

भारतीय विज्ञान शिक्षा एवं
अनुसंधान संस्थान पुणे

वार्षिक प्रतिवेदन २०१८ - २०१९

Indian Institute of Science
Education and Research Pune

Annual Report 2018 - 2019

On the Cover

The image on the cover is a packed view of a chemically ultra-stable Metal-Organic Polyhedra (MOP). In this work, Dr. Sujit K. Ghosh's group has developed a prototype strategy to generate chemically stable MOPs utilising hydrophobic shielding as the cornerstone design principle.

Image Credit

Dr. Sujit K. Ghosh's Group

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वार्षिक प्रतिवेदन २०१८ - २०१९

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH PUNE
Annual Report 2018–2019





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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, 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.

Ranked 23 in India in the overall category of the 2019 NIRF India Rankings, 101-150 in the 2019 Times Higher Education (THE) Young University Rankings, and 601-800 in 2019 THE World University Rankings, IISER Pune is emerging as a prominent academic organisation in India.

The IISER group of Institutions is listed among the top 100 globally for research output by the 2019 Nature Index Normalised Rankings.

Foreword

IISER Pune has always been committed to providing a world class education to its students. When I joined IISER Pune in November 2017, it became clear to me very soon after talking to a wide cross-section of students and faculty members, that it was time to examine whether the BS-MS programme needed tweaking or even more substantive change. The programme was unique with students learning in the classroom, from carrying out research projects, and from supervised reading projects. Any modification in an already successful programme would have to be done with care. But it was clear that students wanted more rigour, and more depth in the courses taught to them. And faculty members wanted to be able to teach more, in depth and in scope.

In any undergraduate programme, it is important to have a good balance between depth and breadth. Breadth in education is important for many aspects of what we consider to be a good education. We want to teach our students to think about problems not just in a dry, analytical manner, but also to think in a manner that combines logic with imagination so that they have new ideas and paradigms to test. They need to learn to think in a manner that does not preclude questioning, not only of the subject matter, but also of their own scientific beliefs, assumptions, and conventions. They need to learn to think in a manner that leads to greater trust in their own abilities, so that they become convinced that they will always be able to learn new things on their own, for the rest of their lives. A breadth in education makes students more balanced, and leads to a better overall development of their character. It teaches them not only how complex science can be, but also how life itself is full of contradictions, and is a constant struggle. A broad education is what provides the way forward for the many of our students who come to us as uncertain teenagers, with minds that have not yet decided what they would want to do in the future when they leave the Institute as young adults.

IISER Pune has always prided itself that it prepares students well for carrying out interdisciplinary research. The education required for carrying out path-breaking interdisciplinary research itself requires a fine balance between breadth and depth. Breadth in the form of exposure to, and training in, multiple subjects, so that the student becomes familiar with, and hence, is not intimidated by any topic. Depth because interdisciplinary fields of research are invariably advanced by scientists who had depth and rigour in their training and thinking, and hence, are real experts in their chosen disciplines. The best interdisciplinary research requires someone who is a

true expert in at least one discipline.

We had an Academic Advisory Committee working hard and long to come up with a new academic programme after many discussions, some quite argumentative. Many of the distinctive features of the IISER Pune BS-MS programme have of course been retained, and the changes made have allowed many of the concerns of students and faculty members to be addressed. The new curriculum for the new programme has been developed under the oversight of our Curriculum Committee, and the individual departments, with much hard work by many faculty members. I am sure that the new academic programme, which is being implemented from this year, will have the right balance of depth and breadth, and will evolve into one of the best undergraduate programmes anywhere.

Of course, there is much left to be done for that to happen. We faculty members need to learn to teach even better, so that we can even more successfully mentor our students, and excite them to start loving topics they had no previous interest in. The Institute plans to have a Centre for Teaching Excellence that will help our faculty members in this, by introducing new pedagogical tools. We need to have programmes in place that will teach students the enduring skills. These include the essential skills to think well, that they will need for the rest of their lives, as well as the soft skills that will help them move successfully from IISER Pune to their next destination. We need to have better systems in place to help our students to find good positions when they leave here for short periods or for good, whether in academic or industrial research, or in science education or science management or science communication, or anything else they become interested in during their stay at the Institute. The Institute is actively recruiting new faculty members in the Humanities, and has made plans to start activities in Computer Science, especially in Artificial Intelligence and Data Science.

For accomplishing all this, and for our academic programmes to flourish, we will continue to need the continuing cooperation and enthusiastic support of all our staff, teaching as well as non-teaching. Fortunately, IISER Pune is an Institute where this is never in short supply.

Jayant B. Udgaonkar

Director, IISER Pune

September 27, 2019

Director's Report



It is my privilege to present the annual report of the Institute for the duration April 2018 to March 2019.

Two significant events occurred during the year. After twelve years of being in Project mode, the Institute underwent a thorough appraisal of its progress on all fronts, including academic and research activities, and campus infrastructure development. On the basis of the Appraisal Report, the MHRD declared IISER Pune to be out of Project mode in August 2018. This development, which acknowledges the contributions of the Institute to education and research, means that the government now considers IISER Pune to be an established institute, much like its peer institutions across the country.

Soon after the MHRD declared IISER Pune out of Project mode, it commissioned an External Peer Review Committee of accomplished academicians to assess all aspects of the Institute's functioning, including its research and academic programmes and outcomes, student activities, and the administration. It is gratifying that the Committee noted that "IISER Pune has already become one of the top 2 to 3 institutes in the country in both undergraduate science education and advanced research". More importantly, the Committee made very useful suggestions about how we can improve

our functioning, give a boost to ongoing programmes, and add new programmes. We have, of course, already started implementing many of the suggestions.

In the 2019 India Rankings of the National Institutional Ranking Framework (NIRF) by the MHRD, which considers all universities and national institutes, IISER Pune has been ranked at the 23rd position, as opposed to the 32nd rank in NIRF 2018. It is perhaps worth mentioning that nearly all the more highly ranked institutes and universities are much larger institutions. We, too, have to grow in size.

A research university such as IISER Pune is known by the quality of its faculty, and its students. We are fortunate that we get to select from amongst the best applicants in the country in both categories. We now have 121 faculty members in our six departments. We also have 1435 students, with 937 BS-MS, 189 Integrated PhD, and 309 PhD students (numbers are as of March 31, 2019).

The quality of teaching and research in any university is often determined by the commitment and accomplishment of its youngest faculty members. New faculty members bring in new scholarship, new expertise,

new technology, and new ways of thinking. We have had three new faculty members join the institute in the past year.

They include K. Karmodiya (Biology); D. Ghosh (Physics); and M. Poddar (Mathematics). We are sure they will do very well, in teaching as well as in research.

The quality and quantity of research publications from the Institute has been increasing over the years. The total number of research publications from the Institute is now 2340. We are also happy that B. Sandanaraj was granted a U.S. patent recently for developing a process for the preparation of hydrophobin mimics.

An indicator of the growing strength of our research programmes is their ability to garner extramural funds. In the past year, the Institute managed over 201 extramural projects, and our faculty members secured 75 new projects. One of the major projects that the Institute has embarked upon is Manav, the human atlas project. Through funding from the Department of Biotechnology, and in partnership with Persistent Systems and the National Centre for Cell Science, this project aims to construct a comprehensive map of the entire human body, which will explicitly document macro to micro level information.

Also initiated during the year is the Pune Biotech Cluster, a joint initiative between the National Centre for Cell Science and IISER Pune set up with funding from the Department of Biotechnology. The goal is to integrate the high-quality work being done at various research organisations in the field of Biology, especially those addressing human disease biology, and for academic institutions and industries to liaise in this endeavour. Aimed at strengthening research capacity in the areas of gravitational wave physics and astronomy is the IUCAA-IISER Joint Centre for Gravitational Physics and Astronomy (CGPA); this project has been initiated during the year.

The quality of research accomplishment at IISER Pune has led to recognition in the form of prestigious awards to faculty members.

M. Bhakta won the Young Scientist Medal of the Indian National Science Academy (INSA), New Delhi; L.S. Shashidhara was elected as European Molecular

Biology Organization (EMBO) Associate Member; G.V. Pavan Kumar was elected as a Senior Member of the Optical Society of America (OSA) and was selected for the DST's Swarnajayanti Fellowship in the area of Physical Sciences for the year 2017–2018; T. Pucadyil was awarded the CSIR's Shanti Swarup Bhatnagar Prize in the area of Biological Sciences for the year 2018; S. Ogale was awarded the Raja Ramanna Fellowship of the DAE; S.G. Srivatsan was selected for the 2019 CDRI Award for Excellence in Drug Research in the Chemical Sciences category; A. Biswas was appointed as an Associate Editor of the journal *Annals of Applied Probability*; A. Raghuram was appointed as a Distinguished Honorary Professor by IIT Kanpur; and A. Natu was honoured by the German Government with the prestigious 'Cross of Merit', and was nominated to be the Chairperson of the Board of Governors of IISER Kolkata.

As a new member of the International Mouse Phenotyping Consortium, IISER Pune is now one of the 20 major mouse genetics centres worldwide. This membership will provide IISER Pune access to transgenic and knockout lines, and promote ways to share information and resources with the scientific community across India. The presence of a world-class Animal House at IISER Pune, has enabled many students to work at the forefront of biomedical research.

Our students continue to do well, and not just in their studies. PhD students Abhijit Gupta and Shubham Singh won the Python Innovation Day Hackathon, an event organised by Intel, IISER Pune, and Amazon Web services, which was held with the aim to motivate and harness talent for solving real world problems in the areas of science and technology. Three IISER Pune members—PhD student Prabhat Prakash, post-doctoral fellow Dr. Siva Koti Sangabathuni, and research scientist Dr. Smita Chaturvedi—have been selected as Fulbright-Nehru Fellows for the year 2018–19. Popular science articles written by Dr. Ulfat Baig and Dr. Gunjan Verma have been selected for the 2018 AWSAR Awards given by the Department of Science and Technology (DST), Govt. of India.

At the 7th Inter IISER Sports Meet (IISM) of 2018 held at NISER Bhubaneswar, teams from IISER Pune were declared champions in Table Tennis (Men) and Badminton (Mixed); and both the Men and Women

basketball teams of the Institute won the third place. IISER Pune members received 2 Gold, 2 Silver, and 4 Bronze medals in the Athletics events. Congratulations to all our sportspersons.

Other extra-curricular events are also very important. 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*, and the Techstars Global Startup Weekend 2018. Disha and Prutha, voluntary organisations at the Institute in the areas of education of the underprivileged and environmental issues, respectively, continue their important work.

The eighteen national and international conferences and workshops organised during the past year brought many outside scientists to the campus. These include a conference on Innovations in Frontier Chemistry; an international workshop on Mathematical Finance; a course on Mouse Sperm and Embryo Cryopreservation Course; an Energy Day symposium; a Breast Cancer symposium; the Mumbai-Pune Quantum Condensed Matter Physics Meeting; a symposium on Chemistry and Physics of Advanced Materials; a workshop on Volume Conjecture and Related Topics in Knot Theory; an international conference on Polymer Science and Technology; a meeting on Facets of Photonics 2018; a Workshop on Molecular Modeling in Chemistry; a Meeting on Statistical Mechanics and Soft Matter; the Number Theory Day Symposium; the 5th Pune Mumbai Number Theory Seminar; a mini symposium on Emergence of Life; a workshop on Parameterized Algorithms; the Pune-Mumbai Collider Meet 2019; and an international conference on Structural and Inorganic Chemistry.

Distinguished speakers delivered thought-provoking public lectures at the institute, including the 'Dawn of gravitational wave physics and astronomy' by Prof. B. Sathyaprakash (Penn State University); 'Chance ki baat hai: How complexity arises in dynamical systems' by Prof. Ram Ramaswamy (Jawaharlal Nehru University); the second Annual P.M. Mukhi Memorial Human Rights Lecture 'Confronting human rights skepticism' by Dr. Pratap Bhanu Mehta (Ashoka University); 'Viewing the beginning of time from the most remote places on earth' by Zeeshan Ahmed (Kavli Institute for Particle

Astrophysics and Cosmology and SLAC National Accelerator Laboratory); 'The works of Michael Atiyah - Some glimpses' by Prof. M.S. Raghunathan (DAE-MU Centre for Excellence in Basic Sciences, Mumbai); a Manthan Leadership Talk 'A social security paradigm under the Government of India' by entrepreneur Milind Kamble; and 'What the world is made of?' by Prof. Arnulf Quadt (Georg August University).

IISER Pune has signed a MoU with Sorbonne University, France, and with Florence University, Italy to support academic collaboration in activities such as student and staff exchange visits, joint symposia/conferences, and research collaboration. The IISER Pune-CNRS joint research programme, launched in April this year, will fund PhD fellowships on each side, and travel. IISER Pune is the joint coordinator for the NAMASTE Plus project in collaboration with the University of Goettingen towards bilateral exchange visits for students, staff and postdocs, as well as joint workshops. This project recently received funding from DAAD.

The Institute was active in promoting government initiatives such as the Rashtriya Avishkar Abhiyan for nurturing creativity through the Science Nurture Programme. This initiative is coordinated by Disha. The Institute hosted two DST-INSPIRE Science Internship Camps for 11th standard school students, and the Vigyan Jyoti Orientation Camp, an initiative by DST to promote awareness about careers in science and technology among girl students from schools. Ten events related to teacher training were conducted by the Centre of Excellence in Science and Mathematics Education (CoESME). The 2018 Jigyasa Science Model Exhibition saw participation from over 13,000 science enthusiasts including students and educators.

Partnerships and collaborations with industry are critical for an institute's growth. While the Government of India continues to provide funding to IISER Pune, it has become clear that, in the future, the institute will require generous support from non-government organisations and from industry.

The Institute organised the first IISER Pune-Industry Conclave in January 2019, which brought together industry leaders, professionals, and academics from the Institute with a shared interest in scientific research and development. With participation from over 20 industry

stalwarts, this Conclave provided a great opportunity for our researchers to network and explore possibilities of partnering with the industry.

In a recent event that brought together students and researchers from academia and the industry, IISER Pune and KPIT together hosted the KPIT Shodh Awards and PhD Conference on Energy and Mobility. Importantly, IISER Pune also conducted a series of science talks titled "Science to the Doorsteps of Technocrats". This lecture series aimed to bring the frontiers of science to technocrats, thereby making them aware of the latest developments, and helping them improve their preparedness for developing and/or adopting newer technologies.

IISER Pune has been fortunate to win the trust and support of several Foundations and Corporates. Our association with the Infosys Foundation, the Balan group, Bajaj Auto Ltd., Precision Wires Ltd., Cipla Foundation, IDEaS, and Xytel India continues. In its second year of association with the Institute, IDEaS has pledged to continue to support academic excellence of students at the Institute. The construction of a modern chemistry research laboratory for undergraduate students, funded by the Cipla Foundation, is now nearly complete. This facility will also provide space for outreach activities involving teacher and student training, and will serve as a platform for developing industry-academia interactions. Endowments from Persistent Foundation and Eppendorf India Pvt. Ltd. will support science popularisation and training in molecular biology, respectively, for school and undergraduate students.

An endowment from Siemens Industry Software India Pvt. Ltd. will support PhD fellowships. IISER Pune now has an MoU with Tata Consultancy Services under its Co-Innovation Network™ (COIN™). TCS COIN™ brings together a network of experts from the start-up, research, academic, and corporate worlds to work on collaborative innovations. New R&D collaborations with multiple other industrial partners including ONGC are underway.

In a new partnership with Tata Technologies, IISER Pune has initiated the STEP for STEM programme through which, over the next two years, 200 teachers and 1000 students will directly benefit from training on activity-based STEM learning. This activity is being coordinated by the Smt. Indrani Balan Science Activity Centre on the campus.

Our faculty and students are talented and enthusiastic, and our administration and engineering services are very supportive. There is therefore no reason why IISER Pune will not be able to overcome academic, research, and financial challenges, in order to meet the expectations of the country, and become one of the best science education and research institutes in India and the world.

It is my pleasure to acknowledge the wise counsel and support of the members of the Board of Governors, the Senate, the Finance and Building Committees, and of the MHRD. They have all been of much assistance in the proper running of the Institute.



Jayant B. Udgaonkar



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List is as per the Official Memorandum issued on April 23, 2018; changes during the year are not shown here

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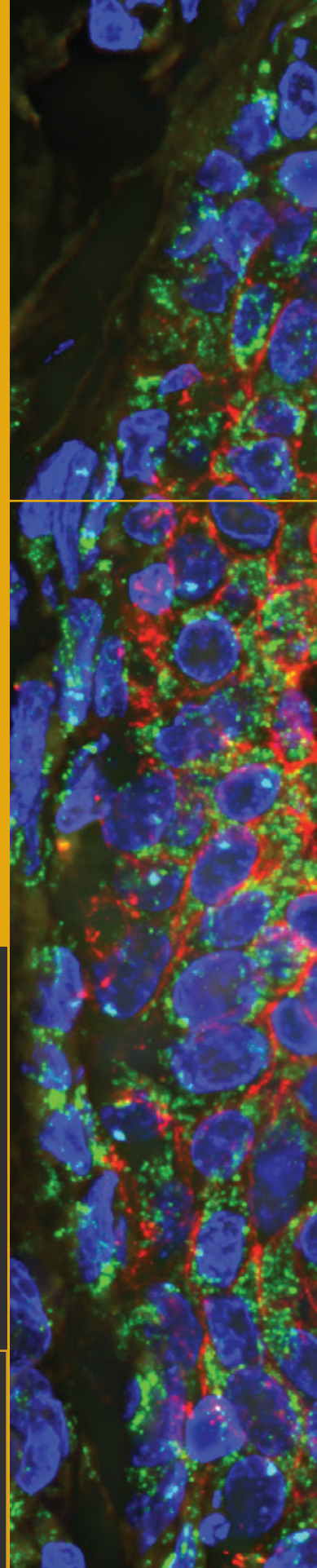
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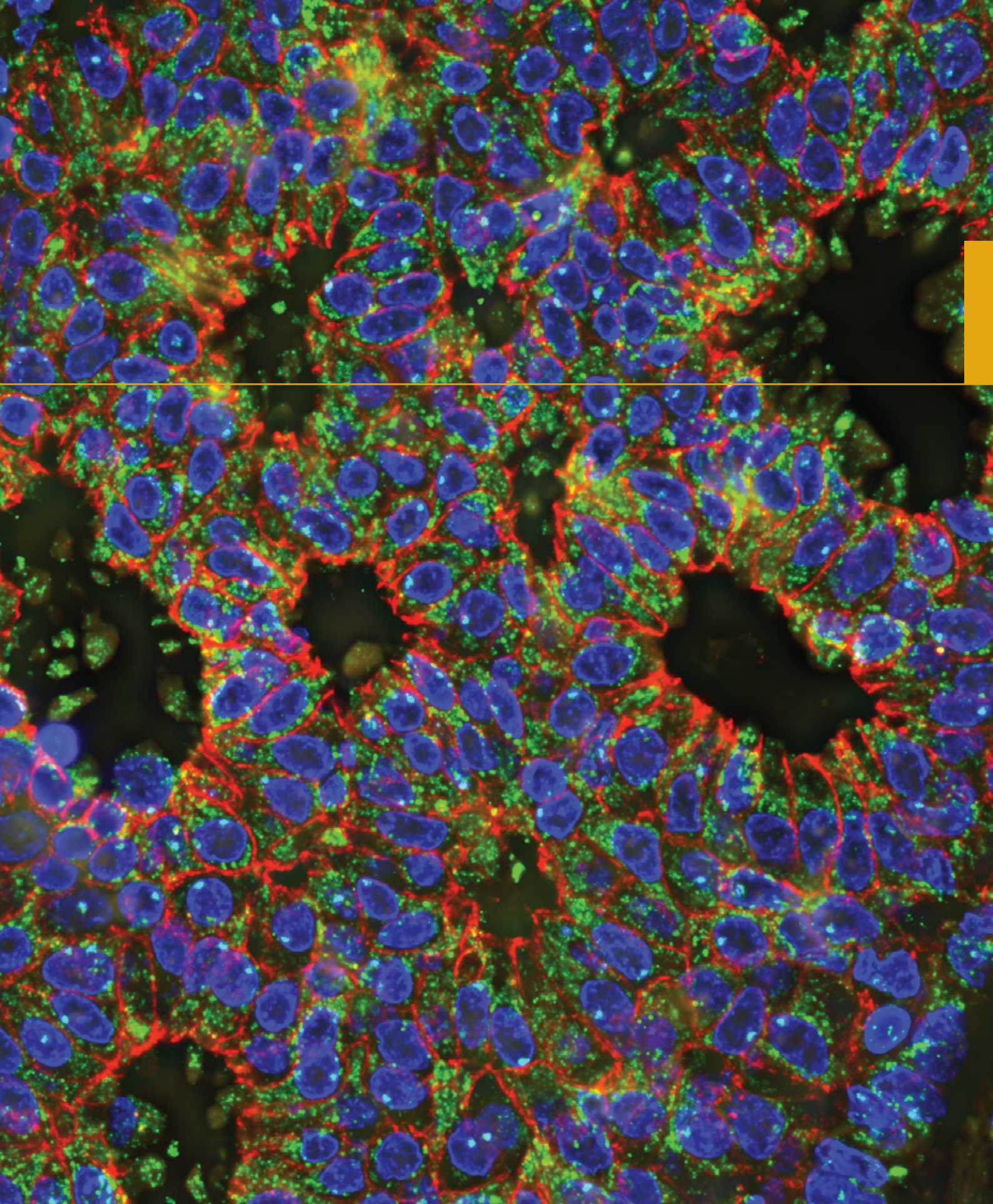
01

Research Activities and Achievements

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- 58 / Awards and Honours
- 60 / Memberships and Affiliations

01





Morphology of a tumour

Image Credit: Abhijit, K., PhD Student, Dr. Mayurika Lahiri's Group



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. The number of patent applications from the Institute is on the rise. During this year, a U.S. patent for the preparation of hydrophobin molecules has been granted to Dr. Britto Sandanaraj. 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 2018

PUBLICATIONS IN 2018: 525



74
BIOLOGY



143
CHEMISTRY



10
EARTH AND
CLIMATE SCIENCE



14
HUMANITIES AND
SOCIAL SCIENCES



22
MATHEMATICS



262
PHYSICS



1.1 Biochemistry and Biophysics

Self-organisation and cell morphogenesis

Work in Dr. Chaitanya Athale's laboratory has focused on mechanobiology of microtubule-motor interactions and predictions these might make for cell shape. The group has been using three approaches: (a) in vitro reconstitution of purified microtubules (MTs) and dynein motors; (b) quantitative microscopy and image analysis; and (c) stochastic simulations of collective transport properties. In the year 2018–19, Dr. Athale's group has employed “gliding assays” where immobilised dynein motors transport MTs and studied minus-ended motor protein (Dynein) from *S. cerevisiae* based MT transport. This ‘minimal’ dynein in experiments showed a 2D directionality that increased with MT length that can be explained by a computational model that combines “search” and “collective mechanics” of the motor (Jain, Khetan & Athale 2019 *Soft Matt.*). They plan to work further on the role of this motor in nuclear positioning during cell division, differentiation, and cancer.

