research bodies and

or hold memberships of national and international scientific societies (list not included here).

Every year, faculty members are invited to present their research work at conferences, workshops, and other events across India and elsewhere. Faculty members are also involved in organising scientific conferences in topics relevant to their research.

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*The list of invited lectures given by the faculty members and academic events they have organised during 2019–2020 is given in the Appendix section of this report.*

# 02

## Academic Programmes

64 / PhD Programme

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69 / Integrated PhD Programme

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73 / BS-MS Programme

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# PhD Programme

PhD students are the main driving force in the research programmes at the Institute. The PhD programme has a year-long coursework before the research work begins. Admission to PhD programmes at the Institute is through national-level tests followed by interviews conducted separately for each department.

**PHD STUDENT NUMBERS ACROSS DEPARTMENTS** as on March 31, 2020

**TOTAL: 342**



**90**  
BIOLOGY



**153**  
CHEMISTRY



**20**  
EARTH AND  
CLIMATE SCIENCE



**06**  
HUMANITIES AND  
SOCIAL SCIENCES



**26**  
MATHEMATICS

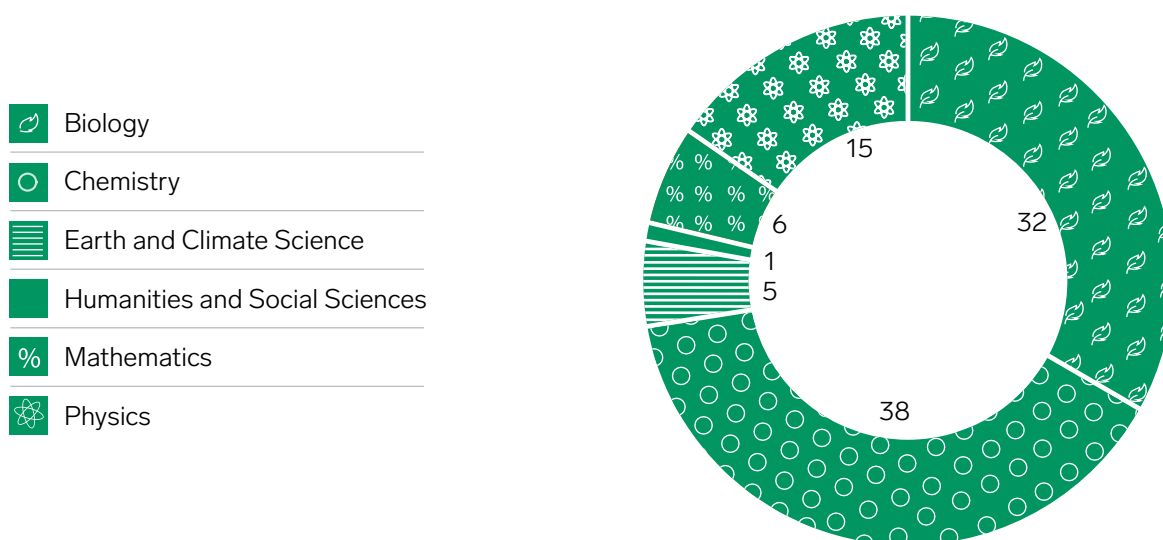


**47**  
PHYSICS

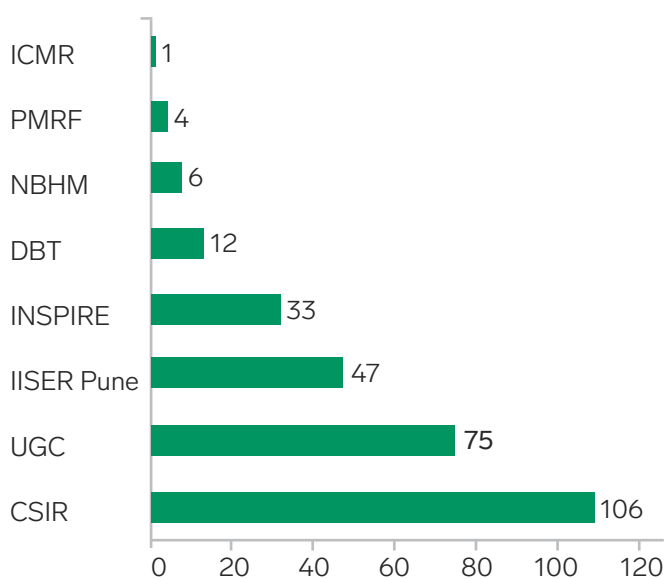
During the August 2019 and January 2020 admission sessions, 97 PhD students were admitted to the PhD programme. The list of enrolled students is available on the IISER Pune website. The number of PhD students at the Institute as of March 31, 2020 is 342.

### PHD STUDENT ENROLLMENT DURING AUGUST 2019 AND JANUARY 2020 SESSIONS

The subject-wise distribution of the 97 PhD students admitted during the year is as follows:



### SOURCES OF FELLOWSHIPS FOR PhD STUDENTS



### Category-wise Numbers of PhD Students

Gender	GE	OBC	SC	ST	PD	Total
Men	148	39	18	2	3	210
Women	106	21	4	1	0	132
<b>Total</b>	<b>254</b>	<b>60</b>	<b>22</b>	<b>3</b>	<b>3</b>	<b>342</b>

A total of 53 PhD students received one or more **travel grants for participating in international conferences and for carrying out collaborative research work**. The funding agencies that the students secured travel awards from include CSIR, DBT, DST, SERB, Infosys Foundation, Erasmus, SPARC programme of the MHRD, German Research Foundation, and IUSSTF.

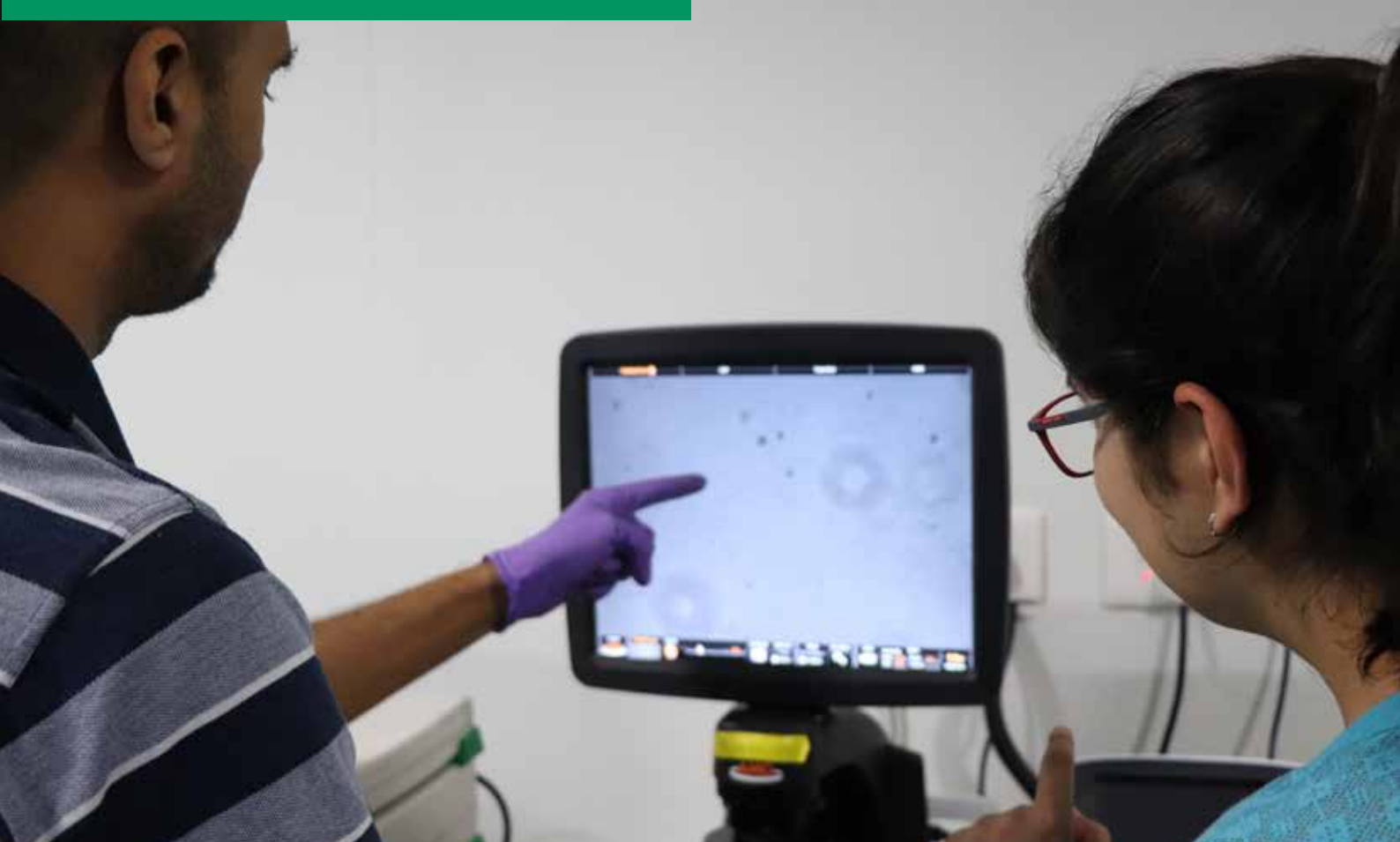
**In the 8<sup>th</sup> convocation held on June 01, 2019, 61 students were conferred PhD degree.**

**The following 41 students have successfully completed their requirements for the award of PhD degree (completed thesis defense on or before March 31, 2020):**

Sr. No.	Student	Department	Advisor	Thesis Title
01	<b>Mullangi Dinesh</b> 20143296	Chemistry	Ramanathan Vaidhyanathan	Designer heterogeneous nano-catalysts using covalent organic frameworks
02	<b>A. Shweta</b> 20113144	Physics	Ramana Athreya	Radio spectral index distribution in galaxy cluster radio halos
03	<b>Jyotirmoy Ganguly</b> 20133274	Mathematics	Steven Spallone	Spinorial representations of symmetric and alternating groups
04	<b>Bibhisan Roy</b> 20143301	Chemistry	Partha Hazra	Design strategy for mechanochromic materials and investigating properties of water inside lyotropic liquid crystalline phases
05	<b>Mansi Sanjay Mungee</b> 20113118	Biology	Ramana Athreya	Elevational diversity profiles of aves and lepidoptera (sphingidae) – a comparative analysis in the eastern Himalayas
06	<b>Devika Andhare</b> 20133251	Biology	Thomas Pucadyil	Numb is a membrane-active clathrin adaptor
07	<b>Vinay Hegde</b> 20143348	Physics	Seema Sharma	Search for supersymmetry in events with a photon, jets, b-jets, and missing transverse momentum
08	<b>Indumathi Patta</b> 20123156	Biology	Sanjeev Galande	Regulation of chromatin organizer SATB1 via TCR induced alternative promoter switch during T- cell development
09	<b>Kamal Kumar Mishra</b> 20143343	Chemistry	Aloke Das	Exploring selenium hydrogen bonding through gas phase spectroscopy coupled with quantum chemical calculations
10	<b>Ajay Kumar Sharma</b> 20143332	Chemistry	Harinath Chakrapani	Synthesis and evaluation of light triggerable redox-active species generators
11	<b>Sankhyayan Shishir Mridul</b> 20123216	Physics	Ramana Athreya, Joydeep Bagchi	Superclusters and the void-high density region correlations in the sloan digital sky survey

Sr. No.	Student	Department	Advisor	Thesis Title
12	<b>Chavhan Yashraj</b> 20133259	Biology	Sutirth Dey	The effects of population size on adaptation and trade-offs: insights from experimental evolution with <i>Escherichia coli</i> and individual-based models
13	<b>Ambi Chaitanya Vishnu</b> 20143346	Mathematics	A. Raghuram	Estimation of the dimension of cuspidal and total cohomology
14	<b>Tanushree Kundu</b> 20133245	Biology	Aurnab Ghose	Role of formin-2 in actin-microtubule coordination during axonal pathfinding and its characterization in axonal branching
15	<b>Shatarupa Ganguly</b> 20123171	Biology	Deepak Barua	Variation in sex organ dimensions across individuals, morphs and species: consequences for reciprocity, herkogamy, and reproductive success in species with style length polymorphism
16	<b>Shivik Rakesh Garg</b> 20133247	Biology	Collins Assisi	Dynamics of inhibitory networks in the olfactory bulb
17	<b>Bappa Ghosh</b> 20143345	Chemistry	Srabanti Chaudhury	Some aspects of non-equilibrium polymer translocation dynamics
18	<b>Chand Mahesh Kumar</b> 20123180	Biology	Saikrishnan Kayarat	Structural and biochemical studies of the Type ISP restriction-modification enzyme LlaBIII
19	<b>Neralkar Mahesh Renukadasrao</b> 20143298	Chemistry	Srinivas Hotha	Identification of novel glycosyl donor chemistry and syntheses of oligosaccharides
20	<b>Shubhanshu Chauhan</b> 20133284	Physics	Sourabh Dube	Search for new phenomena at CMS in the multilepton final state
21	<b>Kunalika Jain</b> 20133246	Biology	Chaitanya Athale	<i>In vitro</i> reconstitution of collective effects in microtubule transport and dynamics
22	<b>Harne Shrikant R.</b> 20133258	Biology	Gayathri Pananghat	Biochemical, structural and genetic studies on the cytoskeletal proteins Fibril and MreBs from <i>Spiroplasma</i>
23	<b>Shaikh Mubeena Bano Abdul Majeed Amina</b> 20103090	Physics	Apratim Chatterji	Wormlike micelle-nanoparticle system: A computational investigation
24	<b>Bipasha Dey</b> 20133250	Biology	Richa Rikhy	Factors regulating the onset of epithelial-like polygonal architecture in the syncytial <i>Drosophila</i> embryo
25	<b>Patil Sohan Dilip</b> 20143330	Chemistry	Sudipta Basu, Nirmalya Ballav	Development of small molecules to impair and image mitochondria in cancer cells
26	<b>Chaudhari Moreshwar Bhagwan</b> 20153378	Chemistry	Boopathy Gnanaprakasam	Metal-catalyzed oxidative transformations of carbonyl compounds: domino reactions, rearrangements, and continuous flow applications

Sr. No.	Student	Department	Advisor	Thesis Title
27	<b>Preeti Chauhan</b> 20143331	Chemistry	Harinath Chakrapani	Towards targeted and tunable release of hydrogen sulfide
28	<b>Rakesh Pant</b> 20133265	Chemistry	Arun Venkatnathan	Computational investigation of structure, dynamics and proton transport in polymer electrolyte membrane fuel cells
29	<b>Namrata Pattanayak</b> 20133281	Physics	Ashna Bajpai	Exploring remanent magnetization in dzyaloshinskii-moriya interaction driven weak ferromagnets
30	<b>Arun Neru B.</b> 20133243	Biology	Collins Assisi	Theta guided sequences in the medial entorhinal cortex
31	<b>Rakesh Gaur</b> 20113128	Chemistry	V.G. Anand	Design, synthesis, characterization and redox properties of planar and non-planar macrocycles derived from thiophene subunits
32	<b>Neelesh Soni</b> 20133244	Biology	M.S. Madhusudan	Computational modeling of the 3D structure of intermediate filaments and molecular mechanism of associated diseases
33	<b>Amit Bhunia</b> 20143308	Physics	Shouvik Datta	Studying the physics of excitons in semiconductor quantum heterostructures
34	<b>Sameer Thukral</b> 20133257	Biology	Richa Rikhy	Analysis of cytoplasmic organization and compartmentalization in syncytial <i>Drosophila</i> embryo
35	<b>Debayan Sarkar</b> 20143323	Biology	Jeet Kalia	The mechanism of activation of the TRPV1 ion channel by the double-knot spider toxin
36	<b>Manoj Kumar Gupta</b> 20143336	Chemistry	Krishna N. Ganesh	Design, synthesis and characterization of "Janus-PNAs": Novel backbone analogues that form double duplexes With cDNA
37	<b>Rane Aditee Prabhakar Supriya</b> 20143352	Physics	Seema Sharma	Search for supersymmetry in proton-proton collisions at $\sqrt{s}=13$ TeV with jets, b-jets and missing transverse momentum
38	<b>Kulkarni Girish Murlidhar</b> 20133273	Mathematics	Amit Hogadi	Gabber's Presentation Lemma
39	<b>Sachin Kumar Singh</b> 20153381	Chemistry	R. Boomi Shankar, Satishchandra Ogale	Design and synthesis of organic-inorganic hybrid device materials for mechanical energy harvesting applications
40	<b>Amit Kumar</b> 20133249	Biology	Anjan K. Banerjee	Investigating the functions of Polycomb group proteins in potato development
41	<b>Prabhat Prakash</b> 20143344	Chemistry	Arun Venkatnathan	Computer simulations of CO <sub>2</sub> absorption in amino acid ionics & ion conduction in alkali metal battery electrolytes



## Integrated PhD Programme

The Integrated PhD programme offers students with a bachelor's degree in science a head-start in identifying an area of research leading to a PhD. Offered in Biology, Chemistry, Mathematics, and Physics, the programme begins with a 1.5–2 years of coursework followed by research. Admission is through national-level tests followed by interviews conducted separately for each department.

**INTEGRATED PhD STUDENT NUMBERS ACROSS DEPARTMENTS** as on March 31, 2020

**TOTAL: 196**



**73**  
BIOLOGY



**60**  
CHEMISTRY



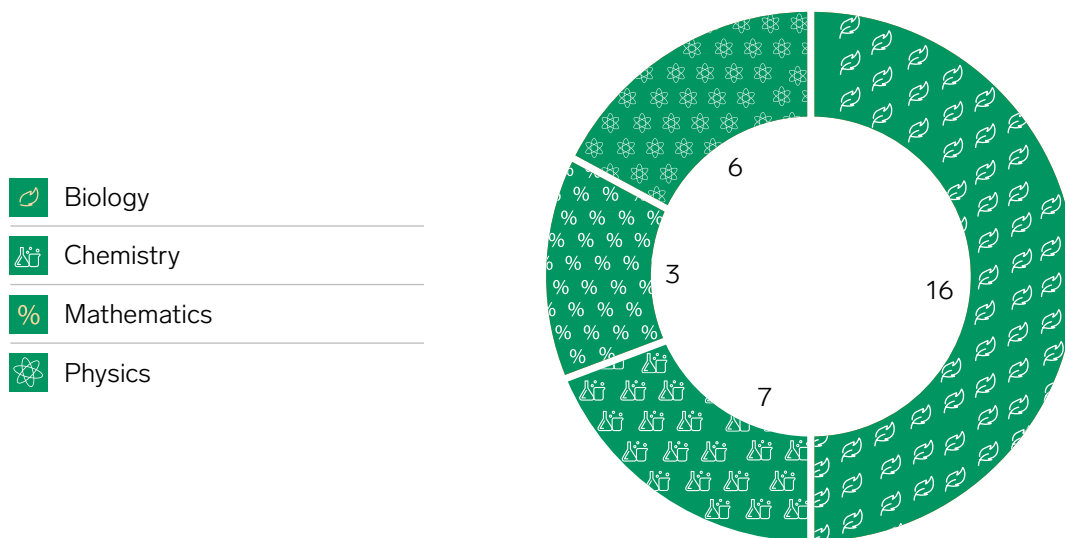
**13**  
MATHEMATICS



**50**  
PHYSICS

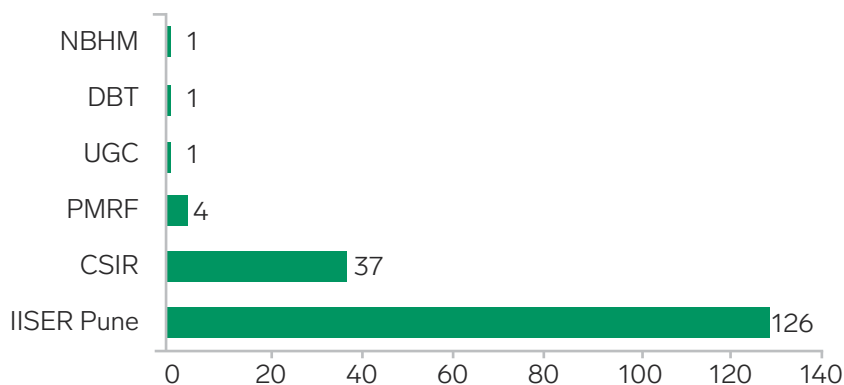
During the August 2019 session, 32 students took admission to post-BSc Integrated PhD programme: 16 in Biology, 7 in Chemistry, 3 in Mathematics, and 6 in Physics. The list of enrolled students is available on the IISER Pune website.

### INTEGRATED PhD STUDENT ENROLLMENT DURING AUGUST 2019 SESSION



### SOURCES OF FELLOWSHIPS FOR INTEGRATED PhD STUDENTS

All Integrated PhD students are provided with fellowships, subject to fulfilling the prescribed academic criteria.



The strength of Integrated PhD students as of March 31, 2020 is 196 (Women: 76; Men: 120) with 73 students in Biology, 60 in Chemistry, 13 in Mathematics and 50 in Physics.

### **Category-wise Numbers of Integrated PhD Students**

Gender	GE	OBC	SC	ST	Total
Men	110	9	1	0	120
Women	75	1	0	0	76
<b>Total</b>	<b>185</b>	<b>10</b>	<b>1</b>	<b>0</b>	<b>196</b>

### Prizes for Academic Excellence were awarded to the following Integrated PhD students:

These prizes are given to the students who have secured the highest CGPA at the end of second year (Academic Year 2017-2019): Ms. Debasmita Mitra (Biology), Pratim Kumar Das (Chemistry), Ronit Debnath (Mathematics), Tamaghna Chowdhury (Physics)

*(These awards are usually announced on the Institute Foundation Day held in April first week every year. The 2020 Foundation Day could not be held as the COVID-19 lockdown began mid-March 2020)*

Integrated PhD students Priya Batra and Rituparna Ghosh were selected to receive the Prime Minister's Research Fellowship (PMRF) during the year.

A total of 36 Integrated PhD students received one or more **travel grants for participating in international conferences and for carrying out collaborative research work**. The funding agencies that the students secured travel awards from include CSIR, DBT, DST, SERB, Infosys Foundation, EMBO, German Research Foundation, CEFIPRA, NAMASTE+, and Newton Bhabha.

**In the 8<sup>th</sup> convocation held on June 01, 2019, 14 Integrated PhD students were awarded dual Master's and PhD degrees.**

**The following 12 students have successfully completed their requirements for the award of Integrated PhD degree (completed thesis defense on or before March 31, 2020):**

Sr. No.	Student	Department	Advisor	Thesis Title
01	<b>G.A.R.S.R.K. Kashyap</b> 20132018	Physics	Prof. G. Ambika	Directed complex networks and their structure and dynamics under link deletion
02	<b>Anjusha V.S.</b> 20122037	Physics	Prof. T.S. Mahesh	Spin architectures for investigating quantum phenomena: NMR and NV centers in diamond
03	<b>Sandip Varkey George</b> 20132013	Physics	Prof. G. Ambika	Nonlinear measures and dynamics from time series data
04	<b>Anshul Kapoor</b> 20132015	Physics	Dr. Sourabh Dube	Search for vector-like leptons in final states with multiple leptons
05	<b>Sadhu Amruta Avinash Anagha</b> 20112013	Physics	Dr. Suneeta Vardarajan	Aspects of linearized perturbations of black holes and flat black strings
06	<b>Jerrin Thomas George</b> 20122026	Chemistry	Dr. Seergazhi G. Srivatsan	Chemo-enzymatic strategies to functionalize RNA with biophysical probes using template dependent and independent polymerases
07	<b>Nandi Aditi Chinmoy Shubraa</b> 20122030	Chemistry	Dr. Sudipta Basu, Dr. Nirmalya Ballav	Self-assembled graphene oxide nanoparticles for damaging DNA in cancer cells
08	<b>Hridya V.M.</b> 20122028	Chemistry	Dr. Arnab Mukherjee	Dynamical recrossing, internal friction and memory effects: Investigating model systems and drug-DNA intercalation process

Sr. No.	Student	Department	Advisor	Thesis Title
09	<b>Meghna Manea A.</b> 20122033	Chemistry	Dr. Anirban Hazra	Photophysics and photosensitizing mechanism of thiothymines investigated using multi-reference quantum chemistry
10	<b>Kulkarni Amogh Maheshchandra</b> 20122031	Chemistry	Dr. Harinath Chakrapani	Design, synthesis and evaluation of small molecules for profiling thiol proteome of microbes
11	<b>Deepak Kumar Sharma</b> 20142020	Physics	Dr. G.V. Pavan Kumar	Interaction of angular momentum carrying optical beams with a single nanowire
12	<b>Deepak Khurana</b> 20132017	Physics	Prof. T. S. Mahesh	NMR characterization and control of noisy quantum systems



## BS-MS Programme

The 5-year BS-MS programme gives students a well-rounded exposure to all areas of science by combining undergraduate level teaching with research. Basic training in Biology, Chemistry, Earth and Climate Science, Humanities and Social Sciences, Mathematics, and Physics is imparted in the first two years. In the next two years, students can choose courses offered by one or more departments according to their liking and future career perspective. The fifth year is allocated to a research project or an internship, leading to a thesis.

The academic year 2019–20 saw 227 students (174 boys and 53 girls) taking admission to the BS-MS programme. Of these, 178 were admitted through the state and central boards' stream, via the IISER Aptitude Test; 17 through the IIT-JEE stream; and 32 through the KVPY stream. The list of enrolled students is available on the IISER Pune website.