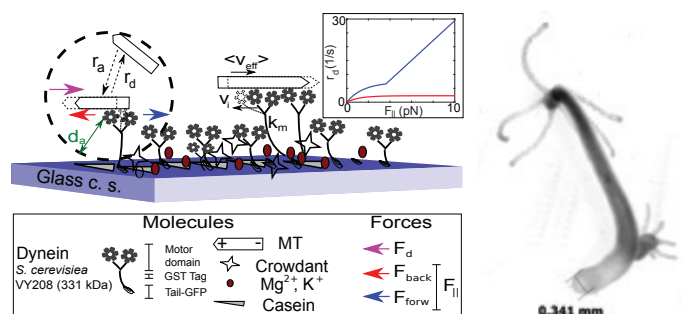


Figure 1: (Left) Schematic representing a gliding assay in which dynein motors immobilised on a glass surface bind to, and walk on microtubules that are in the bulk, resulting in the net transport of the microtubules. The detailed collective mechanics are also modelled using a force-dependent detachment rate model taken from previous reports (inset). (Right) A representative image of *Hydra magnipapillata* used to measure the mechanics of detachment of these sedentary animals from glass and soft substrates. (Dr. Chaitanya Athale's Group)

By developing a “flow-chamber”, they have also examined the surface detachment dynamics of two *Hydra* species that are adhered to hard and soft substrates. In this study, the detachment force was found to be comparable to those the animal is likely to experience in water bodies where it is naturally found (Khetan, Maheshwari and Athale, 2019, *Proc. INSA*). Such work in future could identify both mechanical properties of animal locomotion as well as allow reconciliation of what is known about the biochemical “glues” that bind these animals to their substrates.

A chemical biology approach towards understanding human lipid metabolism and signalling

Genome sequences have revealed that all organisms, including humans, possess a large number of uncharacterised enzymes. This finding belies the notion that our knowledge of cell metabolism is nearly complete and further underscores the vast landscape of unannotated biochemical pathways operating in our cells and tissues. Thus, the functional annotation and biochemical characterisation of these unknown enzymatic pathways represents a grand challenge for researchers in the post-genomic era. To address this problem, Dr. Siddhesh Kamat's group has tailored two technologies namely: (i) activity-based protein profiling, and (ii) lipidomics, and uses them in tandem to functionally annotate enzymes involved in human lipid metabolism and signalling pathways.

The group found that the enzyme ceramide synthase orchestrates the flux of very long chain ceramide lipids, which play an important role in phagosomal maturation. The group is studying the serine hydrolase enzyme ABHD12, mutations of which cause the human neurological disorder PHARC (*p*olyneuropathy, *h*earing loss, *a*taxia, *r*etinitis pigmentosa, and *c*ataract). The group has shown that ABHD12, an endoplasmic reticulum resident lipase, shows a preference for metabolising very long chain lipids. They have also established ABHD12's role in an as-of-yet unknown enzymatic network that controls levels of pro-apoptotic oxidised phosphatidylserine lipids in humans. Together, these findings build upon our current understanding of PHARC and provide new molecular insights into the disease pathology and exciting new opportunities for treating this neurodegenerative disease.

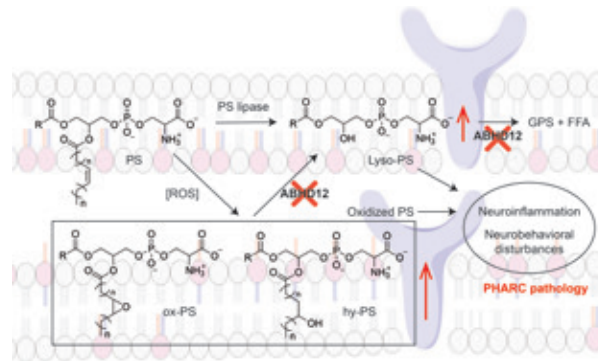


Figure 2: Lipid pathways contributing towards the pathology of PHARC (Dr. Siddhesh Kamat's Group)

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.

The group has characterised a novel small Ras-like GTPase from *Myxococcus xanthus* and found a common GAP protein for two GTPases involved in motility. Oligomeric studies of FrzCD, a novel DNA-binding methyl accepting chemosensory protein, were indicative of the relevance of a trimer-of-dimer interface.

Genetics study on *Spiroplasma* for identifying shape-determining cytoskeletal components is in progress, along with comparative studies between helical and non-helical strains. Structure determination and membrane-binding characterisation of the cytoskeletal proteins is in progress. In another study, a detailed structural analysis of myosin motor domains resulted in the identification of a novel allosteric pathway essential for its function.

Reconstitution biology and membrane fission

Despite its resilience to rupture, cell membranes undergo a regulated fission process during cell division and organelle biogenesis. How is this achieved? The cell membrane, formed by the self-assembly of lipids and proteins and organised as a 5 nm thick bilayer, has unique mechanical properties. Foremost among them is its ability to resist rupture. This property lies at the heart of evolution choosing the lipid bilayer as the material to contain life. But cells divide and compartmentalise their cytoplasm into organelles by processes that require an active bending and fission of the membrane, possibly involving specialised protein machines. Dr. Thomas Pucadyil group's research focuses on identifying such protein machines towards understanding the context in which they

function in cells. Using fluorescence microscopy-based high-throughput membrane fission assays, the Pucadyil lab has identified novel membrane fission catalysts (Kamerkar et al., 2019 *Biochemistry*; Deo and Kushwah et al., *Nature Commun.*, 2018) and identified the mechanism by which known catalysts function in mitochondrial and peroxisomal division (Kamerkar and Krauss et al., *Nature Commun.*, 2018).

1.2 Cell and Developmental Biology

Cell adhesion

Integrin-mediated adhesion regulates trafficking and plasma membrane localisation of raft microdomains to control anchorage-dependent signalling, a process that is subverted in cancers. Endocytosis of raft microdomains is regulated by caveolin and its phosphorylation as well as their exocytosis through the exocyst complex. Ongoing studies in Dr. Nagaraj Balasubramanian's group studies the aurora kinase in Ras-dependent and independent cancers. The group studies the role and regulation of caveolin phosphorylation in regulating adhesion-dependent signalling across 2D and 3D microenvironments of varying stiffness. The lab also aims to understand how adhesion-dependent signalling regulates organelle function, focusing on the Golgi, endoplasmic reticulum, and mitochondria. These studies have revealed integrin-mediated adhesion to dramatically alter Golgi organisation and function, suggesting a role for this regulation in anchorage-independent cancers. Through 3D cell culture and imaging, the group is working to develop and use an assay to understand cellular behaviour around implant surfaces.

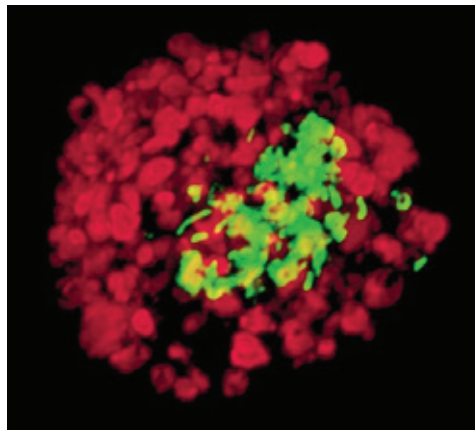


Figure 3: Together but apart - Golgi compartments in non-adherent fibroblasts. Green: Cis-Golgi - Man II GFP; Red: Trans-Golgi - GalTase RFP (Courtesy of Vibha Singh & N. Balasubramanian); Ref: Singh et al. (2018) *J. Cell Sci.* 131: jcs215855 (Dr. Nagaraj Balasubramanian's Group)

DNA damage and maintenance of genome integrity

Dr. Mayurika Lahiri's group has been investigating the process by which DNA damage 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 some key anti-apoptotic as well as checkpoint regulators were deregulated in carcinogen-induced transformed spheroids. The laboratory investigates the transformative potential of such deregulators in breast spheroids to dissect the molecular mechanism of transformation. To understand whether any of these proteins can be used as biomarkers for the Indian population, Dr. Lahiri's laboratory collaborates with Prashanti Cancer Care Mission (PCCM), Pune, to study the expression levels of such markers in the Indian population. Dr. Lahiri's group is also investigating the role of the lipid mediator, PAF in breast cancer initiation, progression, and promotion.

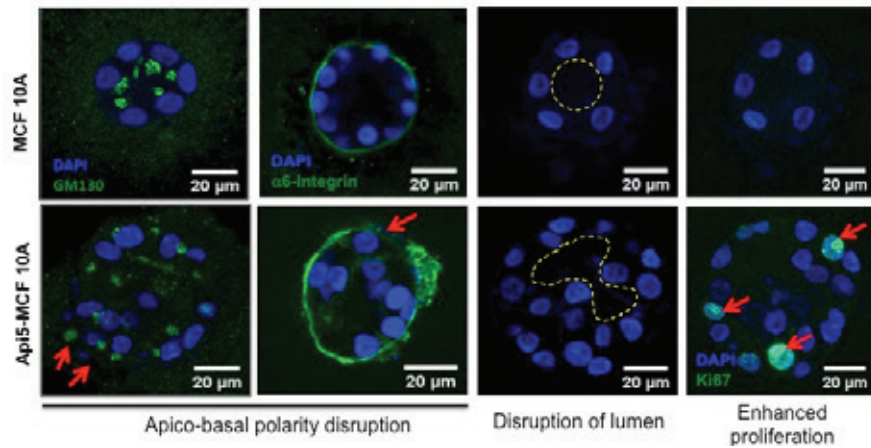


Figure 4: *Api5* overexpression leads to phenotypic transformation as depicted by disruption of polarity and lumen with increase in proliferation in three-dimensional breast acinar cultures (Dr. Mayurika Lahiri's Group)

Cell biology of development and differentiation

Morphogen gradients form across a field of cells to pattern them during organism development. Studies in Dr. Richa Rikhy's group have attempted to characterise the cytoplasmic space in which morphogens spread in the syncytial *Drosophila* embryo. GFP or RFP present in the cytoplasm is enriched beneath the cortex spanning approximately 40 microns below the surface. This is also the space in which the nucleo-cytoplasmic domains become organised in the syncytial division cycles. Anteriorly expressed cytoplasmic molecules fail to create a sharp gradient like Bicoid. Fluorescently tagged plasma membrane associated molecules (PH-PLC-CFP), when expressed anteriorly, produce an exponential gradient like Bicoid in the antero-posterior axis. Local photoactivation at the anterior of photoactivatable-GFP (PA-GFP) and PA-GFP-Tubulin produces a cortical and exponential gradient with a longer length scale for PA-GFP as compared to PA-GFP-Tubulin. The length scales for anteriorly expressed PH-PLC-CFP and anteriorly photoactivated PA-Tubulin depend upon the syncytial blastoderm architecture.

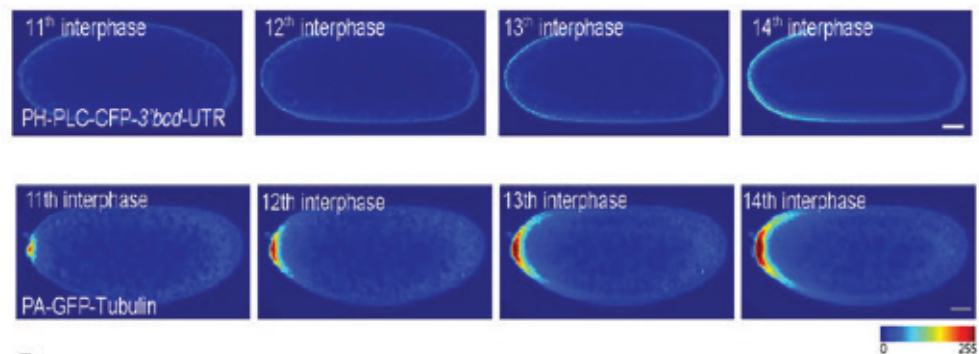


Figure 5: Anteriorly expressed PH-PLC-CFP (upper panel) produces an antero-posterior gradient. Anteriorly photoactivated Tubulin (lower panel) spreads cortically in the antero-posterior axis. (Dr. Richa Rikhy's Group)

Molecular principles underlying animal development and disease

Animals as different as humans, worms and flies use remarkably similar molecular mechanisms to control their development. Discoveries of developmental paradigms in one organism have provided insights into the development processes of other organisms. Dr. Girish Ratnaparkhi's group utilises *Drosophila melanogaster* as a model organism to study common molecular principles underlying animal development and disease. During 2018–19, the group has used a *Drosophila* model of Amyotrophic Lateral Sclerosis (ALS) to uncover relationships between reactive oxygen species levels and clearance

of aggregates in the brain (Chaplot et. al., 2019). The group has uncovered the function of a gene, that they named *brickwall*, to function redundantly with *stonewall* in the specification of female germline (Shukla et. al., 2018). The group has also found that DNA/RNA methyltransferase DMT2 regulates sphingolipid metabolism in the fly, which in turn is important for robust host defense as the animal ages (Abhyankar et. al., 2018).

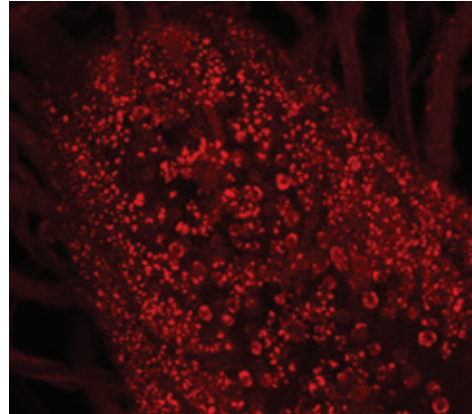


Figure 6: Study of gene networks in neurons that regulate aggregate dynamics: In red are aggregates of dVAPB(P58S) visualised in the *Drosophila* third instar larval brain. The aggregates/puncta mimic inclusions seen in human ALS patients with the hVAP(P56S) mutation. Ref: Chaplot et al (2019) Dis. Model Mech. 12: dmm033803 (Dr. Girish Ratnaparkhi's Group)

1.3 Chromosome Biology and Epigenetic Regulation

Epigenetics and transcriptional regulation in *Plasmodium falciparum*

One of the major problems in controlling malaria is the emergence of resistance against most of the antimalarial drugs. Recently, there are alarming reports of resistance against artemisinin, which is considered as the first line of defense against malaria. Artemisinin-resistant parasites are characterised by slow growth and reduced drug-susceptibility at the ring stage of asexual growth. Population genomics and transcriptomic studies have identified mutations in Kelch13 gene as a molecular marker for artemisinin resistance. However, several reports thereafter indicated that Kelch13 is not the main mediator rather oxidative stress and protein damage responses are the main regulators of the artemisinin resistance. Thus, understanding how *Plasmodium* regulates gene expression during various stress conditions is fundamental to understanding the emergence of artemisinin drug resistance.

Dr. Krishanpal Karmodiya's laboratory uses a variety of approaches including cellular, biochemical, genomics, and transcriptomics to understand the mechanisms of drug-resistance generation in *Plasmodium falciparum*. Identification of a global regulator of stress-responses and artemisinin-resistance could be potentially developed as an important target against artemisinin resistant parasites.

Chromosome biology

The genome is organised in a non-random manner as chromosome territories in the nucleus. Dr. Kundan Sengupta's group addressed the role of nuclear lamins in genome organisation and function, since lamins maintain structure and stability of the nucleus. The maintenance of stable chromosome numbers and function is essential, since chromosomal instability promotes cancers. The group showed that Lamin depletion destabilises chromosome numbers, organisation of chromosome territories and transcription. They also showed that chromosomal instability accompanies cancer progression during epithelial to mesenchymal transitions (EMT). The group investigated the mechanisms of how the nucleus responds to external mechanical stress in cells cultured on softer substrates, whose stiffness closely mimics that of *in vivo* stiffness of human tissues. This showed a striking change in the relative positions of chromosome territories, which was mediated by Emerin and its interactor Lamin, since these nuclear envelope factors integrate and relay mechanical signals perceived by cells into the

... nucleus and chromatin.

1.4 Plant Biology, Ecology, and Evolution

Plant physiological ecology

Understanding the responses of tropical trees to extreme climatic conditions is important in the context of global warming. Work in Dr. Deepak Barua's group examines how integration of anatomical, morphological, and physiological traits translates to plant performance, particularly when experiencing extreme temperatures and drought. Ongoing work investigates the temperature limits of photosynthetic function. The group showed that tropical trees are precariously close to their upper limits and likely to be severely affected by future warming. Importantly, thermotolerance was related to leaf functional traits and photosynthetic rates. Other work investigated water-use strategies, drought tolerance, and hydraulic traits. This followed from studies that showed that xylem size was positively related to water uptake, but negatively related to drought tolerance. This results in a trade-off where water uptake and growth under well-watered conditions is negatively related to drought tolerance. The group plans to extend this work, focused on the Northern Western Ghats, to field sites in Karnataka and Kerala with contrasting climatic conditions.

Population dynamics

Dr. Sutirth Dey's group found that evolution of dispersal in *Drosophila* can lead to a correlated increase in aggression, exploration, and locomotor activity. However, it was not associated with any life-history cost, as there were no differences in longevity or fecundity of the selected flies. Non-targeted NMR analysis suggested that the selected flies have increased levels of cellular respiration and neurotransmitters like octopamine. These findings have serious implications for invasion biology, as traits like enhanced aggression and exploration are strongly associated with the invasion potential of populations. The group found that the dispersal syndrome that evolved due to selection was different from the syndrome that was associated with dispersers in the non-selected population. This suggested that extant correlations between dispersal-related traits cannot be used to predict the outcomes of dispersal evolution.

Communication signals in animals

Dr. Anand Krishnan's research has focused on three themes during 2018–19: community bioacoustics, ecological and behavioural bioacoustics, and evolutionary morphometrics of sound production. The group has focused on using sound to study ecological communities of birds and bats across India, aiming towards both fundamental and conservation-oriented insight. The group also works on smaller groups of species to understand the behavioural strategies the species use to signal distinctly from other species as well as members of their own species. Finally, using natural history collections in the U.S.A., Dr. Krishnan is engaged in a study employing micro-CT scanning to quantify the evolution of bill shapes in the primary study system, the Asian barbets. This study seeks to understand the functional underpinnings of bill diversity, and in the longer term, the relationship between this peripheral vocal structure and the evolution of vocal diversity.

1.5 Neurobiology and Computational Biology

From neural circuits to behaviour

Dr. Nixon Abraham's group uses combination of cutting-edge techniques such as optogenetics, automated behaviour, and electrophysiology to study brain in health and disease using rodent models. In one of the studies, the group investigated the effect of Early Life Stress (ELS) on the olfactory perception in mice. Their results from behavioural

tests in ELS mice indicate deficits in odour detection, discrimination, learning, and memory. Such impairments appear to be age-dependent, exhibiting pronounced deficits during young adulthood. These results are in concordance with increased anxious behaviour displayed in open field test and forced swim test during young adulthood. To dissect out the neural mechanisms underlying the behavioural impairments, the group is using optogenetics for bidirectional modulation of a specific subset of OB interneurons. This will allow identifying the neural circuits causing the altered sensory abilities induced by ELS.

Neuronal networks

Dr. Collins Assisi's laboratory is focused on understanding the intrinsic and network mechanisms involved in creating patterns of neural activity that represent sensory information (olfactory representations in particular) and spatial maps of the world seen within the medial entorhinal cortex. Towards this, the Assisi lab has developed a biophysically-realistic model of sequence generation in the entorhinal cortex. Their work provides a clear understanding of the role of theta oscillations in the formation of spatially periodic grid like patterns of activity. Further, their group demonstrated that memories at various stages of encoding, consolidation, and retrieval invoke different configurations of brain regions that can be dynamically assembled by theta phase coherence across these regions. Investigations into the structure-dynamics relationships in entorhinal networks led the group to a set of simple principles that allow small networks to encode an astronomically (10^9) large number of states. The group has also developed computationally-efficient tools to simulate large networks of neurons using single and multicore CPUs, GPUs, and clusters.