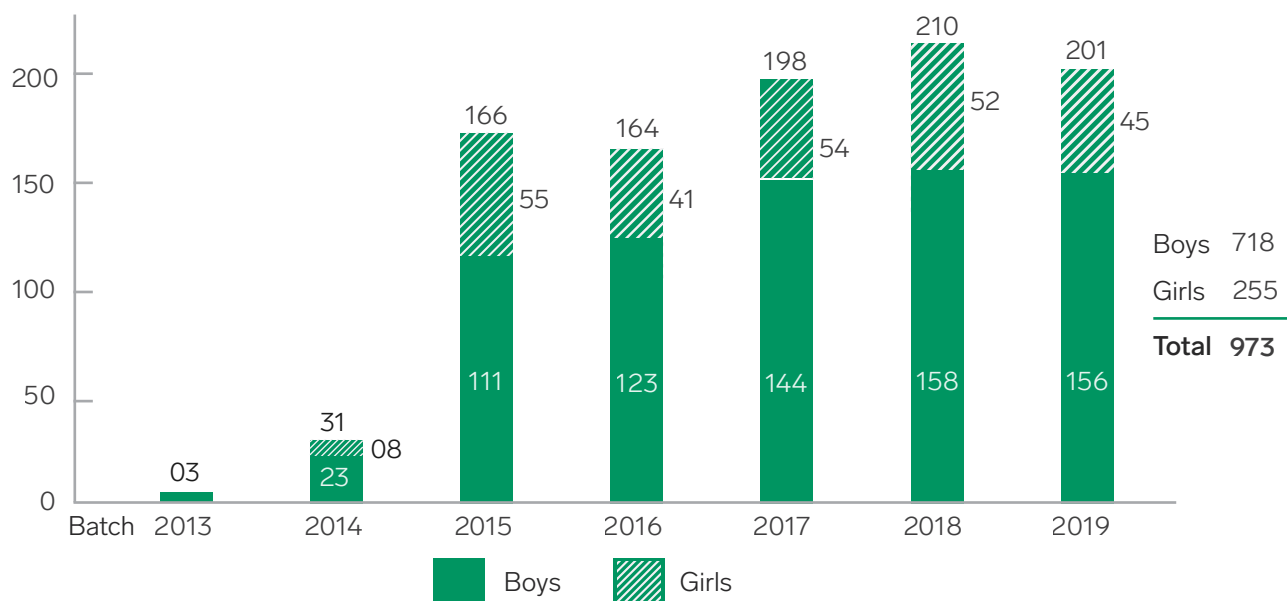
### Category-wise Distribution of Students Enrolled in 2019

Gender	EWS	GE	OBC	PD	SC	ST	TOTAL
Boys	10	83	43	4	22	12	174
Girls	1	20	16	1	10	5	53
<b>Total</b>	<b>11</b>	<b>103</b>	<b>59</b>	<b>5</b>	<b>32</b>	<b>17</b>	<b>227</b>

### Overall Category-wise Distribution of Existing BS-MS Students (as of March 31, 2020)

Gender	EWS	GE	OBC	PD	SC	ST	TOTAL
Boys	10	360	203	10	99	36	718
Girls	1	121	74	3	43	13	255
<b>Total</b>	<b>11</b>	<b>481</b>	<b>277</b>	<b>13</b>	<b>142</b>	<b>49</b>	<b>973</b>

### TOTAL BS-MS STUDENT STRENGTH DURING 2019–20



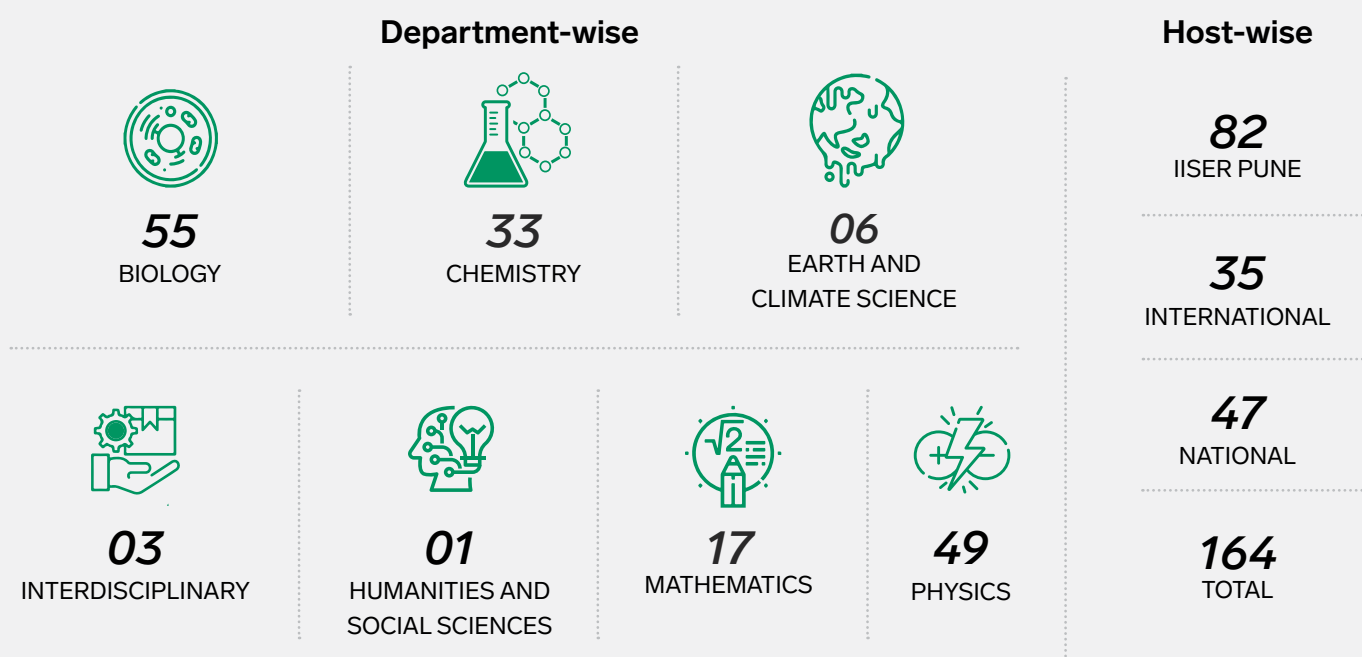
Subsequent to admission, 26 students discontinued from the programme, as they got admission in other courses, making the final number of students enrolled in 2019 to 201. In addition, from the previous batches, 18 students opted to discontinue the programme.

From the 2019 batch, 67 students were found eligible for receiving DST-INSPIRE scholarship and 32 students qualified for KVPY scholarship.


**The total number of BS-MS students receiving DST-INSPIRE and KVPY scholarships is as follows:**

DST-INSPIRE=330, KVPY=196

## FIFTH YEAR PROJECTS CARRIED OUT BY THE OUTGOING BATCH OF BS-MS STUDENTS DURING 2019–20



### Details of the fifth-year projects carried out by the outgoing batch of BS-MS students during 2019–20

Sr. No.	Student	Host Institute	Supervisor	Project Title
	<b>BIOLOGY</b>			
01	<b>Jyothish S.</b> 20151012	IISER Pune	Girish Ratnaparkhi	Uncovering roles for Caspar/dFAF1 in <i>Drosophila</i> development
02	<b>Swati Choudhary</b> 20151016	NCBS, Bengaluru	Sudhir Krishna	Small molecule mediated regulation of oncomiR and its regulatory role on cancer phenotypes
03	<b>Snehal Bhartiya</b> 20151023	IISER Pune	Pranay Goel	Diagnosing cervical cancer with deep learning
04	<b>Koparkar Avani Prasad</b> 20151026	Max Planck Institute of Ornithology, Seewiesen, Germany	Daniela Vallentin	The role of inhibitory interneurons in song learning in zebra finches
05	<b>Bhawana</b> 20151029	National Institute of Plant Genome Research, New Delhi-	Jyothilakshmi Vadassery	Expression and purification of cytosolic domains of Cyclic Nucleotide Gated Calcium Channel (CNGC19)
06	<b>Umesh K.P.</b> 20151031	IISER Pune	Sagar Pandit	Understanding chemical and molecular basis of eggplant-insect herbivore interaction
07	<b>Kiran R.</b> 20151038	IISc, Bengaluru	Raghavendra Gadagkar	Ants of Bangalore with special reference to invasive ants

Sr. No.	Student	Host Institute	Supervisor	Project Title
08	<b>Ajay Verma</b> 20151039	Earth Life Science Institute, Tokyo, Japan	Irena Mamajanov	Structure and function of hyperbranched depsipeptides formed under wet dry cycling conditions
09	<b>A.K. Kausal</b> 20151040	Kerala Forest Research Institute, Peechi (KFRI); IISER Pune	Sreejith Ashtamoorthy	Sensitivity of tropical trees to drought stress: implications of responses of tropical forest to climate change
10	<b>Vikhyath Premugh</b> 20151044	IISER Pune; NCBS, Bengaluru	Mahesh Sankaran	The upper temperature limits of leaf function in tropical trees from a wet tropical forest
11	<b>Anjana T.</b> 20151046	IISER Pune	Girish Ratnaparkhi	A maternal role for Mon1
12	<b>Gayathri K.</b> 20151052	NCBS, Bengaluru	Sanjay Sane	Characterisation of mechanosensory structures along the antennal flagellum in <i>Daphnia nerii</i>
13	<b>Zakhiya P.C.</b> 20151053	IISc, Bengaluru	Kartik Shanker	Effect of species richness and composition on foraging niches in mixed- species bird flocks
14	<b>Malavika Venu</b> 20151054	Max Planck Institute for Evolutionary Biology, Plon, Germany	Paul B. Rainey	Evolution of cell shape in bacteria
15	<b>Theja Sajeevan</b> 20151057	IISER Pune	Siddhesh Kamat	Identification of novel lyso-PS lipase in mammalian tissues
16	<b>Dyuthi Sreekumar</b> 20151059	Mechanobiology Institute, National University of Singapore	G.V. Shivashankar	Laterally confined growth of HMF3A induces reprogramming: Evaluating the structural changes
17	<b>Apoorva S. Sankar</b> 20151060	Ecole Normale Supérieure de Lyon, France	Pascal Bernard	Investigating functional links between Condensin and DNA replication in the fission yeast <i>S. pombe</i>
18	<b>Aarcha Thadi</b> 20151061	IISER Pune	Sutirth Dey	Effect of presence of kin on dispersal and social behaviours in <i>Drosophila melanogaster</i>
19	<b>R. Charvee</b> 20151067	Mechanobiology Institute, NUS, Singapore	G.V. Shivashankar	The effect of mechanical interactions between fibroblasts and epithelial cells in tumour initiation in a 3D collagen matrix
20	<b>Goury Parvathy J. Nair</b> 20151069	IISER Pune	Kundan Sengupta	Role of nucleolar factors in modulating nuclear architecture
21	<b>Namithasree M.</b> 20151071	IISER Pune	Sagar Pandit	Understanding the molecular and chemical basis of plant-insect communication
22	<b>Roshni Das</b> 20151072	IISER Pune	Sagar Pandit	Deciphering the role of host plant miRNAs in the regulation of herbivore gene expression

Sr. No.	Student	Host Institute	Supervisor	Project Title
23	<b>Santhosh</b> 20151073	IISER Mohali	N.G. Prasad	Effect of environmental stress in <i>Drosophila melanogaster</i> evolved under differential levels of sexual selection
24	<b>Shreya Lakhera</b> 20151075	NCBS Bengaluru and KTH Royal Institute of Technology Stockholm	Upinder S. Bhalla	Neural activity sequences arising from spatially correlated asymmetry in EI-networks
25	<b>Prerana Kumar</b> 20151080	Eberhard Karls University of Tübingen	Martin Giese	Investigation of hand and arm synergies based on electromyographic data
26	<b>Nevin Korath Zacharia</b> 20151084	IISER Pune	Saikrishnan Kayarat	Molecular basis and modulation of target DNA recognition in the Type IV restriction endonuclease McrBC
27	<b>Sawale Rajlakshmi Anjan</b> 20151087	University of Queensland, Australia	Ethan Scott	Functional development of the enteric nervous system in larval zebrafish
28	<b>Felix Jose K.</b> 20151091	IISER Pune	Nixon M. Abraham	Olfactory subsystems in rodents: effects of temperature on odour perception
29	<b>Utkarsh Shrivastava</b> 20151095	NCBS, Bengaluru	Shannon B. Olsson	Sleep patterns in generalists and specialists
30	<b>Jiffin Benjamin</b> 20151096	IISER Pune	Kundan Sengupta	Role of nucleoporins in modulating differentiation in embryonal carcinoma cells
31	<b>Jayakrishnan Muhunden Nallappa</b> 20151106	University of Edinburgh, U.K.	Eric Schirmer	Role of muscle-specific nuclear envelope transmembrane protein NET39 in myogenic genome organization
32	<b>Meher Kantroo</b> 20151107	IISER Pune; Heidelberg University, Germany	Nixon M. Abraham	Effect of environmental enrichment on airflow based learning
33	<b>Feba Chacko</b> 20151108	IISER Pune	Aurnab Ghose	Role of energy states and CART signalling in fear and extinction learning in rodents
34	<b>Keshav Jha</b> 20151111	IISER Pune	Sanjeev Galande	Role of DVE-1 and higher chromatin organization in ageing of <i>Caenorhabditis elegans</i>
35	<b>Amritkar Kaustubh Manish</b> 20151113	IISER Pune	M.S. Madhusudhan	Assessing, predicting and designing peptide ligands for proteins
36	<b>Himanshu Lagachu</b> 20151114	IISER Pune	Deepak Barua	Variation in temperature tolerance in grasses and palms and their relationship with leaf functional traits
37	<b>Prateek Yadav</b> 20151116	Institute of Virology, Technical University of Munich, Germany	Sabrina Schreiner	HAdV dependent regulation of HERV expression as a prerequisite for cancer development

Sr. No.	Student	Host Institute	Supervisor	Project Title
38	<b>Akshay Nair</b> 20151122	IISER Pune	Collins Assisi	Building a continuous attractor model of dMEC grid cells using conductance-based neurons
39	<b>Shephali Dansana</b> 20151125	JNCASR, Bengaluru	Sheeba Vasu	Sensitivity of activity/rest rhythms to temperature in populations of <i>Drosophila melanogaster</i> selected for divergent phases of adult emergence
40	<b>Anupam Bhoi</b> 20151130	Laboratoire de Biologie et Modélisation de la Cellule (LBMC), ENS de Lyon, France	Francesca Palladino	Auxin dependent modulation of the Unfolded Protein Response in <i>Caenorhabditis elegans</i>
41	<b>Bagawade Rishabh Mahavir</b> 20151135	IISER Pune	Sutirth Dey	Cumulative cultural evolution in age structured populations: A simulation study
42	<b>Aditi Agarwal</b> 20151138	IISER Pune	Raghav Rajan	Examining the role of dorsomedial nucleus of the intercollicular complex (DM) in the context of song production in zebra finches
43	<b>Tanayaa Bhagdikar</b> 20151144	IISER Pune	M.S. Madhusudhan	To predict the depths of amino acids comprising a query sequence using neural networks
44	<b>Jayapriya C.S.</b> 20151155	IISER Pune	Aurnab Ghose	The role of Formin-2 in the development of retinotectal connectivity in <i>Danio rerio</i>
45	<b>Shelke Sanket Satish</b> 20151169	IISER Pune	Saikrishnan Kayarat	Divalent sulfur mediated interactions in proteins architecture, stability and molecular recognition
46	<b>Aarti Kejriwal</b> 20151174	IISER Pune	Girish Ratnaparkhi	Biological roles for SUMOylation of arginyl tRNA synthetase
47	<b>Dingankar Atharva Arun</b> 20151175	IISER Pune	Nixon M. Abraham	Learning of odor timing
48	<b>Pawar Mahendra Rajendra</b> 20151178	IISER Pune	Sagar Pandit	Understanding the chemical ecology of Brassicaceae specialist herbivore <i>P. xylostella</i> and its predators
49	<b>Shah Saumil Atulkumar</b> 20151179	Max Planck Institute for Evolutionary Biology, Plön, Germany	Arne Traulsen	Modelling dynamics of undetectable disease in leukemia concerning therapy
50	<b>Varun M.</b> 20151180	Inkawu Vervet Project, Mawana Game Reserve, KwaZulu Natal, South Africa	Erica van de Waal	Maternal rank influence on rank acquisition and social integration in wild dispersing male vervet monkeys
51	<b>Renu Raveendran</b> 20141040	NCCS Pune	Deepa Subramanyam	Epigenetic regulation of autophagy genes in stem cells in steady state and stress conditions

Sr. No.	Student	Host Institute	Supervisor	Project Title
52	<b>Manjari Prakash</b> 20141045	IISER Pune	Aurnab Ghose	Evaluation of Formin-2 function in the development and function of posterior lateral line in zebrafish larvae
53	<b>Mane Shrinal Suryakant</b> 20141073	IISER Pune	Mayurika Lahiri	Study of anti-cancerous properties of <i>Withania somnifera</i> and <i>Asparagus racemosus</i> extracts in breast cancer
54	<b>Dimple Adiwai</b> 20141077	Prashant Cancer Care Institute Pune	Madhura Kulakrni	Profiling of Indian Triple-Negative Breast Cancer (TNBCs)
55	<b>Thasneem Musthafa U.K.</b> 20141107	CCMB Hyderabad	Arvind Kumar	Exploring sex difference in epigenetic and transcription regulatory mechanisms underlying neuroglial and behavioral plasticity in the prenatal stress-induced mouse model of depression



## CHEMISTRY

01	<b>Amal S. Kumar</b> 20151004	IISER Pune	Harinath Chakrapani	Design and development of a triggerable biphenyl based novel persulfide donor
02	<b>Rahul Kumar Jingar</b> 20151010	University of Helsinki, Finland	Dage Sundholm	Molecular magnetic properties and properties of magnetically induced current densities
03	<b>Kaarthik R.S.</b> 20151014	IISER Pune	Aloke Das	Conformational study of small peptides using spectroscopy and quantum chemistry calculations
04	<b>Sheryl Sreyas</b> 20151015	IISER Pune	Amrita B. Hazra	Probing the mechanism and genomic context of CobT, the lower ligand activation enzyme in vitamin B12 biosynthesis
05	<b>Athunya P.</b> 20151020	IISER Pune	Angshuman Nag	Yb <sup>3+</sup> doping in 2D (C <sub>8</sub> H <sub>9</sub> NH <sub>3</sub> ) <sub>2</sub> PbBr <sub>4</sub> nanoplatelets and its optical properties
06	<b>Abdul Raafik A.T.</b> 20151027	IISER Pune	Muhammad Mustafa O.T.	Outer sphere redox chemistry for rechargeable flow batteries
07	<b>Haritha A.S.</b> 20151055	IISER Pune	Raghavendra Kikkeri	Controlling Ggycocalyx remodelling: Structural and biological functions of polyamide based proteoglycan mimetics
08	<b>Katre Sujeet Nilkanth</b> 20151064	IISER Pune	Ramanathan Vaidhyanathan	Design and development of robust fluorescent COF'S
09	<b>Naveen Kumar Digrawal</b> 20151066	IISER Pune	Boopathy Gnanaprakasam	Ruthenium-catalysed synthesis of functionalized 4H-chromene derivatives from 1,3-dicarbonyl compounds and 2-hydroxy benzyl alcohols
10	<b>Kiran Anne Roy</b> 20151076	IISER Pune	Satishchandra Ogale	Synthesis and characterization of solid electrolyte and electrode material for all-solid state Li batteries
11	<b>Adarsh Koul</b> 20151086	Ruhr University, Bochum, Germany	Wolfgang Schuhmann	Selective electro-oxidation of glycerol over Co-based ZIF-67 derived catalyst

Sr. No.	Student	Host Institute	Supervisor	Project Title
12	<b>Harsh Jain</b> 20151089	IISc, Bengaluru	Gautam R. Desiraju	Crystal engineering: Design of ternary cocrystals based purely on halogen bonding
13	<b>Saswata Nayak</b> 20151103	IISER Pune	Amrita B. Hazra	Mechanistic investigation of bacterial 3-mercaptopyruvate sulfurtransferase (3MST) and design of inhibitors
14	<b>Shana Shirin V.</b> 20151118	IISER Pune	Pramod Pillai	Metal ion assisted channelling of substrates in gold nanoparticle catalyzed reactions
15	<b>Raghavendra Meena</b> 20151121	IISER Pune; Sorbonne University, France	Michele Casula	Magnetic properties of narrow zigzag graphene nanoribbons from ab initio calculations
16	<b>Mahendra Patel</b> 20151127	EPFL Switzerland	Hubert Girault	Alkaline redox flow batteries
17	<b>Keshav Kumar Yadav</b> 20151131	IIT Delhi	Sandeep Pathak	Studying the effect of chlorine introduction in perovskite through various routes and fabrication of perovskite solar cells
18	<b>Bhise Swapnil Rajkumar</b> 20151134	IISER Pune	Arnab Mukherjee	Investigating the rate (kinetics) for an asymmetric potential barrier using molecular dynamics
19	<b>Shivam Yadav</b> 20151136	IISER Pune	Angshuman Nag	Yb <sup>3+</sup> doped Cs <sub>2</sub> AgIn <sub>1-x</sub> BixCl <sub>6</sub> double perovskite nanocrystals
20	<b>Bhakti Prasad Rout</b> 20151149	IISER Pune	Seergazhi Srivatsan	A nucleoside probe containing a <sup>19</sup> F label serves as an efficient NMR probe to detect different G-quadruplex and i-motif topologies
21	<b>Chandan Shekhar</b> 20151151	IISER Pune	Pankaj Mandal	Ultrafast spectroscopy study of carbonaceous hole transport for perovskite solar cell
22	<b>Rani Gourkhede</b> 20151154	IISER Pune	R. Boomi Shankar	Synthesis and studies of ferroelectric metal organic cages and frameworks
23	<b>Taksande Mayur Rahul</b> 20151158	King Abdullah University of Science Education and Research, Saudi Arabia	Magnus Rueping	Direct trifluoromethylation of heteroarenes using a commercial CdSe semiconductor photocatalyst
24	<b>Heena Suthar</b> 20151162	Dechema Forschungsinstitut (DFI), Frankfurt, Germany	Jean Francois Drillet	Development of cathode material for the rechargeable Al ion battery
25	<b>Nawale Vaibhav Vilas</b> 20151164	IISER Pune	Angshuman Nag	Synthesis and dual excitonic emission of sn-iodide layered hybrid perovskites
26	<b>Lokhande Rugwed Anil</b> 20151165	IISER Pune	Anirban Hazra	Investigating the effect of solvent polarity on the IR and NMR spectra of acetone
27	<b>Ghogare Digvijay Pralhad</b> 20151177	IISER Pune	Muhammad Mustafa O.T.	Electrochemical water ionization for energy storage and water desalination

Sr. No.	Student	Host Institute	Supervisor	Project Title
28	<b>Sinjini Bhattacharjee</b> 20151181	EPFL, Lausanne, Switzerland	Clémence Corminboeuf	Learning activation energies of enantioselective catalytic reactions
29	<b>Aswani S.L.</b> 20151186	IISER Pune	Nirmalya Ballav	Growth study of Ag/AgTCNQ thin film at solid-liquid interface
30	<b>Vyshnav Mohan</b> 20151187	Centre for Materials for Electronic Technology, Pune	Bharat Kale	Uses of Co based ZIF/67 and Zn based ZIF/8
31	<b>Deepshikha</b> 20151188	IIT Gandhinagar	Sudipta Basu	Development of small molecules to inhibit COX-2 by perturbing mitochondria of cancer cells
32	<b>Jainendra Singh</b> 20141011	IISER Pune	Nirmalya Ballav	Thin film of Cobalt hexacyanocobaltate
33	<b>Gudapati Hrithik</b> 20141170	IISER Pune	R. Boomi Shankar	Self-assembled metal-organic cages and their host-guest studies



## EARTH AND CLIMATE SCIENCE

01	<b>Devesh Verma</b> 20151005	Banaras Hindu University, Varanasi	N.V. Chalapathi Rao	Petrogenesis of proterozoic lamprophyres from the Western Dharwar Craton, southern India
02	<b>Shubhangi Khobragade</b> 20151009	SPPU, Pune	Raymond Duraiswami	The study of the Taftan- Bazman volcanic area, South-eastern Iran and its relation with Makran-Chagai Volcanic Arc
03	<b>Date Yuvraj Bhaskar</b> 20151153	IISER Pune	Shreyas Managave	Spatial patterns of the isotopic composition of bird feathers and their implications
04	<b>Sardar Smruti Raju</b> 20151157	IISER Pune	Sudipta Sarkar	Seismic stratigraphic framework and fluid migration patterns of the rifted continental margin offshore North Carolina
05	<b>Ingale Vaibhav Vijay</b> 20141136	Institut De Physique Du Globe De Paris, France	Shyam Rai	1D Inversion of surface wave dispersion for shallow crustal structure of South India
06	<b>Ghaste Prayas Jalindar</b> 20141176	IISER Pune	Sudipta Sarkar	Discriminating lithological diversity within the Nidar Ophiolite Complex, Ladakh, NW Himalaya using multispectral, hyperspectral and thermal remote sensing data



## HUMANITIES AND SOCIAL SCIENCES

01	<b>Reema Jamal Abdul Nassar</b> 20141104	English and Foreign Languages University, Hyderabad	Dilip Kumar Das	Theory for activism
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Sr. No.	Student	Host Institute	Supervisor	Project Title
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## INTER-DISCIPLINARY

01	<b>Atharva Tanksale</b> 20151140	IISER Pune	Anindya Goswami	A data driven approach to option pricing
02	<b>Alekh Ranjan Mahankudo</b> 20151161	IISER Pune	Pranay Goel	Modelling CGM time series using neural ordinary differential equation
03	<b>Dharmendra</b> 20141161	IISER Pune	Venketeswara R. Pai	Critical analysis of algorithms in Vākya School of Astronomy



## MATHEMATICS

01	<b>Adithyan P.</b> 20151006	IISER Pune	Rama Mishra	Geometric Knot Theory
02	<b>Mahajan Jaideep Pralhad</b> 20151008	Indian Statistical Institute, Kolkata	Arup Bose	Resampling: Theory and application
03	<b>Rajdeep Haldar</b> 20151011	Chennai Mathematical Institute,	Sourish Das	Topological data analysis
04	<b>Nikhil Gupta</b> 20151017	IISER Pune	Manish Mishra	Rigid analysis
05	<b>Vishnu N.</b> 20151022	IISc, Bengaluru	Vamsi Pritham Pingali	Kahler geometry with a view towards the Calabi Conjecture
06	<b>Abhishek Adimurthi</b> 20151035	TIFR CAM, Sharadanagar, Bengaluru	Shyam Sundar Ghoshal	Fine properties of measurable functions
07	<b>Sriram Raghunath</b> 20151036	IISER Pune	Tejas Kalelkar	Hyperbolic knot theory
08	<b>Rithwik S.V.</b> 20151049	IISc, Bengaluru	Harish Seshadri	The Hodge theorem and applications
09	<b>Harsha Nyapathi</b> 20151058	IISc, Bengaluru	Siddhartha Gadgil	An overview of Homotopy type theory and Formal methods
10	<b>Siddharth Ramakrishnan C.</b> 20151078	IIT Bombay	Dipendra Prasad	Local Class Field Theory
11	<b>Nazia V.</b> 20151092	IISER Pune	Chandrasheel Bhagwat	Representation Theory of p-adic Groups and the Local Langlands Correspondence for GL(2)
12	<b>Bhalerao Sujeet Ganesh</b> 20151115	IISER Pune	Steven Spallone	Chern classes of representations of symmetric groups
13	<b>Sayantika Mondal</b> 20151129	Australian National University, Australia	Joan Licata	Codimension one foliations related to contact topology in low-dimensional manifolds via open books

Sr. No.	Student	Host Institute	Supervisor	Project Title
14	<b>Arghya Rakshit</b> 20151147	IISER Pune	Mousomi Bhakta	Theory of elliptic PDE
15	<b>Shukla Vikas Laxmikant</b> 20151152	IISER Pune	Anindya Goswami	Study of stochastic integration and differential equations
16	<b>Sayan Sarkar</b> 20141132	Charles University	Tomas Gavenciak	Frontiers in Inverse reinforcement learning
17	<b>Bapat Dhar Nishad</b> 20141147	IISc, Bengaluru	Manjunath Krishnapur	Study of the Laplacian



## PHYSICS

01	<b>Tushar Gopalka</b> 20151019	TIFR, Mumbai	Shiraz Minwalla	In search of consistent classical theories of gravity
02	<b>Amitayush Jha Thakur</b> 20151021	IISER Pune; Sorbonne University, France	Tristan Cren	Electronic structure and local spectroscopy of two-dimensional Mott insulators
03	<b>Kush Mohan</b> 20151025	University of Hamburg, Germany	Peter Schmelcher	Correlation effects in the magnetic properties and nonequilibrium quantum dynamics of spinor Bose Einstein Condensates
04	<b>Shubham Mallik Thakur</b> 20151033	IISER Pune	Diptimoy Ghosh	Cosmological consequences of the recent De-Sitter conjectures
05	<b>Ashwin Gopal</b> 20151034	ICTP Trieste, Italy	Edgar Roldan	Stochastic energetics of non-linear oscillators in active baths
06	<b>Haritha S.V.</b> 20151045	IISER Pune	Sunil Nair	Investigation of some 4d and 5d transition metal based Double Perovskites
07	<b>Shilpi Bhunia</b> 20151047	National Centre for Radio Astrophysics - TIFR, Pune	Divya Oberoi	A survey of the solar data from the Murchison Widefield Array
08	<b>Hrishidev 20151048</b>	Jawaharlal Nehru University, New Delhi	Anirban Chakraborti	Econophysics of Stock Market Dynamics
09	<b>Oddharak Tyagi</b> 20151050	IUCAA, Pune	R. Srianand	Modelling the gas outflows in quasars
10	<b>Anweshha Maharana</b> 20151062	IUCAA, Pune	Dipankar Bhattacharya	Structure and stability of magnetically confined mounds in a Neutron star
11	<b>Srikara S.</b> 20151065	IMSc, Chennai	C.M. Chandrasekhar	Quantum direct communication using quantum walks
12	<b>Rohit Shashikant Patil</b> 20151070	The Australian National University (ANU), Australia	Sean Hodgman	Correlation dynamics and single-atom detection with ultracold metastable helium
13	<b>Patil Sourabh Prakash</b> 20151074	LPTMC in Paris; IISER Pune	Jean-Noël Fuchs	The triangular vortex lattices in the Kitaev honeycomb model

Sr. No.	Student	Host Institute	Supervisor	Project Title
14	<b>J. Bharathi Kannan</b> 20151077	IISER Pune	M.S. Santhanam	Many body dynamical localization and thermalisation in coupled kicked rotors
15	<b>Sreelakshmi J.S.</b> 20151079	Georg-August-Universität Göttingen / II. Physikalisches Institut, Germany	Arnulf Quadt	Interpretation of the top-antitop-photon production rate in effective field theories
16	<b>Ashrith Jacob</b> 20151081	TU Dortmund, Germany; IISER Pune	Dieter Suter	Relaxation maps in MRI of mouse brain
17	<b>Rahul Poddar</b> 20151082	IISER Pune	Sunil Mukhi	Rational conformal field theories: Classification and applications
18	<b>Joshi Yash Jayant</b> 20151085	EPFL, Switzerland	Tobias Kippenberg	Noise filtering and optical readout for quantum circuit electromechanics
19	<b>Feroz Mohamed Hatha</b> 20151090	IISc, Bengaluru	Chethan Krishnan	A gravitational stress tensor for asymptotically AdS spaces from holography
20	<b>Sachin Verlekar</b> 20151094	EPFL, Lausanne	Christophe Galland	Study of molecular vibrations and spectroscopy of nano cavities
21	<b>Abhishek V.</b> 20151097	IISER Pune	Deepak Dhar	A study of causal sets
22	<b>Gogate Niramay Vinayak</b> 20151101	IISER Pune	Seema Sharma	Response of CMS high granularity calorimeter prototype to charged pions
23	<b>Patki Raagini Abhay</b> 20151104	SISSA, Italy and IISER Pune	Carlo Baccigalupi	Investigation of polarized synchrotron frequency dependence for CMB observations
24	<b>Adhickey Shomik Sanjay</b> 20151105	IUCAA, Pune	Sukanta Bose	Advance alerts from gravitational wave searches of binary compact objects for electromagnetic follow-ups
25	<b>Naresh Kumar R.</b> 20151110	National Institute of Technology, Tiruchirappalli	R. Nagalakshmi	Synthesis of organic nanofibers, for Non Linear Optical (NLO) applications
26	<b>Palash Jitendra Singh</b> 20151112	IISER Pune	Sunil Mukhi	Modular invariance in two-dimensional Conformal Field Theories
27	<b>Joshi Prasanna Mohan</b> 20151120	IUCAA, Pune	Sanjeev Dhurandhar	Optimal Vetoing methods for removing glitches that can be modelled from interferometric detector data
28	<b>Dubbaku Sri Pragna</b> 20151123	IISER Pune	Surjeet Singh	Evolution of structural, electronic and magnetic properties upon Mg-doping in Ba <sub>2</sub> O <sub>3</sub>
29	<b>Radhika A.C.</b> 20151124	University of Hamburg, Germany	Robi Banerjee	The small-scale dynamo in the low-Mach number regime
30	<b>Lomte Shivani Sanjay</b> 20151126	IISER Pune	Seema Sharma	Enhancing searches for Supersymmetric-top pairs using Higgs tagging at 13 TeV
31	<b>Pranjal Upadhyaya</b> 20151137	IUCAA, Pune	Sanjeev V. Dhurandhar	Improving the radiometric search for the anisotropic stochastic gravitational wave background with a natural set of basis functions

Sr. No.	Student	Host Institute	Supervisor	Project Title
32	<b>Mayank Goyal</b> 20151139	IISER Pune Sorbonne University, France	Emmanuel Lhuillier	Optoelectronics of nanocrystals: Infrared absorbing lead halide perovskite
33	<b>Prashant Suresh Dagale</b> 20151142	TIFR, Mumbai	Sushil Mujumdar	Designing illumination source for near-field Scanning Optical Microscope
34	<b>Patil Raj Suresh</b> 20151143	IISER Pune	Suneeta Vardarajan	The effective field theory approach to gravitation
35	<b>Arindam Sharma</b> 20151150	IUCAA, Pune	Surhud More	Galaxy clusters as cosmological probes
36	<b>Prasham Jain</b> 20151156	IISER Pune	Diptimoy Ghosh	Constraining some SMEFT operator using LHC data
37	<b>Sontakkey Nupur Vijay</b> 20151163	IISER Pune	Surjeet Singh	Studying half-Heusler based materials for thermoelectric application
38	<b>Madhav Sinha</b> 20151167	Australian National University, Australia	Vladimir Bazhanov	Solvable models and mathematical aspects of Conformal Field Theory
39	<b>Patil Vaishnavi Vilas</b> 20151168	IISc, Bengaluru	Chethan Krishnan	An analysis of Page Curve and the Information Paradox
40	<b>Athira K.V.</b> 20151170	Stony Brook University, U.S.A. and IIT Delhi	Abhay Deshpande	Impact of different event reconstruction methods on diffractive physics studied at the Electron-Ion Collider
41	<b>Deshpande Aniruddha Chandrashekhar</b> 20151171	TIFR, Mumbai	Rajamani Vijayaraghavan	Microwave single photon detectors using superconducting circuits
42	<b>Harish M.</b> 20151173	IITM, Chennai	Ayan Mukhopadhyay	Effective theory of relativistic fluids: Hydrodynamic attractor and bi-criticality
43	<b>Magdum Rushikesh Prakash</b> 20151176	IISER Pune	Satishchandra Ogale	Growth, electrical and magnetic investigations of manganese oxide thin films
44	<b>Vighnesh Digamber Vernekar</b> 20131109	Bose Institute, Kolkata	Dipankar Home	Fundamental aspects of quantum mechanics and their interplay with quantum information
45	<b>Jadhav Rohitkumar Himmatrao</b> 20141033	LRCS, Amiens, France	Sauvage Frederic	Unfolding mysteries of phase separation and suppressing it using molecular ion doping in mixed halide 2D and 3D structured hybrid perovskites for cost effective and highly efficient solar cells and LED applications
46	<b>A. Janani</b> 20141037	IISER Pune	T.S. Mahesh	Evolution of quantum correlations in quantum algorithms
47	<b>Dhruba Bora</b> 20141065	IMSc, Chennai	Sitabhra Sinha	An econophysics study on financial markets
48	<b>Shilbhushan J. Shambharkar</b> 20141068	PRL, Ahmedabad	Subhendra Mohanty	Dark matter in the universe
49	<b>Pawar Vipul Dinesh</b> 20141133	IISER Pune	Sourabh Dube	Classification of high energy tracks using CNNs

## LIST OF COURSES

### August 2019 Semester

Code	Course	Coordinator/Instructor	Credits
<b>Semester I</b>			
BI1113	Introductory Biology - I	Kundan Sengupta, Nagaraj Balasubramanian	3
BI1123	Practical: Basic Biology	Krishanpal Karmodiya, Nixon M. Abraham, Nishad Matange, Tressa Jacob	3
CH1113	Principles of Organic Chemistry	Ramakrishna G. Bhat, Srinivas Hotha	3
HS1113	Academic Communication Skills	Pooja Sancheti	3
MT1113	Calculus - I	Mousomi Bhakta, Baskar Balasubramanyam	3
TD1113	Introduction to computer programming	Vivek Mohan Mallik, Chitrabhanu Chaudhari, Manish Mishra	3
PH1113	Introductory Mechanics	Sudarshan Ananth, Mukul Kabir	3
PH1123	Physics Lab - I	Sourabh Dube, Atikur Rahman, Surjeet Singh, Rejish Nath, Bijay Kumar Agarwalla	3
<b>Semester III</b>			
BIO201	Introductory Biology - III: Ecology and Evolution	Sutirth Dey	3
BIO221	Practical: Ecology and Evolution	Sutirth Dey, Neelesh Dahanukar	3
CHM201	Principles of Inorganic Chemistry	Nirmalya Ballav, Moumita Majumdar	3
CHM221	Chemistry Lab - II : Inorganic Chemistry	Sujit K. Ghosh, R. Vaidhyanathan, Nirmalya Ballav, R. Boomi Shankar, Shabana Khan	3
ECS201	Earth System - I	Gyana Ranjan Tripathy, Shyam S. Rai	3
HSS201	History of Science	Meera Nanda	2
MTH201	Linear Algebra	Diganta Borah	3
PHY201	World of Physics - III : Electricity & Magnetism	Aparna Deshpande, Diptimoy Ghosh	3
PHY221	Physics Lab - II	Vijayakumar Chikkadi, Sunil Nair, Bhas Bapat, Seema Sharma, Arun M. Thalapillil	3
<b>Semester V only</b>			
BIO301	Lab Training/ Theory Project	Collins Assisi	3
BIO311	Advanced Cell Biology	Nagaraj Balasubramanian, Thomas Pucadyil	4
CHM301	Lab Training/ Theory Project - I	Pramod Pillai	3
ECS301	Lab Training/ Theory Project	Shreyas Managave	3
ECS310	Numerical Computation using MATLAB	Suhas Ettammal	4
HSS301	Lab Training/ Theory Project	Pushkar Sohoni	3
MTH301	Lab Training/Theory Project	Mousomi Bhakta	3

Code	Course	Coordinator/Instructor	Credits
PHY301	Lab training / Theory Project	Shivprasad Patil	3
PHY330	Physics Lab - IV	T.S. Mahesh	3
<b>Semester VII only</b>			
BIO352	Animal Physiology - II	N.K. Subhedar, Anand Krishnan	3
BIO353	Advanced Immunology	Vineeta Bal, Satyajit Rath	3
BIO401	Lab Training/ Theory Project	Collins Assisi	3
BIO491	Literature review	Collins Assisi, Aurnab Ghose, Sudha Rajamani	3
CHM401	Lab Training/ Theory Project - II	Pramod Pillai	3
CHM410	Advanced Molecular Spectroscopy	Aloke Das	4
CHM411	Organic Synthesis - II	Boopathy Gnanaprakasam	4
CHM413	Bioinorganic Chemistry	V.G. Anand	4
CHM421	Polymer Chemistry	M. Jayakannan	4
CHM430	Advanced Physical Chemistry Laboratory	Pankaj Mandal, Aloke Das, Pramod Pillai, Muhammed Musthafa	3
CHM431	Chemical Biology	Amrita Hazra	3
CHM432	Solid State Chemistry	Partha Hazra	3
CHM445	Electrochemistry	Muhammed Musthafa	3
ECS411	Exploration Seismology	Rahul Dehiya	4
ECS415	Mineralogy & Petrology	Shreyas Managave, Raymond Duraiswamy (Visiting Faculty)	4
ECS414	Physics of Geological Processes	Utsav Mannu	4
ECS432	Geological Field Training	Sudipta Sarkar, Shreyas Managave, Alok Dave	3
ECS401	Lab Training/ Theory Project	Shreyas Managave	3
ECS318	Atmosphere and Ocean Dynamics	Suhas Ettammal	4
HSS401	Lab Training/ Theory Project	Pushkar Sohoni	3
MTH401	Lab Training/Theory Project	Mousomi Bhakta	3
MTH410	Galois Theory	Supriya Pisolkar	4
MTH412	Algebraic Topology	Rama Mishra	4
MTH413	Algorithms	Chandrasheel Bhagwat	4
MTH415	Probability	Anindya Goswami	4
MTH417	Ordinary Differential Equations	Anup Biswas	4
MTH421	Measure Theory and Integration	Anisa Chorwadwala	4
MTH423	Commutative algebra	Rabeya Basu	4
MTH432	Central simple algebras	Anupam Kumar Singh	4
MTH433	Representation Theory	Chandrasheel Bhagwat	4

Code	Course	Coordinator/Instructor	Credits
MTH434	Modular forms	Debargha Banerjee	3
PHY401	Lab training / Theory Project	Shivprasad Patil	3
PHY410	Physics Lab - VI	Pavan Kumar G.V.	4
PHY411	Condensed Matter Physics - I	Prasenjit Ghosh	4
PHY412	Statistical Mechanics - II	Sreejith G.J.	4
PHY453	Computational Physics	Apratim Chatterji	3
PHY461	Quantum Field Theory	Sachin Jain	3

## Semester V & VII

BIO310	Biostatistics	Pranay Goel, Raghav Rajan	4
BIO313	Advanced Molecular Biology	Mayurika Lahiri, Gayathri Pananghat	4
BIO314	Bioinformatics	M.S. Madhusudhan	4
BIO315	Cellular Biophysics I	Chaitanya Athale	4
BIO316	Neurobiology - I	Nixon M. Abraham, Suhita Nadkarni	4
BIO320	Genetics	Richa Rikhy, Girish Ratnaparkhi	4
BIO321	Plant Biology - I	Anjan Banerjee	4
BIO410	Advanced Biochemistry - I	Siddhesh Kamat, Sudha Rajamani	4
BIO411	Ecology - I	Deepak Barua	4
BIO415	Chemical Ecology	Sagar Pandit	4
BIO431	Epigenetics	Sanjeev Galande	3
BIO454	Structural Biology	Gayathri Pananghat	3
BIO355	Vertebrate Zoology	Anand Krishnan	3
CHM311	Physical Organic Chemistry	Hosahudya N. Gopi	4
CHM312	Main Group Chemistry	R. Boomi Shankar	4
CHM320	Symmetry and Group Theory	Jeetender Chugh	4
CHM332	Separation Principles and techniques	Britto S. Sandanaraj	3
CHM331	Self-Assembly in Chemistry	Pinaki Talukdar	3
CHM340	Advanced Organic Chemistry Laboratory	Raghavendra Kikkeri, Harinath Chakrapani	3
ECS312	Physics of Atmosphere and Ocean	Neena Joseph Mani	4
ECS313	Mechanics for Earth Sciences	Argha Banerjee	4
ECS331	Earth and Planetary Materials	Shreyas Managave	3
ECS330	Earth and Planetary Materials Lab	Shreyas Managave	3
ECS420	Satellite data analysis and image processing	Sudipta Sarkar	4

Code	Course	Coordinator/Instructor	Credits
ECS335	Paleobiology	Devapriya Chattopadhyay	4
ECS317	Isotope Geochemistry	Gyana Ranjan Tripathy	3
HSS333	History of Architecture in India	Pushkar Sohoni	3
HSS342	Introduction to Paninian Grammar	Venketeswara R. Pai	3
HSS351	Technological Evolution of Cinema	Anil Zankar	3
HSS334	Introduction to Economics and Econometrics	Pushkar Sohoni/Anangha Mitra	4
MTH310	Group Theory	Ayan Mahalanobis	4
MTH311	Analysis	Mainak Poddar	4
MTH312	Point Set Topology	Steven Spallone	4
MTH314	Statistical Inference	Uttara Naik-Nimbalkar	4
MTH318	Combinatorics	Krishna Kaipa	4
MTH435	Operations Research	Pallavi Manohar, Anindya Goswami	4
MTH436	Regression Analysis	David Hanagal, Anindya Goswami	4
PHY310	Mathematical Methods in Physics	Suneeta Vardarajan	4
PHY311	Classical Mechanics	Deepak Dhar	4
PHY312	Electrodynamics	Arijit Bhattacharyay	4
PHY313	Quantum Mechanics - I	M.S. Santhanam	4
PHY334	Astronomy and Astrophysics	Ramana Athreya	3
PHY340	Methods of Experimental Physics	Shouvik Datta	3
PHY462	Plasma Physics	Prasad Subramanian	3

## January 2020 Semester

### Semester II

BI1213	Introduction to Biomolecules	M.S. Madhusudhan, Sagar Pandit, Sudha Rajamani, Sanjeev Galande, Girish Ratnaparkhi, Nagaraj Balasubramanian, Tressa Jacob	3
CH1213	Principles of Physical Chemistry	Anirban Hazra, Angshuman Nag	3
CH1223	General Chemistry Practicals I	M. Jayakannan, H.N. Gopi, Moumita Majumdar, Alope Das and Srabanti Chaudhury	3
EC1213	Evolution of Earth and Life	Gyan Ranjan Tripathy, Devapriya Chattopadhyay	3
MT1213	Calculus II	Steven Spallone, Manish Mishra	3
MT1223	Linear Algebra	Kaneenika Sinha, Anupam Kumar Singh	3
PH1213	Introductory Electricity and Magnetism	Atikur Rahman, Diptimoy Ghosh	3
HS1213	History Of Science	Meera Nanda	3

Code	Course	Coordinator/Instructor	Credits
<b>Semester IV</b>			
BIO202	Introductory Biology IV: Biology of Systems	Aurnab Ghose, Collins Assisi	3
CHM202	Principles of Organic Chemistry	Raghavendra Kikkeri	3
CHM222	Chemistry Laboratory III (Organic)	S. Britto, M. Jayakannan, Harinath Chakrapani, Pinaki Talukdar	3
ECS202	Earth System II	Neena Joseph Mani	2
MTH202	Probability & Statistics	Chandrasheel Bhagwat	3
MTH204	Basic Structures of Mathematics	Amit Hogadi, A. Raghuram	2
PHY202	World of Physics IV - Quantum Physics	Sourabh Dube, Sreejith G.J.	3
PHY222	Physics Lab III	Shivprasad Patil, Mukul Kabir, Mahesh T.S., Vijayakumar Chikkadi	3
IDC202	Optics	Umakant Rapol, Rejish Nath	2
<b>Semester VI only</b>			
BIO302	Lab/Theory Project	Kundan Sengupta, Krishanpal Karmodiya	3
CHM360	Advanced Inorganic Chemistry Lab	Nirmalya Ballav	3
CHM302	Lab Training/Theory project	Angshuman Nag	3
ECS302	Lab Training/Theory Project	Shreyas Managave	3
HSS302	Lab Training/Theory Project	Pushkar Sohoni	3
MTH302	Theory Project	Mousomi Bhakta	3
PHY320	Physics Lab V	Sunil Nair, Satish Ogale	4
PHY302	Lab training / Theory Project	Aparna Deshpande	3
<b>Semester VIII only</b>			
BIO463/650	Biology and Disease	Mayurika Lahiri, Siddhesh S. Kamat	4
BIO402	Lab/Theory Project	Kundan Sengupta, Krishanpal Karmodiya	3
CHM420/624	Structural Methods and Analysis	Pinaki Talukdar, S.G. Srivatsan	4
CHM422/640	Statistical Thermodynamics	Srabanti Chaudhury and Anirban Hazra	4
CHM423/628	Medicinal Chemistry	Harinath Chakrapani	4
CHM433/627	Photochemistry and Photophysics	Pramod Pillai	3/4
CHM441/643	Advanced Material Science	R. Vaidhyanathan	3/4
CHM442/630	Organometallic Chemistry	Ramkrishna G. Bhat	3/4

Code	Course	Coordinator/Instructor	Credits
CHM402	Lab Training/Theory Project	Angshuman Nag	3
CHM428/633	Chemistry for Alternative Energy	Angshuman Nag and M. Mushtafa	4
CHM437	Organotransition Metal Catalysis	Shabana Khan	3/4
ECS402	Lab Training/Theory Project	Shreyas Managave	3
ECS453/628	Tropical Meteorology	Suhas Ettammal, Sibin T.P.	4
ECS457/634	Sequence Stratigraphy	Alok Dave	3/4
HSS402	Lab Training/Theory Project	Pushkar Sohoni	3
MTH420	Algebraic Number Theory	Debargha Banerjee	4
MTH411	Functional Analysis	Anisa Chorwadwala	4
MTH422	Differential Geometry	Tejas Kalelkar	4
MTH426	Stochastic Processes	Anindya Goswami	4
MTH423	Commutative Algebra	Chitrabhanu Chowdhari	4
MTH424	Partial Differential Equations	Anup Biswas	4
MTH402	Theory Project	Mousomi Bhakta	3
PHY420/623	Atomic and Molecular Physics	Bijay Kumar Agarwalla	4
PHY421/641	Classical and Quantum Optics	Shouvik Datta	4
PHY422/622	Nuclear and Particle Physics	Sunil Mukhi	4
PHY430	Physics Lab VII	Pavan Kumar, Bhas Bapat	3
PHY402	Lab training / Theory Project	Aparna Deshpande	3
PHY463/658	Advanced Condensed Matter Physics	Deepak Dhar	3/4
PHY557/657	Quantum Field Theory II	Arun Thalapillil	3

### Semester VI & VIII

BIO312/612	Animal Physiology I	Nixon M. Abraham, N.K. Subhedar	4
BIO324/646	Introductory Immunology	Vineeta Bal, Satyajit Rath	4
BIO325/648	Animal Behaviour	Raghav Rajan, Anand Krishnan	4
BIO412/655	Microbiology	Sunish Radhakrishnan, Gayathri Pananghat	4
BIO414/647	Mathematical & Computational Biology	Collins Assisi, Suhita Nadkarni	4
BIO417/628	Advanced Biochemistry II	Thomas Pucadyil, Amrita Hazra	4
BIO460/629	Evolution	Sutirth Dey	3
BIO423/630	Ecology II	Deepak Barua, Sagar Pandit	4
BIO433/649	Applied Plant Biology	Anjan Banerjee	3
BIO451/656/ IDC451	Data Science	Pranay Goel	3
BIO461/639	Genome Biology	Kundan Sengupta, Krishanpal Karmodiya	4

Code	Course	Coordinator/Instructor	Credits
BIO442/671	Physical Biochemistry	Jayant Udgaonkar	3
BIO462/640	From Planets to Cells	Sudha Rajamani	4
BIO420/618	Developmental Biology	Girish Ratnaparkhi, Richa Rikhy	4
CHM310/620	Quantum Chemistry	Arun Venkatnathan	4
CHM321/621	Organic Synthesis-I	Srinivas Hotha, B. Gnanaprakasam	4
CHM322/622	Transition metal Chemistry	Sujit Ghosh, Moumita Majumdar	4
CHM323/623	Fundamentals of Molecular Spectroscopy	Pankaj Mandal	4
CHM334/631	Physical Chemistry of Solutions	Arnab Mukharjee	3/4
CHM351/641	Bioorganic Chemistry	S.G. Srivatsan	3/4
ECS 322/324/624	Introduction to Geophysics	Utsav Mannu	4
ECS332/620	Geochemistry	Shreyas Managave	3/4
ECS333/626	Sedimentology & Stratigraphy	Sudipta Sarkar	3/4
ECS323/617	Structural Geology	Shreyas Managave, Durga Prasad Mohanty	4
ECS454/629	Geophysical Fluid Dynamics	Suhas Ettammal	4
ECS455/630	Geoelectromagnetic Exploration	Rahul Dehiya	4
ECS456/633	Glacier Dynamics	Argha Banerjee	3/4
HSS360/615	(Contemporary) Stories from the Subcontinent	Pooja Sancheti	4
HSS361/616	History of Mathematics in India	Venketeswara Pai R.	3
HSS362/617	Introduction to Development Studies	Bejoy K. Thomas	3
HSS363/618	Science as Narrative in Literature and Cinema	Anil Zankar	4
MTH320	Vector Spaces, Rings and Modules	Rabeya Basu	4
MTH321	Complex Analysis	Baskar Balasubramanyam	4
MTH322	Calculus on Manifolds	Vivek Mallick	4
MTH323	Graph Theory	Soumen Maity	4
MTH328	Coding Theory	Krishna Kaipa	4
MTH445	Advanced Operations Research	Pallavi Manohar	4
PHY322	Statistical Mechanics I	Apratim Chatterji	4
PHY321/613	Quantum Mechanics II	Suneeta Vardarajan	4
PHY341/647	Physics at Nanoscale	Surjeet Singh	3/4
PHY342/642	Nonlinear Dynamics	Santhanam M.S.	3/4
PHY361/636	Quantum Information	Sachin Jain	3/4
PHY464/659	Astrophysical Processes	Prasad Subramanian	3/4

## **ACADEMIC ACHIEVEMENTS OF BS-MS STUDENTS**

CNR Rao Education Foundation Prize was awarded to the following students. This prize is given to first year BS-MS students who have secured the highest CGPA in the first two semesters.

Kshitij Verma (Semester I August 2019)  
Mihir Shridhar Dingankar (Semester II January 2019)

Prizes for Academic Excellence were awarded to the following BS-MS students. These prizes are given to the BS-MS students who attained the highest CGPA in Semester III to VIII.

Madheshvaran S. (Semester III August 2019)  
Sabarenath J.P. (Semester IV January 2019)  
Patil Rushikesh Anil (Semester IV January 2019)  
Viraj Meruliya (Semesters V & VI 2018-2019)  
Sriram Raghunath (Semesters VII & VIII 2018-19)  
Palash Jitendra Singh (Semesters VII & VIII 2018-19)

*(These awards are usually announced on the Institute Foundation Day held in April first week every year. The 2020 Foundation Day could not be held, as the COVID-19 lockdown began mid-March 2020.)*

BS-MS students Kumar Aanjaneya Ajay was selected to receive the Prime Minister's Research Fellowship (PMRF) during the year.

**During the 8<sup>th</sup> Convocation of the Institute held on June 01, 2019, 145 students graduated with BS-MS dual degrees, and 05 students took BS Exit.**

Bhagwat Pankaj Uttam who secured a CGPA of 9.8 was awarded the Institute Gold Medal.

### **The following 22 students passed with Distinction (CGPA>9.0):**

Komal Gupta	Meera Mohan	Bhagwat Pankaj Uttam
Seethalakshmi K.	V. Sowmya	Nida Farheen
Supriya Tiwari	Raghuram H.V.	P.V.S. Pavan Chandra Vamsi
Devika Varma	Surabhi K.S.	Abhishek Ojha
Shraddha Lall	Mrutyunjay Nair	Bhoite Vishwajeet
Vikram Ravindranath	Joshi Gaurav Shrikant	Basila M.A.
Komal Sah	Sandeep Joy	
Sri Ramesh Chandra Ammanamanchi	Deshpande Sanyukta Parag	

# 03

## Conferences, Events, and Initiatives

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## Conferences, Symposia, and Workshops

**Conferences and workshops organised by IISER Pune researchers bring together the scientific community from within and outside India. These provide an opportunity for all members to discuss and develop their research and education goals. In addition to the conferences and workshops listed below, IISER Pune has hosted ~230 research seminars during 2019-20.**

The institute also hosts several academic outreach events reaching out to external audiences such as students, teachers and members of the public. These activities are described in the *Outreach* chapter of this report.