Structural plasticity of neuronal circuits

Cytoskeletal remodelling in neurons has been a recurrent theme of research in Dr. Aurnab Ghose's group. Apart from identifying new regulatory modalities in neuronal motility, the group has investigated mechanical resilience and responses of neurites to physical forces. These studies are expected to inform neurodevelopmental processes and responses to injury. The group has also explored mechanisms underlying the regulation of neuronal activity by neuropeptides. Their studies reveal that the responses to food- and predator-associated odorant cues are modulated by neuropeptide activity, which encode physiological states like satiety or hunger.

Intracellular calcium stores mediate metaplasticity at hippocampal dendritic spines

Long-term plasticity mediated by NMDA receptors supports input-specific, Hebbian forms of learning at excitatory CA3-CA1 connections in the hippocampus. There exists an additional layer of stabilising mechanisms that act globally as well as locally over multiple time scales to ensure that plasticity occurs in a constrained manner. Dr. Suhita Nadkarni's group investigates the role of calcium (Ca^{2+}) stores associated with the endoplasmic reticulum (ER) in the local regulation of plasticity at individual CA1 synapses. Their study is spurred by (1) the curious observation that ER is sparsely distributed in dendritic spines, but over-represented in large spines that are likely to have undergone activity-dependent strengthening, and (2) evidence suggesting that ER motility at synapses can be rapid, and accompany activity-regulated spine remodelling. The model developed by the group shows how IP₃-sensitive Ca^{2+} stores affect spine Ca^{2+} dynamics during activity patterns mimicking the induction of long-term potentiation (LTP) and depression (LTD). Their results suggest that the presence of ER modulates NMDA receptor-dependent plasticity in a graded manner that selectively enhances LTD induction. They propose that ER may locally tune Ca^{2+} -based plasticity, providing a braking mechanism to mitigate runaway strengthening at potentiated synapses. This

study from the group provides a biophysically accurate description of postsynaptic Ca^{2+} regulation, and suggests that ER in the spine may promote the re-use of hippocampal synapses with saturated strengths.

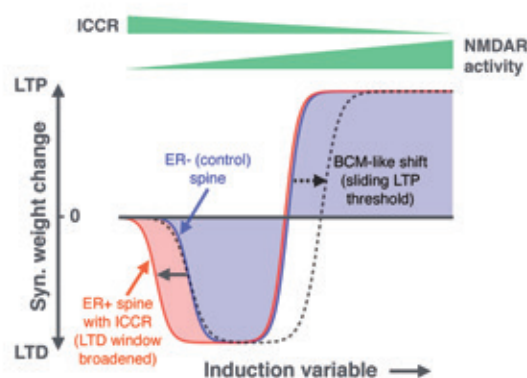


Figure 7: Endoplasmic Reticulum (ER) Ca^{2+} store introduces a novel form of synaptic metaplasticity at individual CA1 dendritic spines. Results from the analysis of frequency- and spike timing-dependent plasticity are summarised by a comparison of the plasticity profiles for the reference ER- spine (blue) and a spine with ER (red). The induction variable (which can stand for the synaptic input frequency f , or spike timing

difference Δt) controls the activation of both NMDAR and ICCR, these dependencies being represented by tapering bars at the top. Also shown for comparison is the modified plasticity curve arising from a BCM-like sliding LTP threshold (dashed curve). (Dr. Suhita Nadkarni's Group)

Neurobiology of movement initiation

Dr. Raghav Rajan's laboratory is interested in understanding how the brain initiates learned movement sequences that are ethologically relevant to animals. To achieve this, the group studies song initiation in the adult male zebra finch, a songbird. The song of the zebra finch is a stereotyped sequence of sounds that is learned by young birds. Song bouts begin with a variable number of repetitions of a short syllable called introductory notes. In the past year, the group has shown that neural activity in the zebra finch brain begins as early as $\frac{1}{2}$ a second before the first introductory note. They have also shown that the number and structure of introductory notes are learned by young birds. However, real-time sensory feedback is not required for the progression of introductory notes to song in adult birds. These results suggest the presence of internal neural preparatory processes involved in song initiation. The group is currently investigating the origin and role of these processes in song initiation using neural recordings and pharmacological manipulations.



2. CHEMISTRY RESEARCH REPORT

2.1 Organic and Chemical Biology

Novel chemical technologies for synthesis of protein amphiphiles

Natural protein nanomaterials evolved to perform advanced functions *in vivo*. They achieve this remarkable feat through several reversible/irreversible post-translational modifications, thus converting the static structure into dynamic one and *vice versa*. Hence, access to more building blocks (chemical entities) is essential to realise dynamic/adaptive behaviour. While the incorporation of several unnatural amino acids onto protein through modified genetic method was demonstrated long back, to date there are only few reports on the use of unnatural amino acids for design of *de novo* protein nanomaterial. Alternatively, protein engineering using chemical strategies provides opportunities for the design of stimuli-responsive protein nanomaterials because of access to innumerable building blocks. Despite this advantage, most of the designs yield polydisperse samples and therefore lack detailed analytical characterisation. Hence, the underlying design rules are still elusive. Dr. Sandanaraj Britto's group has developed

a chemical method for rational design of monodisperse protein nanomaterials with stimuli-responsive function/adaptive behaviour.

Redox homeostasis

A number of small sulfur-based molecules play key roles in cellular growth and survival. For example, hydrogen sulfide (H_2S) acts as a vasodilator, neuromodulator and pathogen response to antibiotics. Its oxidized congener, SO_2 attributes to the antibacterial properties and also plays a role as a vasorelaxant. In order to better understand their physiological roles and to gauge their therapeutic potential, we require tools for controlled and site directed delivery of these gaseous species. One strategy involves trapping carbonyl sulfide (COS) gas in the form of a small molecule tethered to a trigger for site selective delivery and a leaving group for modulating the rate of release. COS is released and is readily hydrolysed by a widely prevalent enzyme carbonic anhydrase to give H_2S . A reactive oxygen species (ROS) triggered tunable release of H_2S was achieved by varying the pK_a of the leaving group amine. A mechanism by which H_2S exerts its effects is protein persulfidation which is an oxidative post-translational modification where a cysteine (Cys-SH) residue is modified to Cys-SSH group. However, since persulfides are unstable in a biological milieu, it is challenging to generate these reactive sulfur species in a controllable manner.

To address these major gaps, a ROS-triggerable persulfide donor, which was based on a hitherto unexplored 1,4-O,S-relay mechanism, was designed and developed in Dr. Harinath Chakrapani's group. The compound was able to protect cells from oxidative stress induced by exogenous ROS generators. In addition, SO_2 , an oxidised form of H_2S has recently gained importance as a vasorelaxant. In order to understand the role of SO_2 in a physiological system, the group designed a new class of SO_2 donors. They considered the use of sulfones, a scaffold that has hitherto not been used to generate SO_2 . The reported tools can be used for mechanistic and therapeutic understanding of these gasotransmitters.

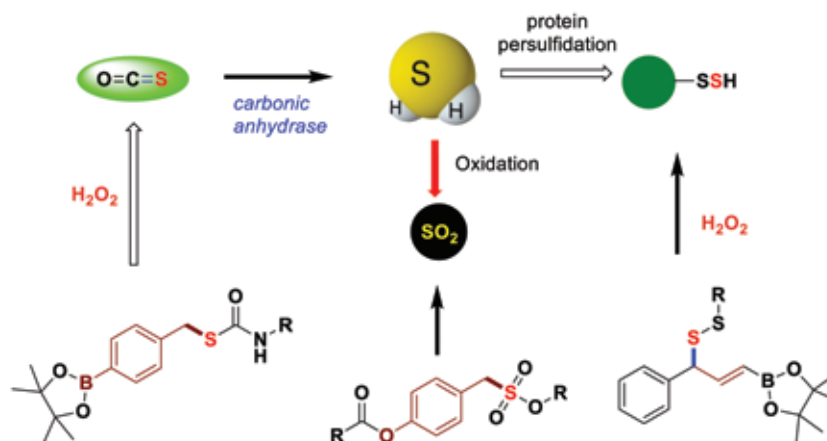


Figure 8: Methodologies to generate reactive sulfur species (Dr. Harinath Chakrapani's Group)

Oxindole synthesis using metal catalyst

Oxindole based nitrogen heterocycles are found in many therapeutic drugs and naturally occurring molecules. In this direction, Dr. Gnanaprakasam's research group has developed metal catalysed approach for the C-H olefination of 2-oxindoles to generate selectively antimalarial 3-(diphenylmethylene)indolin-2-one derivatives. In addition, an unprecedented skeletal rearrangement of oxindole based peroxy compounds using Sn -catalyst has been developed to afford a series of fluorophoric (Z)-2-arylidene and alkylidene-2H-benzo[b][1,4]oxazin-3(4H)-one derivatives. Dr. Gnanaprakasam's

research group has also established a series of continuous flow approach for the sustainable synthesis of various organic intermediates. For instance, his research group has developed continuous flow Fe-catalysed direct transformation of nitro compounds to aldehyde in absence of additional additives such as bases and oxidants using recyclable Fe-zeolite catalyst. Moreover, his research group has developed Amberlyst®-15 as the H⁺ source, catalysed the synthesis of β -keto-vinylogous esters, transesterification and their reversibility in continuous flow using simple and ample precursors such as di-keto compounds, alcohols and water. Further, Fe-catalysed transesterification and their reversibility using environmentally benign alcohol/water under homogeneous or heterogeneous condition in continuous flow mode has been established by his research group.

Vitamin biosynthesis

In nature, microorganisms are found in consortia, where several species of microbes coexist and perform complex metabolism. Dr. Amrita Hazra's group uses vitamin biosynthesis and exchange as a window to look into the world of microbial metabolism. Using the tools of mechanistic enzymology, analytical chemistry, and microbial genetics, the group is investigating the enzymology of Vitamin B1, B2, and B12 synthesis in bacteria and archaea and in some eukaryotes such as yeast, and further designing vitamin-based drugs and biosensors based on the enzyme mechanisms.

Three ongoing projects in Dr. Amrita Hazra's laboratory include the following. (a) To understand the enzymology of three unique methylation reactions that occur during the biosynthesis of 5,6-dimethylbenzimidazole, the lower ligand of Vitamin B12. (b) To explore the biosynthesis of riboflavin (Vitamin B2) and its conversion to flavin mononucleotide and flavin adenine dinucleotide. The group is interested in understanding the molecular basis of choice of nucleotide (ATP in this case) for these two conversions, and wishes to alter the specificity of the enzyme to accept various nucleotides. (c) To interrogate the biosynthesis of Vitamin B1 in a synthetic microbial community, and its cross-talk with nucleotide biosynthesis in *Escherichia coli*. Gaining an understanding of microbial vitamin biosynthesis pathways that are not present in humans not only allows us to improve industrial vitamin production, but also provides a platform for the design of specific drugs and antibiotics for inhibiting microbes while not affecting human health.

Extracellular matrix glycopeptides for cell surface markers

Extracellular matrix (ECM) is a non-cellular component, providing essential biochemical and mechanical support for the cellular constituents. The enormous molecular complexity of the ECM has limited the knowledge of structure-function relationship concerning cellular events, especially drug resistance and metastasis in cancer cells. Hence, deciphering the molecular code of ECM implicates the development of modern drug strategies for cancer treatment.

Recently, Dr. Raghavendra Kikkeri's group has developed a host-guest strategy to synthesise ECM glycopeptides, which selectively identifies specific carbohydrate-peptide epitope critical for cell migration and wound healing processes. They have now combined chemical synthesis, supramolecular chemistry, and microarray technology to decipher molecular codes of ECM in cancer cell metastasis and as well as in drug resistance. In particular, the group is addressing three fundamental aspects of cell-matrix interactions: (a) what is the molecular level combination of glycosaminoglycans (GAGs) and active peptide sequences of ECM proteins (collagen, laminin and fibronectin) necessary for cancer cell proliferation? (b) How 3D-matrix of synthetic ECM components and its physical properties (stiffness, topology) alter tumour cell drug

resistance and metastasis? (c) how the cross-talk between synthetic ECM epitope and the cancer cell in the presence of the stromal cells and immune cells contributes to the cancer cell survival and metastasis.

Nucleic acid chemistry and biophysics

Dr. 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. It is expected that these self-assemblies would provide platforms for designing biosensors, biomaterials, and scaffolds for non-templated/non-enzymatic oligomerisation of nucleic acids.

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 (*Angew. Chem.* 2017) and non-canonical nucleic acid structural motifs such as G-quadruplexes and i-motif in real time, cell models (*ChemBioChem* 2018), 3D and live cells by using combinations of fluorescence, NMR and X-ray crystallography techniques (*JACS* 2018).

His group has recently developed practical chemical labelling and imaging methods for cellular RNA by using chemo-selective reactions and environment-sensitive fluorescent peptide nucleic acid probes (*ChemBioChem* 2018, *Nucl. Acids Res.* 2018).

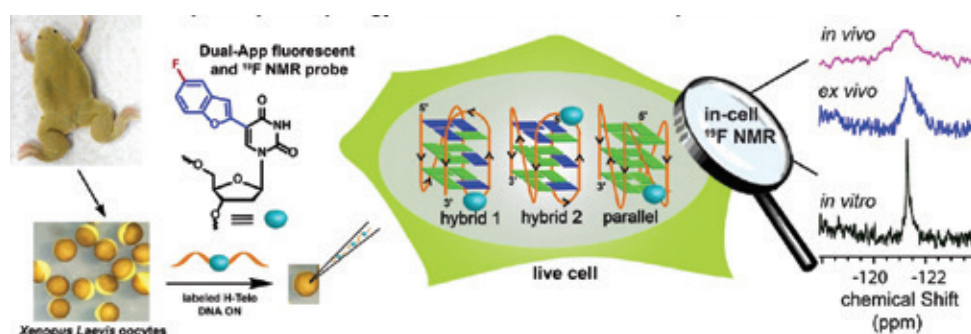


Figure 9: A dual-app fluorescent and NMR probe enables the determination of the human telomeric overhang G-quadruplex structure in vitro and in live cells (frog oocytes) (Dr. S.G. Srivatsan's Group)

Self-assembly and molecular recognition

Dr. Pinaki Talukdar's research predominantly aims at the development of artificial ion transport systems to mimic and understand the functions of their natural congeners. He has developed barrel-rosette and barrel-stave chloride channels utilising the self-assembly of fumaramides and illustrated the photodeactivation of transport. To address the practical application of chloride transporters in cancer treatment, he has adopted two innovative strategies (i) by exploiting the typical acidic microenvironment of tumour tissues, and (ii) by light. In the first strategy, he has developed a synthetic carrier that facilitates proton-anion symport upon deprotonation of the sulfonamide N–H proton. In the second strategy, he has developed the first artificial protransporter (i.e., the inactive form of an ion transporter), which upon photocleavage of its protecting group releases the active Cl⁻ transporter in cells. This pioneering work has paved the foundation for future application of ion transporters in the anticancer photodynamic therapy.

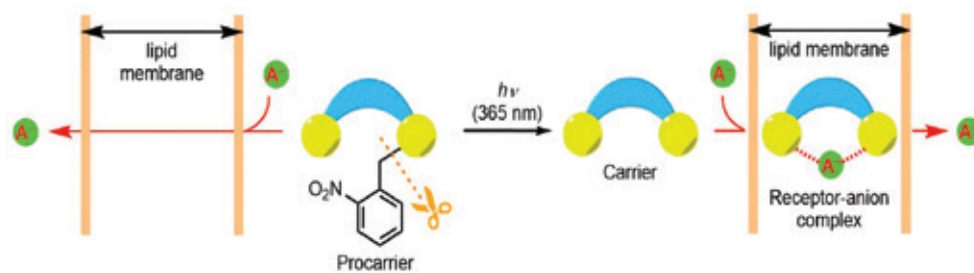


Figure 10: Activation of transmembrane ion transport by light as a tool to target cancer (Dr. Pinaki Talukdar's Group)

2.2 Inorganic and Materials Science

Solid-Liquid interface

The metal-ligand coordination at solid-liquid interface was investigated in Dr. Nirmalya Ballav's group. Remarkably, spontaneous reduction of Cu(II) to Cu(I) at a solid-liquid interface—without the need of any extraneous reducing agent—was observed unlike in liquid-phase reaction whereby no reduction of Cu(II) to Cu(I) took place. As a consequence of the interfacial reduction reaction (IRR), stimuli-responsive thin films of Cu-TCNQ and Cu-Hexacyanoferrate (Cu-HCF) were deposited onto a thiol-functionalised Au substrate via layer-by-layer (LbL) method. IRR is anticipated to be very useful in generating new materials which are otherwise difficult to achieve via conventional liquid-phase reactions.

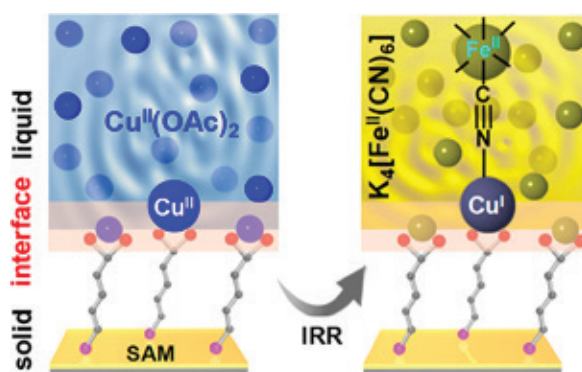


Figure 11: Spontaneous chemical reduction at the solid-liquid interface (Dr. Nirmalya Ballav's Group)

2D nanosheets of metal-organic framework (MOF) comprised of Co(II) ion and benzenedicarboxylate (BTC) ligand synthesised at room temperature exhibited unusual metamagnetic behaviour – antiferromagnetic (AGM) transition at 32 K (highest value metamagnetic MOFs reported till date) followed by metastable canting at 15 K leading to remarkably high-coercivity of around 19 kOe at 5 K.

Synthetic inorganic chemistry: Materials applications

Dr. R. Boomi Shankar's group has pioneered the generation of elusive tris(imido)phosphate trianions in polar and protic solvents and their utility in stabilising charge-neutral Pd(II) containing cages in tetrahedral and cubic topologies. Subsequently, by subtle alteration of the linker backbone and its substituents, they have shown the encapsulation of Xylene isomers in a preferential manner. Thus, the cages tethered with chloranilate linkers selectively encapsulate o-xylene whereas the cages built of bromo- and iodoanilates are selective for p-xylene. The cage supported by un-substituted anilate anions is selective for bigger guest molecules such as mesitylene. Utilising chiral tri(imido)phosphate anions, they have prepared enantiopure tetrahedral cages which can be utilised for the enantio-separation of racemic styrene-epoxide in a non-HKR method with a highest ee of 78%.

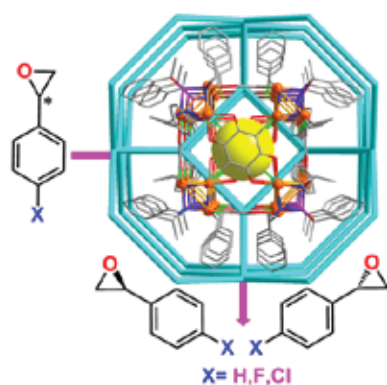


Figure 12: Enantio-separation of styrene epoxides supported by an enantiopure Pd(II) based neutral cage crystallised in Sodalite topology. (Dr. R. Boomi Shankar's Group)

Over the past years, his group has also been investigating metal-organic ferroelectrics using novel di- and tri-podal phosphoramidate ligands. They were able to prepare a family of ferroelectric materials that show tuned ferroelectric response assisted by choice of metal ions, ligand substituents, dimensionality of the obtained assemblies, and guest molecules present in them. Further, they are investigating ferroelectricity in polar organic and hybrid organic-inorganic salt-like materials based on phosphonium and ammonium cations and their utility in mechanical-energy harvesting applications. Recently, they have prepared acentric A_2CdBr_4 type discrete halogenometallates with benzylamino substituted A-site ammonium cations and investigated their room-temperature ferroelectric behaviour. Furthermore, they have prepared composites of these salts with polydimethylsiloxane (PDMS) and employed them as flexible devices for harvesting mechanical energy by using a home-built impact force setup. The obtained output voltage of ~ 65 V is the highest for all the known organic-inorganic hybrid salts supported by PDMS polymer.

Hydrolytic and chemical stability of MOFs

Detoxification of water has been demonstrated with a viologen-based cationic organic network (compound-1) developed in the group of Dr. Sujit Ghosh, which was stable not only in water, but also in acidic and basic media. The presence of free exchangeable Cl^- ions inside the network of compound-1 and a high physicochemical stability of the materials offered a suitable scope for the capture of hazardous anionic pollutants from water. Rapid removal of the toxic water pollutant and carcinogenic chromate (CrO_4^{2-}) from water was shown with compound. Furthermore, the oxo-anion of the radioactive isotope of technetium (^{99}Tc), i.e. the TcO_4^- ion, also counts as a toxic water pollutant and by using surrogate anions (MnO_4^- and ReO_4^-), a model capture study was performed. Notably, compound-1 showed high capacity values for each of the oxoanions and these were comparable to some of the well-performing compounds reported in the literature.

Silylene as a ligand in Transition Metal Chemistry

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. However, the area of transition metal silylene complexes had been held back for many years especially because of the very low yield of silylenes. Since the high yield isolation of Si(II) compounds by dehydrohalogenation protocol, there is a significant paradigm shift in the chemistry of transition metal silylene complexes. Dr. Shabana Khan's group is exploring silylene $[PhC(NtBu)_2SiN(SiMe_3)_2]$ as a ligand to prepare Cu(I), Ag(I), and Au(I) complexes which are being utilised further for photophysical and catalytic applications. Besides, the group prepared a series of sila-thione/selenone from the corresponding silylene and used them as ligands for coinage metals. These studies are further extended towards germylene and stannylene to examine and compare the nucleophilicity of the latter with their lighter congener.