### Scientific Events

**ChemSymphoria 2019: Chemistry In-house symposium**

July 18–20, 2019

**Organiser** Dr. Nirmalya Ballav

**Hands-on workshop on phase separation in genome organization (PSiGO)**

July 22–August 02, 2019

**Instructors** Prof. Geeta Narlikar (UCSF, U.S.A.); Prof. Sanjeev Galande (IISER Pune); Dr. Kundan Sengupta (IISER Pune); Dr. Krishanpal Karmodiya (IISER Pune)

**Workshop on Bioluminescence: Advanced light microscopy**

Building Bharat-Boston Biosciences (B4) Young Scientist Program (Funded by Department of Biotechnology, Govt. of India)

August 01–14, 2019

**Organisers** IISER Pune; The Lakshmi Mittal and Family South Asia Institute; Harvard University; Institute of Bioinformatics and Applied Biotechnology, Bengaluru

### Mathematics in-house symposium 2019

August 30–31, 2019

**Organiser** Mathematics Department of IISER Pune

### GPU Application Hackathon 2019 (GAH – 2019)

September 14–18, 2019

**Organiser** OpenACC.org; C-DAC; IISER Pune; and NVIDIA under the aegis of National Supercomputing Mission (NSM)

### 1st TCGA-themed conference and workshop in India:

#### Multi-omics studies in cancer: Learnings from TCGA

September 21–25, 2019

**Organisers** IISER Pune, Centre for Translational Cancer Research (CTCR), Persistent Systems and TCGA, NIH, U.S.A.

### In-house symposium of the Centre for Energy Science

October 18, 2019

**Organiser** Dr. Nirmalya Ballav

### Workshop on parallel programming

October 05, 2019

**Organiser** Mathematics Department;

**Instructor** Nisha Kurkure

### Workshop on thermodynamics in the Earth Sciences

October 10–15, 2019

**Organiser** Earth and Climate Science Department;

**Instructor** Prof. Axel Kleidon, Max-Planck-Institut für Biogeochemie, Jena

### A short course on Physics and Mechanics of rocks: A practical approach

November 05, 2019

**Organisers** IISER Pune Student Chapter of Society of Exploration Geophysicist (SEG) and European Association of Geoscientists and Engineers (EAGE);

**Instructor** Prof. Manika Prasad

### 9<sup>th</sup> International Conference of LASA India (LASACON 2019) on Laboratory Animals in Biomedical Research - The way forward

November 22–23, 2019

**Organisers** IISER Pune; National Centre for Cell Science, Pune; Laboratory Animal Scientists' Association (LASA), India

### One-day workshop on introduction to functional programming through Scala language

December 01, 2019

**Organiser** Mathematics Department

**Instructor** Imran Kazi, Deutsche Bank Group, Pune

### New electrochemical technologies for sustainable fuels, chemicals and industrial processes

*Indo-U.K. Newton-Bhabha Fund Researcher Links workshop*

December 02–05, 2019

**Organisers** Dr. Mark Symes (University of Glasgow, U.K.), Dr. Muhammed Musthafa (IISER Pune)

### 3<sup>rd</sup> National post doc symposium (2019)

December 10–13, 2019

**Organisers** IISER Pune; NCBS Bengaluru; inStem Bengaluru; Post Doc Fellows Association-NCBS-inStem (PDFA); IndiaBioscience

### IFCAM winter school on graphs and random processes

December 16–20, 2019

**Organisers** Fabrice Gamboa (Toulouse University, France); Govindan Rangarajan (IISc, Bengaluru); Anindya Goswami (IISER Pune); Anup Biswas (IISER Pune)

### Winter school on geometric algorithms and their applications

December 16–21, 2019

**Organisers** Academic Coordinator: Aritra Banik (NISER Bhubaneswar); Local Coordinator: Dr. Soumen Maity (IISER Pune)

### Challenges of TB

*U.K.-India Newton-Bhabha Fund RSC Researcher Links workshop*

December 16–19, 2019

**Organisers** Dr. Harinath Chakrapani (IISER Pune); Dr. Joanna Bacon (Public Health England); Prof. Seshadri Vasani (Public Health England); Newton-Bhabha Fund; Royal Society of Chemistry

### National conference on aquatic ecosystems:

#### Sustainability and conservation

December 20–21, 2019

**Organisers** Dr. Neelesh Dahanukar (IISER Pune); Dr. Ulfat Baig (IISER Pune); Maharashtra Gene Bank Programme, Rajiv Gandhi Science & Technology Commission (RGSTC), Government of Maharashtra

### Technology and Innovation in Mathematics Education (TIME) Conference 2019

December 26–28, 2019

**Organisers** IISER Pune; IIT Bombay; BATU, Lonere

### No Garland Neuroscience (NGN) 2019

January 02–04, 2020

**Organiser** Neuroscience Interest Group, IISER Pune

**5<sup>th</sup> Asia Pacific *Drosophila* Research Conference (APDRC5) and Indian *Drosophila* Research Conference**

January 06–10, 2020

**Organiser** Dr. Girish Ratnaparkhi; Prof. Girish Deshpande; Prof. L.S. Shashidhara; Dr. Richa Rikhy; Prof. Sutirth Dey

**Sameeksha: Annual in-house symposium of Earth and Climate Science department**

January 11, 2020

**Organiser** Earth and Climate Science Department

**Workshop on data science ecosystem tools**

January 24, 2020

**Organisers** IISER Pune in association with NVIDIA;

**Instructor** Sunil Patel, Senior Solution Architect, NVIDIA

**International symposium on cell surface macromolecules**

February 17–20, 2020

**Organiser** Dr. Thomas Pucadyil (IISER Pune), Dr. Durba Sengupta (CSIR-NCL, Pune)

**Workshop on Parameterized Complexity 201**

March 06–08, 2020

**Organiser** Dr. Soumen Maity (Coordinator), IISER Pune

**Capacity Building**

**Molecular Biology workshops for undergraduates**

November 01, 2019–February 16, 2020 (Series of 3-day workshops)

**Instructors** Prof. Sutirth Dey, Poornima Raveendran, Anuja Salgaonkar

**Mentoring programme: Prodigious women in Chemical Sciences**

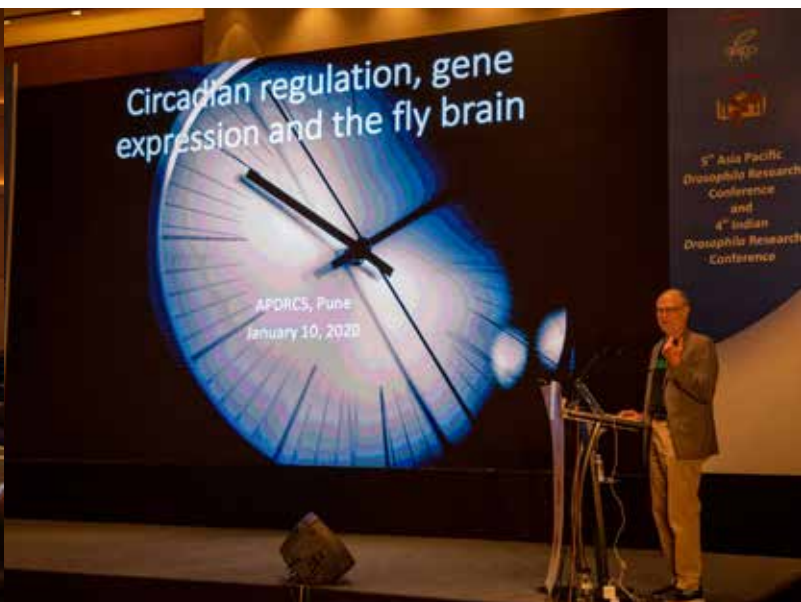
November 21, 2019

**Organiser** Dr. Moumita Majumdar

**Workshop on scientific project financial management**

January 27–31, 2020

**Organisers** Dr. Vandana Gambhir, CA. Vasundhara Laad IISER Pune in association with DST, Govt. of India



The 5<sup>th</sup> Asia Pacific *Drosophila* Research Conference (APDRC5) and the Indian *Drosophila* Research Conference, held in Pune, brought two Nobel Laureates, Prof. Eric Wieschaus (Left) and Prof. Michael Rosbash (Right), to the IISER Pune campus.

# COLLOQUIA AND PUBLIC LECTURES

Connecting science with the society and offering first-person views on a diverse set of topics in science are the Institute Colloquia, Named Lectures, and other lectures that are open to the public. Many of these lectures are made available online through the IISER Pune Science Media Centre's YouTube channel.



## Institute Colloquia

### **Quest for cosmic origin**

Prof. Tarun Souradeep, Professor & Chair (Physics), IISER Pune  
August 16, 2019

### **The dynamic packaged genome**

Prof. Geeta Narlikar, University of California, San Francisco, U.S.A.  
August 23, 2019

### **Black holes**

Prof. Shiraz Minwalla, Tata Institute of Fundamental Research, Mumbai  
August 30, 2019

### **Understanding the evolution of social life in animals: The bitter-sweet saga**

Prof. Raghavendra Gadagkar, Indian Institute of Science, Bengaluru  
September 06, 2019

### **Molding 3D curved structures by selective heating**

Prof. Nitin Nitsure, Tata Institute of Fundamental Research, Mumbai  
September 13, 2019

### **Architecture as evidence of cultural continuities: The Sultanate of Ahmadnagar**

Dr. Pushkar Sohoni, IISER Pune  
September 20, 2019

### **Lipid assemblies: Bending and wetting**

Dr. Guruswamy Kumaraswamy, CSIR-National Chemical Laboratory, Pune  
October 04, 2019

### **Understanding the Earth from a thermodynamic systems perspective**

Prof. Axel Kleidon, Max-Planck-Institute for Biogeochemistry, Jena, Germany  
October 11, 2019

### **Competitive exams, competitive societies and rents an analysis using Game Theory**

Prof. Milind Sohoni, IIT Bombay, Mumbai  
November 01, 2019

### **Archaeo-genetic research at the Harappan Site of Rakhigarhi**

Prof. Vasant Shinde  
National Maritime Heritage Complex  
November 08, 2019

### **A mere surface bond!**

Dr. Nirmalya Ballav, IISER Pune  
November 15, 2019

### **Scale issues in hydrology in the Anthropocene**

Prof. Pradeep P. Mujumdar  
Indian Institute of Science, Bengaluru  
November 22, 2019

### **Evolution in small and isolated tiger populations**

Dr. Uma Ramakrishnan, National Centre for Biological Sciences, Bengaluru  
January 24, 2020

### **Thinking about water: Why we need a paradigm shift**

Dr. Sharachchandra Lele, Ashoka Trust for Research in Ecology and the Environment, Bengaluru  
February 14, 2020

### **The origins of modern Indian biodiversity: Climate implications**

Prof. Ashok Sahni, Panjab University, Chandigarh  
March 06, 2020

## **Special Colloquia**

### **The Cancer Genome Atlas: Getting to know the enemy**

Dr. Jean C. Zenklusen, The Cancer Genome Atlas (TCGA), National Cancer Institute, National Institutes of Health, U.S.A.  
September 23, 2019

### **Water so common, so mysterious**

Prof. Richard N. Zare, Stanford University, U.S.A.  
November 25, 2019

### **Wonder world seen with ultrashort light**

Prof. Tahei Tahara, RIKEN, Japan  
February 12, 2020

## **Named Lectures**

*Second K.S. Krishnan Memorial Lecture in Neuroscience*

### **Straighten up & fly right: Insect flight control from neurons to ecosystems**

June 21, 2019  
Dr. Michael Dickinson, The California Institute of Technology, U.S.A.

*Sixth Annual Homi Bhabha Memorial Public Lecture*

### **Probing the Universe using Radio Waves: From Sir J.C. Bose to modern times**

Prof. Yashwant Gupta, National Centre for Radio Astrophysics (TIFR), Pune  
October 25, 2019

*Third Annual P.M. Mukhi Memorial Human Rights Lecture*

### **The Technological Fix - and what it does to our rights and the rights of others**

January 25, 2020  
Usha Ramanathan, Human Rights Expert

# NEWS AND EVENTS

## ***Ninth Foundation Day***

*April 13, 2019*

The Foundation Day Lecture was delivered by Prof. Govind Swarup (Former Centre Director, National Centre for Radio Astrophysics of TIFR, Pune; Former Project Director, GMRT, Pune). His talk was titled 'Great discoveries in Radio Astronomy: Big Bang to Black Holes'. Through describing the journey of radio astronomy in India, Prof. Swarup also conveyed that it is possible to do great work in India and narrated the early efforts of several members from Pune towards developing the idea of IISERs. Director of IISER Pune, Prof. Jayant Udgaonkar, gave the Institute report. Student magazine *Kalpa 2019* and *Disha's* chronicle *Pahal 2019* were released. Foundation Day awards were given to students and staff in recognition of their academic and professional excellence.



## ***Inauguration of Sports Facilities***

*April 13, 2020; August 15, 2020*

Coupled with the 9<sup>th</sup> Foundation Day celebration, outdoor sports facilities—tennis, volleyball, and basketball courts—were inaugurated on the Institute campus by the Director Prof. Jayant Udgaonkar and Registrar Col. G. Raja Sekhar (Retd.). The indoor sports complex with badminton and basketball courts was inaugurated by the Director on August 15, 2019.

## ***Eighth Convocation Ceremony***

*June 01, 2019*

During the 8<sup>th</sup> Convocation of the Institute held on June 01, 2019, 150 (this includes 5 students who got the degree of BS only) BS-MS students, 14 Integrated PhD students and 61 PhD students received their degrees.



The Institute Gold Medal for the BS-MS Programme was presented to Bhagwat Pankaj Uttam. Xytel Best MS Thesis Awards were given to 6 BS-MS students (S. Ramesh Chandra Ammanamanchi, Mrutyunjay Nair, Seethalakshmi K., Shraddha Lall, Meera Mohan, Jayanth Kumar Narayana) and 4 PhD students (Debangana Mukherjee, Roopali Sainath Pradhan, Santosh Kumar Singh, Adarsh B. Vasista). MS Thesis: Honourable Mentions were given to 3 BS-MS students (Anupam Prasoon, Bhagwat Pankaj Uttam, Surabhi K.S.). Chief Guest Mr. S. Kris Gopalakrishnan (Co-founder, Infosys and Chairman, Axilor Ventures) delivered the convocation address.

**Grand Finale Smart India  
Hackathon 2019 (Hardware  
Edition)**

July 08-13, 2019

IISER Pune, along with CSIR-NCL, was one of the 19 centres across India where the grand finale of this national competition was held simultaneously. This is a Ministry of Human Resource Development (HRD) initiative for innovative solutions in product development. Honourable Minister for HRD Shri. Ramesh Pokhriyal inaugurated the Grand Finale via video conference.

At IISER Pune, 173 students from twenty-five teams worked on their suggested solutions over a period of five days. Each team consisted of about six students and two teacher mentors. Problems from diverse areas such as healthcare & biomedical devices, smart vehicles, robotics and drones, waste management, clean water, renewable energy, etc. are being addressed by the teams. The teams interacted with company product designers, mentors, and judges.

**Hindi Fortnight Celebrations**

September 12-26, 2019

During the Hindi Fortnight, several competitions were organised for the institute members. These included Hindi essay writing (Topic: *Human's role in environmental enrichment*), Hindi solo songs, Hindi word knowledge, general knowledge, poetry writing, story writing, comic strip making, shayari writing and news reporting.

An exhibition Hindi books was organised by the Srinivasa Ramanujan Library. The message of the Hon'ble Minister for HRD on this occasion was read out. Cultural programmes were conducted for staff, faculty and student during the fortnight. Winners of the competitions were given prizes and certificate.

During the year 2019-2020, two Hindi workshops were organised on the topics of 'Official language policies and problems faced in Hindi translation' (June 18, 2019) and on 'Use of Hindi in science' (September 25, 2019).

**Silver Medal at iGEM-2019 to  
the IISER Pune Team**

November 2019

A team of undergraduate students, who competed at the international Genetically Engineered Machines (iGEM) contest, won a silver medal at the Giant Jamboree held October 31 to November 04, 2019 in Boston, U.S.A. The team was led by Dr. Chaitanya Athale and co-supervised by Dr. Aurnab Ghose. The students in the team were Pranav S.R., Sayantan Datta, Varsha Jaisimha, Abhinav Masih, Utkarsh A. Mahajan, Shubhankar Londhe, Nishant Baruah, Supratim Das, and Vasudha Aher. They worked on designing a system that can regulate the mutation rate of *E.coli* and thus can be used as a useful tool for directed evolution.

**Inter IISER Sports Meet  
(IISM) 2019**

December 08-15, 2019

Inter IISER Sports Meet (IISM) is a premier multi-sport event of the national institutes dedicated to basic sciences and research. Instituted in 2012, it is held every year in December and has expanded from IISERs to include other national science institutes. IISM has been a symbol of camaraderie and sportsman-spirit and fosters interactions between these reputed institutions of learning.

IISER Pune hosted the eighth edition of IISM this year. The following Institutes participated in Inter IISER Sports Meet (IISM 2019): IISER Berhampur, IISER Bhopal, IISER Kolkata, IISER Mohali, IISER Thiruvananthapuram, IISER Tirupati, NISER Bhubaneswar, Indian Institute of Science (IISc) Bengaluru, Center for Excellence in Basic Sciences (CEBS) Mumbai, and IISER Pune. IISER Bhopal secured the 1<sup>st</sup> position and IISER Pune stood in the 2<sup>nd</sup> position in this sports meet. IISER Pune students bagged 4 gold, 5 silver and

3 bronze medals in the athletics and the championship in Table Tennis Single (Men), Basketball (Men) and Basketball (Women).

**Visit by the Honourable Prime Minister of India**

December 07, 2019

Honourable Prime Minister of India Shri Narendra Modi visited IISER Pune and met with some of the faculty members and students in a brief but highly interactive gathering. IISER Pune Director Prof. Jayant Udgaonkar presented an overview of the institute profile outlining the institute's objectives, achievements, and aspirations. He also spoke about the importance of basic science in paving the way for new discoveries and developments that have a broad impact on the society.



Faculty members made short presentations about their research at the institute, focusing on the significance of the work and the outcomes of the research. The Prime Minister then visited two research facilities on the campus: the supercomputer facility PARAM Brahma that was deployed at the institute this year by C-DAC through the National Supercomputing Mission; and the NMR facility that helps researchers determine molecular structure and enables quantum computing. Through the visit, Prime Minister Shri Modi had extensive discussions on the topics of the presentation and shared his inputs. He was appreciative and supportive of the work being carried out at the institute and he urged researchers to explore ways by which research can help fast-track India's growth.

### ***Inauguration of the Bajaj Auto Hall of Residence for Women***

*January 11, 2020*

The construction of a hostel for women research scholars, made possible through a generous endowment from Bajaj Auto Ltd., was completed during the year.



Dr. Raghunath A. Mashelkar inaugurated the building in the presence of Shri. Rahul Bajaj. In his welcome address, IISER Pune Director Prof. Jayant Udgaonkar thanked Dr. Mashelkar for his foresight and key role in facilitating the association with Bajaj Auto. Dr. Mashelkar said that Bajaj Auto, by building a home away from home, has directly contributed to the cause of education for women. Mr. Rahul Bajaj was felicitated on this occasion. IISER Tirupati Director and former Director of IISER Pune, Prof. K.N. Ganesh, recollected the early meetings and discussions that built this association with Mr. Rahul Bajaj and with Bajaj Auto.

Taking the association further with IISER Pune, Mr. Rahul Bajaj announced supporting three Chair Professorships and one Distinguished Professorship at IISER Pune.

### ***Mimamsa***

*January 18, 2020*

*Mimamsa* is a nation-wide inter-college science competition organised by IISER Pune students annually. It is a two-tiered event, with Prelims and Mains, where teams across India compete under scientific and critical ways of thinking. 'Mimamsa Prelims 2020' were held on January 18, 2020, in 18 cities spanning 21 centres. Over 900 teams registered from all over the country.

*Mimamsa* 2019 received technical and financial support from Praj Industries, through an MoU with Praj in November 2019. This year's edition reached out to four new cities - Goa, Nagpur, Jaipur and Ahmedabad and an additional centre in Hyderabad. About 600 undergraduate students participated at the Prelims event held at the institute. The final round of *Mimamsa* 2020, planned in the latter half of March 2020, could not be held due to the lockdown announced across India as a result of the COVID-19 pandemic.

### ***Inauguration of the Cipla Foundation-IISER Pune Centre***

*January 29, 2020*

Cipla Foundation-IISER Pune Centre for Chemistry Education and Research on the IISER Pune campus was inaugurated by Dr. Yusuf K. Hamied (Non-Executive Chairman, Cipla Ltd.) with the unveiling of the plaque and plantation of a sapling in front of the building. The Centre, housing chemistry research labs along with an in-class demo facility provides space for outreach activities involving teacher and student training and will serve as a platform for developing industry-academia interactions.

Director of IISER Pune Prof. Jayant B. Udgaonkar; Prof. K.N. Ganesh, former Director of IISER Pune, who initiated this effort; and Dr. A.A. Natu who was closely involved with the collaboration with Cipla were present at the occasion. Dr. Y.K. Hamied, Mrs. Farida Hamied and Ms. Rumana Hamied were felicitated during the event.



*On the occasion of the inauguration of the Cipla Foundation-IISER Pune Centre*

***Prodigious Women in Chemical Sciences: Biannual Mentoring Programme***

*November 21, 2019; February 20, 2020*

This event aims to foster women's retention and progression in the field of chemical sciences. Hosted by the Chemistry department and organised by faculty member Dr. Moumita Majumdar, this programme discussed the underrepresentation of women in STEMM, the challenges that women face in academia at various levels, and the plausible measures that could be undertaken to minimise the disproportionate gender representation. The discussion panel had representation from faculty members and students from PhD, Integrated PhD and BS-MS programmes.

Prof. Lakshmi Kantam Mannepalli, former Director, CSIR-IICT, Hyderabad (in the first event in Nov 2019) and Prof. Evamarie Hey-Hawkins, Leipzig University, Germany (in the Feb 2020 event) gave invited talks.

***National Science Day 2020***  
*February 28, 2020*

As part of the 2020 National Science Day celebration, the following events were organised at the institute: The 6<sup>th</sup> Linus Pauling Interschool Science Quiz Competition; a book exhibition; and a public lecture on the *Story of Chemistry* by Dr. Anirban Hazra.

***International Women's Day 2020***  
*March 05, 2020*

Organised by the Internal Committee of IISER Pune, this event included talks by mathematician Dr. A. Mani (Visiting Faculty/Researcher, HBCSE, TIFR) and Aashima Dogra (Founder, Life of Science). The role of conditioning in attitudes towards women and ways to counter the biases were discussed along with policies sharing the struggles and successes of women in science. A dance cover rendition of "Baale: an anthology of womanhood" was performed by IISER Pune BS-MS students and Dance Club members Gowri Niranjana, Keerthana M, and Ritvee Talele.

***Theme-based Events***

The Institute celebrated these events during the year: International Day of Yoga (June 21, 2019); Independence Day (August 15, 2019); Fit India Movement (August 29, 2019); Vigilance Awareness Week (October 28 to November 02, 2019); National Unity Day (Rashtriya Ekta Diwas Pledge, October 31, 2019); Constitution Day (November 26, 2019); Swachhata Pledge (January 16, 2020); and Republic Day (January 26, 2020). These events were coordinated by the Administration section of the Institute.

## External Events hosted at IISER Pune

Two important external events were hosted on the IISER Pune campus during the year:

**Annual Conference of Director Generals of Police / Inspector Generals of Police** (December 06–08, 2020): This meeting was attended by top police officials from across India and was also attended by the Honourable Prime Minister of India Shri Narendra Modi. During his stay, Shri Modi visited the Main Building of the Institute and interacted with the faculty, students, and staff members.

**India Science Festival** (January 11–12, 2020): A 2-day public event on science organised by Aspiring Minds was held on the Institute campus. Scientists from India and abroad gave public talks. The event also included demos and panel discussions on various topics that impact science and connect science with the society.

## Events by / for Student Teams

### Abel Prize Symposium

The Mathematics Club of IISER Pune organised the Abel Prize Symposium shortly after the announcement of the recipient of this prize for 2019. The programme consisted of talks by IISER Pune faculty members on the life and work of three previous winners of this prize.

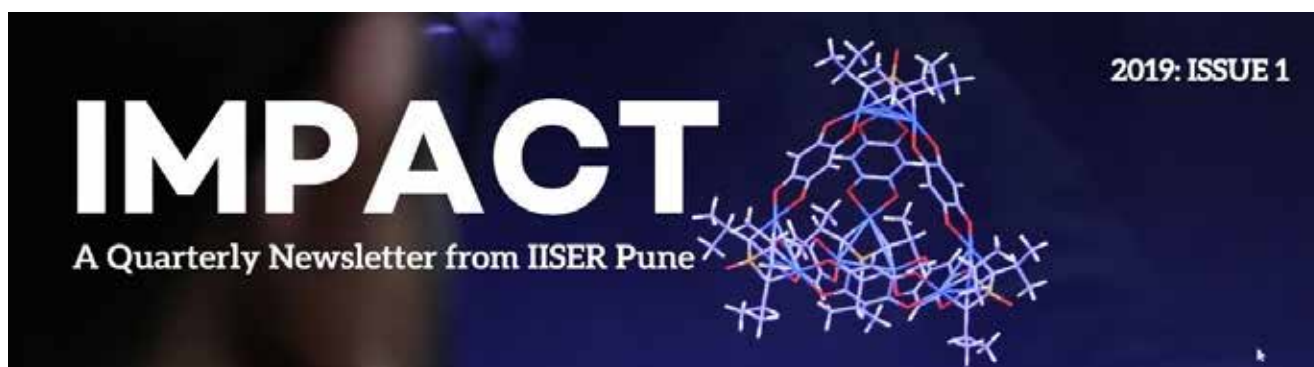
### Nobel Evenings 2019

The Science Club of IISER Pune organised *Nobel Evenings* (February 10-11, 2019), a series of public talks on the discoveries that won the Nobel Prizes this year.

### Curious Minds: Academia-Industry Interaction

The Entrepreneurship and Innovation Cell (EIC) in collaboration with Merck organised this event on July 20, 2019 for students to interact with experts and leaders from different segments of the life science industry and to understand current trends.

Several cultural events were held during the year including the ones held through the SPIC-MACAY IISER Pune chapter, the annual student-led socio cultural festival *Karavaan*, and other student initiatives, enriching the academic and creative ambience of the IISER Pune campus.



During the year, the Research Communications Office, in association with the Partnerships and Outreach Office at the institute, initiated *Impact*, a quarterly e-mail newsletter. *Impact* adds to the institute's news dissemination channels on the website, news blog, and social media pages, and reaches out to our internal and external audiences with news snippets on IISER Pune's activities and achievements.

# INTERNATIONAL RELATIONS

IISER Pune's international partnerships are centered on the institute's research and teaching mandate to foster exchange of ideas across the globe. The institute hosts delegations, builds partnerships, and offers international student and scholar services through its International Relations Office.



## MEMORANDA OF UNDERSTANDING (MoU) AND AGREEMENTS SIGNED DURING 2019–20

Partner Organisation/s	Purpose
<i>Apr 15, 2019</i> MoU with Florence University, Italy	To support academic collaboration including exchange visits and joint research activities
<i>Jun 20, 2019</i> MoU with the University of Turku, Finland	To collaborate on the academic level and promote student and faculty interaction
<i>Jun 28, 2019</i> MoU with University of Manchester, U.K.	For jointly undertaking graphene research and commercialisation of projects for industries with involvement from the Graphene Engineering and Innovation Centre of the University of Manchester
<i>Jul 03, 2019</i> MoU with the University of Notre Dame Du Lac, U.S.A.	To develop collaborations and exchanges in fields of shared interest and expertise between IISER Pune and the University of Notre Dame
<i>Sept 11, 2019</i> MoU with the Friedrich Schiller University Jena, Germany	To extend cooperation and develop academic and cultural exchange in education, research, and other areas
<i>Nov 19, 2019</i> Agreement with King Abdullah University of Science and Technology (KAUST), Saudi Arabia	To implement a Visiting Student Research Program (VSRP) fully funded by KAUST wherein students from IISER Pune carry out research work at KAUST up to 1 year. The programme is targeted for 3 <sup>rd</sup> to 5 <sup>th</sup> -year BS-MS students.

## ACTIVITIES UNDER EXISTING MoUs

### With IBAB, LMSAI, Harvard University, U.S.A.

August 01–14, 2019: IISER Pune in association with The Lakshmi Mittal and Family South Asia Institute, Harvard University and the Institute of Bioinformatics and Applied Biotechnology (IBAB), Bengaluru, has organised “Workshop on Biolmaging: Advanced Light Microscopy” under the aegis of Building Bharat-Boston Biosciences (B4) Young Scientist

Program (Funded by Department of Biotechnology, Govt. of India). The aim of this workshop was to introduce students to advances in contemporary light microscopy through lectures and hands-on training in imaging modalities ranging from basic microscopy to super-resolution imaging.

### **With University of Melbourne, Australia**

Members from the University of Melbourne, Australia, including Dr. Alex Johnson, Associate Dean, International; Prof. Deb King, Director of the BSc; and Mr. Andrew Drinnan visited the institute during the year and discussions were held on strategies for furthering institutional cooperation and on possible research collaborations. Activities related to teacher training workshops in pedagogy and programmes for women in STEM were also discussed.

### **With Sorbonne University, France**

Prof. Abhay Shukla and Dr. Emmanuel Lhuillier from Sorbonne University made a collaborative visit funded by Erasmus+ faculty exchange programme to meet and interact with their collaborators Dr. Surjeet Singh and Dr. Angshuman Nag at IISER Pune.

### **With ENS Network**

September 20, 2019: Delegation led by President, Prof. Pascal Magnol, and Vice President International Relations and Research, Prof. Arnaud Debussche from ENS Rennes visited IISER Pune to discuss the ongoing academic collaboration and identify opportunities to further strengthen the partnership. The schemes like IISER-CNRS joint research programme, GIAN, VAJRA, Erasmus+ were identified to support and initiate research collaboration and bilateral student/staff exchange.

October 17–18, 2019: A delegation of the Deans and faculty representatives from all IISERs visited ENS Lyon to participate in the Indo-French Knowledge Summit at Lyon. The summit was preceded by a network meeting to discuss joint-academic programmes to further strengthen the partnership. It was agreed that ENS Lyon and IISER Pune will lead the submission of application for a joint-symposium in the area of teacher training and pedagogy to CEFIPRA.

December 19, 2019: Prof. Rachid Bennacer, Dean of Doctoral Programme from ENS Paris-Saclay visited to discuss strategies on further strengthening the partnership between ENS Paris-Saclay and IISER Pune via student exchanges, joint-degree programmes, and research collaboration.

### **With University of Glasgow, U.K.**

Dr. Naresh Sharma and Dr. Neeraja Dashaputre visited the University of Glasgow to participate in a Training workshop in the area of Internationalization of Higher Education from April 01–05, 2019.

May 10, 2019: Visit by Prof. Cushley to discuss the student and faculty exchanges funded by Erasmus+ project and other joint-academic activities.

July 26–31, 2019: IISER Pune delegation of 4 faculty members headed by the Dean of International Relations and Outreach, Dr. Harinath Chakrapani and Chair Chemistry, Prof. H.N. Gopi, visited the University of Glasgow to participate in the bilateral Chemical Biology symposium. This visit and symposium were part of the Erasmus+ funded staff exchange programme.