Main-group and transition metal compounds for catalysis

Dr. Moumita Majumdar's group's focus is to establish (poly)cationic ligands for Lewis acid catalysis. They have stabilised bis(chlorogermlyiumylidene) within a bis(α -iminopyridine) framework. The two $[:\text{GeCl}]^+$ units within the ligand framework are conducive to reductive cyclisation of the bis(α -iminopyridine), which has otherwise remained elusive. The reaction pathway involves the formation of a triplet diradical and subsequent protonation led to the isolation of the 2,3-di(pyridin-2-yl) substituted piperazine stabilised Ge(II) dication. The chelating effect exerted by the Ge(II) dication intermediate governs the exclusive formation of the *meso*-diastereomer. The group has also synthesised a variety of bis(chlorogermlyiumylidene) stabilised within diiminodiphosphine and diaminodiphosphine ligand frameworks. In addition to their potential usage as cationic ligands towards transition metals, these bifunctional molecules will serve as monomers for ionene polymers. A variety of polystannylenes within tetradentate ligand frameworks have been established. The coordination of the stannylene centres to transition metals leading to multi-metallic clusters is currently being investigated.

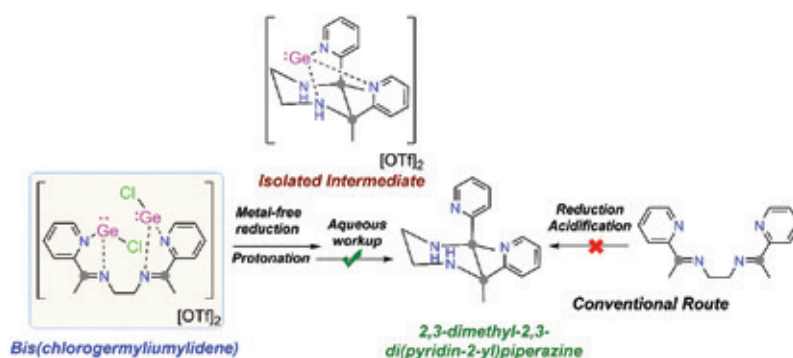


Figure 13: Role of bis(chlorogermlyiumylidene) in an elusive reductive cyclization reaction (Dr. Moumita Majumdar's Group)

Rechargeable hydrogen battery

Dr. Muhammed Musthafa's group has recently employed proton-coupled electron transfer in hydrogen storage molecules (BQ/QH₂ couple) to unlock a rechargeable battery chemistry based on the cleanest chemical energy carrier molecule, hydrogen. Electrochemical, spectroscopic, and spectroelectrochemical analyses evidenced the participation of protons during charge-discharge chemistry and extended cycling. In an era of anthropogenic global climate change and paramount pollution, a battery concept based on a virtually non-polluting energy carrier molecule demonstrates distinct progress in the sustainable energy landscape. In the ongoing research, efforts are being dedicated to develop all solid-state proton battery and quinone-H₂O battery.

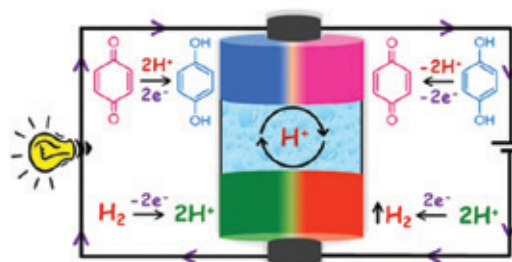


Figure 14: Schematic of rechargeable hydrogen battery. *J. Phys. Chem. Lett.*, 2018, 9 (10), 2492–2497. Spotlight Article (Dr. Muhammed Musthafa's Group)

The design of rechargeable hydrogen battery by coupling the proton-coupled electron transfer in a BQ/QH₂ redox couple and the catalytic nature of the noble metal electrode for the H₂ redox reaction is a distinct step towards building green energy storage modules. This is mainly because it is a battery concept based on a virtually non-polluting

chemical energy carrier molecule, hydrogen. Efforts are dedicated to develop an all solid-state and rechargeable proton battery by exploiting the ability of tungsten oxides for reversible proton insertion/de-insertion and proton-coupled electron transfer in hydrogen storage molecules.

Developing novel semiconductors with desirable optoelectronic properties

Thermodynamics create intrinsic defects in a crystal. Additionally, nanocrystals have surface defects. The major objective of Dr. Angshuman Nag research group is in the rational design of semiconductors (nanocrystals to centimetre-sized single crystals) to eliminate the detrimental effects of defects, for optoelectronic applications. They have shown that manipulation of energy levels of surface defects in lead halide perovskite nanocrystals yields efficient optoelectronic properties that are unprecedented for any other semiconductor nanocrystals.

In the year 2018–19, the emphasis of their work was to stabilise and understand/improve optical properties of metal halide perovskites. Doping Mn and Yb in CsPbX_3 (X = Cl, Br, I) nanocrystals yielded down converted light emission in visible and near infrared red region, along with improved stability of the host material. Similar optical properties were achieved by doping more stable Pb-free perovskites nano and microcrystals as well. In another project, they prepared 2D layered perovskite $(\text{C}_4\text{H}_9\text{NH}_3)_2\text{PbI}_3$ single crystals with unique stacks of quantum well electronic structures. The study of temperature dependent (10-300 K) optical, structural, and electronic properties of a single crystal led to the discovery of a possible dual band gap in the same crystal. This is a fundamentally new observation that requires further understanding.

Functional nanomaterials

Dr. Pramod Pillai's group is interested in controlling the fundamental forces, and thereby interparticle interactions, to understand and improve various processes occurring at the nanoscale. In one example, the group has developed an elegant strategy to accomplish efficient photocatalysis by taking advantage of ligands on the nanoparticle surface. The introduction of favourable interaction between AuNP catalyst and substrate improves the NP accessibility to the substrates and the probability of hot electron transfer, thereby suppressing the 'poisoning' effect of the 'insulating' organic ligands. They were also successful in demonstrating an electrostatically regulated photoinduced electron transfer in 'cationic' eco-friendly $\text{CuInS}_2/\text{ZnS}$ ([+] CIS/ZnS) QDs in water. The electrostatic attraction between oppositely charged [+] CIS/ZnS QD and [-] ICG dye was responsible for the formation of a strong ground state complex, which was vital in achieving an efficient electron transfer process in water. In yet another example, the group demonstrated a highly efficient photoinduced electron transfer from perovskite QDs to few-layer black phosphorous. These advancements in the existing optoelectronic properties of nanomaterials through the fine control over interactions are expected to expand the scope of nanoscience in energy and health research.

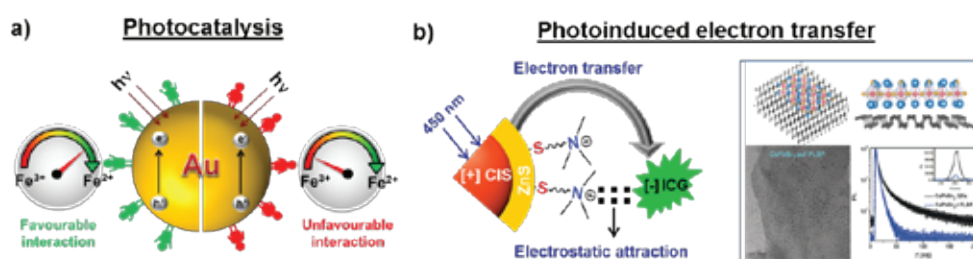


Figure 15: Precise tuning of nanoscale interactions a) outplays ligand poisoning in photocatalysis and b) enhances photoinduced electron transfer in QD nanohybrid systems (Dr. Pramod Pillai's Group)

Poly (glycerol sebacate) based polyester-polyether copolymers and their networks with polyester-ether elastomers

Poly (glycerol sebacate) (PGS), produced from renewable monomers such as sebacic acid and glycerol, has been explored extensively for various bio-medical applications. However, relatively less attention has been paid to the possibility of using PGS as sustainable materials in applications such as elastomers and rigid plastics primarily because of serious deficiencies in physical properties of PGS. Prof. Sivaram's group developed two new approaches for enhancing the properties of PGS, namely, (i) preparation of block copolymers of PGS with poly(tetramethylene oxide) glycols (PTMO) and (ii) preparation of a blend of PGS-b-PTMO with a polyester thermoplastic elastomer derived dimethyl terephthalate, 1,4-butanediol and PTMO.

The group found that the produced films were transparent and tough. Using a wide variety of physico-chemical methods, they examined the structure of such materials. These materials can be designed with high sustainability quotient since they can be degraded under hydrolytic conditions, unlike cross-linked hydrocarbon derived elastomers which persist indefinitely in the environment.

Graphene suitable for preparing biocompatible polymer

The success of developing graphene-based biomaterials depends on the ease of synthesis, use of environmentally benign methods, and low toxicity of the chemicals involved as well as biocompatibility of the final products/devices. Prof. Sivaram's group reported a simple, scalable, and safe method to produce defect free few layers graphene using naturally available phenolics, i.e., curcumin/tetrahydrocurcumin/quercetin, as solid-phase exfoliating agents with a productivity of ~45 g/batch ($D/G \leq 0.54$ and $D/D' \leq 1.23$). The simplicity of the method, the general safety of the exfoliating agents employed, the useful properties obtained in thin film nanocomposites and its biocompatibility make this approach an interesting and useful method to produce commercial products, which come in contact with body parts or body fluids.

COFs as heterogeneous catalyst/electrocatalyst, electrodes, single-source white-light emitter and MOFs for CO₂ capture

Covalent Organic Frameworks (COFs) are a new class of porous crystalline all-organic polymers with a modular construct that favours functionalisation, while MOFs are porous frameworks formed by linking metals with organic ligands. Dr. R. Vaidhyathan's group has grown exceptionally small-sized metallic nanoparticles (2-3nm) within COFs as dispersions and have used it as electro-catalysts for water splitting and industrially-relevant organic transformations. In another study, the group has demonstrated the use of exfoliated COF as fast ion-diffusion anode in Li-ion battery, and they have constructed COFs with fluorescent modules to accomplish single-source flexible white-light emitters required in next generation solid-state lighting. Additionally, to address the issue of mitigating atmospheric CO₂ concentrations, they have successfully made a 3-D pillared-layered permanently porous MOF, with a good CO₂ uptake and CO₂/N₂ selectivity. The group adopts a combined experimental-computational approach to provide deep insights into these materials' functions.

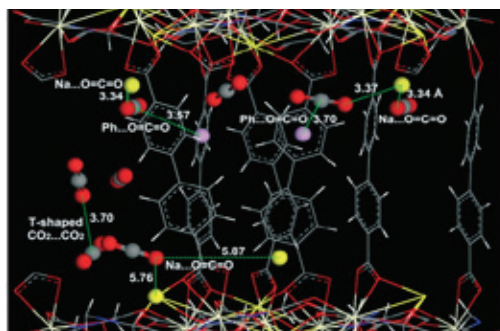


Figure 16: A MOF showing favourable Na+...CO₂ interactions within their nanopores (Dr. R. Vaidhyathan's Group)

2.3 Spectroscopy, Theoretical, and Computational Chemistry

Dynamics of polymer translocation

Translocation of polymers through nanometer-sized biological pores has attracted a lot of attention in the last two decades. Many experiments have been designed to understand the contribution of various factors such as the salt concentration, the sequence of the polymer, the applied voltage gradient, the electrostatic interactions and so on. A change in the salt concentration gradient or pH difference can lead to a change in the polymer-pore interaction. Dr. Srabanti Chaudhury's group performs Molecular Dynamics simulation and show that with the change in the charge distribution that mimics different pH conditions, the external driving force and the peptide-pore electrostatic interactions play a significant role in the translocation process. During the exit of the polymer through the pore, the electrostatic interactions as well as the external electric field act in concert in determining the exit time through the pore. The simulation results can capture many features observed in experiments.

In the context of single enzymes, the group studies the effect of substrate number fluctuations in stochastic enzyme kinetics using a chemical master equation approach. This is important for catalytic reactions taking place in intracellular compartments, the substrate molecules are fed in and out of the compartment and are catalysed into product molecules within the compartment.

Protein-RNA interactions

Taking leads from a handful of double-stranded RNA-binding domains (dsRBDs) interacting with a massive number of double-stranded RNAs (dsRNAs) in multiple biological pathways, Dr. Jeetender Chugh's group is engaging model dsRBDs to understand the shape-dependent dsRNA recognition phenomenon employed by the dsRBDs. In this direction, the group 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 proposed that dynamics (observed in multiple dsRBDs by NMR-based relaxation dispersion studies) in the RNA-binding region of the protein allows it to access the conformational space required for shape-dependent RNA-recognition.

Another area of interest is the applicability of NMR to metabolomics where the group collaborates with biology labs across India to find various problems that can be addressed by NMR. The group has shown that o-phosphocholine to UDP-N-acetylglucosamine ratio may act as a potential biomarker in glucotoxic/lipotoxic/glucolipotoxic conditions in pancreatic β -cells. 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.

Studying weak non-covalent interactions

Dr. Alope Das's research group is focused on the molecular level understanding of subtle interplay between various weak non-covalent interactions. They are also interested in exploring $n \rightarrow \pi^*$ interaction, Se hydrogen-bonding, folding motifs of secondary structures of small peptides, conformation-specific electronic circular dichroism spectroscopy, etc. Here is a glimpse of the recent research in his group.

(a) *Unconventional hydrogen bonds (S-H...S) are as strong as conventional hydrogen bonds*: Despite being a century old concept, hydrogen bond is still the most enthralling topic of research in the scientific community. Hydrogen bond is denoted by X-H...Y, where both X and Y are electronegative atoms for conventional strong

hydrogen bonds. However, the recent redefinition of the hydrogen bonding by the IUPAC committee goes beyond the conventional wisdom on this non-covalent interaction. Consequently, there has been a growing search for finding the presence of this ever interesting non-bonded interaction considering various atoms in the periodic table as hydrogen bond donor (X-H) and acceptor (Y). In the literature, there are reports of spectroscopic studies of unconventional hydrogen bonding involving either weak hydrogen bond donor (C-H) or weak hydrogen bond acceptor (S, Se or P). In this work, Dr. Alope Das's group has shown for the first time through gas phase IR spectroscopy that unconventional hydrogen bonds (S-H...S) with both weak donor and acceptor atoms are as strong as any conventional hydrogen bond

- (b) *Observation of a C5 hydrogen-bond in a dipeptide:* It has been reported recently that intra-residue C5 hydrogen bonds contribute greatly to the stability of peptides and proteins. In this work, the group has studied structures and conformational preferences of a dipeptide Z-Gly-Pro (Z=Carboxybenzyl) using mass-selected vibrationally-resolved electronic spectroscopy and IR-UV double resonance spectroscopy coupled with quantum chemistry calculations. Two conformers of the peptide are observed in the experiment. One of the conformers has extended structure stabilised by C5 hydrogen-bonding while the other one is folded through O-H... π interaction.

Study of excited state phenomena in molecules using quantum chemical tools

Molecules in their electronically excited states play critical roles in living organisms, the atmosphere, synthetic chemistry, and light harvesting devices. In excited states, unlike in the ground state, the chemistry is largely governed by the crossing of potential energy surfaces, or more generally by the coupling of electronic and nuclear motion. Using theoretical methods, primarily, multi-reference quantum chemical calculations, Dr. Anirban Hazra's group investigates mechanism of a variety of excited state phenomena.

The group has comprehensively investigated the photoisomerisation and photo decay mechanisms in ortho-nitrotoluene (oNT), which is a model for the widely used ortho-nitrobenzyl (oNB) type of photolabile caged compound. The primary step in the photoinduced deprotection is an excited state intramolecular hydrogen transfer (ESIHT) leading to tautomerisation of the oNB compound and subsequent release of the protecting group. The group has discovered that this process is largely driven by intersystem crossing. There is a barrierless path for oNT to relax to the lowest triplet state. In this T1 state, the ESIHT products are more stable than T1 oNT. Hydrogen-transfer occurs on the T1 state followed by relaxation to the ground state to give the isomerised product.

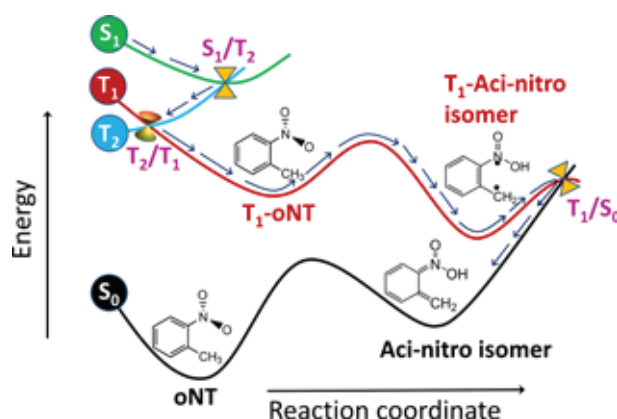


Figure 17: Photoisomerisation and photo decay mechanisms in ortho-nitrotoluene (oNT) (Dr. Anirban Hazra's Group)

Photophysics of biologically important molecules

Dr. Partha Hazra's group worked on the topic "how to activate centrosymmetrically packed organic luminogens?". To achieve this goal, a series of fused biheterocyclic luminogens exhibiting centrosymmetric packing organic luminogens have been synthesised. The designed luminogens do not respond to external mechanical stimulus. However, the application of heat as an effective stimulus leads to "centrosymmetric to noncentrosymmetric crystal to crystal" phase transitions at their corresponding crystallisation temperature. After that, they have successfully activated the luminogens to external mechanical stimuli. The above-mentioned strategy may be useful to activate large numbers of centrosymmetrically packed organic luminogens and, for their promising applications in optical storage, mechanical sensors, security systems, and optoelectronic devices.

In another work on the biophysical aspect, Dr. Hazra's group demonstrated that silica nano-channels can instigate the formation and stabilisation of i-motif DNA (ssDNA \rightarrow i-motif) at neutral and alkaline medium. Subsequently, they have reversed this conformational transition (i-motif \rightarrow ssDNA) by introducing Lyz protein in the same system, which drags the DNA from the MCM-41 nanopores leading to the disruption of i-motif structure.

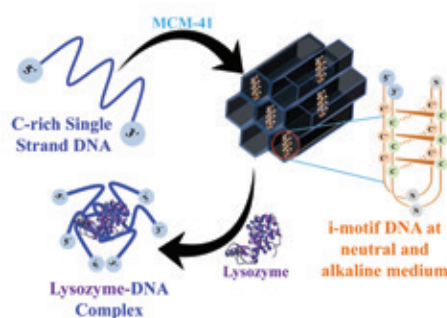


Figure 18: Reversible formation and stabilisation of i-motif DNA inside the silica nano-channels (MCM-41) (Dr. Partha Hazra's Group)

They also worked on isoquinoline based alkaloid chemosensor for detection of alkanes. Presently, they are working on the white-light generation by a single organic molecule, and tunable copper cluster for the application of optoelectronics and light emitting diodes. They are also working on designing a novel fluorophore, which can detect amyloid fibril more efficiently and effectively.

Internal friction in proteins

Using simple model systems, Dr. Arnab Mukherjee's group showed that the internal friction, as defined in the literatures of protein folding studies, is essentially an effect due to the memory-dependence of friction. Their work demonstrated that the method used in experiments as well as in theory to estimate the internal friction and attribute it to various physical phenomena might be at flaw. The group also worked on PNA-RNA interaction in collaboration with Prof. Danith Ly from CMU, USA. The other ongoing topics of research in the group include water entropy and diffusion in supercooled liquid – both in bulk and around ions.

Understanding properties of materials through simulation methods

Dr. Arun Venkatnathan's group focuses on computer simulations of battery electrolytes, polymer electrolyte membranes for fuel cells, proton transport, and carbon capture in ionic liquids. In one of the projects, the group investigated the nanostructure and dynamics in hydrated Nafion-doped graphene-oxide (GO) systems using classical Molecular Dynamics simulations. The simulations highlight the role of GO as fillers in hydrated Nafion environments. It was found that the presence of GO results in the

formation of Nafion layers along a direction normal to the GO surface. The retention of water at the Nafion/GO interface was found only at high hydration.

In a different study with experimental groups at Temple University, Philadelphia, U.S.A., the group explored a potential battery electrolyte material formed by a sodium perchlorate (NaClO_4) co-crystal mixed with an adiponitrile cosolvent. This electrolyte was found to show room temperature conductivity of $10^{-4} \text{ S-cm}^{-1}$ and was stable even at elevated temperatures. Results from simulations provided insights into ion-solvent and inter-ionic interactions, structural characteristics, decomposition temperature, and mobility of ions in the surface and bulk of the co-crystalline electrolyte. The simulations of defects in the supercells of co-crystals show that interstitial ionic dislocations play a key role in ion conduction. The activation energy barrier of sodium ion conduction calculated from simulations was found to be in agreement with impedance spectroscopy experiments. The mechanism of ion conduction (calculated using plane-wave density functional theory calculations), suggested that solvent coordinated transition state facilitates the migration of sodium ions.



3. EARTH AND CLIMATE SCIENCE RESEARCH REPORT

3.1 Earth Surface Processes and Climate

Himalayan glaciers

Dr. Argha Banerjee's group is working on the Himalayan glaciers and is studying their ice thickness. Himalayan glaciers are losing about 4m of ice thickness per decade on the average. However, the pattern of thinning across the Himalaya shows large spatial variability. Analysis of remote-sensing data and model simulation reveal that a significant part of the variability is due to the distribution of dynamic response properties of glaciers. For example, gently sloping glaciers are losing more ice systematically as they have a large response time, and therefore, are further away from a steady state due to the recent warming. Work from his group shows that more than 50% of the volume loss is happening in 23% of the glaciers with slope less than 0.36.

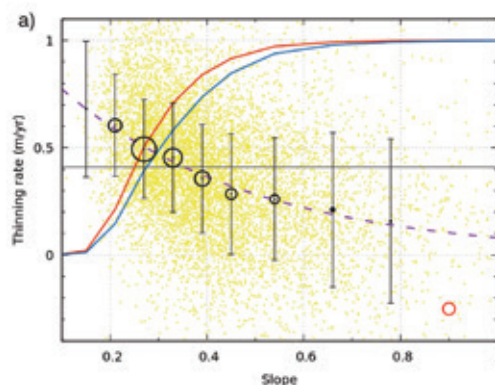


Figure 19: Observed thinning rate of Himalayan glaciers (yellow dots) decline exponentially (dashed line) as a function of glacier slope. Circles with error bars denote bin averages of the thinning rate values and their spread. Solid red and blue lines are the cumulative distribution of glacier area and volume loss. (Dr. Argha Banerjee's Group)

Organisation of tropical convection

Atmospheric convection is a multi-scale phenomenon and it closely interacts with various modes of the tropical circulation. Understanding the scale-interaction between small convective processes and large-scale circulation in the tropic is still an open unresolved issue. Using 11 years of high resolution CloudSat satellite observations, Dr. Suhas Ettammal's group has estimated convection sensitive parameters (entrainment, detrainment, the level of maximum detrainment, deep convective core, etc) over different

geographical and climate regimes. These observations will be used for verifying the sensitivity of atmospheric convection to local dynamic and thermodynamic conditions. The organisation of convection into large spatial and temporal scale is another unsettled issue. The equatorial wave is considered as one of the building blocks of such organisation. The group has examined the characteristics of Mixed Rossby Gravity (MRG) waves, one of the equatorial waves, using 39 years of reanalysis data and found that the amplitude, horizontal and vertical structures, and phase speed are sensitive to background conditions in the Pacific. The La Nina conditions and extra-tropical forcings favour strong MRG waves whereas El Nino conditions inhibit MRG waves in the Pacific.

Stable isotope geology

Climate-proxy characterisation: To characterise commonly used rainfall proxies, systematic sampling of soil and plants was done across the Western Ghats by Dr. Shreyas Managave's group. The samples are being processed for analysis. The hypothesis to be tested include (i) does rainfall control the proxy response (carbon and hydrogen isotopic composition of plants and soil organic matter); average chain length of n-alkanes and sediment magnetic properties (ii) are there any thresholds in the responses, and (iii) how coherently these proxies respond?

Bird migration studies using stable isotopic composition of feathers: Analysis of the isotope ratios of feathers of a bird could reveal its migratory route. In this context, a project has been devised in collaboration with the Bombay Natural History Society, Mumbai. Samples of bird feathers of resident bird species from several location (see the accompanying map) have been collected by Dr. Managave's group. These samples are being processed for hydrogen, carbon, and sulfur isotopic studies.

Stable Isotope Studies in India



Figure 20: The locations from where samples of bird feathers of resident bird species have been collected for isotope studies (Dr. Shreyas Managave's Group)

Weather prediction and understanding natural variability

Research in Dr. Neena Joseph Mani's group during the past year focused on identifying the common modes of variability in monsoons over the East and South Asia. This is motivated by the fact that reconstruction of past monsoon variability is largely based on tree rings and speleothems from the East Asian monsoon domain, with very little contribution coming from the Indian region. The Palmer drought severity index was identified as a metric to evaluate the monsoon strength and the variability in the two monsoon regions were studied. Speleothem data collected from the two regions were also examined to understand the decadal to centennial variability. Also, to understand

the effect of different climate modes like the Atlantic Multidecadal Oscillation and the Pacific Decadal variability, Last Millennium climate simulations made by eight climate models were examined. In another ongoing research, an objective method was developed to identify the intra-seasonal convection initiation events over the Indian Ocean.

Marine methane hydrates help to quantify thermal variations in a young extensional basin

Methane hydrates are detected in shallow marine sediments from the presence of a gas hydrate bottom simulating reflector (BSR) in a young oceanic basin located in the central Gulf of California. Methane hydrates are ice-like compounds that store substantial methane in their molecular structure. The methane in the hydrate structure is a result of biogenic activity and thermogenic reactions, such as cooking of organic carbon facilitated by hot intruding magma in the sedimentary basin. From the occurrence of methane hydrates, Dr. Sudipta Sarkar determined the variation of heat flux in the basin. He is investigating the timing of fluid release episodes and formation of hydrates using basin analysis techniques and paleoceanographic information. Methane is a crucial climate warming agent. The release of methane stored in marine sediments and subsequent rapid transfer to the atmosphere may facilitate warming. Therefore, quantification of hydrate-bound methane and ascertaining potential methane release mechanisms are relevant to understand the role of geosphere in bringing about abrupt climate change.

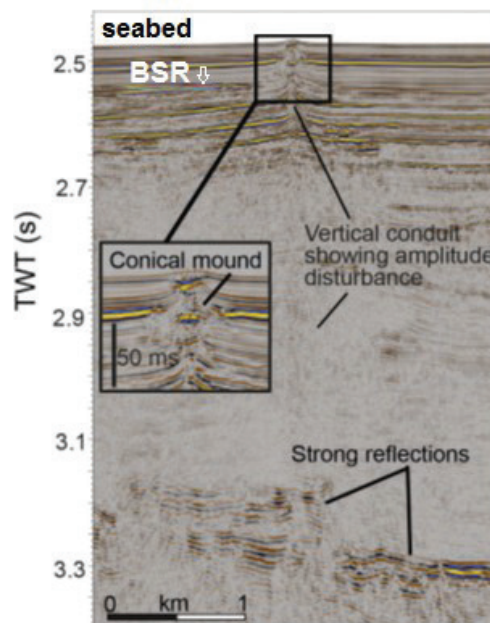


Figure 21: Venting of methane in a sedimentary basin. Subsurface seismic imaging reveals a BSR (bottom simulating reflector) and a near-vertical pipe that once transferred hot fluid and methane from the geosphere to the ocean floor. Strong reflections between 3 and 3.3 seconds represent igneous intrusions (hot magma that was injected into sediments). (Dr. Sudipta Sarkar's Group)

Weathering and erosion

The freshwater-seawater interface, a biogeochemically active oceanic regime, regulates the ultimate delivery of dissolved solutes from rivers to the ocean. Among these chemical constituents, Boron is a bio-essential metalloid and its isotopic compositions of marine carbonates serve as a reliable paleo-pH proxy; however, its oceanic budget is not yet well-constrained. Dr. Gyana Ranjan Tripathy's group has investigated spatial and seasonal distributions of dissolved boron of the Chilika lagoon, India (Asia's largest brackish-water lagoon) and its possible source waters have been investigated to constrain its coastal behaviour and chemical budget. The boron concentrations show significant spatial distribution, with the lower values being observed in the river-dominated northern sector of the lagoon. Co-variation between boron and salinity of the samples establishes conservative behaviour during onset of the monsoon (June) and also, in the monsoon (Aug) seasons. The boron-salinity trend and boron/salinity

ratios of pre-monsoon (May) samples, however, point to its non-conservative behaviour with significant boron removal at low-saline regime through ion-exchange (adsorption) processes. Removal of boron is mostly limited to salinity <15 psu and the intensity (in %) of removal increases steadily with decrease in salinity. These adsorptive losses of boron during pre-monsoon period are mostly dependent on the water residence time; higher residence time allows efficient particulate-water interaction, which possibly intensifies the removal. Further, the boron concentrations show significant changes on diurnal and fortnightly timescales due to tide/ebb cycles. However, the coastal behaviour of boron, despite of large concentration changes, remains invariant due to tidal forcing. Outcomes of this study underscore adsorptive removal of boron from coastal regimes and its importance in understanding authigenic boron distribution in clay-rich sedimentary archives from near-shore settings.

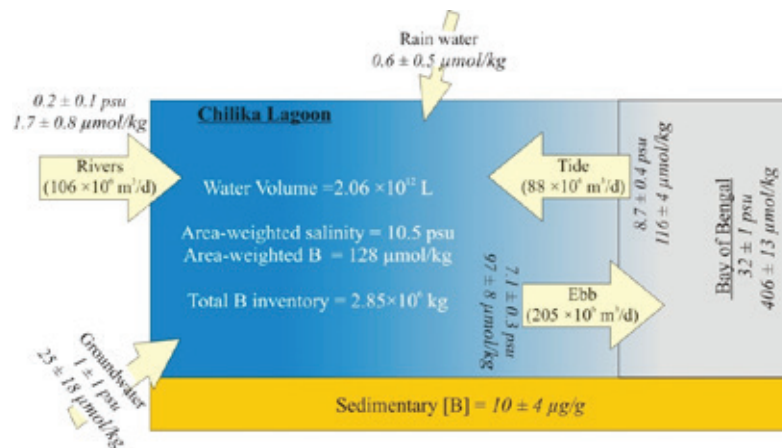


Figure 22: Dissolved boron budget of the Chilika lagoon for the monsoon season. The boron (in $\mu\text{mol/kg}$ units) and salinity (in psu units) data are from this study, whereas water volume and fluxes are from the existing literature (Gupta et al., 2008). (Dr. Gyana Ranjan Tripathy's Group)

3.2 Computational Geoscience

Modelling of geophysical data

Multi-grid forward modelling algorithm of electromagnetic data: Electromagnetic (EM) techniques are vital geophysical tools for exploration, exploitation, and management of natural resources such as hydrocarbon, ground water and minerals. Efficient and accurate modelling of EM data is essential to attain full potential of these techniques specially in case of complex geology. To address this issue, Dr. Rahul Dehiya is currently working on developing EM forward modelling algorithm based on finite difference multi-grid method. The basic idea is to decompose the computation domain (grid discretization) into two parts, namely, modelling domain and stretched domain. The stretched domain arises due to the application of boundary condition, however it leads to very slow convergence of matrix solver needed for solving system matrix. This mainly occurs due to poor conditioning of system matrix caused by grid stretching. The ongoing research work is intended to address this issue using multi-grid scheme.



4. HUMANITIES AND SOCIAL SCIENCES RESEARCH REPORT

4.1 History of science, architecture, material culture

History and development of astronomy and mathematics in India

Dr. Venketeswara Pai has recently completed a major work (started in 2009, completed in 2017) on study of an astronomical text *Karanapaddhati*, which provides the mathematical rationales behind one type of astronomical texts known as *karana* texts which aims at preparing astronomical manuals by using simple mathematical techniques. This has been published as a book by Hindusthan Book Agency, New Delhi and reprinted by Springer in 2018. Co-authors : K. Ramasubramanian, M.S. Sriram and M.D. Sriram. Currently he is also working on another text *vākyakarana* composed during 13th century. Study of this text will throw some light on the development of *vākya* school of astronomy which is prevalent in South India.

In collaboration with M.S. Sriram of University of Madras, Dr. Pai is working on the auto commentary (*vāsanabhāṣya*) of the text *Siddhānta'siromani* of Bhāskara II (12th century), which is an important text during the time and will provide insights into the development of astronomy in India during the 12th century.

Dr. Pai completed work on an astronomical text "*Drkkarana*" which emphasises on the observations to be made and to revise the astronomical parameters and mathematical model accordingly. He is also preparing a star catalogue based on the information available from different astronomical texts on star coordinates. This will throw some light on the development of observational astronomy in India. The work is done in collaboration with Dr. B.S. Shylaja (Former Director, Jawaharlal Nehru Planetarium, Bengaluru).

History of architecture and material culture

Dr. Pushkar Sohoni's research articles on various aspects of architectural and cultural history continued to be published in leading journals. His book on the architecture of the Nizam Shahs was published by I.B. Tauris.

Since May 2018, he has been part of a large project along with three other architects, to write a two-volume work titled *Mahārāstrātīla Vāstukalā: paramparā āni vātacāla*. These books have been commissioned by the Rājya Marāthī Vikāsa Samsthā and should be published in early 2020. Through a grant from the Department of Science and Technology, Dr. Sohoni would be investigating the material properties of historic lime mortars.

As part of research outreach, Dr. Sohoni continued to write for the *Pune Mirror*, and was engaged with other popular media, e.g., he featured prominently in a documentary on the website *Live History India*.

4.2 Literature

Fictional worlds and their analyses

Dr. Pooja Sancheti is currently working on two papers: Octavia Butler's short story "Amnesty" and how it explores the economic and linguistic struggles of a colonized state, and another on the novels of Cyrus Mistry and how they capture turbulent moments in Indian history, and pit against them young, rebellious, and sentimental Parsi protagonists. A paper titled "Locating Ben Okri's *The Age of Magic* in a Cosmopolitan Framework" is

under review. Dr. Sancheti's research focuses on the interplay of minorities, community, class, caste, individual, history, and identity in the confusion that is Indian culture.



5. MATHEMATICS RESEARCH REPORT

5.1 Algebra and Number Theory

Special values of L-functions associated to automorphic forms

Dr. Baskar Balasubramanyam's research involves the study of special values L-functions and p-adic families of automorphic forms. His recent work, in collaboration with Dr. Kaneenika Sinha, involves studying Asai L-functions attached to automorphic representations for $GL(n)$ over CM fields at critical points.

Arithmetic geometry and automorphic forms

In a joint work with Loic Merel (Sorbonne University, Paris), Dr. Debargha Banerjee's work proved a generalisation of Main-Drinfeld Theorem.

Whitehead group of general orthogonal modules

Dr. Rabeya Basu's work deduces an analogue of Quillen--Suslin's local-global principle for the transvection subgroups of the general quadratic (Bak's unitary) groups. As an application, the result of Bak--Petrov--Tang on injective stabilization for the K_1 -functor of the general quadratic groups is revisited.

Self-dual cuspidal representations of finite and p-adic reductive groups

In a joint work with Dr. Jeffrey Adler, Dr. Manish Mishra gave the necessary and sufficient condition for the existence of self-dual cuspidal representations of finite and p-adic reductive groups.

In a joint work with PhD student Basudev Pattanayak, Dr. Mishra showed that depth is not necessarily preserved under local Langlands Correspondence for tori.

In a joint work with Dr. Amy Binny Philip, they generalised the 3d distance theorem to a new class of periodic functions with period one. This includes the distance to the nearest integer function.

Special Values of automorphic L-functions

Prof. A. Raghuram has continued with his work on the special values of various automorphic L-functions. He uses analytic techniques from the Langlands programme involving automorphic forms, and geometric techniques from the cohomology of locally symmetric spaces. During the year 2018--19, he has completed work on the special values of Rankin-Selberg L-functions for $GL(n) \times GL(m)$ over a CM field. This project was going on for more than three years and a first draft of this 50+ page manuscript is now ready for circulation.

Witt groups of associative rings

Dr. Supriya Pisolkar has been working on the problem of comparing two constructions of ring of Witt vectors of non-commutative rings, one of an abelian group $W(A)$ given by Lars Hesselholt and the other is a construction of a ring $E(A)$ by Cuntz and Deninger where A is an associative ring. Both $E(A)$ and $W(A)$ are topological groups and are equipped with the Verschiebung operator V and the Teichmüller map $\langle \cdot \rangle$. Moreover, $W(A)$ and $E(A)$ are isomorphic to the classical construction of ring of p-typical Witt vectors when A is commutative and p-torsion free. where p is a prime number. It is natural to see how these constructions are related when A is non-commutative. This work has

answered negatively a question of L. Hesselholt which asks whether for an associative ring A , $W(A)$ is isomorphic to $HH_0(E(A))$? The group proved earlier that for $p = 2$ and $A = \mathbb{Z}\{X, Y\}$ there is no continuous surjective map from $W(A) \rightarrow HH_0(E(A))$ which commutes with V and $\langle \cdot \rangle$. One of the main results of the recent paper generalises this result to any prime p .

It is also natural to see whether there is a continuous surjective map in the opposite direction which commutes with the ghost maps. They prove that this is also not possible in the case where p is any prime and $A = \mathbb{Z}\{X, Y\}$.

5.2 Analysis and Applicable Mathematics

Elliptical particle differential equations

Dr. Mousmi Bhakta worked on two topics. 1) Semilinear nonlocal elliptic equations and systems with measure data: The group studied a priori estimates of non-negative solutions, existence and multiplicity of positive solutions and the associated regularity results. This was done in a series of three papers with collaborator Prof. Phuoc Tai Nguyen from Czech Republic, one of which was published in 2019 and the other two have been submitted to journals. 2) (With former PhD student Dr. Mukherjee) The group studied multiplicity of general solutions and nonnegative solutions of nonlocal elliptic equations involving (p, q) -fractional Laplacian operator and critical type nonlinearity (*Advances in Differential Equations*, 2019). They also studied nonlocal scalar field equations: qualitative properties, asymptotic profiles and local uniqueness of solutions (*Journal of Differential Equations*, 2019). In another project with Dr. Debdeep Ganguly and Luigi Montoro, Dr. Bhakta has begun to study fractional Hardy equations with supercritical nonlinearities.

Probability theory and control theory

Dr. Anup Biswas, in a joint work with Lorinczi, has developed a potential theoretic approach for a general class of nonlocal operators and used them to resolve some important questions in the field of nonlocal PDE. He has also been involved in generalising variational representation of the ergodic risk-sensitive value.

Shape optimisation problems

In the paper Chorwadwala and Roy (*Journal of Optimization Theory and Applications*, 2019), Dr. Anisa Chorwadwala dealt with an obstacle placement problem which can be formulated as the following eigenvalue optimisation problem: We consider a disk $B \subset \mathbb{R}^2$. We want to place an obstacle P , having a specific symmetry, within B so as to maximise or minimise the fundamental Dirichlet eigenvalue λ_1 for the Laplacian on $B \setminus P$, in the case when the centres of mass for P and B are nonconcentric. That is, we want to extremise the function $\lambda_1(B \setminus \rho(P))$, where ρ runs over the set of all rigid motions of the plane fixing the centre of mass for P such that $\rho(P) \subset B$. We consider the case where the obstacle P is invariant under the action of a dihedral group D_n ; $n \geq 2$; n even.

The group also proved the generalisations of their result from the Euclidean plane to other manifolds, and from the differential equations involving the Laplace operator to the ones involving the Schrödinger-type operators. They also provide some numerical evidence to validate our theoretical results for the case when the obstacle P has D_4 symmetry.

Partial differential equations of elliptic and parabolic type and nonlinear analysis on manifolds

Dr. Debdip Ganguly works on sharp functional inequalities and spectral theory and its applications to partial differential equations.

With Elvise and Gabriele, they obtained improved Multipolar Poincare-Hardy inequality on the Cartan-Hadamard manifolds. This extends their previous result of single pole singularity to multipolar singularities on negatively curved manifolds. In particular, they prove a family of improved Multipolar Poincare-Hardy inequalities on Cartan-Hadamard manifolds. For suitable configurations of poles, these inequalities yield an improved multipolar Hardy inequality and an improved Poincare inequality such that the critical unipolar singular mass is reached at any pole.

With Y. Pinchover, they prove some new and interesting results concerning perturbation theory for positive solutions of second-order linear elliptic operators, including further study of the equivalence of positive minimal Green functions and the validity of a Liouville principle for nonsymmetric operators.

Mathematical finance

Dr. Anindya Goswami's group has studied the European option pricing problem by considering a regime-switching jump diffusion model of the underlying financial asset price dynamics. The regime process is assumed to be a semi-Markov process on finite state space. Under this model assumption, they found the locally risk minimising price of European type path independent options. The Follmer-Schweizer decomposition is adopted to show that the option price satisfies an evolution problem, as a function of time, stock price, market regime, and the stagnancy period. They have established existence and uniqueness of classical solution to the evolution problem in an appropriate class. The group further asked the question that since the option price is obtained by assuming observability of regime switching, can one retrieve the full information of regime just from the knowledge of the prices of stock and all possible call options on it. They have proved that the answer is affirmative.

5.3 Discrete Mathematics

Elliptic curve discrete logarithm problem

Dr. Ayan Mahalanobis is working with Vivek Mallick and Ansari Abdullah to find attacks on the elliptic curve discrete logarithm problem. Recently, the group was successful in finding a new attack on the elliptic curve discrete logarithm problem. The paper was presented in *Progress of Cryptology – Indocrypt 2018*.

Combinatorial problems

The computationally hard problems are classified as NP-hard. These problems are neither known to have a polynomial time solution, nor has anyone been able to prove that such a solution does not exist. The best known algorithms that are used to solve them, require exponential time or worse. Some approaches to tackle these problems are approximation and parameterization. Approximation algorithms are those that run in polynomial time to yield a solution that is closed to the optimum. A relatively recent approach to solving NP-hard problems is parameterization. Dr. Soumen Maity's group works in the area of parameterized algorithms. They have proposed two parameterized algorithms which take as input an undirected temporal graph G and a positive integer k , and determine whether or not G contains a k -vertex temporal path. They have also proposed a FPT algorithm for minimum neighbourhood problem with respect to the parameter tree-width.

5.4 Geometry and Topology

Low-dimensional topology

Dr. Tejas Kalelkar's work in the past year has focused on studying triangulations of manifolds. A manifold is a space that locally looks like Euclidean space, while its triangulation is a combinatorial description obtained by breaking it up into simple pieces like tetrahedra.