July 24–31, 2019: Fiona Stubbs, Careers Manager and Celine Reynaud, International Experiences Manager, University of Glasgow visited IISER Pune as part of Erasmus+ funded staff exchange programme to share and discuss various aspects including student exchange management and academic exchange opportunities.

January 06–11, 2020: Prof. Richard Hartley visited IISER Pune to interact with faculty members in the Biology and Chemistry departments. He presented a research seminar.

January 10, 2020: Glasgow-IISER Meet was held to discuss the upcoming funding opportunities such as UKIERI, Erasmus+ to develop partnership related to pedagogy.

### **With CNRS**

Twenty-two applications were received in response to the call for joint-applications towards IISER-CNRS joint research programme made in March 2019. The joint committee funded two proposals, one from Dr. Chaitanya Athale and Dr. Marie Delattre, second from Dr. Sreejith G.J. and Dr. Fabien Alet. The start date of the grants is October 01, 2019.

### **With University of Göttingen, Germany**

October 16, 2019: Netra Bhandari, Director India Office/ Regional Coordinator (South-, Southeast-, Central Asia & Middle East), Goettingen International (GI), Goettingen University visited to discuss joint programmes under the DAAD funded NAMASTE+ project. The discussions also included joint-programmes for teacher training, pedagogy, joint-workshops in specific research areas of Humanities, Chemical ecology.

November 20, 2019: A public lecture by Prof. Stefan Tetzlaff from Göttingen University titled 'Local prerogatives and foreign assistance: Technical training for workers and Indian industry between WWII and the present' was held.

March 01, 2020: Submitted "IGNITES: Indo-German Network for Enhancing Teaching, Education and Research in Science" proposal for Indo-German Partnerships in Higher Education 2020-24.

## VISITS BY INTERNATIONAL DELEGATIONS / REPRESENTATIVES

Academicians, policymakers, and delegations of administrators and other professionals from foreign universities, research organisations, high commissions, consulates, and embassies visited IISER Pune to explore and discuss research collaborations and academic programmes. These comprised 36 such visits (number of visits shown in parenthesis) from 11 countries: Australia (07); Bangladesh (01); Canada (01); Finland (03); France (03); Germany (01); Japan (02); Saudi Arabia (01); Uganda (01); U.K. (09); and U.S.A. (07).

## OTHER ACTIVITIES

May 13–16, 2019: IISER Pune delegation of 6 faculty members and 6 students headed by the Dean of Research and Development, Prof. Sanjeev Galande, visited the Weizmann Institute of Science (WIS), Israel to participate in the bilateral symposium in the area of chemical biology and materials science.

June 20, 2019: IISER Pune hosted an open innovation workshop for Swiss business CxOs (Pune-based) titled “Developing innovation strategies for organizational transformation”. This half-day workshop was conducted by Swissnex and the target audience were startups and business CxOs.

December 10, 2019: A consultation meeting “Enhancing employability of graduate students” was organised by IISER Pune along with British Council and Royal Society Chemistry. This meeting was a part of a larger multi-stakeholder project titled “India Innovation Science Research Competency Enhancement Programme” of the British Council.

January 11–12, 2020: IISER Pune hosted the India Science Festival 2020 organised by Aspiring Minds in association with academic partner, Lakshmi Mittal and Family South Asia Institute at Harvard University. The two-day programme included experiments, discussions and public talks from various scientists in the areas such as artificial intelligence (AI) and neuroscience, astronomy, life sciences and others. About 13,000 students, parents, professionals attended the event over two days.

## OUTGOING STUDENTS

A total of 103 students (BS-MS, Integrated PhD and PhD) from the Institute have undertaken summer internships / 5<sup>th</sup> year projects / collaborative research at various foreign institutes/ universities.

Some of the universities/organisations where the students have taken up these activities include CERN (4); ENS Network, France (6); Glasgow University, U.K. (7); University of Göttingen, Germany (2); Leipzig University, Germany (4); Michigan University, Ann Arbor, U.S.A. (7); Australia National University (7); Sorbonne University, France (5); KAUST, Saudi Arabia (1); and Max Planck Institutes, Germany (5).

## INCOMING STUDENTS

A total of 17 students from abroad have visited IISER Pune as part of exchange programmes or collaborative visits to carry out short-term research projects.

Some of the parent institutions/universities of the incoming students include Sorbonne University, France (1); University of Göttingen, Germany (4); Michigan University, Ann Arbor, U.S.A. (1); and Leipzig University, Germany (3).

# INDUSTRY PARTNERSHIPS AND ENDOWMENTS

In the 2019-20 financial year, IISER Pune continued its association with several of our long-time partners and forged new bonds with many more. Two major endowment projects, namely, the 'Bajaj Auto Ltd. Hall for Residence for Women' and the 'Cipla Foundation-IISER Pune Centre for Chemistry Education and Research' have been successfully completed and inaugurated. The other endowments progressed well and we have also received new endowments which will be executed in 2020-21.

## INDUSTRY – ACADEMIA COLLABORATION

Exploratory meetings for joint research collaboration were conducted with experts from Kirloskar Pneumatic Company Ltd., Cipla Ltd., Sudarshan Chemicals Ltd., and BASF.

IISER Pune had signed 17 agreements during FY 2019-20 with both national and international industries. The non-disclosure agreements with UPL Limited, Livguard Energy Technologies, Genova Biopharmaceuticals Limited, Datar Cancer Genetics Limited, and Cipla Limited are aimed at exploring common interest in both education and research and development in cutting edge areas of science. New joint research agreements have been made with Sanghar Exports and Livguard Energy Technologies for collaborative research in energy. The agreements with Pilkington Technologies Management Limited, England; KPIT Technologies Limited; Dentsply Sirona Implants, Sweden; Ajeet Seeds; and Zumator Biologics Inc. received an extended term of partnership.

The second annual IISER Pune-KPIT Shodh Awards and Energy & Mobility PhD Conference was held at IISER Pune campus on January 30 and 31, 2020. The conference saw participation from IITs, IISERs, and CSIR-NCL

Manav Human Atlas project, a collaboration between IISER Pune, Persistent Systems, and the National Centre for Cell Science, was launched on May 10, 2019, by the Department of

Biotechnology (DBT) Secretary Dr. Renu Swarup. Funded by the DBT, this project aims to construct a comprehensive map of the entire human body which will explicitly document macro to micro level information.

## ENDOWMENTS

### Ongoing Endowments

The Bajaj Auto Hall of Residence for Women was inaugurated on January 11, 2020. Dr. Raghunath A. Mashelkar was the Chief Guest of the ceremony and Shri Rahul Bajaj was the Guest of Honour.

In 2017, Bajaj Auto Ltd. had pledged Rs. 50 crores as an endowment to IISER Pune for the construction of the Bajaj Auto Hall of Residence for Women. With the completion of this project, the Institute can now accommodate up to 2,000 students on the campus; of this, the Bajaj Auto Hall of Residence provides for an occupancy of 756.

The Cipla Foundation-IISER Pune Centre for Chemistry Education and Research was inaugurated on January 29, 2020, by Dr. Yusuf K. Hamied, Non-Executive Chairman, Cipla Ltd. The occasion was also graced by Ms. Farida Hamied, Ms. Rumana Hamied along with senior officials from Cipla Ltd. and Cipla Foundation. The Centre includes in-class demonstration

*Bajaj Auto Hall of Residence for Women*



*The Cipla Foundation-IISER Pune Centre for Chemistry Education and Research*



facilities, 4 laboratories in line with international standards as well as a range of chemistry outreach activities at a single location. The Centre offers opportunities for teacher and student training and serves as a platform for developing industry-academia interactions.

Through the Infosys Foundation Endowment Fund, tuition fee waiver has been extended to 24 BS-MS and Integrated PhD students and travel grants were awarded to 47 PhD and Integrated PhD students.

Integrated Decisions and Systems (India) Private Limited (IDeaS), endowed Rs. 5 Lakhs in January 2019, for the tuition fee waivers for a single semester during the academic year of 2019-20. Nine BS-MS students, 6 integrated PhD students, and 3 outstanding PhD students received scholarships with a full waiver of tuition fees for the August 2019 semester.

The Precision Wires grant instituted in 2016-2017 has enabled IISER Pune students and faculty to participate in conferences and interactive workshops both nationally and internationally. Such participation has given wider visibility to research done in India and also provided advanced training to students to render them internationally competitive in the field.

IISER Pune-Xytel Best Thesis Award: In 2019, a total of 10 students were declared as winners of the awards by the relevant Thesis Evaluation Committees. The students received the award during the 8<sup>th</sup> Convocation, held on June 01, 2019, at which Shri. S. 'Kris' Gopalakrishnan, Co-founder, Infosys and Chairman, Axilor Ventures was the Chief Guest.

In January 2019, Eppendorf India Ltd. declared support for a period of three years to hold a Molecular Biology training outreach programme for school and undergraduate students. During the reporting period, the project team conducted 15 school workshops and 12 college workshops. A total of 243 students have been trained in these workshops of which 100 were outstation participants.

Prof. Michael Dickinson, Division of Bioengineering and Aeronautics, Caltech, delivered the second Prof. K.S. Krishnan Memorial Lecture in Neuroscience on June 08, 2019. In his lecture entitled 'Straighten up and fly right: Insect flight control from neurons to ecosystems' Prof. Dickinson discussed the hierarchy of neural mechanisms that enable flies to maintain a stable course in the face of external and internal perturbations. Prof. K.S. Krishnan Memorial Lecture was instituted by Prof. Krishnan's students, friends, and well-wishers.

In 2018, ONGC Ltd. gave a one-time grant for the implementation of 'Biodiversity Conservation and Livelihoods

through Local Community Ecotourism in Eaglenest Wildlife Sanctuary, Arunachal Pradesh'. The grant helped to train a team of 7 youth, including 2 women, in creating a checklist of over a thousand species of moths from the area. In particular, the team developed a strategy for non-lethal sampling of tens of thousands of moths for research purposes and an ecotourism database – hitherto all moth sampling strategies require the collection of specimen.

## New Endowments in 2019–20

Corpus for three Chair Professorships and one Distinguished Professorship: On the occasion of the inaugural function of Bajaj Auto Hall of Residence on January 11, 2020, Mr. Rahul Bajaj announced that Bajaj Auto would support the founding of three Chair Professorships and one Distinguished Professorship at IISER Pune through a corpus of Rs. 4 crores. These awards will be instituted from 2021.

Praj Industries declared its support for *Mimamsa*, India's leading national level inter-collegiate science quiz, for a period of three years starting from *Mimamsa* 2020 with a base donation of Rs. 10 lakhs, with a 15% escalation every year. The preliminary round of *Mimamsa* 2020 was successfully held at 21 centres across the country on January 18, 2020. Due to the COVID-19 pandemic, the final round of *Mimamsa* 2020 has unfortunately been postponed.







ZF Steering Gear (I) Ltd. provided a one-time donation of Rs. 1.14 Crores for an R&D project titled "Development of life-saving drugs of carbohydrates and peptides origin" to be implemented by Prof. H.N. Gopi and Prof. Srinivas Hotha from the Chemistry Department.

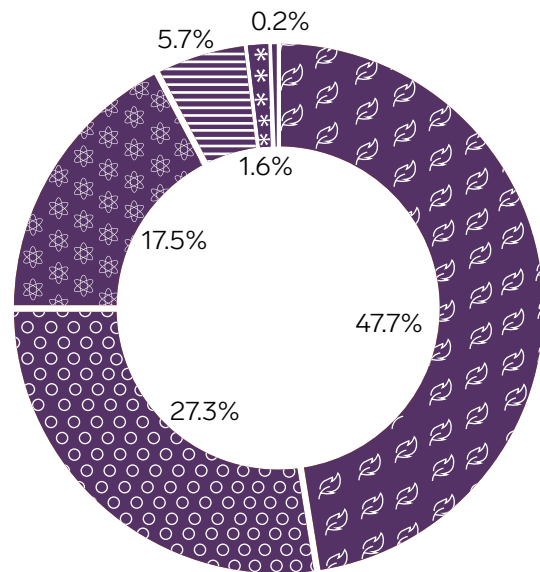
Innoplexus Consulting Services Pvt. Ltd. announced one-time financial support to IISER Pune in the form of a grant of Rs. 5.37 lakhs for the IISER Pune-Innoplexus Travel Award. The award will be given to students during the academic year 2020-21 for furthering their research activities.

Delta Faucet Co. India Pvt. Ltd. and Scivic Engineering I. Pvt. Ltd. contributed Rs. 5 Lakhs and Rs. 4.5 Lakhs respectively to support IISER Pune students at the upcoming 2020 edition of International Genetically Engineered Machine (iGEM) Competition hosted at the Massachusetts Institute of Technology (MIT) Boston, U.S.A.

Prof. A.A. Natu and Smt. Urmila Natu endowed the 'Prof. C.R. Narayanan Award' through a donation of Rs. 2 lakhs. The award is for a researcher having published in the highest-impact journal during the last four years.

**SUMMARY OF PURPOSES OF ENDOWMENTS RECEIVED TILL MARCH 2020**

-  Infrastructure Support
-  Student Development and Recognition
-  Faculty Development and Recognition
-  Research Support
-  Outreach Activities
-  Other



# OUTREACH ACTIVITIES

The overall goals of educational and social outreach activities at IISER Pune include improving teaching methods, particularly in science; informing the public about career and research opportunities in science; and spreading awareness about the impact of science on the society.

## *Visits from schools and colleges*

The institute welcomes visiting groups from schools, junior and senior colleges, and universities from across India, as one of its outreach initiatives. Visitors are provided information about IISER Pune's academic and research activities and are shown around lectures halls, teaching and research labs, specialised instrumentation facilities, and library on the campus. The visits are customised to suit the background and age-group of the students. Some college groups are also given an opportunity to interact with IISER Pune faculty members from the relevant area. School groups also spend some time at the Science Activity Centre.

During 2019-20, over 2,858 visitors from 54 institutes from different parts of the country visited IISER Pune. Of these, 2,635 visitors were from Maharashtra. The rest were from other states such as Gujarat, Goa, Karnataka, Odisha, and Kerala. Among the visitors 1,324 were school students accompanied by 129 teachers and 1,314 were college students accompanied by 90 teachers.

## *Science Media Centre (SMC)*

The SMC at IISER Pune works in four different areas: training in science and scientific communication; production of online content for higher education; research communication for laypersons; and institutional promotional materials and event documentation.

In the year 2019-20, the SMC conducted ten workshops, of which nine were funded by the National Council for Science & Technology Communication (NCSTC), Department of Science and Technology (DST) and one was funded by Vigyan Prasar. These workshops aimed to train participants in science communication, science writing, science writing in regional languages, science in theatre, and science illustration. During two such video production workshops, the SMC produced nine videos showcasing the research at IISER Pune. A magazine 'Scintillate' was produced as part of the workshop WoW Science '19 (Workshop on Writing Science-2019). As part of internships offered to train students in science communication, five students carried out internships with the SMC and created two research videos and one informational video at the SMC.

During the year, the SMC has recorded and produced four National Programme on Technology Enhanced Learning (NPTEL) courses and one course as part of the ARPIT 2019, the NRC on Climate Change at IISER Pune which was presented by Dr. Rahul Chopra.

In a new video series 'SciTalk@SMC' that interviews distinguished scientists from IISER Pune and visitors from elsewhere, the SMC produced fourteen videos in 2019-20. The SMC has recorded and made available 13 institute colloquia on its YouTube channel. In August 2019, the SMC organised an event to screen the documentary "Sir

**Centre of Excellence in  
Science and Mathematics  
Education (COESME)**

Fred Hoyle; The Man Ahead of Time” produced at SMC. The SMC has collaborated with the ‘Science Monitor’ programme telecasted by the Rajyasabha TV to promote research from IISER Pune.

The SMC offers assistance in creating promotional content for the institute as well as for the faculty members including in creating cover art, graphical abstracts, and animations for the research publications published by the research groups at IISER Pune. The SMC has provided videography and photography services in several scientific and non-scientific events at IISER Pune.

Films/Videos made at the SMC have been widely appreciated. In the International Science Film Festival of India (ISFFI) 2019 held at the Satyajit Ray Film & Television Institute in Kolkata, three films/videos by the SMC were nominated for competition in different categories. Three films/videos received nominations at the National Science Film Festival (NSFF) 2020, which was to be held from 18/03/2020 at Agartala, Tripura.

CoESME has been functioning at IISER Pune under the MHRD’s Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNTT) scheme since October 2015. The Centre aims to strengthen science education in India by engaging school and undergraduate level science and mathematics teachers. The focus is on pedagogy for inquiry, hands-on and concept-based learning. Independently and in partnership with other agencies, CoESME has worked on the following aspects of educational outreach in 2019-20:

**1) Teaching/learning of scientific concepts:**

- A. School Teachers: A preparatory workshop and the subsequent state-level teachers’ science congress, where teachers presented their pedagogical innovations, were conducted during the year. In collaboration with an associate from Northwestern University, U.S.A., a workshop was conducted on the use of computational thinking to inculcate scientific inquiry (CT-SI) among students. Selected teachers from this workshop participated in an advanced phase where they co-designed CT-SI modules for their own classes along with resource persons. Together, these events saw participation from 171 school teachers.
  
- B. College Teachers: Thirteen training activities were conducted at 10 different locations for 557 college teachers from all over India. Majority of these were part of an on-going series of workshops on Research-based Pedagogical Tools (RBPTs) that help students learn the process of science and not just facts. The activities in this series (initiated through a collaboration with British Council and DBT/DST, Govt. of India) are held at various levels – national workshops, training-of-trainers workshops for selected candidates, and regional workshops where previously trained teachers are resource persons. This year, nine regional RBPT workshops were conducted for about 50 teachers each. CoESME also conducted subject-specific workshops for teachers on diverse and inter-disciplinary areas like Machine Learning for Lifescience Applications, Inter-relations between Physics and Mathematics, Women in Science Education, etc.

In addition, two rounds of 3.5 week long Faculty Induction Programmes (FIP)

for newly recruited college teachers were conducted to orient participants on various aspects of teaching-learning. Through its National Resource Centre (NRC) on climate change education, CoESME has produced and run a second round of ARPIT refresher course for teachers this year, through the MHRD's SAWAYAM platform.

**2) Creation of Educational Resources:** CoESME and its Science Activity Centre created and documented ~105 new hands-on science toys and models using easily available material. These can be used by teachers to teach complex scientific concepts in a fun and active way. About 185 short videos demonstrating the use of such toys have also been created in the past year.

**3) Enthusing and motivating school students:** A DST-INSPIRE science camp was conducted to introduce 167 school students to the joys of science through hands-on sessions, talks, and interactions.

**4) Smt. Indrani Balan Science Activity Centre (SAC):** Established under the broad aegis of CoESME, the SAC develops innovative science toys with easily available material, to give students a hands-on flavour of the subject. Between April 2019 to March 2020, more than 22,000 people including students, teachers and other visitors, visited the Centre. Two major public events were held – Children's Day where more than 13,000 people visited and Jigyasa Science Exhibition attended by more than 2,200 visitors people visited the Centre. Under the project sponsored by Tata Technologies, 200 teachers were trained in STEM pedagogy in the Level I of the project till November 2019. Fifty selected teachers from these 200 teachers are undergoing Level II of the workshops to use activity-based teaching tools, and develop resources with the SAC team, which will be widely used by the school teachers.



### ***Cipla Foundation-IISER Pune Centre for Chemistry Education and Research***

The Cipla Foundation-IISER Pune Centre for Chemistry Education and Research, set up during the year and inaugurated on January 29, 2020, works to promote experimental learning in the chemical sciences. Since its inception, the Centre has hosted various programmes for students and teachers. Programmes mainly focus on capacity building for chemistry teachers, hands-on chemistry workshops for students, and science popularisation. Notable mentions are RSC-Salters Institute Hands-on Chemistry Camp, the Yusuf Hameid Inspirational Science Programme, and the National Programme on Technology Enhanced Learning-laboratory workshop. Through these activities, more than 100 teachers and 500 students have visited the Centre.

### ***Exciting Science Group (ESG)***

A joint venture of IISER Pune and CSIR-National Chemical Laboratory (NCL), the ESG aims to connect scientists from the two research institutions with high school

students and teachers to convey the excitement of science and technology. Initiated in 2008, ESG (earlier based at the NCL Innovation Park) moved to IISER Pune in 2017. During the year 2019-20, the Exciting Science Group has conducted weekly public lectures with school children as the target audience. A list of these lectures is included at the end of this chapter.

## Social Outreach

Social outreach activities are conducted by voluntary organisations at the institute run primarily by the IISER Pune student community in association with faculty coordinators and volunteers.



**Disha** is a student run social outreach organisation at IISER Pune, now in its 10<sup>th</sup> year of being set up. It is a platform for IISER Pune students to work towards the goal of socioeconomic equity. *Disha* works for making education accessible for children from the underprivileged and marginalised communities from nearby localities. Here are the programmes run by *Disha*:

**Abhyasika:** Volunteers teach mathematics and language to students Lamanvasti, a nearby *vasti* (locality). Around 30 students from standard I – VIII attend these 90 min classes held on weekday evenings at the *vasti*'s community centre. Some of the children attending these classes with a keen interest in studies have been inducted into *Pradnya*, a new programme *Disha* initiated this year.

**Mindspark:** The goal of this programme is to equip students of standard VII and VIII with basic skills in language, communication, logic and mathematics which will help them with competitive exams and give them more opportunities in the future. Volunteers hold classes every Saturday and Sunday and around 30 students from nearby municipal schools attend the programme regularly. A monsoon camp was also held this year to select the kids for the coming year.

**Science Nurture Programme (SNP):** This programme aims to popularise science and increase scientific temper among students in municipal schools (from class 8 and 9) by explaining scientific concepts through fun activities and exciting demonstrations. It is funded by the MHRD initiative Rashtriya Avishkar Abhiyan. Around 30 students attend this programme every Sunday from nearby municipal schools.

**Prerana:** The aim of this programme is to help prepare students from 11<sup>th</sup> and 12<sup>th</sup> standard who cannot afford expensive coaching for their competitive examinations. This year there were 6 students who regularly attended the classes.

**Spread the Smile:** This is an annual programme *Disha* conducts in which volunteers visit nearby villages and demonstrate fun scientific experiments, hold interesting activities like sextant making and sky-watching, and hold career guidance sessions for the village students. In January 2020, over a period of three weekends, around 140 students from IISER and other colleges in Pune visited the villages: Bhavadi, Gangapur, Gohe, Gulani, Nimgaon, Pimpalgaon, Wafgaon in groups of 8 to 10 to carry out these sessions. Around 450 students from all schools attended the sessions.

**MMF Camp:** Three members of *Disha* conducted a 5-day camp for school students from Ratnagiri district (180 km from Pune) in collaboration with Mukul Madhav Foundation (MMF), an NGO of Pune funded by the Finolex Group. While the health-checkups were being done, the students conducted various activities for students of all age-groups in the following villages: Bhoke, Ganpatipule, Medhe, Pavas, Umre. *Disha* reached out to ~1000 students through this camp.

**Talk for Twenty:** This is a platform for students from IISER Pune and speakers from outside to speak about the issues that they are passionate about and attempt to educate others about the issue. In the academic year 2019-20, there were discussions on topics 'Why do social work?' and 'A direction for social work' by Mr. Amrut Bang.

In addition to running various programmes, *Disha* volunteers work in teams to organise and maintain resources, to translate content required in their programmes, and put together *Pahal*, the annual magazine of *Disha*.

*Prutha*, a green initiative by IISER Pune students, works to create awareness about issues related to the environment and to promote a clean campus.

Organised around the Earth Hour theme in April 2019, in addition to observing an hour of lights-off on the campus, *Prutha* arranged for a film screening in collaboration with Kaleidoscope and a guest talk. Vastrasamman, the annual clothes collection drive by *Prutha*, conducted along with a book collection drive in April-May 2019, received an overwhelming response. The collected clothes were donated to Goodwill India. *Prutha* conducted an E-waste collection drive in May 2019, and handed over the collected waste for suitable disposal to Poonam Ecovision Foundation, a Pune-based NGO.

During the summer of 2019 and the following semester, *Prutha* interfaced between the institute's Landscape Committee and the student community and coordinated efforts to involve students in tree plantations on the campus. *Prutha* also organised several nature walks, including those to Parvati Hills; Baner Hill in Pune; and Panchavati Hills for the freshers batch of 2019. Bird-watching sessions led by students were conducted in Panchavati Hills, in which students with a diverse range of experiences joined, shared their knowledge, and enjoyed.

In early 2020, *Prutha* collaborated with PadCare Labs to set up a pilot project of installing eco-friendly sanitary waste disposal machines in the girls' hostel. These have received a positive response, and *Prutha* is keen to carry this initiative forward.

Through innovative cartoons designed by students and displayed on the CCTV screens in campus, *Prutha* reaches out to the campus members to create awareness on the practice of eco-friendly measures. *Prutha* has installed boards in dining areas to record and display the daily wastage of food, as a way to encourage diners to avoid wastage of food.

With Manish Jain (Creative Learning Initiative, IIT Gandhinagar) as the resource person, Smt. Indrani Balan Science Activity Centre organised a workshop in October 2019 to raise this 15-foot giant geodesic dome with bamboo sticks, now installed at the Lecture Hall Complex building on campus.



# 04

## Support Structure

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# SUPPORT STRUCTURE AND FACILITIES

IISER Pune has set up institutional policies and procedures to facilitate smooth functioning of the institute and to coordinate activities on the campus. Matters related to general administration, finance, human resource management, IT requirements, procurement of equipment and consumables, civil, electrical and other engineering infrastructure are all handled by qualified staff members in consultations with institutional committees.

The institutional committees are comprised of teaching and non-teaching staff members with a dual purpose: to oversee all support systems and to develop and implement plans to support future needs of the institute.

The **Administration** section takes care of recruitment to regular positions and of personnel under various research projects; maintains personal records, service books, and Annual Performance Appraisal Reports; and facilitates security, housekeeping, and transport services.

The **Finance and Accounts** section handles preparation of budget estimates, monitoring of expenses under various account heads, internal audit of payments and disbursements, preparation of the Annual Accounts, and interaction with the audit team of CAG (Comptroller and Auditor General of India).

The **Purchase** section of the institute looks after the regular procurement and issuance of material required for the entire institute and finalises the rate contract, maintenance, and service related tenders. The procurement process is managed through the Central Public Procurement Portal (CPPP) and Government eMarket (GeM). To streamline and expedite the purchase process, an open order system has been introduced for frequently required materials.

The offices of the Dean Graduate Studies and Dean Doctoral Studies constitute the **Academic** section that handles all aspects pertaining to the student admission process, timetable and classroom requirements, conducting of exams, and maintaining of student records.

The campus is connected through a dedicated leased line of 1 Gbps National Knowledge Network and a 155 Mbps line for uninterrupted internet access. The institute has a centrally controlled indoor and outdoor dual band campus wide Wi-Fi access network along

with IT security perimeter protection. The **Information Technology (IT)** section manages setting up and operations of these facilities along with hosting infrastructure services such as email, website, DNS, Eduroam, Institute Information Management System, computer laboratory, virtual reality laboratory, dining management system, biometric attendance system, and admissions software. The IT team provides support for high performance clusters across the research groups at the institute. The team also manages institute machines and a local area network, voice over internet phones (VoIP), VPN, and audio-video equipment during on-campus events, and offers support in the running of campus facilities such as the auditorium and e-classrooms.



During the year, the IT section helped set-up the PARAM Brahma supercomputer at the Institute. Deployed by C-DAC at IISER Pune under the National Supercomputer Mission build approach, PARAM Brahma is a state-of-the-art supercomputing system with a peak computing power of 797 Teraflops. This will allow scientists to enhance the spatial and temporal scales at which research problems can be studied.

The IISER Pune campus has world-class infrastructure for teaching, research, and housing and recreational facilities for students and employees. The physical infrastructure consists of Main Laboratory Building, Lecture Hall Complex, Animal House Facility, Guest House-cum-Convention Centre, students' hostels with central dining facility and on-campus housing for employees. Further common amenities include outdoor sports facilities and an indoor sports complex. The **Engineering** section handles all construction activities on the campus along with maintenance and upkeep.