Any two triangulations of a 2- or 3-dimensional 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 that Dr. Kalelkar submitted in 2018, they have obtained such a bound for hyperbolic, spherical and Euclidean manifolds of any dimension. Their ongoing effort is to show that any two such geometric triangulations are in fact related by geometric Pachner Moves, so that the intermediate triangulations in the sequence are also geometric in nature. This would allow defining the properties of the geometry of the manifold in terms of any geometric triangulation of the manifold, provided the property is invariant under geometric Pachner Moves.

Toric vector bundles and tensor triangular geometry

The main area of research is tensor triangular geometry. Algebraic varieties are the central objects of study in Algebraic Geometry. The properties of varieties are encoded in an algebraic construct called the derived category. Derived categories are rich objects, and some abstraction is necessary to study them efficiently. In a joint work with Dr. Umesh Dubey, Dr. Vivek Mallick is interested in two such abstractions. One abstraction is the notion of tensor triangulated categories, and the other is the notion of a differential graded category. It turns out there is a relation between these two notions, as was studied by Kapranov, Drinfeld et al. They make use of this connection to study a construction of Eilenberg and Moore for a monad in the category. Using this construction, they can recover some theorems of Elagin, a relation between Bousfield localization of triangulated categories and Drinfeld localisation of DG-categories and also some results on twisted derived categories (work submitted).

In an ongoing work, they are extending Balmer-Klein's notion of Chow groups to the G -equivariant setting.

In an attempt to understand vector bundles on toric varieties, specially trying to understand combinatorially the existence of certain functorial resolutions, Dr. Vivek Mallick and Dr. Jose Ignacio Burgos Gil came up with the combinatorial construction of multifiltrations, which not only describe toric vector bundles, but can be used in other fields also. For example, in a submitted paper, they study the representations of a solvable finite group in terms of multifiltrations.

With Dr. Ayan Mahalanobis, Dr. Mallick has used an algebraic geometric approach to design an attack on elliptic curve cryptography (published in *Indocrypt*).

However, the experimental results suggest that their algorithm is faster than the estimated complexity. They are trying to sharpen the complexity estimates.



6. PHYSICS RESEARCH REPORT

6.1 Atomic and Molecular Physics, Optics, and Quantum Information

Light-matter quantum systems

Dr. Bijay Kumar Agarwalla's research is focused on understanding the dynamics and steady state properties of small non-equilibrium quantum systems. During this year, they developed a first principle theoretical approach to study energy transport statistics for systems where the interaction with the surroundings can vary from weak to strong and put forward the answer to the question of how efficiency of a quantum device depends on the coupling strength (*New J. Phys.* 20:083026). For similar type of problems, they take the full counting statistics approach to develop an exact numerical technique based on path integral to simulate non-equilibrium dynamics. This work was selected as Editor's pick (*J. Chem. Phys.* 150:084111).

They also investigated theoretical bounds on non-equilibrium fluctuations, also known as thermodynamic uncertainty relation and showed the conditions under which these relations can be violated (*Phys. Rev. B* 98:155438). In collaboration with Prof. T.S. Mahesh's group, they described how to simulate a quantum non-Markovian dynamics using classical stochastic noise (*Phys. Rev. A* 99:022107).

Plasmon enhanced Raman and fluorescence scattering in Fourier space

Dr. G.V. Pavan Kumar's group is working in the research areas of nanophotonics of plasmonic nanowires and nanoparticles and soft matter system interacting with plasmonic mesostructures.

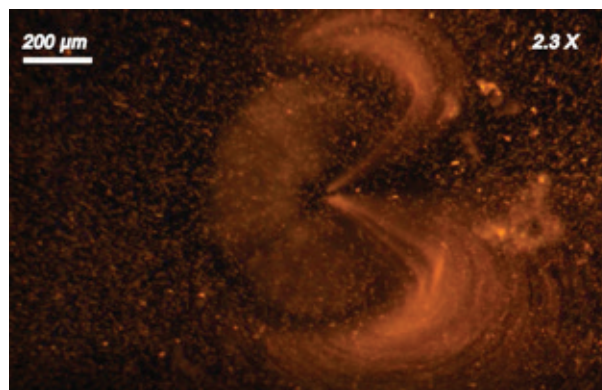


Figure 23: Plasmon assisted dynamics of dielectric colloids. The instability due to the thermo-optical field at the interface creates interesting dynamics, which is currently being studied. (Dr. G.V. Pavan Kumar's Group)

Ultra cold dipolar gases and Rydberg atoms

Dr. Rejish Nath's group has studied different perspectives in dipolar gases. In particular, they introduce the concept of doubly-dipolar Bose gases, and also look at how one can control the quantum states in Rydberg lattices. Along the same lines, the various studies involved are dynamical localisation, freezing dynamics, quantum many body phases of Rydberg fermions, quantum walks of Rydberg excitations in photonic crystals, and spin textures in spinor gases. Recently concluded work involves the study in a two atom setup. Here, a novel phenomenon was identified, which they termed as Rydberg biased freezing. The quantum correlations such as entanglement entropy and quantum discord are being characterised. The effect of dissipative mechanism has been probed on the correlation dynamics.

Dr. Umakant Rapol's group is working on developing novel matter wave interferometers using Bose-Einstein condensate (BEC) and quasi-continuous wave 'Atom Laser' extracted from a reservoir of BEC. In this direction there has been significant progress on two fronts. 1) Demonstrating diffraction of atom laser in the Raman-Nath Regime and the 2) Talbot interferometry with BEC.

Atom interferometer is a ubiquitous tool for measurement of fundamental constants and inertial sensing. While it has been extremely useful in measuring inertial rotations, the fine structure constant, gravity gradients and local gravity; the measurement process lacks the ability to probe continuously due to its single-shot nature. The group has experimentally demonstrated the diffraction of an atom laser in the Raman-Nath Regime—a key step towards the development of an atom laser-based interferometer. The diffraction orders can be precisely controlled, and momenta up to $\sim 18 \hbar k$ can be imparted to the atom laser. They form the 'atom laser' by outcoupling a quasi-continuous beam of coherent atoms from a reservoir of ^{87}Rb Bose-Einstein Condensate (BEC) lasting up to 400 ms. This 'atom laser' then interacts with a grating formed by a standing wave of far-detuned laser light. By controlling the interaction time, the strength of diffraction into various orders can be controlled. Such diffraction would allow for the construction of an atom interferometer to probe changes in physical environments continuously up to a few hundred milli seconds.

The group is also exploring another type of atom interferometer called resonant kicked rotor which is operated in time domain. It relies on splitting of a narrow momentum atomic wavepacket (BEC) into discrete momenta, imparted by photons in an off-resonant pulsed standing light wave. By inverting the phase of the standing wave, one can reverse the effect of these pulses and revert the atomic wavepacket into its initial state. This reversal in time is very sensitive to the phase gathered by the wave-packets during the free propagation time in between the pulses. The group has characterised the sensitivity of this interferometer experimentally.

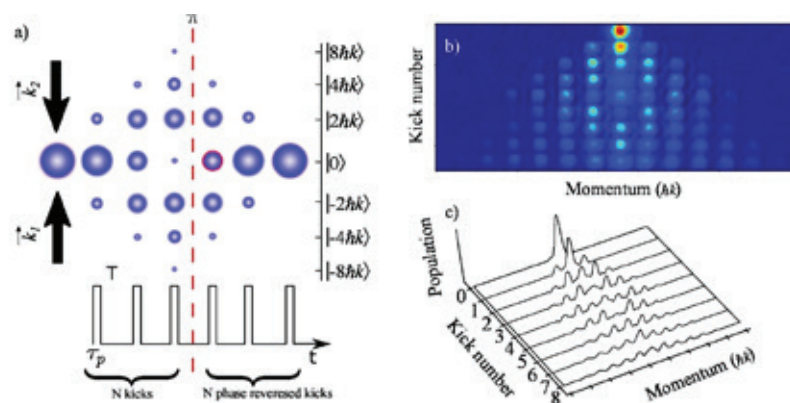


Figure 24: a) Kick sequence schematic for atom interferometry b) optical density plot of experimental data for a BEC subjected to 8 kicks c) waterfall plot of the above data (Dr. Umakant Rapol's Group)

In addition, a strontium atom based laser cooling experiment is being developed. Currently, Dr. Umakant Rapol's group can load upto 5 million Sr atoms in a magneto-optic trap at temperatures of ~ 4 mK. This experimental platform will be used for developing distributed quantum information processing in applications for quantum networking.

6.2 Complex Systems

Nonlinear dynamics

Dr. G. Ambika's research group completed a study that shows how the heterogeneity in the dynamical time scales of connected nonlinear dynamical systems can generate many interesting emergent phenomena, like amplitude death, cluster synchronisation, frequency synchronisation, etc. The pattern in which the slowness of a single system on a network spreads over the network and cause dynamical transitions in them is interesting. This addresses this important question; how robust is the network against such perturbations when there is a multiplicity of time scales deciding their dynamics.

This study, when applied to the context of a community structured modular network of chaotic neurons with inhibitory synapses, showed sequences of travelling bursts with recurring patterns that are characteristic of the time-scale mismatch and coupling strengths. These results have significance in the process of information coding in terms of frequency of firing dynamics among neurons and in selective communication among them.

Recently, the group conducted a systematic and detailed study on link deletion in directed networks, to understand the robustness of directed networks under random and targeted removal of links.

Along with collaborators from IUCAA, Pune, Dr. Ambika developed a mechanism for generating weighted recurrence networks, which introduces a new class of complex networks with strength distribution having a power law with exponential tail. This method will soon become potentially important tools for the analysis of short and noisy time series from the real world systems.

6.3 Condensed Matter, Statistical Physics, Materials

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

Dr. Arijit Bhattacharyay's group works on two areas of condensed matter physics (1) Bose-Einstein Condensate and Analogue Gravity in BEC and (2) Statistical Physics of mesoscopic systems with coordinate dependent diffusion and damping. On the BEC topic, the group has recently shown the change in structures of solitons with the change in nonlocal interactions and have proposed that solitons can be used to probe nonlocal interactions in BEC. On the topic of analogue gravity, they are working on an inflation model using expanding BEC to explore the effect of background density profile on the scale invariant power spectrum. Dr. Arijit Bhattacharyay has shown a derivation of an alternative structure of Langevin dynamics, and a generalisation of Boltzmann distribution of a Brownian particle in the presence of coordinate dependent damping and diffusion. He has also derived a relation between such diffusivity and damping in equilibrium.

Soft condensed matter

Dr. Apratim Chatterji's group identified that the release of topological constraints, the presence of molecular crowders, and cylindrical confinement effects play pivotal roles in the organisation of the bacterial chromosome for *E. coli* and *C. crescentus*. The group has identified key parameters to optimise to obtain a range of nanostructures with different morphologies by using mixtures of self-assembling polymers (micelles) and nanoparticles, which in turn leads to hierarchical and synergistic self-organisation of the polymers and nanoparticles. The key role played by the elasticity gradient along the body column of the *Hydra* organism, and how that helps in completing the somersault

during the locomotion of *Hydra* by minimising the energy spent to complete the locomotion have been studied. The group developed a coarse grained model for the protein monellin, and simulations are on to understand the short-time and long-time folding dynamics of monellin as seen in experiments.

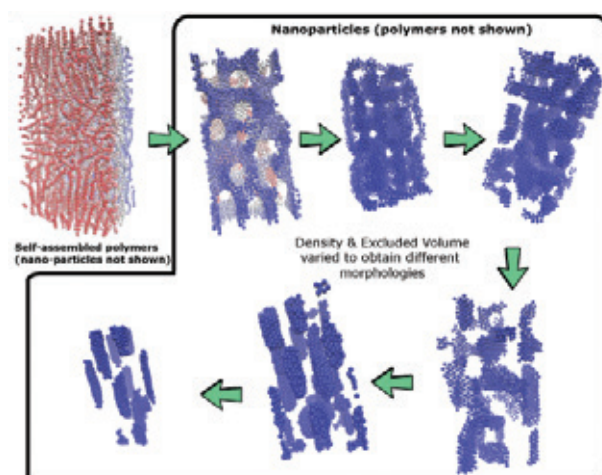


Figure 25: Nanostructures with diverse morphologies obtained from mixtures of self-assembling polymers and nanoparticles (Dr. Apratim Chatterji's Group)

Optoelectronics

Excitons are atom like quasiparticles of hydrogenic bound pairs of negatively charged electrons and positively charged holes within semiconductors. So far, excitons were studied mostly using optical spectroscopies only. However, interfacial excitons, where electrons and holes reside in two different but adjacent layers of one hetero-interface, have strong dipole moments. This has allowed Dr. Shouvik Datta's group to study excitonic many body physics in III-V semiconductors using dielectric measurements for the first time. They could also show and explain the observation of negatively charged excitons or Trions and Fermi-Edge Singularities at reasonably high temperature of 100 Kelvin. This research will be helpful in future exploration of quantum properties of excitonic Bose-Einstein Condensation (BEC) as spontaneously coherent light emitters with considerably lower operational energy thresholds than the conventional photonic lasers; exciton mediated superconductivity possibly even at room temperature; topologically protected optoelectronic properties of interfacial excitons; application of excitons/polaritons as two-level quantum state in next generation quantum technologies, etc.

Matter at the atomic scale

Topological Insulator (TI) materials, unique due to an insulating bulk but a conducting surface, are endowed with surface states that are immune to backscattering. Properties like these beckon applications in spintronics and quantum computing. Bismuth selenide (Bi_2Se_3) is one such example of TI materials that Dr. Aparna Deshpande's group studies. When exposed to an organic molecule like copper phthalocyanine (CuPc) with semiconducting properties, the CuPc- Bi_2Se_3 molecule-surface hybrid system, upon an atomic scale investigation using an ultrahigh vacuum scanning tunneling microscope (UHV STM) at low temperature (77 K), shows a one dimensional (1D) molecular chain self-assembly in a 'standing-up' configuration at the step edges of Bi_2Se_3 . A strong intermolecular interaction between the upright molecules mediates this assembly. It can lead to an indirect spin exchange among the molecules thus making it a designer molecule-based magnetic system to probe spin interactions. The hybrid CuPc- Bi_2Se_3 interface opens up channels for molecular magnetism and for spintronic applications.

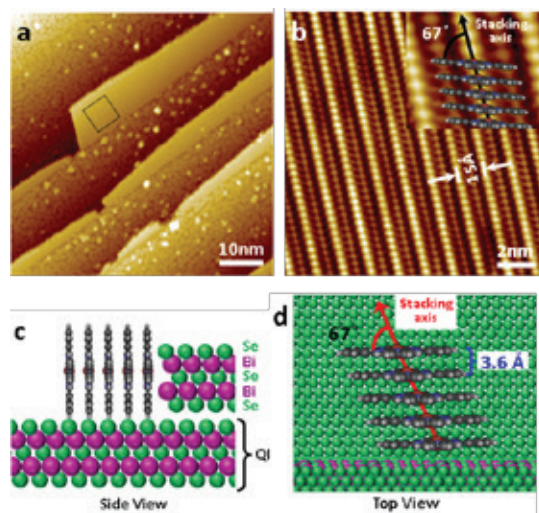


Figure 26: (a) STM image showing the step edge of Bi₂Se₃ with CuPc 1D chains marked by a black box; (b) Zoomed-in view of box in a; (c) Schematic of the upright molecular assembly at the step edge; (d) the stacking angle of molecular chains. Image parameters are tunneling voltage $V = 1.8$ V and tunneling current $I = 0.2$ nA. (Dr. Aparna Deshpande's Group)

Phase transitions, sorting dynamics

Prof. Deepak Dhar's work in the last year has dealt with phase transitions in models with only hard-core or soft-core interactions. For a model of hard needles whose centres of mass are equi-spaced points on a line, it was shown that equilibrium free energy shows an infinite number of singularities as a function of the ratio of the needle length to the lattice spacing. For a model of 2x2x2 hard cubes on a cubic lattice, it was shown that the system undergoes a transition from the disordered, to layered, to sub-lattice ordered to columnar phases, as the density of the cubes is increased.

A phenomenological model was developed to describe the experimentally observed folding transition of a small plant protein monellin. It was found that in this protein, on changing the pH of the solution to a value favouring the folded state, a large fraction of molecules initially go in to a misfolded configuration, from which the relaxation to the native state occurs very slowly.

Gate-dependent vacancy diffusion in graphene

Dr. Mukul Kabir's group has worked on the various exciting problems in two-dimensional and quantum materials. One such study is described here. The kinetics of vacancy defect in graphene drives structural modifications leading to disorder, multivacancy complex, and edge reconstruction. Within the first-principles calculations, the group studied the microscopic vacancy defect, and the intricate dependence of carrier doping is systematically investigated. They demonstrated that the lattice relaxation perpendicular to the graphene sheet along with the in-plane strain relaxation play predominant roles in predicting the correct microscopic mechanism for vacancy diffusion. The calculated activation barrier increases upon both electron and hole doping and the observed trends are explained by the differential charge density distribution and hardening of the responsible low-energy phonon modes. Electron doping essentially freezes the vacancy motion, and thus any degradation mediated by it. While tracking and analysing the vacancy diffusion experimentally in graphene is a difficult task, the present results will motivate new experimental efforts and assist interpretation of the results.

Computational materials science, energy-based materials

In an effort to understand the mechanistic details of electrocatalytic reduction of CO₂ to methanol and formic acid using Palladium-polyaniline (Pd/PANI) composite, Dr. Prasenjit Ghosh's group has performed calculations using *ab initio* density functional theory based calculations. The synergistic effects between Pd and PANI results in a high selectivity of formic acid over methanol production. The full mechanistic pathway

is shown in the figure given below. The electroreduction of CO₂ to formic acid proceeds through the formate pathway while methanol is formed through the formation of carbon monoxide.

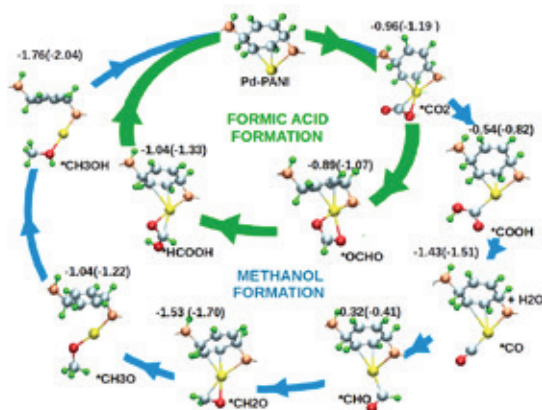


Figure 27: Mechanistic pathway with a high selectivity for formic acid production over that of methanol (Dr. Prasenjit Ghosh's Group)

Nanostructured materials: From quantum transport to energy harvesting

During 2018–2019, the group led by Dr. Atikur Rahman made significant progress in the fabrication and characterisation of nanodevices made of two-dimensional (2D), transition metal dichalcogenides (TMDs) and inorganic perovskite nanowires. The main idea is to understand the charge transport properties of nanostructured devices and the use of nanomaterials for energy harvesting applications. The group has also built new equipment like reactive ion etching (RIE) and a setup for monitoring nanowire growth.

The group is currently studying the effects of various growth parameters on the chemical vapour deposition of 2D TMDs. Monolayer sample up to several cms has already been grown; a new growth promoter has also been identified. The optoelectronic properties and field effect characteristics of these 2D nanodevices showed promising result. In another study, all inorganic nanowire of very large length (~100µm) has been synthesised in a well-controlled manner. A new photolithography technique has been developed for fabricating nanowire device.

Nanomechanics

Biomechanics of Hydra somersault: Dr. Shivprasad's group discovered the existence of differential Young's modulus between the shoulder region and rest of the body column of *Hydra*. They show that somersault of *Hydra* depends primarily on this graded variation in tissue stiffness using computational models to accurately recapitulate the mechanics involved in this process. The perturbation of observed stiffness gradient in *Hydra* body column by modulating the extracellular matrix (ECM) polymerisation impairs the 'somersault'. These results provide mechanistic basis for the evolutionary significance of differential ECM properties and tissue stiffness.

Diffusion in nano-confined water: The group has developed a novel instrument to measure diffusion of tracer molecules in few nm thick water films. The instrument is able to measure, for the first time, diffusion of tracer molecules under such extreme confinements. They have developed a Monte-Carlo method to extract diffusion coefficients from the data.

Diffusion of Li⁺ ions: Dr. Patil's group measured the dependence Li-ion concentration on its diffusion coefficient in a typical solvent. The work clearly relates the slow-down in diffusion at higher concentrations to slower charging rates. It is hypothesised that this is due to the solvation layers formed around Li⁺ ions.

Interacting quantum many body systems

The primary focus of Dr. Sreejith G.J.'s group has been on understanding the structure of fractional quantum Hall wavefunctions from the point of view of multivariable symmetric polynomials. The zeroes of these polynomials hide in them the information of the patterns of flux attachments on electrons. These patterns are characteristic fingerprints of the different fractional quantum Hall phases. More recently, they have been working towards constructing numerically tractable models that can be used to understand the effect of coupling at the interface of different fractional quantum Hall phases. Independent of these projects on FQHE, Dr. Sreejit has been working on developing numerical libraries based on "Matrix Product States" formalism to simulate complex non-equilibrium thermodynamics of interacting quantum many body systems.

6.4 Particle Physics and Gravity

Gravity and Yang-Mills

Quantum Field Theory (QFT) describes three of the four fundamental forces in Nature with remarkable accuracy. The fourth force, gravity, does not have a consistent quantum description. While the application of QFT to gravity runs into problems, there is a lot to learn from this approach, in the presence of new symmetries.