The Maharashtra State Police conducted this year's Annual Conference of DGsP/IGsP at IISER Pune during December 06-08, 2019. The conference was presided by Hon'ble Prime Minister Shri Narendra Modi, Hon'ble Union Home Minister Shri Amit Shah, National Security Advisor Shri Ajit Doval, Director of Intelligence Bureau and DGsPs of all states of the nation. The various facilities at the campus were appreciated by the Director of Intelligence Bureau Shri Arvind Kumar vide DO letter no. DIB/Desb/2019-614 dated December 09, 2019 and DGsP of Maharashtra Police Shri S.K. Jaiswal during the conference.



Facilities such as conference hall, delegates sojourn, banquet area and yoga hall were made available at the institute campus. Efforts of the Engineering section were appreciated towards outstanding team work in achieving assigned goals associated with Hon'ble PM's visit. Prime achievements were converting the dining hall to a 181-seater capacity conference hall with high-quality acoustics (approved by ARAI); stay

arrangement of delegates by renovation of the guest house rooms to VVIP suits (112 Nos); PM suit, UHM and delegates suits; painting of the campus building; water management; and ensuring uninterrupted power supply air conditioning and campus lighting. All dignitaries, senior officials, delegates and observers appreciated with the overall arrangements at the venue.

Working at the interface of research and administration, the **Research Administration and Development Integration Office (RADIO)** is envisaged to further the research progress of IISER Pune through support in the following areas: garnering research funding; forging national and international partnerships; bringing in endowments; engagement through research communications via print and online media including annual report, institute website and social media portals; and actively engaging with various stakeholders in government and private bodies, alumni, and members of the public.

Supporting the teaching, learning, and research programmes on campus is the **Srinivasa Ramanujan Library**. With over 26000 print books, 4000 e-journals, and over 6000 e-books, the library facilitates access to electronic, print and multimedia resources and provides essential and specialised online information services. Several online resources and 1604 print books have been added to the library collection during 2019–20. A large part of the journals and online resources' subscription is through e-ShodhSindhu - a national consortium for higher education e-resources formed by the Ministry of Human Resource Development (MHRD), Govt. of India and 'IISER Library Consortium'. Library operations are completely automated and the circulation kiosk is integrated with RFID technology and biometric user authentication system.

The Library provides online access to different research tools and also provides research support services such as Plagiarism Checking Service, Remote Access Portal for e-Resources, Current Awareness Service, Document Delivery Service, Inter Library Loan, conducting Author Workshops, Orientation, Training and Digital Literacy Programmes. Digital Repository (DR) has been set up to preserve and provide instant access to scholarly output of IISER Pune faculty, students, staff and others associated with the institute. It serves as a platform to the IISER Pune community to share their research work with wider community. Metadata records of the repository are also integrated with National Digital Library of India.



The Library has organised an author workshop by the editorial team of Institute of Physics (IOP) Publishing on September 03, 2019. The objective of the workshop was to educate research scholars on writing a scientific paper, choosing a journal, peer review process, publication and promotion of research. Over 100 research scholars have actively participated in the workshop. Library has also organised book exhibitions on the eve of Hindi Day and National Science Day.

**Living on campus:** Along with on-campus accommodation for students and employees, the IISER Pune campus houses a wellness clinic with a 24x7 ambulance service, a daycare facility, dining hall, gym, and indoor and outdoor sports facilities including basketball court and football and cricket fields. The campus is green with increasing tree cover each year. Student clubs such as *Disha*, *Prutha*, and *SPICMACAY@IISER* offer volunteering opportunities for engaging with the community within and beyond the campus through educational, cultural, and environment awareness programmes.

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The infrastructure and facilities on the campus cater to a total of 146 faculty members (124 regular faculty members + 22 faculty fellows, independent scientists, and visiting faculty); 131 non-teaching staff members; 63 postdoctoral fellows; 1511 students (342 PhD, 196 Integrated PhD, and 973 BS-MS); and 145 research and management staff recruited through extramural projects. The numbers are as of March 31, 2020.

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# 05

## Accounts at a Glance

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124 / Balance Sheet

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125 / Income and Expenditure Statement

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# ACCOUNTS AT A GLANCE

The Annual Accounts of the Institute were approved by the Finance Committee and the Board of Governors during its meeting held on May 29, 2020. The annual audit for the Financial Year 2019–20 was carried out during May 31–June 07, 2020. The balance sheet and the income and expenditure statement for the Financial Year 2019–20 are given in the following pages.

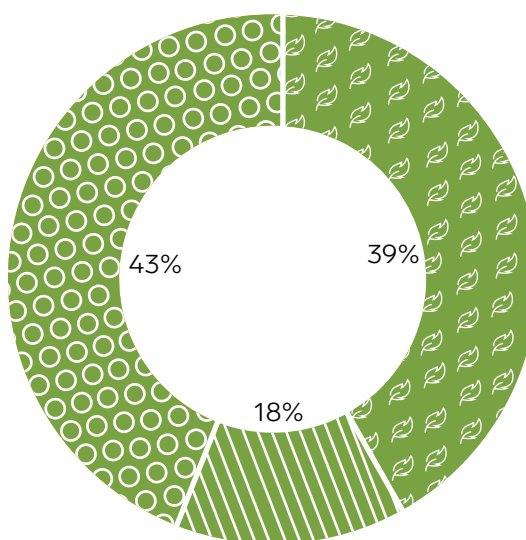
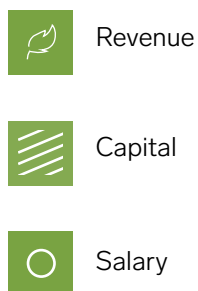
## FUNDS RECEIVED FROM MHRD

During the Financial Year 2019–20, IISER Pune received an amount of Rs. 137.98 crores from the MHRD under the budget heads revenue, capital, and salary. The break-up across the three budget heads is as below.

Revenue Rs. 53.50 crores

Capital Rs. 25.30 crores

Salary Rs. 59.18 crores



## CORPUS

The cumulative corpus fund as on March 31, 2020 from the Internal Revenue generated is Rs. 61.89 crores. The Institute generated an amount of Rs. 14.82 crores during the Financial Year 2019–20 from internal receipts.

## EXTRAMURAL GRANTS

A number of research projects receive support from extramural grants through individual competitive research grants that faculty members have secured. During the Financial Year 2019–20, a total of Rs. 41.49 crores have been received by the Institute via extramural grants. New grants initiated during the Financial Year 2019–20 are listed in the *Appendix* section of this report.

## ENDOWMENTS

Some of the activities at IISER Pune are supported through endowments from corporate organisations including the Balan Group, Bajaj Auto Ltd., Precision Wires Ltd., Cipla Foundation, Infosys Foundation, Xytel India, Forbes Marshall Foundation, K.N. Krishnan Lecture Endowment, IDeaS, ONGC, Persistent Foundation, Eppendorf, Siemens, Praj, Innoplexus Consulting Services, Delta Faucet Co, Scivic Engineering I.P. Ltd., and ZF Steering Gear. The Institute has received an amount of Rs. 75.18 crores via endowments up to March 31, 2020.

## BALANCE SHEET

as on March 31, 2020

Amount in ₹

Sources of Funds	Schedule	Current Year 2019-20	Previous Year 2018-19
Corpus/Capital Fund	1	681,60,15,159	629,46,63,458
Designated/ Earmarked/Endowment Funds	2	16,45,29,184	14,64,60,231
Current Liabilities and Provisions	3	88,00,22,010	93,44,42,301
<b>Total</b>		<b>786,05,66,353</b>	<b>737,55,65,989</b>

Application of Funds	Schedule	Current Year 2019-20	Previous Year 2018-19
<b>Fixed Assets</b>	4		
Tangible Assets		604,10,38,059	559,38,72,936
Intangible Assets		4,94,55,401	4,30,27,552
Capital Works-In-Progress		10,65,75,958	16,19,89,076
<b>Investments From Earmarked / Endowment Funds</b>	5		
Long Term		-	-
Short Term		15,35,22,078	17,62,18,571
<b>Investments - Others</b>	6	116,22,12,698	93,19,10,094
<b>Current Assets</b>	7	15,41,45,736	17,85,32,480
<b>Loans, Advances and Deposits</b>	8	19,36,16,420	29,00,15,278
<b>Total</b>		<b>786,05,66,353</b>	<b>737,55,65,989</b>

<b>Significant Accounting Policies</b>	23
<b>Contingent Liabilities and Notes to Accounts</b>	24

For and on behalf of IISER Pune

sd/-  
CA. Vasundhara Laad  
Jt. Registrar (F & A)

sd/-  
Col. G. Raja Sekhar (Retd.)  
Registrar

sd/-  
Prof. Jayant B. Udgaonkar  
Director

Place: Pune | Date: May 15, 2020

# INCOME AND EXPENDITURE STATEMENT

For the year ended March 31, 2020

Amount in ₹

Particulars	Schedule	Current Year 2019-20	Previous Year 2018-19
<b>Income</b>			
Academic Receipts	9	5,96,25,266	4,54,50,987
Grants/Subsidies	10	112,68,00,000	81,85,00,000
Income from Investments	11	-	2,14,09,747
Interest Earned	12	-	-
Other Income	13	5,68,69,687	5,97,97,059
Prior Period Income	14	3,17,01,521	2,03,011
<b>Total (A)</b>		<b>127,49,96,474</b>	<b>94,53,60,804</b>
<b>Expenditure</b>			
Staff Payments and Benefits (Establishment Expenses)	15	51,92,03,042	48,01,34,526
Academic Expenses	16	13,90,97,037	13,81,25,594
Administrative and General Expenses	17	25,92,64,139	24,41,54,099
Transportation Expenses	18	57,70,186	52,03,634
Repairs and Maintenance	19	13,55,85,067	4,98,63,643
Finance Costs	20	2,39,743	1,87,389
Depreciation	4	33,98,01,466	33,02,40,426
Other Expenses	21	11,65,901	69,62,230
Prior Period Expenses	22	7,39,452	22,99,699
<b>Total (B)</b>		<b>140,08,66,033</b>	<b>125,71,71,240</b>
<b>Balance being excess of Income over Expenditure (A-B)</b>		<b>(12,58,69,559)</b>	<b>(31,18,10,436)</b>
<b>Less: Transfer to Designated Fund</b>			
Others - Institute Reserve Fund (Sch 9 + Sch 13)		(11,64,94,953)	(10,52,48,046)
Less : Excess Revenue Expenses adjusted from Corpus		2,33,93,859	
Net To be taken to Institute Reserve Fund		(9,31,01,094)	
Transfer to Capital Fund (Depreciation)		33,98,01,466	33,02,40,426
Over Utilisation of Grant in Aid for Revenue Exps (Schedule 3C)			(8,68,18,056)
Under Utilisation of Grant in Aid for Revenue Exps (Schedule 3C)		12,08,30,813	
<b>Significant Accounting Policies</b>		23	
<b>Contingent Liabilities and Notes to Accounts</b>		24	

For and on behalf of IISER Pune

sd/-  
**CA. Vasundhara Laad**  
Jt. Registrar (F & A)

sd/-  
**Col. G. Raja Sekhar (Retd.)**  
Registrar

sd/-  
**Prof. Jayant B. Udgaonkar**  
Director

Place: Pune | Date: May 15, 2020

# 06

## Appendix

127 / Publications in 2019

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147 / Invited Lectures

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153 / Academic Events Organised

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155 / New Extramural Grants Received

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# PUBLICATIONS IN 2019

The names of authors with IISER Pune affiliation are in all-caps. Names of faculty members, fellows, and scientists are shown in bold.



## BIOLOGY

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499. SUDHEER KUMAR, C.S. 2019. Violation of space-time Bell-CHSH inequality beyond the Tsirelson bound and quantum cryptography. *Pramana*, 93(5), 67.
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 **BOOKS**

01. **GHOSH, SUJIT K.** (Ed). Metal-organic-frameworks (MOFs) for environmental applications. Elsevier, 2019. Pp. 464. ISBN: 9780128146330; 9780128146347.
02. **RAGHURAM, ANANTHARAM;** Harder, Gunter. Eisenstein Cohomology for GLN and the Special values of Rankin-Selberg L functions. (*Annals of Mathematics* 203), Princeton University Press, 2019, pp 240. ISBN: 9780691197883.

 **BOOK CHAPTERS**

01. **GNANAPRAKASAM, BOOPATHY;** CHAUDHARI, M. B. 2019. Metal-Catalyzed synthesis of peroxides. In: *Science of Synthesis Knowledge Updates 2019/2*. Georg Thieme Verlag KG.
02. **KAMAT, SIDDHESH S.;** SINGH, SHUBHAM; RAJENDRAN, ABINAYA; Gama, Simanga R.; Zechel, David L. 2019. Enzymatic strategies for the catabolism of organophosphonates. In: *Reference Module in Chemistry, Molecular Sciences and Chemical Engineering* Elsevier B.V. ISBN 9780124095472
03. KANYAL, ABHISHEK; NAHATA, SUNIL; **KARMODIYA, KRISHANPAL.** 2019. Epigenetics in infectious disease. In: *Prognostic Epigenetics*, pp. 171-201. Elsevier 10.1016/B978-0-12-814259-2.00008-X.
04. PILLAI, ANUP; **NADKARNI, SUHITA.** 2019. Purinergic signaling at tripartite synapses. In *Computational Glioscience*, pp. 227-244. Springer 10.1007/978-3-030-00817-8\_9.
05. **PAI, VENKETESWARA R.** 2019. *Mandalavākyas*: An intermediate numerical table used in the computation of planetary longitudes. In: *East-West Encounter in the Science of Heaven and Earth*, 50. Institute for Research in Humanities, Kyoto University.
06. **PAI, VENKETESWARA R.** 2019. The Yogyadi-Vakyas: A numerical table for computing the longitude of the sun. In: *The Growth and Development of Astronomy and Astrophysics in India and the Asia-Pacific Region*, Astrophysics and Space Science Proceedings, Volume 54. ISBN 978-981-13-3644-7. Hindustan Book Agency 2018 and Springer Nature Singapore Pte Ltd., 2019, p. 225.
07. CHAPLOT, KRITI; Ratnaparkhi, Anuradha; **RATNAPARKHI, GIRISH S.** 2019. Understanding motor disorders using flies. In: *Insights into Human Neurodegeneration: Lessons Learnt from Drosophila*, pp. 131-162. Springer Nature Singapore Pte. Ltd. 10.1007/978-981-13-2218-1\_5.
08. **SOHONI, PUSHKAR.** 2019. Architectural continuity across political ruptures: Early Marathas and the Deccan Sultanates. In: *Spaces and Places in Western India: Formations and Delineations*, Eds. Laurie McMillin and Bina Sengar, Routledge India, pp. 107-114. ISBN 9780815392583.

# INVITED LECTURES

At conferences/workshops and at colleges/universities/institutes/  
outreach events

## Bijay Kumar Agarwalla

*Experimental verification of quantum heat exchange fluctuation relation* University of Toronto, Canada, June 11, 2019; Physics Department of Technical University, Berlin, July 04, 2019 • *Non-equilibrium physics for small quantum systems: Transport and fluctuations in non-Markovian regime* Max Planck Institute for the Science of Light, Erlangen, Germany, July 25, 2019; East China Normal University, Shanghai, China, December 09, 2019 • *Fundamental and practical aspects of non-equilibrium statistical physics of small quantum systems* Quantum Thermal Machine Workshop, IIT Gandhinagar, September 21–22, 2019 • *Thermodynamic Uncertainty Relation: Theory and experiment* S N Bose National Centre for Basic Science, Kolkata, February 05, 2020; Saha Institute of Nuclear Physics, Kolkata, February 06, 2020; Indian Statistical Physics Meeting, TIFR-International Centre for Theoretical Sciences, Bengaluru, February 19–21, 2020

## Chaitanya Athale

*A cell's sense of direction: Predictions from modeling cytoskeletal polarization* National Conference on Cell Migration: Biophysical and Mathematical Perspectives, Institute of Bioinformatics and Biotechnology, Savitribai Phule Pune University, Pune, February 03, 2020 • *Emergent properties of mathematical and biophysical models of cytoskeleton-motor systems* Conference on Molecular Motors, Transport and Trafficking (M2T2), National Brain Research Centre, Manesar, October 18, 2019

## Nagaraj Balasubramanian

*Advance Techniques in Animal Physiology*, Savitribai Phule Pune University, Pune, April 2019 • *Cell Dynamics: Organelle-Cytoskeleton Interface Meeting*, Lisbon, Portugal, May 19–22, 2019 • *Phenotypic Heterogeneity as a Driver of Cancer Progression*, Indian Institute of Science, Bengaluru, January 05–09, 2020 • *20<sup>th</sup> International Symposium on Chromaffin Cell Biology (ISCCB-20)* IIT Madras, Chennai, January 23–26, 2020 • *International Conference on Biotechnology: Perspective and Challenges (ICBT-2020)*, Modern College, Pune, February 14–15, 2020 • *International Symposium on Cell Surface Macromolecules*, IISER Pune, February 17–21, 2020

## Baskar Balasubramanyam

*Overconvergent cohomology and p-adic L-functions* International Colloquium on Arithmetic Geometry, Tata Institute of Fundamental Research, Mumbai, January 09, 2020 • *Special values of Asai L-functions* Oberseminar, Max Planck Institute for Mathematics, Bonn, Germany, July 18, 2019

## Nirmalya Ballav

*Graphene for futuristic energy storing devices & beyond* TATA Motors Pune, July 12, 2019; Indian Graphene Camp, Pune, November 26, 2019; CoEP Pune, December 16, 2019; ACSC Pune, March 05, 2020 • *A mere surface bond* Institute Colloquium, IISER Pune, November 15, 2019 • *Possible room-temperature ferromagnetism in molecular semiconductors* MTMM-2029, IISER Bhopal, November 29, 2019 • *S=1/2 Kagome-like lattices in reducing Graphene Oxide* CTFM-2020, National Institute of Technology Karnataka, Surathkal, January 15, 2020 • *Functional materials by reducing Graphene Oxide* ICEM-14, CSIR-National Institute for Interdisciplinary Science and Technology (NIIST) Thiruvananthapuram, February 06, 2020 • *Chemistry at solid-liquid interfaces: How interesting interface is?* NCONC-2020, IIT Gandhinagar, February 12, 2020

## Argha Banerjee

*Variability of debris thickness and estimation of glaciological mass balance on debris-covered glaciers* International Union of Geology and Geophysics General Assembly 2019, Montreal, Canada, July 08–18, 2019 • *Glacial geomorphology* National Workshop on Quantitative Geomorphology, IIT Gandhinagar, February 14–15, 2020

## Debargha Banerjee

*Twisting of modular forms by quadratic characters* Indian Statistical Institute, Kolkata, December 28, 2019 • *Eisenstein cycles and Manin-Drinfeld property* University of Bordeaux, France, May 21, 2019

## Bhas Bapat

*First Results from IISER Pune EBIS: Collisions under slow highly charged ion impact* 8<sup>th</sup> ISAMP Topical Conference, IIT Roorkee, March 04, 2020

## Rabeya Basu

*Classical K-Theory and some results related to Serre's Problem on projective modules* International Conference on Algebra, Analysis and their Applications, Madurai Kamaraj University, Madurai, January 12, 2020 • *Rings and Module Theory* Series of lectures for graduate students, Kalyani University, Nadia, February 20–29, 2019 (UGC sponsored programme) • *Results related to Serre's Problem on projective modules* International Conference, ICMSA 2020, Department of Mathematics, University of Kalyani, Nadia, February 26–28, 2020 • *Linear algebra and K-Theory* Departmental Seminar, IISER Kolkata, February 20, 2020

## Chandrasheel Bhagwat

*Spectral analogues of strong multiplicity one theorem* Indian Statistical Institute, Bengaluru, October 31, 2019 • *Special values of L-functions and period relations for motives* Indian Institute of Science, Bengaluru, November 06, 2019

## Mousomi Bhakta

*Hardy equations with critical and supercritical exponents* Goethe University, Germany, May 27, 2019; University of Perugia, Italy, November 21, 2019 • *Nonlocal scalar field equations* IIT Bombay, Mumbai, December 24, 2019

## Rajeev Bhalerao

*The myriad colorful ways of understanding extreme QCD matter* Phenomenology of the Quark-Gluon Plasma, Special Lecture, TIFR-International Centre for Theoretical Sciences, Bengaluru, April 01–17, 2019 • *Collectivity in large and small systems formed in ultrarelativistic collisions* Two lectures at the First IMSc Discussion Meeting on Extreme QCD Matter, IMSc, Chennai, September 16–21, 2019 • *Primordial non-gaussianity in heavy-ion collisions* Workshop on QCD in the Nonperturbative Regime, Tata Institute of Fundamental Research, Mumbai, November 18–20, 2019

## Arijit Bhattacharyay

*A new single vortex solution of Gross-Pitaevskii equation with nonlocal interactions* CNSD 2019, IIT Kanpur, December 12–15, 2019 • *Brownian motion with coordinate dependent diffusivity and damping* Soft Matter and Statistical Mechanics 2019, IISER Pune, January 04–05, 2019

## Anup Biswas

Talk at the meeting of Applied Probability Meeting, Nice, France, September 26–28, 2019 • *Advances in Applied Probability*, Bengaluru, August 15, 2019

## R. Boomishankar

*Organic and organic-inorganic hybrid ferroelectric materials supported by amino-phosphorus (V) scaffolds* Inorganic Chemistry Colloquium, Institute of Inorganic Chemistry, University of Leipzig, Leipzig, May 29, 2019; University of Göttingen, Göttingen, June 11, 2019 • *Neutral polyhedral cages built from imido-P(V) trianion supported trinuclear Pd(II)-clusters* Institute of Inorganic Chemistry, University of Leipzig, Leipzig, June 05, 2019; Symposium on Modern Trends in Inorganic Chemistry (MTIC-18), IIT Guwahati, December 11–14, 2019 • *Organic and organic-inorganic hybrid ferroelectric materials supported by ammonium and phosphonium cations for energy harvesting application* Chemsymphoria, Department of Chemistry, IISER Pune, July 18–20, 2019 • *Session Chair*, Chemical Frontiers-2019, Goa, August 22–25, 2019 • *Ferroelectric materials supported by ammonium and phosphonium cations for energy harvesting application* Indo-German Workshop under UGC-DAAD, FU Berlin-IIT Bombay Umbrella on Emerging Trends in Chemistry and Materials, IIT Bombay, Mumbai, August 28–29, 2019; National Symposium on Convergence of Chemistry & Materials (CCM-2019), BITS-Pilani, Hyderabad Campus, India, December 17–18, 2019

### S. Sandanaraj Britto

*Novel chemical technologies for applications in the area of functional protein nanotechnology and molecular imaging* 88<sup>th</sup> SBCI Annual Meeting, BARC Mumbai, November 02, 2019; JNCASR Bengaluru, September 24, 2019; ACTREC Mumbai, September 13, 2019; Genova Biopharmaceuticals, Pune, September 21, 2019 • *Rational design of stimuli-responsive supramolecular protein complexes* SPSI Local Chapter 2019, IISER Kolkata, July 06, 2019

### Apratim Chatterji

*Bacterial chromosome organization: Few special cross-links, cell confinement, and molecular crowders play the pivotal roles* Institute of Mathematical Sciences, Madras, October 29, 2019; ISMC-International Soft Matter Conference, Edinburgh, U.K., June 04–07, 2019 • *Heirarchical self assembly: Self organized nano-particle structures in self assembled polymer matrix* Compflu, Bhopal, December 05–07, 2019 • *Spontaneous helix formation in semi-flexible polymers using generic potential and without packing effects* Indian Statistical Physics Discussion Meeting, TIFR-International Centre for Theoretical Sciences, Bengaluru, February 19–21, 2020

### Chitrabhanu Chaudhuri

*Arakelov geometry of modular curves  $X_0(p^2)$*  IIT Hyderabad, August 02, 2019 • *Introduction to adic spaces* Perfectoid Spaces Workshop and Discussion Meeting, TIFR-International Centre for Theoretical Sciences, Bengaluru, September 11, 2019 • *Topics in Complex Analysis, Refresher Course for College Teachers in Complex Analysis*, KSOM, Kozhikode, November 28 – December 01, 2019

### Devapriya Chattopadhyay

*Diversity and distribution of marine molluscs around Indian coast and its implications* Indo-French Marine Ecology Thematic Workshop, Banyuls Marine Research Station, Banyuls, France, July 08, 2019 • *My vision of The Indian Museum of Earth (TIME)* TIME International Consultation, Indian National Science Academy, New Delhi, April 02, 2019

### Srabanti Chaudhury

*Characterizing and quantifying fluctuations in single-molecule enzyme kinetics* Complexity of Dynamics and Kinetics from Single Molecules to Cells, TSRC, Telluride, CO, U.S.A., June 16–20, 2019; *Chemical Frontiers* Goa-2019, August 22–25, 2019 • *Non-equilibrium effects of polymer translocation through a nanopore* ACS-CRSI Meeting, IIT Kanpur, July 18, 2019

### Vijayakumar Chikkadi

*Insights into deformation and flow of glasses using colloidal suspensions* Soft Matter Young Investigators Meet 2019, Shillong, May 14, 2019 • *Hyperuniformity in dense colloidal suspensions* Compflu 2019, IISER Bhopal, December 06, 2019 • *Visualising yielding of amorphous solids using colloidal suspensions* Recent Topics in Statistical Mechanics 2019, NISER Bhubaneswar, December 12, 2019

### Jeetender Chugh

*Biophysics of RNA-Protein interactions* 26<sup>th</sup> National Magnetic Resonance Society Meeting and Conference on NMR – from Molecules to Human Behavior and Beyond, Saurashtra University, Rajkot, Gujrat, February 18–21, 2020; *National Conference on Relationship between Chemical Sciences and Society (RCSS-2020)*, Shivaji College, University of Delhi, January 16–17, 2020 • *Biophysical insights into RNA-Protein interactions* 107<sup>th</sup> Indian Science Congress, University of Agricultural Sciences Bengaluru, January 03–07, 2020 • *Panel Discussion* 5<sup>th</sup> Anniversary Symposium of Sakura Science Plan, University of Tokyo, Japan, November 11, 2019 • *Multi-scale structural life science and the advanced technologies* Japan-Korea Bilateral Symposium, Institute for Protein Research, Osaka University, Japan, March 15, 2019

### Aloke Das

*$n \rightarrow \pi^{*ab}$  non-covalent interaction and microsolvation* 17<sup>th</sup> Discussion Meeting on Spectroscopy and Dynamics of Molecules and Clusters, Udaipur, February 20–23, 2020 • *Unconventional hydrogen bonds are conventional in strength* Department of Chemistry, University of California Santa Barbara, U.S.A., January 31, 2020 • *Exploring weak  $n \rightarrow \pi$  non-covalent interaction* 2020 Gordon Research Conference on Molecular and

Ionic Clusters, Ventura, CA, U.S.A., January 26–31, 2020 • *Deciphering the nature of unconventional hydrogen-bonds from IR spectroscopy data* Conference on One Hundred Years of Hydrogen Bonding, Indian Institute of Science, Bengaluru, January 09–10, 2020 • *Unconventional hydrogen bonds with chalcogens are conventional in strength* Conference on Let there be Light-A Discussion Meeting on Spectroscopy and Microscopy, Udaipur, November 10–13, 2019 • *Unconventional hydrogen bonds are as strong as conventional hydrogen-bonds* 23<sup>rd</sup> International Conference on Horizons in Hydrogen Bond Research (HBOND2019), Vrije University, Amsterdam, The Netherlands, September 24–27, 2019 • *Unconventional non-covalent interactions are as important as conventional ones* Annual Chemistry Day, Chemsymphoria-2016, IISER Pune, July 18–20, 2019

### Shouvik Datta

*How particles team up! - Many body physics of excitons in semiconductors* Faculty Development Program, Workshop on Nanomaterials- Synthesis, Properties and Characterization, Department of Metallurgy and Materials Science, College of Engineering (CoEP), Pune, December 16–20, 2019

### Sutirth Dey

*Stabilizing biological populations: An experimental biologist's perspective* Mathematical and Statistical Explorations in Disease Modelling and Public Health (July 01–11, 2019), TIFR-International Centre for Theoretical Sciences, Bengaluru, July 02, 2019 • *Introductory lecture on biostatistics* Teaching Under their Program, NCCS, Pune, October 17, 2019 • *Size matters: Effects of population size on adaptation in bacteria* ISEB1: Celebrating Ecology and Evolution in India, JNCASR, Bengaluru, October 24–25, 2019 • *Evolution: Beyond the modern synthesis* Arihant College of Arts, Commerce & Science, Bavdhan, Pune, January 23, 2020 • *Evolution: Beyond the modern synthesis, dispersal evolution: The Drosophila story* 2-day Workshop on Evolution and Phylogenetics, Department of Zoology, St. Xavier's College, Mumbai, February 06, 2020 • *Evolution of dispersal in laboratory populations: The drosophila story* Two-day Seminar Series on Concepts, Tools and Techniques in Ecology and Behavioural Research, SP College Pune, February 12, 2020; *Seminar Series on Ecology and Evolution*, Ashoka University, February 28, 2020 • *Dispersal evolution: Lessons from the humble fruit-fly* Faculty Development Program on Biodiversity and Chemical Ecology, organized by UGC-HRDC, Pune, February 20–29, 2020, Savitribai Phule Pune University, February 23, 2020 • *Mutations* 6<sup>th</sup> Foundations of Biology Meeting organized by Ashoka University, IIT Delhi, March 01, 2020

### Deepak Dhar

*Polymers in random media* Soft Matter and Statistical Physics, IISER Pune, January 04, 2019 • *Universality classes of sandpiles* Universality of Random Structures: Martices, Sandpiles and Interfaces, TIFR-International Centre for Theoretical Sciences, Bengaluru, February 07, 2019 • *Self-organized criticality* A 9-lecture course for Spring College on the Physics of Complex Systems, The International Centre for Theoretical Sciences, Trieste, February 24–March 08, 2019 • *Phase transitions in hard core models* A set of 5 lectures, Bangalore School on Statistical Physics X, TIFR-International Centre for Theoretical Sciences, Bengaluru, June 24–28, 2019 • *Applications of game theory in econophysics* Talk in a Panel Discussion on Game Theory and Economics, Stat-Phys Kolkata X, Presidency University, Kolkata, November 25–29, 2019 • *Improved upper bounds in first passage percolation* Recent Trends in Statistical Physics, National Institute of Science Education and Research Bhubaneswar, December 11–13, 2019 • *Singularities in the free energy of a one-dimensional system of hard rods* TIFR Centre for Interdisciplinary Sciences, Hyderabad, December 17, 2019

### Sourabh Dube

*Scientific careers* Swadhaa Waldorf School, Pune, April 09, 2019 • *Fundamental particles and the machines that find them* MIT Academy of Engineering, Pune, September 06, 2019 • *Experimental particle physics* DST-INSPIRE Camp, Arihant College of Arts, Commerce & Science, Pune, January 21, 2020

### G.V. Pavan Kumar

*Gap plasmonics* ICONSAT, Kolkata, March 06, 2020; *FCS 2019*, Tata Institute of Fundamental Research, Hyderabad, December 18, 2019 • *Soft photonics* Compflu, IISER Bhopal, December 05, 2019 • *Gap plasmon polaritons* OSI Annual Meeting, Dehradun, October 19, 2019

### Aurnab Ghose

*Actin-microtubule coordination in the neuronal growth cone: A novel role for formin 2* EMBO Workshop on Cell Biology of the Neuron: Polarity, Plasticity and Regeneration, Heraklion, Greece, 07-10 May, 2019 • *Coupling actin and microtubule cytoskeletons: An atypical formin function in neurons* Molecular Motors, Tracks and Transport (M2T2) Meeting, NBRC, Manesar, October 2019 • *Coordinated remodelling of cytoskeleton elements in the development of functional neural circuits* XXVII Annual Meeting of the Indian Academy of Neurosciences, AIIMS, New Delhi, November 2019 • *Hungry or not? Shaping of behaviour by physiology* AICTE Sponsored Gen- Next Pharmacology: Today's Discovery Tomorrow's Medicine, Poona College of Pharmacy, Pune, November 2019 • *Imaging techniques in neuroscience* IBRO-APRC Workshop on Neuroepigenetics, Savitribai Phule Pune University, Pune, November 2019 • *Brain matters: some tricks and treats* Meet a Scientist Lecture Series, Muktangan Exploratory Science Centre, Pune, December, 2019 • *Introduction to the neuromodulation: Neuropeptides in neural encoding of physiological states development of nervous systems; Cytoskeletal remodelling: Formation and plasticity of neural circuits;* 2<sup>nd</sup> IBRO-APRC Associate School in Neuroscience: Fundamental Neuroscience, Neural Disorders and Neural Engineering, UIU, Dhaka, Bangladesh, December 04-08, 2019 • *Food for thought: Neural control of eating* Concepts, Tools and Techniques in Ecology and Behavioural Research, S.P. College, Pune, February 2020 • *The brain and its discontents* Modern College, Pune, February 2020 • *Neuromodulation of feeding: A case for neuropeptides* Workshop on Molecular Neurobiology: From Genes, Neurons to Behavior in Health and Disease, Regional Centre for Biotechnology, Faridabad, February 2020

### Prasenjit Ghosh

*Descriptors for prediction of efficient dye sensitized photocatalysts for hydrogen evolution* Weizmann-India Exchange: Chemical Biology and Material Science, WIZ, Rehovot, Israel, May 14–16, 2019 • *Modelling activated processes in materials* Workshop on Computational Material Science (COMATS 2019), Cochin University of Science and Technology, Cochin, Kerala, October 29 – November 02, 2019 • *Modelling solid liquid interfaces using QMMM simulations: Pt-water interface* International Conference on Materials Genome organized by the Asian Consortium on Computational Materials Science, SRM University, Andhra Pradesh, February 05–07, 2020 • *Understanding and design of materials using computers* Raman Memorial Conference-2020, Department of Physics, Savitribai Phule Pune University, February 14–15, 2020

### Sujit K. Ghosh

*Metal-organic frameworks (MOFs) based remediation of environmental pollutants for clean water* Annual General Meeting of MRSI, Kolkata, February 11–14, 2020 • *Functional metal-organic frameworks (MOFs): Sensing and sequestration of water based environmental pollutants* Modern trends in inorganic chemistry (MTIC-XVIII), IIT Guwahati, December 11–14, 2019 • *Metal-organic frameworks (MOFs): Sensing and sequestration of environmental pollutants* School of Chemistry, University of Hyderabad, November 22, 2019 • *Functional metal-organic frameworks (MOFs) for sensing and sequestration of environmental pollutants* Department of Chemistry, IIT Kanpur, April 18, 2019

### Sreejith G.J.

*Patterns and positions of zeros of FQH states* Geometric Phases in Optics and Topological Matter, TIFR-International Centre for Theoretical Sciences, Bengaluru, January 21–24, 2020; Workshop on Two-Dimensional Electronic Systems in Magnetic Field, IISER Kolkata, December 14–15, 2019 • *Scaling of Loschmidt echo in boundary driven Z3 potts model* Young Investigator Meet on Quantum Condensed Matter Theory, SNBNCBS Kolkata, December 11–13, 2019

### Boopathy Gnanaprakasam

*Metal-catalyzed peroxidation and its molecular rearrangement using batch/continuous flow mode* International Conference on Emerging Trends in Catalysis, Vellore Institute of Technology, Vellore, Tamil Nadu, January 06–08, 2020 • *Sustainable chemical synthesis using continuous-flow* Green Chemistry Techniques in Laboratory, Goa, January 10–11, 2020 • *Sustainable peroxidation and its molecular rearrangement using batch/continuous flow mode* New Frontiers in Chemistry-From Fundamentals to Applications, BITS, Goa, December 20–22, 2019 • *Sustainable synthesis of reactive intermediates under continuous flow* Green Chemistry and

Technology Conference, France, July 10–11, 2019

### Anindya Goswami

*Option pricing in a regime switching jump diffusion model* Statistics Colloquium, JLU, Giessen, July 02, 2019 • *Testing of binary regime switching models using squeeze duration analysis* ISBIS Satellite Conference, Lanai Kijang in Kuala Lumpur, August 15, 2019

### Anirban Hazra

*Flipped classroom* Induction Programme for Newly Recruited College Teachers, Centre of Excellence in Science and Mathematics Teaching, IISER Pune, May 07, 2019 • *Introduction to research in theoretical and computational chemistry* NPTEL Workshop in Theoretical Chemistry, IISER Pune, June 20, 2019 • *Does chance determine the outcome of a chemical reaction?* Chemsymphoria 2019, Chemistry in-House Symposium, IISER Pune, July 18, 2019 • *The story of chemistry* Celebration of the International Year of the Periodic Table organized by IISER Pune along with Royal Society of Chemistry and Tata Technologies, IISER Pune, December 21, 2019; STEP for STEM Teachers, Science Activity Center, IISER Pune, January 28, 2020; Public Lecture organized by the Exciting Science Group, IISER Pune, February 29, 2020 • *The chemical revolution* Abasaheb Garware College, Pune, December 30, 2019 • *Higher studies in science: A scientist's perspective* Keynote speech at the Kaveri INSPIRE Internship Camp, Dr. Kalmadi Shamarao Junior College, Pune, March 04, 2020

### Mukul Kabir

*Metal-free magnetism in graphene* DAE Solid State Physics Symposium, IIT Jodhpur, December 18–22, 2019 • *Advances in two-dimensional phosphorene* Workshop on 2D Electronic Systems in Magnetic Field, IISER Kolkata, December 14–15, 2019 • *Vacancy diffusion in graphene* Young Investigator Meet on Quantum Condensed Matter Theory, S. N. Bose National Centre for Basic Sciences, Kolkata, December 11–13, 2019 • *Room-temperature ferromagnetism in graphene?* Weizmann-India Exchange: Chemical Biology & Materials Science, Weizmann Institute of Technology, Israel, May 14-16, 2019 • *Two-dimensional phosphorene: The new wonder material?* Joint Indo-Swedish Conference on Dynamics in Functional Materials, Goa, February 12–14, 2020

### Tejas Kalelkar

*Taut foliations on compact 3-manifolds with constrained boundary slopes* 2019 Georgia Topology Conference, University of Georgia, U.S.A., May 25, 2019 • *Geometric triangulations of constant curvature manifolds* Conference on Geometric Topology, Bhaskaracharya Pratishthan, Pune, December 06, 2019

### Siddhesh S. Kamat

*Enzyme function annotation using an integrated chemical proteomics and metabolomics approach* International Symposium on Cell Surface Macromolecules 2020, IISER Pune, February 02, 2020; Advances in Mass Spectrometry Symposium, IISER Tirupati, November 19, 2019; International Chemical Biology Society, 8<sup>th</sup> Annual Meeting, ICT Hyderabad, November 04, 2019; Indo-U.K. Chemical Biology Symposium, University of Glasgow, U.K., July 31, 2019

### Krishanpal Karmodiya

*Single cell RNA-sequencing reveals cellular heterogeneity, stage transition and antigenic variation during stress adaptation in synchronized Plasmodium falciparum* 30<sup>th</sup> National Congress of Parasitology & Global Summit on Malaria Elimination, Jawaharlal Nehru University, New Delhi, September 26–28, 2019 • *Plasmodium falciparum epigenome in virulence and drug-resistance emergence* Phase Separation in Genome Organization (PSiGO), IISER Pune, August 01, 2019 • *Introduction to the model organisms* INSPIRE Science Camp, IISER Pune, January 07–09, 2020

### Shabana Khan

*N-heterocyclic silylenes versatile ligands in homogeneous catalysis* International Conference on Organometallics and Catalysis, ICOC-II, Goa, March 07–10, 2020 • *Main group compounds in cyanosilylation and hydroboration reactions* International Conference on Recent Trends in Catalysis, NIT Calicut, February 26–29, 2020 • *The journey of N-heterocyclic silylenes from chemical curiosities to emerging ligands*

in catalysis 14<sup>th</sup> CRSI-RSC Joint Symposium, VIT Vellore, Tamil Nadu, February 06, 2020 • *The curious case of silylene (as a ligand)* Chemistry Day Symposium, IISER Tirupati, January 18, 2020; 1<sup>st</sup> Chemical Science Young Investigator Symposium, IISER Kolkata, October 18–20, 2019; 7<sup>th</sup> Asian Silicon Symposium, Nanyang Technological University, Singapore, July 28–31, 2019; Institut für Siliciumchemie, Technische Universität München, Germany, July 19, 2019; *Department of Chemistry*, University of Saarbrücken, Germany, July 17, 2019 • *Silylene as a ligand for copper and gold complexes* Leibniz Lecture and Workshop, IIT Madras, August 26, 2019 • *Silylene as a ligand in transition metal chemistry* Department of Chemistry, University of Regensburg, Germany, July 26, 2019

#### Raghavendra Kikkeri

*Exploring microheterogeneity of heparan sulfate and its biology by using synthetic glycans* CARBO-XXXIV: International Conference on Emerging Frontiers in Carbohydrates Chemistry and Glycobiology, Department of Chemistry, University of Lucknow, Lucknow, December 05–07, 2019

#### Mayurika Lahiri

*Understanding cancer* Ramkrishna More College Under DBT Star College Scheme, Akurdi, Pune, October 11, 2019 • *DNA-PK plays a central role in transformation of breast epithelial cells following alkylation damage* 1<sup>st</sup> TCGA Conference in INDIA Multi-Omics Studies in Cancer Learnings from The Cancer Genome Atlas (TCGA), IISER Pune, September 21–22, 2019

#### T.S. Mahesh

Lecture Training Program, Pondicherry University, July 2019 • *Start-upology quantum registers* Quantum Matter Conference, Indian Institute of Science, Bengaluru, July 2019 • *Understanding noise in nuclear spin registers* Workshop on Quantum Thermodynamics, IIT Gandhinagar, September 2019 • *NMR quantum processors: Aspects and prospects* Colloquium @ IACS, Kolkata, February 2019 • *NMR – a brief introduction* NMR Workshop, DIAT, Pune, October 2019 • *Push-pull optimization of quantum controls: Methods and applications* QFTA2019, IISER Mohali, October 2019 • *Nuclear spins as quantum bits* Colloquium @ Physics Department, IIT Madras, October 2019 • *Investigating quantum correlations through nuclear magnetic resonance* International Conference on Quantum Foundations and Frontiers, Raman Research Institute, Bengaluru, January 2020 • *Charge-states of nitrogen vacancy centers in diamond: Conversion dynamics and filtering methods* National Magnetic Resonance Society Meeting, Sourashtra University, Rajkot, February 2020 • *Quantum computer software & hardware: A brief overview on progress & prospects* NITTE Engineering College, Mangalore, February 28, 2020 • *Ongoing revolution in information science: From bits to qubits* Saint Aloysius College, Mangalore, February 29, 2020 • *Information science: Past, present, and future* DST-INSPIRE camp, IISER Pune, March 05, 2020

#### Moumita Majumdar

*Low-valent germanium in catalysis and energy applications* International Conference on Heteroatom Chemistry, Prague, Czech Republic, July 05, 2019 • *Catenating the molecules and nanomaterials of germanium* Germanium, Tin and Lead Conference, Saitama, Japan, September 01–06, 2019 • *Genial germanium and tin tweaks in catalysis and energy applications* RSC Young Investigator's Meet, IISER Kolkata, October 2019 • *Low-valent group 14 elements in organic transformations* Advances in Organic Syntheses, Pune, January 2020

#### Vivek Mohan Mallick

*Tensor triangulated Chow groups* Derived Categories and Geometry of Algebraic Varieties, Tata Institute of Fundamental Research, Mumbai, February 17, 2020

#### Neena Joseph Mani

*Predictability of MISO initiations over Indian Ocean* Technical Discussion Meeting Under the Ocean Mixing and Monsoon (OMM) Programme, Space Applications Centre (SAC), ISRO Ahmedabad, January 27–28, 2020

#### Manish Mishra

*Regular bernstein blocks* Seminar, Tata Institute of Fundamental Research, Mumbai, December 2019; Seminar, ISI Delhi, January 2020 • *A generalization of the 3d distance theorem* Seminar, JNU Delhi, February 2020

#### Sunil Mukhi

**Technical Talks:** *On 2d CFT with one critical exponent* Challenges and Advances in Theoretical Physics, Korean Institute for Advanced Study, South Korea, May 23, 2019; Quantum Information and String Theory 2019, Yukawa Institute for Theoretical Physics, Kyoto, May 28, 2019; TIFR-International Centre for Theoretical Sciences, Bengaluru, June 28, 2019 • *Rational conformal field theory and the holomorphic modular bootstrap* The University of Chicago, U.S.A., September 05, 2019; 10th Regional Conference on String Theory and Cosmology Kolymbari, Crete, September 18, 2019 • *RCFT and the modular bootstrap* National Strings Meeting, IISER Bhopal, December 27, 2019 • *Conformal invariance in physics* IIT Bombay, February 25, 2019 • *Holomorphic modular bootstrap for 2d CFT* Rencontre Theoriciennes, Sorbonne University, Paris, March 12, 2020

**Non-technical/Policy/Popular Talks:** *Gravity and the universe* Presidency University, Kolkata, August 03, 2019 • *String theory and its origins in particle physics* Centre for Excellence in Basic Science, Mumbai, October 25, 2019 • *What are we made of?* Mukangan Exploratory, Pune, December 13, 2019

#### Muhammed Musthafa

*Isomerism-activity relation in molecular electrocatalysis* International Conference on Electrochemistry in Industry Health and Environments (EIHE-2020), DAE Convention Centre, Anushaktinagar, Mumbai, January 21–25, 2020 • *Electrochemistry: The philosophy and the science* Sir Syed College, Taliparamba, Kerala, January 11, 2020 as a part of three days residential programme for selected plus one science students organized by Samagra Shiksha, Kerala and Directorate of Higher Secondary Education, Kerala • *Hydrogen economy with electrochemical energy devices* National Seminar on Frontiers in Chemical Sciences FCS 2020, University of Calicut, Kerala, January 31, 2020 • *Realization of hydrogen economy with electrochemical energy devices* Recent Trends in Chemical Sciences for Sustainable Development, Department of Chemistry, Vijayanagara Sri Krishnadevaraya University, Ballari, Karnataka, September 26–27, 2019; Department of Physics, Fergusson College, Pune, September 20, 2019

#### Suhita Nadkarni

EMBO Symposium on Calcium Signaling: Molecular mechanisms to role in health and diseases, National Center For Biological Sciences, Bengaluru, January 28, 2020 • EMBO Symposium, from synapses to memory: RNA based regulatory mechanisms, National Brain Research Centre, Delhi, October 15–18, 2019 • Lecture series on computational approaches to memory and plasticity, Summer School for PhD Students and Postdocs, National Center For Biological Sciences, Bengaluru, June 29– July 14, 2019

#### Angshuman Nag

*Possibility of dual bandgap in organic-inorganic Pb-halide layered perovskite* Workshop on Colloidal Nanocrystals, Sorbonne University (Jussieu campus), Paris, May 07, 2019; Kaleidoscope: A Discussion Meeting in Chemistry, Goa, July 04–07, 2019; DGIST Global Innovation Festival (DGIF), Daegu Gyeongbuk Institute of Science and Technology (DGIST), Daegu, South Korea, November 11–12, 2019; Ulsan National Institute of Science and Technology (UNIST), Ulsan, South Korea, November 13, 2019; Korea University, Seoul, November 14, 2019 • *Mn- and Yb- doping in metal halide perovskite nanocrystals* ESPCI, Paris, May 08, 2019; Hybrid and Organic Photovoltaics Conference (HOPV19), Rome, Italy, May 12–15, 2019 • *Pb-free metal halide perovskite nanocrystals* Sorbonne University (Jussieu campus), Paris, May 09, 2019 • *Millimeter wavelength to Li-Fi* ChemSymphoria, In-House Symposium of Chemistry Department, IISER Pune, July 18–19, 2019 • *Pb-halide and "unleaded" perovskite nanocrystals for optoelectronics* Unit Day, New Chemistry unit JNCASR Bengaluru, August 08, 2019 • *Metal ion doped halide perovskite phosphors* Hanyang University, Seoul, November 14, 2019 • *Do we understand optical transitions in 2D hybrid perovskites?* Medal Lecture in Material Research Society of India (MRSI) Conclave, CSIR-CGCRI, Kolkata, February 11–14, 2020

#### Rejish Nath

*Doubly dipolar bose-einstein condensates* Physical Research Laboratory, Ahmedabad, Gujarat, December 10, 2019; University of Nottingham, U.K., July 31, 2019 • *Excitation dynamics in an atomic array embedded in a photonic crystal* 4<sup>th</sup> International Workshop on Rydberg Atoms and Molecules, Hangzhou, China, June 08, 2019

### A. A. Natu

Gave 50 lectures on topics such as opportunities in basic sciences, interdisciplinary sciences, new education policy, greener aspects of drug discovery all over India in various seminars, symposia all over India. Has carried out several counselling sessions pertaining careers in science for students, parents, and teachers in various colleges and schools

### Gayathri Pananghat

*FrzCD: A bacterial chemosensory protein that binds DNA* Second Meeting of Molecular Microbiology (M-cube), CDFD, Hyderabad, July 12, 2019  
• *Helical shape determination in spiroplasma* Pre-Conference Workshop, BMSV 2019, Spier, Cape Town, South Africa, November 22–23, 2019  
• *Structural analysis of small ras-like GTPases* International Conference on Structural Biology and Computer Assisted Drug Design (ICSBCADD), Alagappa University, Karaikudi, December 13, 2019  
• Panel discussion on Women in Science, Stella Maris College, Chennai, December 12, 2019  
• *Bacterial cytoskeleton: Diversity in structure and function* for the event related to Women's Day, National Chemical Laboratory, Pune, March 09, 2020

### Shivprasad Patil

*The mechanics of hydra locomotion* Linz Winter Workshop on Single Molecule Biophysics, Linz, Austria, February 03, 2020; Compflu 2019: A Conference on Soft Matter, IISER Bhopal, December 05–07, 2019  
• *Ion transport in structured solvents* FCS 2019: National Workshop on Fluorescence and Raman Spectroscopy 2019, Tata Institute of Fundamental Research, Hyderabad, December 16–21, 2019  
• *Force extension of single polymer chains: Static versus dynamic* ISPCM-2020: 7<sup>th</sup> Indian Statistical Physics Community Meeting 2020, International Centre for Theoretical Sciences, Bengaluru, January 19–21, 2020

### Pramod Pillai

*Ligand as a 'Gatekeeper' in nanoparticle catalyzed reactions* International Conference on Recent Trends in Catalysis 2020 (RTC 2020), NIT Calicut, Kerala, February 26–29, 2020  
• *Surface ligand directed light harvesting by nanoparticles* International Conference on Ultrafast Spectroscopy (ICUS 2020), IISER Thiruvananthapuram, Kerala, February 21–22, 2020  
• *Surface ligand directed catalysis and light harvesting by nanoparticles* International Conference on Energy and Environment (ICEE 2k19), T.K.M. College of Arts & Science, Kollam Kerala, December 12–14, 2019; Institut Charles Sadron (ICS) – CNRS, University of Strasbourg, Strasbourg, France, June 18, 2019  
• *Crafting advanced nanoparticle functions through interplay of forces and interactions* Institut de Science et d'Ingénierie Supramoléculaires (ISIS), University of Strasbourg, Strasbourg, France, June 17, 2019  
• *Regulation of interparticle interactions: In search of advanced nanoparticle functions* Donostia International Physics Center (DIPC), San Sebastian, Spain, June 13, 2019; Westfälische Wilhelms-Universität (WWU), Muenster, Germany, June 04, 2019  
• *Transformations on the surface of nanoparticles: Not all ligands are 'Poisonous' for catalysis* Students Seminar Organized by SFB 838, Westfälische Wilhelms-Universität (WWU, SFB 858), Münster, Germany, June 05, 2019  
• *Regulation of interparticle forces for advanced nanoparticle functions* Institute for Biological Interfaces 1 (IBG-1), Karlsruhe Institute of Technology (KIT), Germany, May 15, 2019

### Sunish Kumar Radhakrishnan

*Orchestrating cell division with flagellar assembly: A forward genetics narrative* Bacterial Morphogenesis, Survival and Virulence Conference 2019, Cape Town, South Africa, November 28, 2019

### Girish Ratnaparkhi

*Neuroaggregates and neurodegeneration* Workshop on Molecular Neurobiology: From Genes, Neurons to Behaviour in Health and Disease, Regional Centre for Biotechnology, Faridabad, February 27–28, 2020  
• *ALS8: A breakdown in the VAPB social network* National Centre for Biological Sciences, Bengaluru, November 01, 2019  
• *Foundations of animal development* Exciting Science Group, IISER Pune, October 20, 2019

### Chaitra Redkar

*Swaraj as critique of representation* Symbiosis School of Liberal Arts, Pune, January 17, 2020  
• *Revisiting Gandhi with Kumarappa's perspective* Modern College, Pune, January 08, 2020  
• *Relevance of Gandhi's economic ideas* Department of Political Science, SRT Nagpur University,

Nagpur, February 21, 2020

### Richa Rikhy

*Molecular and geometric principles of polygonal epithelial architecture formation and maintenance* Thirsting for Theoretical Biology, TIFR-International Centre for Theoretical Sciences, Bengaluru, June 03–07, 2019  
• *Role of actin remodeling and polarity proteins in plasma membrane shape morphogenesis in embryogenesis* Unravelling Cellular Processes - Models and Experiments, Coorg, India, December 01–05, 2019

### Pooja Sancheti

*Writing tasks for a large mixed-proficiency/ability first year undergraduate class* ELTIS-SIFIL 10th National Conference on "A 360° View of Language Teaching Materials: Development, Utilisation and Evaluation" hosted by English Language Teaching Institute of Symbiosis (ELTIS), Pune, February 07–08, 2020  
• *Professional writing: CV and SOP writing workshop* Full Day Workshop on CV and SOP Writing, Symbiosis School of Liberal Arts (SSLA), Pune, February 19, 2020  
• *Presentation skills in academia* Two-Day Workshop on Academic Presentation Skills for Senior MSc and Early PhD Students in the Sciences, Science Media Centre (funded by NCSTC), IISER Pune, September 20–21, 2019  
• *Ways of writing: Non-fictional essay writing* Four Lectures as Part of a First Year Core Course on Creative Writing, Symbiosis School of Liberal Arts (SSLA), Pune, August 14, 16 and 23, 2019  
• *Aspects of research reading and writing* Research Skills and Ethics of Research as Part of the Certificate Course in Research Methodology 2019, Deccan College, Pune, July 31, 2019  
• *Official communication skills* Resource Person for the Induction Program for Newly Recruited College Teachers, IISER Pune, May 02–03, 2019

### Kundan Sengupta

*Role of twist1 in inducing chromosomal instability during epithelial to mesenchymal transitions (EMT)* Cancer Heterogeneity Meeting, Indian Institute of Science, Bengaluru, January 05–07, 2020  
• *Lamins modulate morphology and function of the nucleolus – a liquid droplet compartment* Bioscience & Bioengineering Department, IIT Bombay, Mumbai, November 19, 2019  
• *Lamins modulate genome organization and function in the interphase nucleus* Annual Meeting of the Society for Biological Chemists of India (SBCI), Bhabha Atomic Research Center, DAE, Mumbai, October 31–November 03, 2019  
• *Genome organization in cells on softer matrices* Nextgen Genomics, Biology, Biotech Conference, Mumbai, September 30–October 02, 2019; NCBS/InStem, Bengaluru, July 05, 2019  
• *Genome architecture in the nucleus* Centre for DNA Fingerprinting And Diagnostics, Hyderabad, July 18, 2019

### Kaneenika Sinha

*Central limit theorems for sato-tate sequences* International Conference on Number Theory, Sastra University, Kumbakonam, Tamil Nadu, December 21–22, 2019

### Pushkar Sohoni

*The oriental bazaar and the colonial market hall* Jnanapravaha, Mumbai, March 21, 2020  
• Discussant on a Panel Discussion About Tony Joseph's Book *Early Indians*, with Tony Joseph, Sudha Gopalakrishnan, and Kesavan Veluthat, Kerala Literature Festival (KLF), Kozhikode, January 16, 2020  
• *Jewish heritage of the Deccan* Public Lecture for the Indian National Trust for Art and Cultural Heritage (INTACH), Bengaluru Chapter, January 12, 2020  
• *Medieval temples of Maharashtra and Odisha* Lecture for the *Ek Bharat Shreshtha Bharat* Programme of the Ministry of Human Resources and Development, Government of India, IISER Pune, December 15, 2019  
• *Beyond faith after death: The Ahmadnagar Group of funerary monuments* Symposium of the American Council on South Asian Art (ACSAA), Hosted by Edinburgh College of Art, The University of Edinburgh, Scotland, November 09, 2019  
• *Strike two: Afterlife of Bahamani Coinage* Annual Conference of the American Council for South Asia, Madison WI, October 19, 2019  
• *Verse or worse: Obscenity and vulgarity in the poetry of B.S. Mardhekar and Namdeo Dhasal* Pre-Conference Workshop – Vulgarity and Power - Annual Conference of the American Council for South Asia, Madison WI, October 18, 2019  
• *Evolution and morphology of the Hindu Temple and Maratha Temples* Jnanapravaha, Mumbai, September 21, 2019  
• *Architecture as evidence: The Sultanate of Ahmadnagar* Institute Colloquium, IISER Pune, September 20, 2019  
• *Counterstruck coins from the Deccan: New methods of analysis* Conference Money-Use in