Dr. Sudarshan Ananth's research over the past year has focused on two different symmetries. (1) Higher spin symmetries: The question addressed was can the symmetries associated with interacting higher spin particles allow us to write down a consistent theory of quantum gravity? Key results include a derivation of interaction vertices in flat backgrounds and preliminary work towards interaction vertices in curved spacetime. (2) Conformal symmetries: Despite two decades of research, no one had succeeded in writing down a Lagrangian for the $(N=2,0)$ conformal field theory in $d=6$. This model is of importance for a range of reasons (the simplest being its link to $N=4$ Yang-Mills theory). The group derived a Lagrangian for this model using a light-cone field theory framework.

Ultra-relativistic heavy-ion collisions

Prof. Rajeev Bhalerao formulated a general theory of thermal fluctuations within the second-order viscous hydrodynamic evolution of matter formed in relativistic heavy-ion collisions. The fluctuation was treated perturbatively on top of a boost-invariant longitudinal expansion. Numerical simulation of thermal noise was performed for a lattice QCD equation of state and for various second-order dissipative evolution equations. Phenomenological effects of thermal fluctuations on the two-particle rapidity correlations were studied.

Elliptic flow (v_2) in ultra-relativistic nucleus-nucleus collisions fluctuates event to event, both in magnitude and in orientation with respect to the reaction plane. Even though the reaction plane is not known event to event in experiment, they show that the statistical properties of v_2 fluctuations in the reaction plane can be precisely extracted from experimental data. Previous studies have shown how to measure the mean, variance and skewness using the first three cumulants $v_2\{2\}$, $v_2\{4\}$ and $v_2\{6\}$. Complementing these studies, they provide a formula for the kurtosis, which requires an accurate determination of the next cumulant $v_2\{8\}$.

Experimental high energy physics

The analysis of data collected by the CMS experiment in 2016, 2017, and 2018 continued this year in Dr. Sourabh Dube's group. They studied models of vector-like leptons

(VLLs). These VLLs arise in many scenarios of beyond-standard-model physics such as supersymmetry, grand unified theories and so on. A significant improvement to the multilepton analysis was the addition of channels with hadronically decaying taus. This increased the sensitivity to the VLL model significantly. A preliminary result constraining the masses of possible VLLs was documented in CMS-PAS-EXO-18-005. This was the first result for VLLs from Run 2 of the LHC. A paper based on this work will be submitted shortly.

In addition, using all of Run 2 data collected by the CMS experiment, a search for Type-III seesaw fermions was also carried out and documented in CMS-PAS-EXO-19-002. An interesting addition was the search for a light scalar resonance produced in addition with a top quark antiquark pair.

Conformal field theory

During this year, an outstanding mathematical problem in conformal field theory was given a complete solution through Prof. Sunil Mukhi's research. This was the problem of classifying weakly modular vector-valued modular forms of rank 2 with non-negative coefficients. Previous attempts at classification, dating from 1988, had only provided a classification of such theories with $l=0$ and 2, where l is a positive integral parameter proportional to the number of zeroes of the Wronskian of the two characters. In the preprint "Towards a complete classification of two-character rational conformal field theories", it was shown that such pairs exist for all even l , and a method was provided to construct them explicitly in terms of quasi-characters. In the follow-up work "Curiosities at $c=24$ " it was explicitly shown that at $l=6$ (for which no theories were previously known) there are over 132 consistent RCFT's, defined through a coset construction.

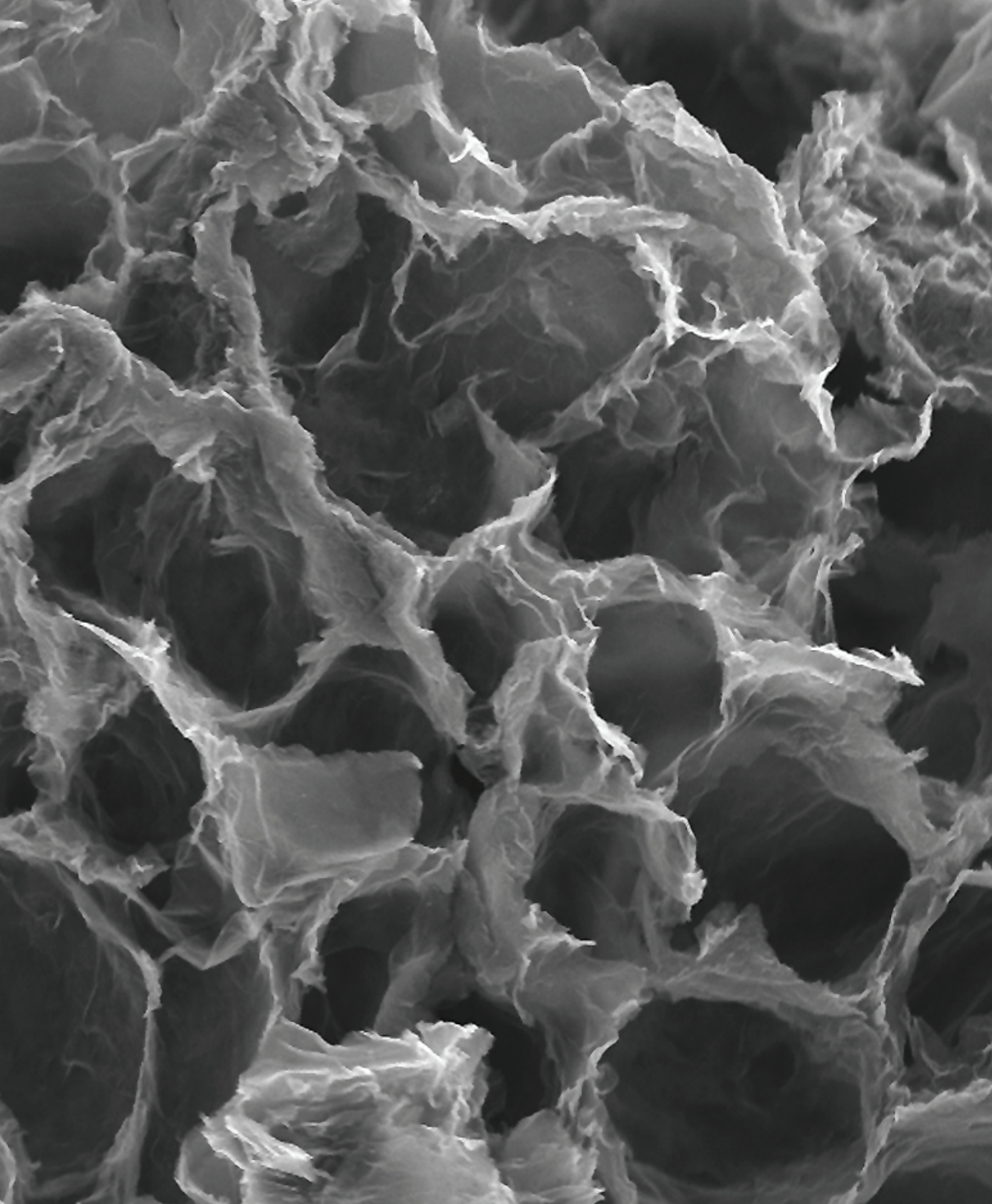
Probing new physics

Dr. Arun Thalappillil, along with his students, over the past year has continued to explore theoretical and phenomenological aspects of QED in its non-perturbative regime; where notions from an ordinary perturbative analysis, such as Feynman diagrams break down. In this context, the group has been interested in probing exotic phenomena and bounds on new particles, such as magnetic monopoles, from astrophysical systems such as neutron stars, and gravitational waves generated by them. In many cases, these bounds supersede terrestrial limits on these particles, and related phenomena would be difficult to observe in terrestrial experiments, such as high energy colliders and high power LASER facilities.

Gravitation, mathematical physics

With student Amruta Sadhu, Dr. Suneeta Vardarajan has analysed the semiclassical stability of the Schwarzschild anti-de Sitter black hole in the Euclidean partition function approach. They have demonstrated stability for a large class of perturbations by using the large dimension (D) limit of general relativity. They have also analysed spherically symmetric perturbations and demonstrated the appearance of an unstable mode for small black holes. An expression for the eigenvalue of the unstable mode to next to leading order in a $1/D$ expansion has been obtained. This is the analogue of the Hawking-Page phase transition in semiclassical stability analysis.

With student Dhanya Menon, Dr. Vardarajan has analysed gravitational perturbations of various spacetimes in weakly nonlinear perturbation theory. They have obtained a simple expression for the perturbation equations at any order in perturbation theory. They are currently analysing the system using techniques from nonlinear dynamics.



..... **Electron micrograph of a graphene-based material**

Image Credit: Dr. Nirmalya Ballav's Group

..... *Carbon (2019) 148: 354–360*

PUBLICATIONS AND PATENTS

PUBLICATIONS

IISER Pune has published a total of 2340 papers since inception. In 2018, institute members published 525 research papers, 07 book chapters, and 02 books.

The list of publications from IISER Pune members in the 2018 calendar year is given in the Appendix section of this report.

DEPARTMENT-WISE NUMBER OF PUBLICATIONS, 2006–2018

Numbers in parenthesis are for the calendar year 2018

TOTAL: 2340 (525)



384 (74)
BIOLOGY



828 (143)
CHEMISTRY



38 (10)
EARTH AND
CLIMATE SCIENCE



22 (14)
HUMANITIES AND
SOCIAL SCIENCES



119 (22)
MATHEMATICS



949 (262)
PHYSICS

PATENTS

IISER Pune has filed 22 patent applications. Among them, 2 patents have been granted. Numbers are as of March 31, 2019.

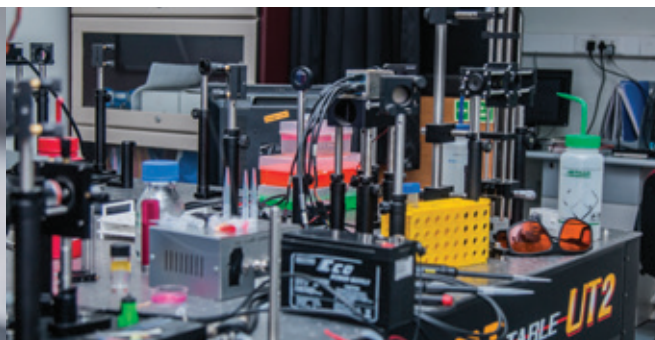
- 1) **Chakrapani, H. and Malwal, S.R.** (2015). Thiol mediated/activated prodrugs of sulfur dioxide (SO₂) having anti-bacterial activity. *US Patent No.: 9,079,870B2*.
- 2) **Britto, S.S., Reddy, M.M., Bhandari, P.J. and Rao, K.J.** (2019). Hydrophobin mimics: Process for preparation thereof. *US Patent No.: 10,188,136B2*.

EXTRAMURAL GRANTS

IISER Pune faculty members have been consistently securing competitive research funds from various government science and technology departments. In the 2018–19 financial year, the Institute has received Rs. 43.86 crores of research funds for 201 research projects.



The list of new extramural grants sanctioned during the 2018–19 financial year is given in the Appendix section of this report.



NEW PROJECTS SANCTIONED IN 2018–19

In the 2018–19 financial year, 75 new research projects have been initiated, marking a 50% increase in comparison to the past financial year, 2017–18. This surge has been due to projects funded through new funding schemes such as Mathematical Research Impact Centric Support (MATRICS), Teachers Associateship for Research Excellence (TARE) and Distinguished Investigator Award (DIA) introduced by SERB.

Some of the high value projects aimed at strengthening the research capacity initiated in the 2018–19 financial year include

Manav-Human Atlas Project (Awardee Dr. Nagaraj Balasubramanian): This will be a collaboration between IISER Pune, Persistent Systems, and the National Centre for Cell Science. Funded by the Department of Biotechnology, this project aims to construct a comprehensive map of the entire human body which will explicitly document macro to micro level information.

IUCAA-IISER Joint Centre for Gravitational Physics and Astronomy (CGPA) (Awardees Prof. Sunil Mukhi and Dr. Umakant Rapol): The goal of the CGPA is to develop highly skilled human resource at different levels of expertise to realise the goals of LIGO India and to respond to the global impetus on gravitational wave physics and astronomy.

Establishment of the Pune Biotech Cluster (Awardee Prof. Jayant Udgaonkar): This is a joint initiative between the National Centre for Cell Science (NCCS) and IISER Pune set up with funding from the Department of Biotechnology. The goal is to integrate the high-quality work being done at various research organisations in the field of Biology, especially those addressing human disease biology, and for academic institutions and industries to liaise in this endeavour.

FURTHER HIGHLIGHTS

Dr. Shouvik Datta (Physics) and **Dr. Pinaki Talukdar** (Chemistry) were selected for the DIA award from SERB.

Prof. Satish Ogale's Raja Ramanna Fellowship from DAE has been initiated.

Dr. Diptimoy Ghosh and **Dr. Sachin Jain** received the Ramanujan Fellowship.

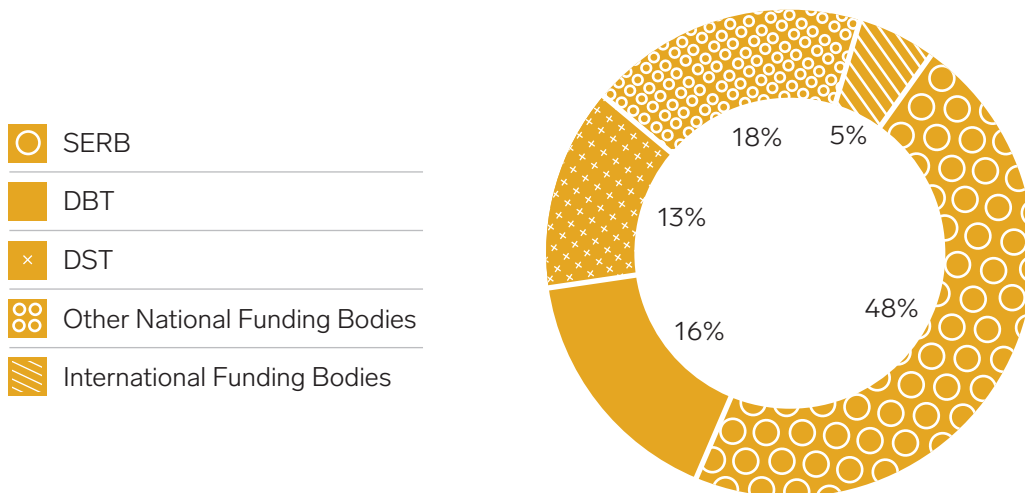
Research grants through the DST Women Scientist Scheme were awarded to

Dr. Madhuri Vangala, Dr. Antina Ghosh, Dr. Luminita Harnagea, Dr. Sheelan Sengupta, and Dr. Sunita Khanderao Gadakh

Dr. Debdip Ganguly, Dr. Utsav Mannu and Dr. Sarvesh Kumar Dubey received DST-INSPIRE Faculty Awards.

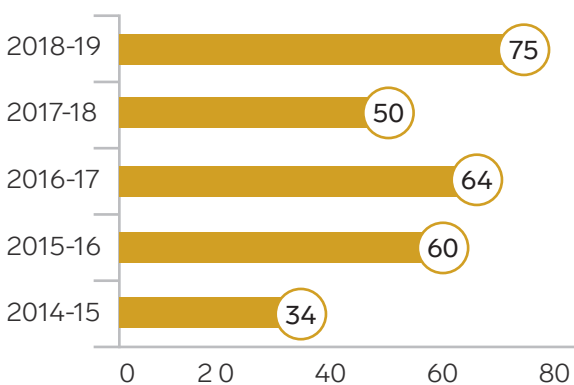
SOURCES OF EXTRAMURAL GRANTS, 2018–19

Majority of the funds received through extramural grants have been from government bodies. SERB, contributing to 48% of the research funds received in 2018–19, has been the primary funder along with DBT (16%) and DST (13%). Funding from other Indian funding bodies (DRDO, DAE, MoES, MoEF, MHRD, and AYUSH) has contributed to 18% of funds for research in education, defense, atomic energy, ayurveda, and environment, and forest. The international funding bodies (AOARD and the Engineering and Physical Sciences Research Council) have contributed to 5% of the total research funds.



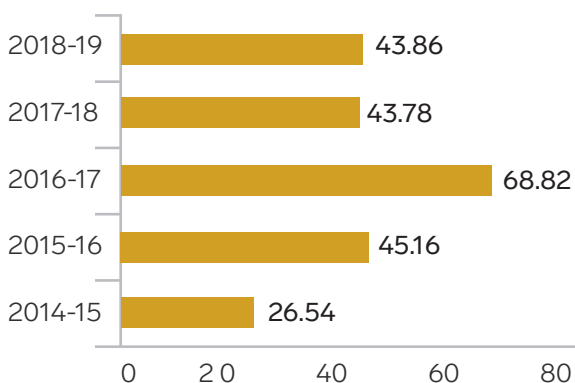
NUMBER OF NEW EXTRAMURAL GRANTS SANCTIONED

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. Mousomi Bhakta

Assistant Professor

Won the INSA Young Scientist Medal of the Indian National Science Academy (INSA), New Delhi (2018)



Dr. Anup Biswas

Associate Professor

Appointed as an Associate Editor of the journal *Annals of Applied Probability*



Dr. G.V. Pavan Kumar

Associate Professor

Elected as a Senior Member of the Optical Society of America (OSA); Selected as a Swarnajayanti Fellow in Physical Sciences by the Department of Science and Technology, Govt. of India



Dr. Aurnab Ghose

Associate Professor

Elected member of the Asia-Pacific Regional Committee (APRC) of the International Brain Research Organization (IBRO)



Dr. Mukul Kabir

Associate Professor

Received the Nano-Micro Science Innovation Award, Nano-Micro Conference, Korea (2018)



Dr. Shabana Khan

Assistant Professor

Received Young Scientist Award at Chemical Frontiers, Goa (2018)



Dr. Soumen Maity

Associate Professor

Received Fulbright-Nehru Academic and Professional Excellence Award (2019–2020)



Dr. Angshuman Nag

Assistant Professor

Reviewer Excellence (Top 1% reviewer) Award for 2018 from *Chemistry of Materials*



Dr. A.A. Natu

Honorary Faculty Member

Received the prestigious 'Cross of Merit' from the Government of Germany; Nominated to be the Chairperson of the Board of Governors of IISER Kolkata



Prof. Satishchandra Ogale

Emeritus Professor

Awarded the Raja Ramanna Fellowship of the Department of Atomic Energy (DAE)



Dr. Venketeswara R. Pai

Assistant Professor
Mādhava Ganita Award, Constituted
by Mādhava Ganita Kendra,
Irinjalikkuda, Kerala (2018)



Dr. Thomas Pucadyil

Associate Professor
Awarded Shanti Swarup Bhatnagar
Prize in Biological Sciences by the
Council of Scientific and Industrial
Research (2018)



Prof. A. Raghuram

Professor
Appointed as a Distinguished
Honorary Professor at IIT Kanpur, for
three years starting March 2019



Dr. Atikur Rahman

Assistant Professor
Winner of "Grand Prize" at Create the
Future Design Contest, U.S.A. (2018)



Prof. L.S. Shashidhara

Professor
Elected as an Associate Member
of the European Molecular Biology
Organization (EMBO)



Prof. S. Sivaram

INSA Senior Scientist
Won Gold Medal for Life-time
achievement in chemical research
from the Chemical Research Society
of India (2019); Won the International
Award of the Society of Polymer
Science, Japan (2018)



Dr. S.G. Srivatsan

Associate Professor
Selected for CDRI Award for
Excellence in Drug Research in the
Chemical Sciences category (2019)



**Dr. Ramanathan
Vaidhyanathan**

Associate Professor
Awarded Materials Research Society
of India (MRSI) Medal (2019);
Awarded Bronze Medal from the
Chemical Research Society of India
(2019)

MEMBERSHIPS AND AFFILIATIONS

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

Bijay Kumar Agarwalla Visiting Professor at the Department of Chemistry, University of Toronto, Canada, May–June 2018

G. Ambika Editorial Board Member, *Proceedings of Royal Society A, London* • Visiting Associate, IUCAA, Pune

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

Sudarshan Ananth Member, National Academy of Sciences India (NASI), Allahabad • Founder Member, Indian National Young Academy of Science (INAYAS) of INSA

Nagaraj Balasubramanian Review Editor in Cell Adhesion and Migration, *Frontiers in Cell and Developmental Biology*

Baskar Balasubramanyam Visiting Assistant Professor, University of California Los Angeles, October 2017 to June 2018

Nirmalya Ballav Editorial Board Member, *ISRN Spectroscopy* • Visiting Scientist, Paul Scherrer Institute (ETH Domain), Switzerland

Argha Banerjee Scientific Editor, *Journal of Glaciology*

Deepak Barua Associate Editor, *Journal of Ecology* (2017–present)

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*

Harinath Chakrapani Editorial Board Member, *Scientific Reports*

Anisa Chorwadwala Ambassador, IMU-CWM (International Mathematical Union - Committee for Women in Mathematics) (since August 2016)

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

Sutirth Dey Member, Editorial Board, *Journal of Theoretical Biology* (2015) • Editorial Board Member, *Dialogue: Science, Scientists and Society* (2017) • Founder Member and Treasurer, Indian Society of Evolutionary Biologists

Deepak Dhar Fellow, Indian Academy of Sciences, Bengaluru; Council Member (2016–2019) • Fellow, National Academy of Sciences, Allahabad • Fellow, Indian National Science Academy, New Delhi, • Fellow, The World Academy of Sciences (TWAS), Trieste • Member, Editorial Board of *Journal of Statistical Physics*