Pre-Modern India, University of Pennsylvania, Philadelphia PA, May 03, 2019 • *Monument of modernity: The colonial market hall* Jnanapravaha, Mumbai, April 27, 2019 • *Foundation myths of Indian cities: Types and tropes with special reference to the foundation of Mumbai* South Asia Center Speaker Series: Rethinking Urban Sustainability in India, Syracuse University, Syracuse NY, March 07, 2019 • *Shifting settlements: Responses to gunpowder and water management in medieval India* Asian Studies Spring Faculty Symposium, University at Buffalo, State University of New York, Buffalo NY, March 06, 2019 • *Foundation myths of Indian cities: Types and tropes* at the Event Water & Myth: Two Talks on Medieval Indian Cities, University of Rochester, NY, March 05, 2019 • *Forts in the Deccan: Changing paradigms of defense* Conference on the Forts of Maharashtra, K.R. Cama Oriental Institute, Mumbai, February 16, 2019

#### **Tarun Souradeep**

*Quest for cosmic origin* Institute Colloquium, IISER Pune, August 16, 2019; Physics Department Colloquium, IIT Madras, Chennai, September 18, 2019 • *LIGO-India: An Indian mega-science (ad)venture* Frontiers of Gravitational Wave Astronomy, TIFR-International Centre for Theoretical Sciences, Bengaluru, August 22, 2019; IASH-INSA Joint Workshop, Israel Academy of Science Humanities, Jerusalem, December 02–03, 2019; Meeting of the Astronomical Society of India (ASI-2020), IISER Tirupati, February 14–17, 2020 • *Driven by quests: Hearing aids & polarized glasses for space-time ripples* International Conference on Fundamentals of Physics, BM Birla Science Centre, Hyderabad, September 07, 2019 • *Our place in the universe* Institute of Science, Banaras Hindu University, Varanasi, November 07, 2019; Colloquium, TIFR-International Centre for Theoretical Sciences, Bengaluru, November 11, 2019 • *Quests for cosmic origin* Colloquium, DAE-Saha Institute of Nuclear Physics, Kolkata, November 20, 2019 • *CMB-Bhārat: Indian flavours in the next generation CMB effort* CoSyne: Cosmological Synergies in the Upcoming Decades, IAP Paris, December 09–12, 2019 • *Universe unravelled* Public talk on National Science Day, Inter-University Centre for Astronomy and Astrophysics, Pune, February 28, 2020

#### **S.G. Srivatsan**

*Clickable nucleotide toolbox for visualizing RNA and displaying functional small molecules on specific gene targets* NOST- XX Organic Chemistry Conference, Udaipur, December 04–07, 2019 • *Functionalized nucleoside toolbox for probing nucleic acids in cells* International Conference on Molecular Imaging and Minimally Invasive Therapy (2019 MIMIT), Beijing, October 18–20, 2019 (Keynote Speaker) • *Probing mood (structure) swings in therapeutic nucleic acid motifs* CDRI Award Lecture, CSIR-Central Drug Research Institute, Lucknow, September 27, 2019 • *Probing*

*mood (structure) swings in nucleic acids using multifunctional nucleoside probes* Organic Chemistry Symposium (OCS 2019), Lucknow, September 13–15, 2019 • *Nucleoside analogs for probing mood (structure) swings of non-canonical nucleic acid motifs* Indo-German Workshop on Emerging Trends in Chemistry and Materials, IIT Bombay, Mumbai, August 28–29, 2019 • *International summer school on nucleic acid chemistry and synthetic biology* Würzburg, Germany, July 28–August 02, 2019 • *Probing mood (structure) swings of non-canonical nucleic acid motifs* Institute of Organic Chemistry and Biochemistry, Academy of Science of the Czech Republic, Prague, July 24–26, 2019 • *Probes for understanding mood (structure) swings in nucleic acids* Karlsruhe Institut für Technologie (KIT), Germany, July 09, 2019; University of Konstanz, Germany, June 05, 2019 • *Probing mood (structure) swings of non-canonical nucleic acid motifs* 9<sup>th</sup> India Alliance Fellows' Meeting, Bengaluru, June 13–15, 2019 • *Functionalized nucleosides as supramolecular synthons and probes* SupraBio 2019, Barcelona, May 15–17, 2019 (Plenary Speaker)

#### **Arun Thalapillil**

*Astrophysics shedding light on exotic light states* Theoretical High Energy Physics Seminar, IIT Bombay Mumbai, October 17, 2019

#### **Bejoy Thomas**

Task Team on Politics, Conference on Cities Facing Escalating Water Shortages: Lessons Learned and Strategies Moving Forward, University of the Western Cape, South Africa, January 27–28, 2020 • Resource Person, Session on Normative Concerns, Integrated Water Resources Management (IWRM) Training Programme, ATREE, Bengaluru and Advanced Centre for Integrated Water Resources Management (ACIWRM), Government of Karnataka, December 02, 2019

#### **Gyana Ranjan Tripathy**

*Role of ion-exchange processes on trace elements of coastal lagoon system* Workshop on Application of ICP-MS in Earth, Planetary, Ocean and Atmospheric Sciences, Organized by CSIR-National Institute of Oceanography, Regional Centre, Mumbai, November 01, 2019

#### **Suneeta Vardarajan**

*The instability of anti-de sitter spacetime: Analytical aspects* International Conference of Gravitation and Cosmology (ICGC), IISER Mohali, December 13, 2019

#### **Arun Venkatnathan**

*Nanostructure and dynamics of polymer electrolyte membranes: Insights from molecular dynamics simulations* IISER Tirupati, May 27, 2019

# ACADEMIC EVENTS ORGANISED

## **Bijay Kumar Agarwalla**

Organiser, Quantum Thermal Machine workshop, Indian Institute of Technology (IIT), Gandhinagar, September 21–22, 2019

## **Chaitanya Athale**

Coordinated and led a seven-member undergraduate and three-member doctoral student team from IISER Pune for iGEM2019, an international synthetic biology competition

## **Nagaraj Balasubramanian**

Organiser, 1<sup>st</sup> TCGA-themed Conference and Workshop in India titled Multi-Omics Studies in Cancer: Learnings from TCGA, IISER Pune, September 21–25, 2019

## **Baskar Balasubramanyam**

Organiser, Number Theory Day, IISER Pune, February 17, 2020

## **Nirmalya Ballav**

Organiser, In-House Symposium of the Department of Chemistry - ChemSymphoria 2019, IISER Pune, July 18–20, 2019 • Organized In-House Symposium of the Centre for Energy Science - Energy Day 2019, IISER Pune, October 18, 2019

## **Argha Banerjee**

Organiser, Workshop on Thermodynamics in Earth Science, IISER Pune, October 09–15, 2019

## **Debargha Banerjee**

Organiser, Conference on Perfectoid Space, International Center for Theoretical Studies, Bengaluru, September 09–20, 2019

## **Bhas Bapat**

Organiser (along with Prof. C.V. Dharmadhikari), Workshop by CoESME on developing low-cost experiments for undergraduate physics laboratories, July 2019

## **Chandrasheel Bhagwat**

Member, Organising Committee for the workshop titled Intertwining Strands in Physics and Mathematics: Symmetry for undergraduate teachers in Mathematics and Physics, IISER Pune, January 14–18, 2020

## **Rajeev Bhalerao**

Member, National Advisory Committee, 64th DAE-BRNS Symposium on Nuclear Physics, Lucknow University, Lucknow, December 23–27, 2019

## **Mousomi Bhakta**

Organiser (along with Debdeep Ganguly, Anisa Chorwadwala, Manish Mishra, Steven Spallone), In-house Math Symposium, IISER Pune, August 30–31, 2019

## **Anup Biswas**

IFCAM school on Graphs and Random Processes, IISER Pune, December 16–20, 2019

## **Apratim Chatterji**

NPTEL Course on Computational Physics: video recorded and taught along with Dr. Prasenjit Ghosh as co-instructor

## **Chitrabhanu Chaudhuri**

Workshop on Quasiconformal Mappings and Teichmüller Theory, KSOM Kozhikode, February 19–23, 2020 (with Prof. Pranav Haridas) • Refresher course for College Teachers in Complex Analysis, KSOM Kozhikode, November 28–December 01, 2019 (with Prof. Pranav Haridas) • Workshop and Discussion meeting on Perfectoid Spaces, ICTS Bengaluru, September 09–20, 2019 (with Dr. Debargha Banerjee)

## **Jeetender Chugh**

Hosted 2<sup>nd</sup> Alumni Meeting of the India Sakura Science Club Alumni Association, Indian Institute of Technology, Delhi, February 15, 2020

## **Shouvik Datta**

Co-Organizer, 6<sup>th</sup> Mumbai-Pune Semiconductor Meeting, DIAT, Pune, March 21, 2020 (post-poned due to COVID-19 lockdown)

## **Sutirth Dey**

Co-organizer, Asia Pacific *Drosophila* Research Meeting (APDRC5), Westin Hotel, Pune; Chaired a session on Ecology and Evolution • Co-organizer, 6<sup>th</sup> Foundations of Biology Meeting, Ashoka University

## **Deepak Dhar**

Co-organiser, Intertwining Strands in Physics and Mathematics: Symmetry for undergraduate teachers in Mathematics and Physics, IISER Pune, January 14–18, 2020

## **Aurnab Ghose**

Co-organiser, B4 Bioluminescence Workshop, IISER Pune, August 01–14, 2019 • Co-organiser, 3<sup>rd</sup> National Post Doc Symposium 2019, IISER Pune, December 10–13, 2019

## **Anindya Goswami**

Arranged 2 elective courses for 3-4 year BS-MS students by guest lecturers: Regression Analysis, August 01, 2019; Operation Research, August 01, 2019; Advanced Operation Research, January 01, 2020 • Organised a two-day workshop on Introduction to Functional Programming through Scala Language for the internal students by guest lecturer, IISER Pune, December 01, 2019 • Organised a two-day Indo-French School on Graphs and Random Processes for internal and external research scholars, IISER Pune, December 16–20, 2019

## **Partha Hazra**

Co-ordinated Prof. Richard Zare's visit in IISER Pune

## **Neena Joseph Mani**

Co-convened a session "Understanding the Indian Ocean's past, present, and future", European Geophysical Union General Assembly 2019, Vienna, Austria, April 07–12, 2019

## **Tejas Kalelkar**

Co-organised Conference on Geometric Topology jointly with the Bhaskaracharya Pratishthana at their campus in Pune, December 06–08, 2019

## **Krishanpal Karmodiya**

Course Faculty, Hands-on course on Phase Separation in Genome Organization (PSiGO), IISER Pune, July 22–August 02, 2019

## **Mayurika Lahiri**

Organiser, 1<sup>st</sup> TCGA-themed Conference and Workshop in India titled Multi-Omics Studies in Cancer: Learnings from TCGA, IISER Pune, September 21–25, 2019

## **Moumita Majumdar**

Organiser, Biannual Mentoring Programme titled 'Prodigious Women in Chemical Sciences' November 21, 2019; February 20, 2020 • Arranged Wiley-VCH workshop themed on research publications conducted by Dr. Anne Deveson, Editor of *Chemistry Select* and Deputy Editor of *Chemistry-A European Journal* and Dr. Partha Pal, Wiley-VCH India, November 28, 2019

## **Vivek Mohan Mallick**

Co-organised a mini-symposium on Moduli, Cycles and Motives, Harish-Chandra Research Institute, Prayagraj:

## **Shreyas Managave**

Member, Organising Committee, Annual In-house Symposium of the Earth and Climate Science Department titled 'Sameeksha', January 11, 2020

**Manish Mishra**

Co-organiser, Conference on Number Theory and Branching Laws, IIT Bombay, March 2020 (Organisers: Anne-Marie Aubert, U.K., Anandavardhanan, Wee Teck Gan and Manish Mishra) (was cancelled due to the ongoing COVID-19 pandemic)

**Muhammed Musthafa**

Organised and Conducted Indo-U.K. Researcher Link Workshop on New Electrochemical Technologies for Sustainable Fuels, Chemicals and Industrial Processes, IISER Pune, December 02–05, 2019

**Suhita Nadkarni**

Computational Approaches to Memory and Plasticity, Summer School, Bengaluru, 2019 • No Garland Neuroscience (NGN) Meeting, January 02–04, 2020

**Angshuman Nag**

Organiser, Low Dimensional Materials (LDM) 2020, IISER Pune, March 11, 2020

**Shivprasad Patil**

Convenor, Conference called Soft Matter Young Investigator Meet (SMYIM) 2019, Shillong, May 12–14, 2019

**Mainak Poddar**

Co-organiser, Conference on Geometric Topology, Bhaskaracharya Pratisthana, Pune, December 06–08, 2019

**Girish Ratnaparkhi**

Co-organiser, Asia-Pacific *Drosophila* Meeting (APDRC5), along with the Indian *Drosophila* Research Conference (InDRC), IISER Pune, January 06–10, 2020 • Co-organiser, NCCS-IISER joint conference titled 'Signals from the Gut', January 05–06, 2020

**Richa Rikhy**

Co-organiser, B4 BioImaging workshop, IISER Pune, August 01–14, 2019 • Co-organiser, Asia Pacific *Drosophila* meeting, Westin, Pune, January 06–10, 2020

**Suneeta Vardarajan**

Scientific Organiser, ICGC Mohali, IISER Mohali, December 10–13, 2019

# NEW EXTRAMURAL GRANTS RECEIVED

Amount in ₹, Lakhs

Sr. No.	Name of the Project	Project Leader	Project Code	Funding Agency	Period From-To	Funds Received During the Year
01	CRISPR-Cas9 based genome editing approach to explore functions of actin binding proteins in zebrafish: Unravelling F-actin regulation underlying behaviour of cells, tissues and animals	Dr. Aurnab Ghose / Dr. Tressa Jacob	GAP/DBT/BIO-19-429	DBT	02.05.2019 01.05.2022	75.86
02	Studies on continuous flow macrolactonization using metal catalyst towards drug and natural products	Dr. Boopathy Gnanaprakasam	GAP/SERB/CHE-19-430	SERB	21.05.2019 20.05.2022	34.73
03	Plasmodfluidics in k space: Raman and Mie scattering studies- Swarnajayanti Fellowship	Dr. G.V. Pavan Kumar	GAP/DST/PHY-19-431	DST	28.06.2019 27.06.2024	125.44
04	Dispersal evolution in laboratory population of <i>Drosophila melanogaster</i> under low nutrition conditions	Prof. Sutirth Dey	GAP/SERB/BIO-19-432	SERB	27.06.2019 26.06.2022	22.56
05	FIST Program - ECS	HOD-ECS	GAP/DST/ECS-19-433	DST	28.06.2019 27.06.2024	125
06	VAJRA Faculty Scheme - Dr. Aditya Mohite, Rice University, Houston, U.S.A.	Prof. Satishchandra Ogale	GAP/SERB/PHY-19-434	SERB	05.07.2019 04.07.2020	10.92
07	Analysis of gravitational collapse using classical semi classical and stochastic gravity -Women Scientist Scheme A (WOS-A)	Dr. Seema Eruch Satin	GAP/DST/PHY-19-435	DST	16.07.2019 31.12.2020	9.38
08	Academic Innovatiion Research (AIR) - Electro spun nanofibre based multi stimuli responsive transdermal B12 deliver patch	Prof. Satishchandra Ogale	GAP/BIRAC/PHY-19-436	BIRAC	24.07.2019 23.01.2021	10.5
09	Analysis of epithelial to mesenchymal transaction regulation by mitochondrial morophology and metabolism in <i>Drosophila</i>	Dr. Richa Rikhy	GAP/SERB/BIO-19-437	SERB	25.07.2019 24.07.2022	26.56
10	Uncovering mechanistic roles for the post translational modifier SUMO in early <i>Drosophila</i> development	Dr. Girish Ratnaparkhi - Dr. Dipti Trivedi - NCBS	GAP/SERB/BIO-19-438	SERB	06.08.2019 05.08.2022	17.8
11	Developing cancer models using CRISPR-Cas9 Technique in zebrafish	Prof. Sanjeev Galande	GAP/DBT/BIO-19-439	DBT	26.07.2019 25.07.2022	15.86
12	Biophysical and structural studies on Frzcd, a cytoplasmic methyl accepting chemosensory protein (MCP) involved in <i>Myxococcus xanthus</i> motility	Dr. Gayathri Pananghat	GAP/SERB/BIO-19-440	SERB	06.08.2019 05.08.2022	28.3
13	Development of cyclic saccharide based synthetic chloride transporters and evaluation of their apoptosis inducing activity	Dr. Pinaki Talukdar	GAP/DST/CHE-19-441	DST	29.07.2019 28.07.2022	53.14
14	Single molecule biophysics using a small amplitude atomic force microscopy	Dr. Shivprasad Patil	GAP/DST/PHY-19-442	DST	19.06.2019 18.06.2021	3.23
15	International Genetically Engineered Machines Contest (iGEM-2019) - at Massachusetts Inst of Tech (MIT), Boston, U.S.A.	Dr. Chaitanya Athale	GAP/DBT/BIO-19-443	DBT	09.09.2019 04.11.2019	8
16	High performance graphene based supercapacitors	Dr. Nirmalya Ballav	GAP/DST/CHE-19-444	DST	24.09.2019 23.09.2022	40.79
17	Room temperature aqueous phase alcohol dehydrogenation with electricity generation	Dr. Muhammed Mustafa O.T.	GAP/DST/CHE-19-445	DST	20.09.2019 19.09.2022	21.18
18	Collaborative project for development of science videos	Dr. Harinath Chakrapani	GAP/PRATHAM/CHE-19-446	Pratham Education Foundation	01.10.2019 28.02.2021	4.72

Sr. No.	Name of the Project	Project Leader	Project Code	Funding Agency	Period From-To	Funds Received During the Year
19	Adsorption and separation of CO <sub>2</sub> by porous carbon obtained from agro residues through cost effective clean energy methodology	Dr. Sujit Kumar Ghosh	GAP/DST/CHE-19-447	DST	09.10.2019 08.10.2022	6.05
20	AOARD - The quest for magnetoelectric multiglasses	Dr. Sunil Nair	GAP/AOARD/PHY-19-448	Asian Office of Aerospace R & D (AOARD)	16.10.2019 03.11.2020	17.73
21	Nanovesicle mediated delivery of MLN8237 to specifically target the Aurora Kinase A (AURKA)-RalA anchorage independence pathway in cancers	Dr. Nagaraj Balasubramanian	GAP/ICMR/BIO-19-449	ICMR	25.09.2019 24.09.2020	18.6
22	The nature of biotic interaction and community structure of marine molluscs as a response to regional environmental triggers in a tropical island ecosystem	Dr. Devapriya Chattopadhyay	GAP/SERB/ECS-19-450	SERB - Transfer from IISER Kolkata	19.03.2019 18.03.2022	12.9
23	The Rufford Foundation Grant for Ram Mohan-29441-1 / To support acoustics and conservation-Bats and birds in semiarid landscapes	Ram Mohan (student of Dr. Anand Krishnan)	GAP/RUFFORD/BIO-19-451	The Rufford Foundation	01.11.2019 31.01.2021	5.4
24	J C Bose Fellowship to Prof. Sanjeev Galande	Prof. Sanjeev Galande	GAP/SERB/BIO-19-452	SERB	30.10.2019 29.10.2024	10
25	Seismic analysis of sub seafloor gas migration over an arctic methane hydrate retreat zone	Dr. Sudipta Sarkar	GAP/SERB/ECS-19-453	SERB	15.11.2019 14.11.2021	15
26	Stable isotopic and molecular composition of vegetation and soil organic matter across the precipitation gradient of the Western Ghats	Dr. Shreyas Managave	GAP/SERB/ECS-19-454	SERB	20.11.2019 19.11.2022	23.5
27	Centralisers and conjugacy in algebraic group	Dr. Anupam Kumar Singh	GAP/SERB/MTH-19-455	SERB	18.12.2019 17.12.2022	10.62
28	Design and development of organic persulfide donors	Dr. Harinath Chakrapani	GAP/SERB/CHE-19-456	SERB	04.01.2020 03.01.2023	40.98
29	Non linear dielectric materials based on cyclic and acyclic organo and amino P (V) motifs for energy harvesting and storage applications	Dr. R. Boomi Shankar	GAP/SERB/CHE-19-457	SERB	04.01.2020 03.01.2023	41.52
30	Insights into mechanical failure of amorphous solids using colloidal suspensions	Dr. Vijayakumar Chikkadi	GAP/SERB/CHE-19-458	SERB	04.01.2020 03.01.2023	19.42
31	Multi functional amino acid based biodegradable polymer scaffolds for cancer treatment	Prof. M. Jayakannan	GAP/SERB/CHE-19-459	SERB	04.01.2020 03.01.2023	39.09
32	Surface ligand directed catalysis outplaying ligand poisoning in metal and semiconductor nanoparticle catalyzed reactions	Dr. Pramod Pillai	GAP/SERB/CHE-19-460	SERB	29.01.2020 28.01.2023	20
33	Aspects of relativistic heavy ion collisions and quark gluon plasma	Dr. Sourabh Dube	GAP/SERB/PHY-19-461	SERB	15.01.2020 14.01.2023	8.06
34	Combination of scandium triflate and diverse propargyl aryl diazoacetates as novel catalyst reagent system for the direct asymmetric site selective C-H bond functionalization an easy access to bioactive compounds	Dr. R.G. Bhat	GAP/SERB/CHE-19-462	SERB	28.01.2020 27.01.2023	16.51
35	Genome India cataloguing the genetic variation in Indians	Dr. Mayurika Lahiri	GAP/DST/BIO-19-463	DBT	16.01.2020 16.01.2023	12
36	Antibodies targeting the heparanase active site for cancer therapy	Dr. Raghavendra Kikkeri	GAP/SERB/CHE-19-464	SERB	05.02.2020 04.02.2023	49.26
37	A mechanism based approach to the biosynthesis of vitamin B2 cofactor analogs	Dr. Amrita Hazra	GAP/SERB/CHE-19-465	SERB	05.02.2020 04.02.2023	38.72

Sr. No.	Name of the Project	Project Leader	Project Code	Funding Agency	Period From-To	Funds Received During the Year
38	Tautomeric ligands for metal ligation and as building blocks for conjugated macrocycles	Prof. V.G. Anand	GAP/SERB/CHE-19-466	SERB	05.02.2020 04.02.2023	29.43
39	CEFIPRA Research Project-62T5-1- Understanding mechanobiological basis of the evolutionary diversity in spindles dynamics of nematodes	Dr. Chaitanya Athale	GAP/CEFIPRA/BIO-19-467	IFCPAR-CEFIPRA	04.01.2020 03.01.2022	12.7
40	Investigating magneto structural transitions using resonant ultrasound spectroscopy	Dr. Sunil Nair	GAP/SERB/PHY-19-468	SERB	07.02.2020 06.02.2023	56.53
41	Conformational properties of block polyelectrolytes a coarse grained molecular dynamics study	Dr. Srabanti Chaudhury	GAP/SERB/CHE-19-469	SERB	11.02.2020 10.02.2023	34.72
42	MHRD-STARS-From the Gut: Sumo cycles its way into gastrointestinal disorders	Dr. Girish Ratnaparkhi	GAP/MHRD/BIO-19-470	MHRD	13.02.2020 12.02.2023	29.82
43	MHRD-STARS-Deciphering chemical code of Extracellular matrix in cancer biology	Dr. Raghavendra Kikkeri	GAP/MHRD/CHE-19-471	MHRD	05.02.2020 04.02.2023	16.48
44	MHRD-STARS-Borophene a new entrant in flatland en route to synthetic materials design	Dr. Aparna Deshpande	GAP/MHRD/PHY-19-472	MHRD	05.02.2020 04.02.2023	22.08
45	SERB MATRICES Grant - Certain shape optimization problems	Dr. Anisa Chorwadwala	GAP/SERB/MTH-19-473	SERB	15.02.2020 14.02.2023	2.2
46	SERB MATRICES Grant - Chaos and dynamical localization in an interacting many body system with a classical limit	Prof. M.S. Santhanam	GAP/SERB/PHY-19-474	SERB	15.02.2020 14.02.2023	2.2
47	SERB-MATRICES Grant -What is the next fundamental length scale of nature	Dr. Diptimoy Ghosh	GAP/SERB/PHY-19-475	SERB	20.02.2020 19.02.2023	2.2
48	SERB-MATRICES Grant - Local and global statistics for sato Tate sequences	Dr. Kaneenika Sinha	GAP/SERB/MTH-19-476	SERB	15.02.2020 14.02.2023	2.2
49	SERB-MATRICES Grant -Equivariant bundles over toric varieties	Prof. Mainak Poddar	GAP/SERB/MTH-19-477	SERB	18.02.2020 17.02.2023	2.2
50	Design of structure based peptidomimetic inhibitors for P53-MDM2 interactions: a new strategy to develop cancer therapeutics	Prof. H.N. Gopi	GAP/SERB/CHE-19-478	SERB	17.02.2020 16.02.2023	34.49
51	Understanding the cooperativity of protein folding reactions	Prof. Jayant B. Udgaonkar	GAP/SERB/BIO-19-479	SERB	20.02.2020 19.02.2023	21.27
52	Development of metal organic frameworks (MOFs) based sensory materials for detection of environmental pollutants in water	Dr. Sujit Kumar Ghosh	GAP/SERB/CHE-19-480	SERB	21.02.2020 20.02.2023	37.54
53	Excitonic condensed matter physics of dipolar electron hole bilayers at the hetero interface	Dr. Shouvik Datta	GAP/SERB/PHY-19-481	SERB	25.02.2020 24.02.2023	69.51
54	Quantum Information technologies with ion trap and optical lattice devices of Interdisciplinary cyber Physical Systems (ICPS) Division of DST - Cluster Proposal	Dr. Umakant Rapol	GAP/DST/PHY-19-482	DST	27.03.2020 26.03.2023	50
55	Quantum information technologies with nitrogen vacancy and magnetic resonance of Interdisciplinary cyber Physical Systems (ICPS) Division of DST - Cluster Proposal	Prof. T.S. Mahesh	GAP/DST/PHY-19-483	DST	27.03.2020 26.03.2023	50
56	Mechanism of DNA translocation by NTP dependent restriction enzymes - S Ramachandran National Bioscience Award for Career Development (NBACD)-2019	Dr. Saikrishnan Kayarat	GAP/DBT/BIO-19-484	DBT	07.02.2020 06.02.2023	7

Sr. No.	Name of the Project	Project Leader	Project Code	Funding Agency	Period From-To	Funds Received During the Year
57	A novel approach to docking and identification of prospective drug like compounds	Dr. Arnab Mukherjee	GAP/DBT/BIO-19-485	DBT	28.02.2020 27.02.2023	17.26
58	Pilot Programme of India Innovation Competency Enhancement Program (IICEP)	Dr. Harinath Chakrapani	GAP/DBT/CHE-19-486	DST	27.03.2020 26.03.2023	400
59	Pilot Programme of India Innovation Competency Enhancement Program (IICEP)	Dr. Harinath Chakrapani	GAP/Tata/CHE-19-487	Tata Technologies Ltd.	27.03.2020 26.03.2023	100
60	SERB Matrics Grant - Shear bonding in complex fluids: developing a microscopic understanding using a coarse grained polymer model	Dr. Apratim Chatterji	GAP/SERB/MTH-19-488	SERB	03.03.2020 02.03.2023	2.2
61	Functional characterisation of the novel actin interacting protein kaptin and its regulation of cytoskeleton dynamics in neurons	Dr. Aurnab Ghose	GAP/SERB/BIO-19-489	SERB	19.02.2020 18.02.2023	10.76
62	Women Excellence Award to Dr. Mousomi Bhakta	Dr. Mousomi Bhakta	GAP/SERB/MTH-19-490	SERB	30.03.2020 29.03.2023	6



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