Sourabh Dube Member, India-CMS Collaboration • Member, CMS Collaboration, CERN, Geneva

Sanjeev Galande Honorary Associate, Sydney Medical School, Sydney, Australia 2013–2019 • Fellow, Indian Academy of Sciences, Bengaluru • Fellow, Indian National Science Academy • Fellow, National Academy of Sciences, 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 Editorial Board Member, *Journal of Biosciences* (March 2017 to March 2020) • Review Editor, *Frontiers in Molecular Neuroscience* (since March 2015) • Review Editor, *Frontiers in Cell and Developmental Biology* (since July 2018) • Executive Council Member, Indian Subcontinent Branch of the International Neuropeptide Society (ISBINPS)

Prasenjit Ghosh Regular Associate of the Abdus Salam International Centre for Theoretical Physics Jan 2012 to Dec 2017

Sujit K. Ghosh Editorial Board Member, *Scientific Reports*

Anindya Goswami Visiting Associate Professor, Macquarie University

Partha Hazra Editorial Board Member (in Chemistry), *Scientific Reports* from January, 2017

Krishanpal Karmodiya Editorial Board Member, *Scientific Reports*, Nature Publishing Group

Shabana Khan Editorial Advisory Board Member, *Organometallics*

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

Ayan Mahalanobis Editorial Board Member, *International Mathematical Forum*

John Mathew International Advisory Board Member, *British Journal for the History of Science*

Rama Mishra Editorial Board Member, *American Journal of Mathematical Analysis*

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

Suhita Nadkarni Reviewing Editor, *Cellular Neurophysiology, Frontiers in Cellular Neuroscience* • Editor, Special Issue “Multimodal Regulation of Brain Function by Astrocytes” in *Neural Plasticity*

Angshuman Nag Associate, Indian Academy of Sciences, Bengaluru • Editorial Advisory Board Member, *Chemistry of Materials*

A.A. Natu Research Ambassador, DAAD • Visiting Professor, Bielefeld University, Germany • Editorial Board Member, *Indian Drugs*

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

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

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

A. Raghuram Fellow, Indian Academy of Sciences, Bengaluru • Editor, *Proceedings of the Indian Academy of Sciences, Mathematical Sciences* • Editor, Newsletter, Mathematics Teacher’s Association

Sudha Rajamani Editorial Board Member, *Life* • Adjunct

Faculty, Dr. Vikram Sarabhai Institute of Cell & Molecular Biology, MSU, Baroda

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

Girish Ratnaparkhi Board Member, Indian Society for Developmental Biology (InSDB)

Richa Rikhy Editorial Board Member and Manuscript Handling Editor, *Scientific Reports*

M.S. Santhanam Editorial Board Member, *Physics Education* (India)

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

Kundan Sengupta Handling Editor, *Science Matters* • Editorial Board Member, *Journal of Biosciences*

L.S. Shashidhara Fellow and Vice-President (Science and Society), Indian National Science Academy, New Delhi (2016–2018) • Secretary-General, International Union of Biological Sciences (IUBS) (2016–2019) • Fellow, Indian Academy of Sciences, Bengaluru • Fellow, National Academy of Sciences, Allahabad • Associate Editor, *Current Science, Journal of Genetics* • Editorial Board Member and MS Handling Editor, *Scientific Reports*

S. Sivaram Fellow: Indian National Science Academy, New Delhi; Indian Academy of Sciences, Bengaluru; National Academy of Sciences, Allahabad; Indian National Academy of Engineering, New Delhi; Academy of Sciences for the Developing World, Trieste (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, Polytecnico de Leiria, Marinha Grande, Leiria, Portugal, 2018–22; Distinguished Visiting Professor, The King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, 2019

Pushkar Sohoni Associate Editor, *South Asian Studies* (Journal of the British Association of South Asian Studies)

Nishikant Subhedar President, Indian Subcontinental branch of the International Neuropeptide Society

Gyana Ranjan Tripathy Young Associate (2015–2018), Indian Academy of Sciences, Bengaluru

V.S. Rao Adjunct Visiting Professor, Savitribai Phule Pune University

Jayant Udgaonkar Fellow, Indian National Science Academy, New Delhi • Fellow, The World Academy of Sciences (TWAS), Trieste • Fellow, Indian Academy of Sciences, Bengaluru • Editorial Board Member, *Protein Engineering, Design and Selection* • Associate Editor, *Biochemistry*

R. Vaidhyanathan Editorial Board Member: *ACS Materials Letters*; *Nature Scientific Reports*

Suneeta Vardarajan Member, Council, Indian Association for General Relativity and Gravitation (IAGRG)

Milind Watve Fellow and Council Member, Indian National

Science Academy, New Delhi • Fellow, Indian Academy of Sciences, Bengaluru

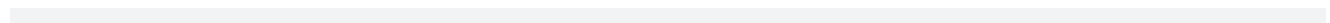
In addition, several of our faculty members serve on committees and boards of educational/research bodies and or hold memberships of national and international scientific societies (list not included here).

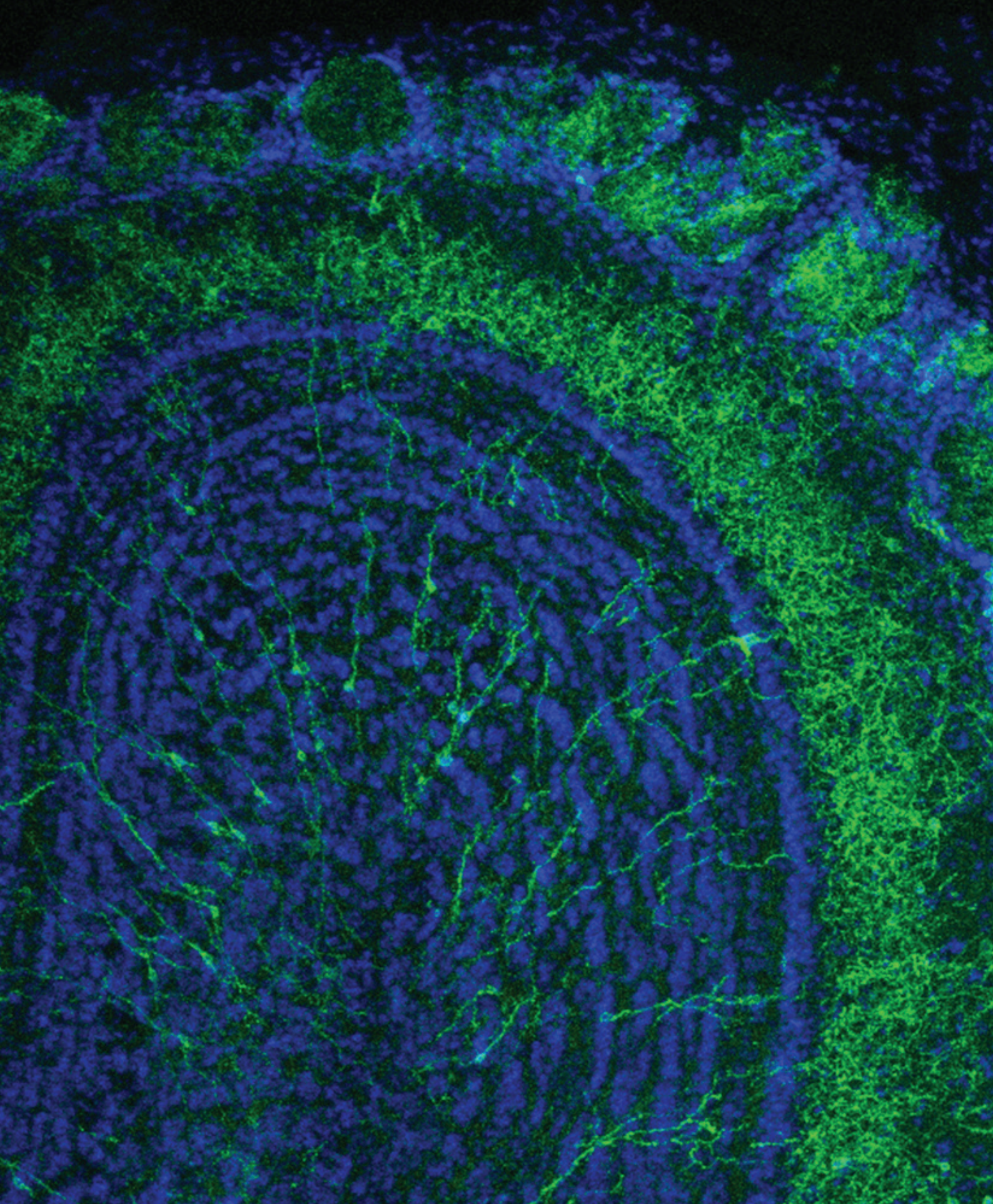
Every year, faculty members are invited to present their research work at conferences, workshops, and other events across India and elsewhere. Faculty members are also involved in organising scientific conferences in topics relevant to their research.

.....

The list of invited lectures given by the faculty members and academic events they have organised during 2018–19 is given in the Appendix section of this report.

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Interneurons in the olfactory bulb of mice in an excited state

Image Credit: Dr. Nixon Abraham's Group

02

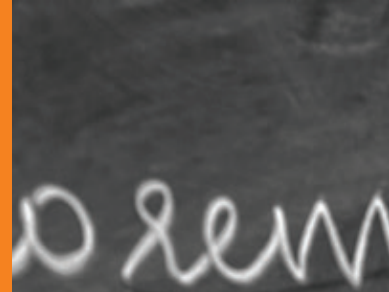
Academic Programmes

66 / PhD Programme

72 / Integrated PhD Programme

76 / BS-MS Programme

02



Let $k = k(x)$ so that $\frac{\log k}{\log x} \rightarrow \infty$

f : eigenform. $I \subset [-2, 2]$.
 $N_I(f, x) : \# \{ \rho \leq x \}$

Then, for any $A < B$

$$\text{Prob} \left[\frac{N_I(f, x) - \pi(x) \mu_\infty}{\sqrt{\pi(x) (\mu_\infty(I) - \mu_\infty^2)}} \right]$$



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, 2019

TOTAL: 309



80
BIOLOGY



142
CHEMISTRY



15
EARTH AND
CLIMATE SCIENCE



05
HUMANITIES AND
SOCIAL SCIENCES



24
MATHEMATICS

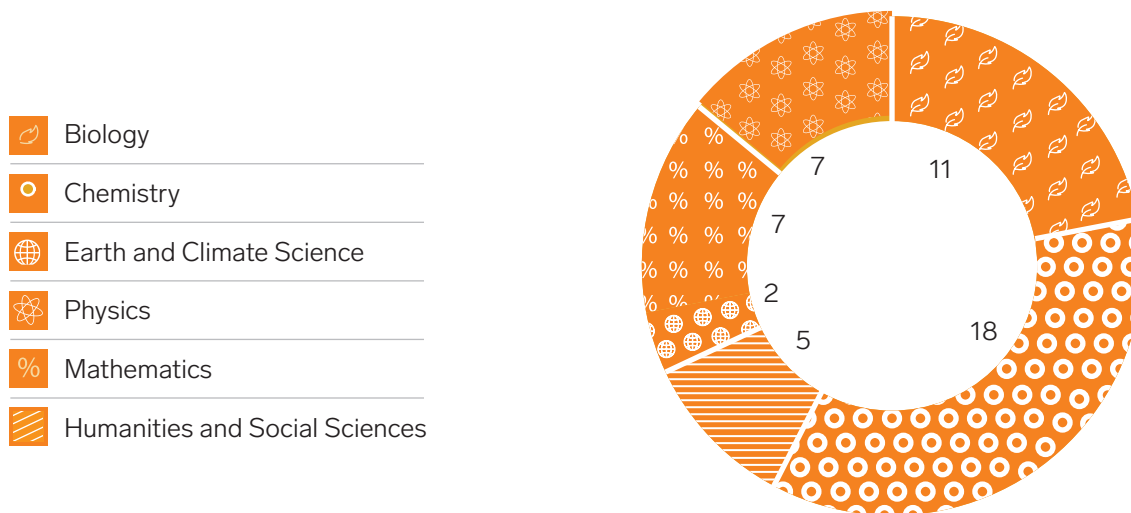


43
PHYSICS

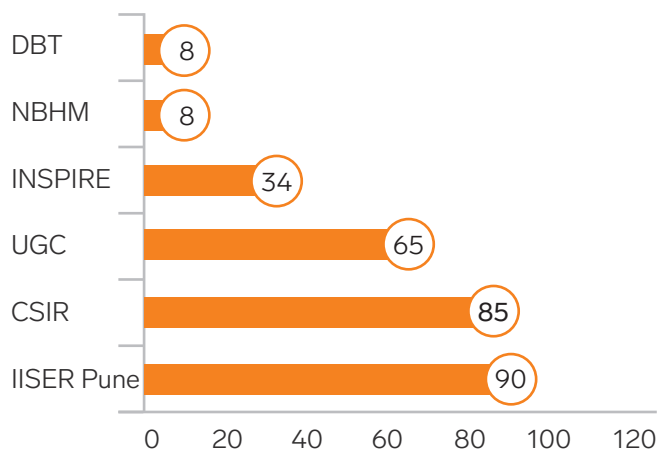
During the August 2018 and January 2019 admission sessions, 50 PhD students were admitted to the PhD programme. The list of enrolled students is available on the IISER Pune website. The number of PhD students at the Institute as of March 31, 2019 is 309.

PhD STUDENT ENROLLMENT DURING AUGUST 2018 AND JANUARY 2019 SESSIONS

The subject-wise distribution of the 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	141	37	15	3	33	199
Women	89	16	4	0	11	110
Total	230	53	19	3	44	309

In the 7th convocation held on May 26, 2018, 40 students were conferred PhD degree.

The following 56 students have successfully completed their requirements for the award of PhD degree (completed thesis defense on or before March 31, 2019):

Sr. No.	Student	Department	Thesis Title	Advisor
01	Sanku Paul	Physics	Chaos, localization, and transport in kicked rotor and its variants	M.S. Santhanam
02	Devani Ravi Sureshbhai	Biology	Investigating sex expression and modification in dioecious <i>Coccinia grandis</i> through an integrated transcriptomic and proteomic approach	Anjan Banerjee
03	Milan Kumar Das	Mathematics	Portfolio optimization & option pricing in a component-wise semi-markov modulated market	Anindya Goswami
04	Amandeep	Physics	Shear rheology of nanoconfined liquids	Shivprasad Patil
05	Kajari Gupta	Physics	Emergent dynamics of slow and fast systems on complex networks	G. Ambika
06	Plawan Kumar Jha	Chemistry	Chemically reduced graphene oxide for supercapacitor applications	Nirmalya Ballav
07	Kundansingh Amarsingh Pardeshi	Chemistry	Design, synthesis and evaluation of bioactivable organic donors of sulfur dioxide (SO ₂)	Harinath Chakrapani
08	Sampada Prabhakar Mutalik	Biology	Role of the cytoskeleton in regulating axonal tension and growth cone traction dynamics	Aurnab Ghose
09	Turmoli Neogi	Physics	N - Extended super-BMS3 algebras and generalized gravity solutions	Sunil Mukhi
10	Shahaji Hanumantrao More	Chemistry	Polyproline and collagen peptides derived from 4(R/S)-OH/NH ₂ -L/D-Proline: Synthesis, conformational and morphological studies	Krishna N. Ganesh
11	Madhanagopal B.	Biology	Stereo-Controlled supramolecular assembly of 4(R/S)-Aminoproline based peptides and peptide nucleic acids	Krishna N. Ganesh
12	Sucheta Majumdar	Physics	Symmetries in Gravity and Supergravity in the light-cone gauge	Sudarshan Ananth
13	Debangana Mukherjee	Mathematics	Non-local elliptic equations: Existence and multiplicity results	Mousomi Bhakta
14	Ishtiyag Ahmed	Biology	Biochemical and crystallographic studies of Type III restriction modification enzymes: insights into the mechanism of ATP-dependent endonuclease	Saikrishnan Kayarat
15	Boominathan M.	Biology	Investigating leaf development in moss (<i>P. patens</i>) using Tnt1 insertional "short-leaf (shlf)" and targeted knockout "slender-leaf" mutants	Anjan Banerjee
16	Datar Avdhoot Shrikrishna	Chemistry	Understanding photostability of biomolecules using multi-reference quantum chemical methods	Anirban Hazra

Sr. No.	Student	Department	Thesis Title	Advisor
17	Tathagata Mandal	Mathematics	Some properties of elliptic modular forms at the supercuspidal primes	Debargha Banerjee
18	Ayantika Sen Gupta	Biology	Role of nuclear Lamins in the regulation of nucleolar structure and function	Kundan Sengupta
19	G. Mahesh	Chemistry	Mechanistic investigation of photochemistry and chemiluminescence using multi-configurational quantum chemistry	Anirban Hazra
20	Ravikumar G.	Chemistry	Real-time monitoring of Nitric Oxide release	Harinath Chakrapani
21	S.K. Rejaul	Physics	Exploring molecule-metal and molecule-topological insulator interface at atomic scale	Aparna Deshpande
22	Shyamapada Nandi	Chemistry	Designed ultra-microporous metal organic frameworks for selective CO ₂ capture	R. Vaidhyanathan
23	Neha Nirwan	Biology	Assembly and architecture of the modification-dependent restriction enzyme McrBC	Saikrishnan Kayarat
24	Deshmukh Mahesh Sadashiv	Chemistry	Peripherally functionalized silane and siloxane scaffolds for the assembly of multi-metallic cages, clusters and supramolecules	R. Boomi Shankar
25	Lakshmi V.R. Babu Syamala	Chemistry	Synthesis and utilization of α , β -Unsaturated carbonyl compounds: Access to functionalized piperidines and selective reduction of alkylidene β -Keto esters	Ramakrishna G. Bhat
26	Khopade Tushar Manik	Chemistry	Meldrum's Acid: A useful platform for tandem organocatalytic synthesis of pyroglutamic acids, δ -ketoesters, γ -butyrolactones and α , β -unsaturated carbonyl compounds	Ramakrishna G. Bhat
27	Noothanaganti Ashok	Chemistry	Functionalized nucleoside analogs as probes for nucleic acid recognition and synthons for supramolecular assemblies	S.G. Srivatsan
28	Nishtha Sachdeva	Physics	Dynamics of solar Coronal Mass Ejections: forces that impact their propagation	Prasad Subramanian
29	K. Raj Kumar	Chemistry	Exploring the optical properties of anticancer drugs/metal nanoclusters inside the confined environments and on the graphene oxide surface	Partha Hazra
30	Trimbak Baliram Mete	Chemistry	Transition-metal-free synthesis of aryl thiocyanates, aldehydes and ketones, azaheterocyclic carboxamides and styrenyl ethers	Ramakrishna G. Bhat
31	Sudipta Tung	Biology	Theoretical and empirical investigations on population stability and dispersal evolution using laboratory populations of <i>Drosophila melanogaster</i>	Sutirth Dey
32	Manasi Subhash Gangan	Biology	Cell growth in <i>Escherichia coli</i> : Study of Fluctuations and asymmetry in cell extension	Chaitanya Athale
33	Manikandan R.	Chemistry	Ruthenium-catalyzed redox-free C-H bond functionalization reaction: An efficient route to substituted alkenes and heterocycles	Jeganmohan Masilamani
34	Metikoti Jagadeeswara Rao	Chemistry	Defect mediated photoluminescence and solar cell from colloidal III- VI semiconductor nanocrystals	Angshuman Nag
35	Singh Vibha	Biology	Role of cell matrix adhesion G34 in regulating golgi organization and function	Nagaraj Balasubramanian
36	Sonashree	Chemistry	L-Amino acid based polyester nanocarriers for drug delivery and bioimaging	M. Jayakannan

Sr. No.	Student	Department	Thesis Title	Advisor
37	Kunal Kisan Kothekar	Physics	A search for the evidence of type-III seesaw mechanism in multileptonic final states at the LHC	Sourabh Dube
38	Deshpande	Chemistry	Polysaccharide nanovesicles for combination and targeted drug delivery in cancer cells	M. Jayakannan
39	Nilesh Umakant Bijoyananda Mishra	Chemistry	[Au]/[Ag]-catalyzed activation of glycosyl alkynyl carbonates and their application to the syntheses of various glycoconjugates	Srinivas Hotha
40	Yettapu Gurivireddy	Chemistry	Ultrafast carrier dynamics in CsPbBr ₃ perovskite nanocubes and nanoplatelets: Time-resolved TeraHertz Spectroscopy study	Pankaj Mandal
41	Kulkarni Bhagyashree Bapusahab	Chemistry	Fluorescent biodegradable block copolymer nano-assemblies for bioimaging and drug delivery	M. Jayakannan
42	Neha	Chemistry	Development of anode materials for rechargeable batteries	Muhammed Musthafa and Sathishchandra Ogale
43	Shinde Sopan Valiba	Chemistry	Design and synthesis of small molecule chloride receptors for selective transmembrane transport activity	Pinaki Talukdar
44	Shalini	Chemistry	Enhancing proton conduction in metal organic frameworks by post-synthetic modification	R. Vaidhyathan
45	Sai Harshini Tekur	Physics	Distribution of level spacing ratios in random matrix theory and chaotic quantum systems: variants and applications	M.S. Santhanam
46	Bapat Niraja Vijay	Biology	Role of co-solutes in nonenzymatic RNA replication on prebiotic Earth	Sudha Rajamani
47	Pendse Abhijit Suhas	Physics	Non-local interactions in Bose-Einstein Condensates	Arijit Bhattacharyay
48	Shiv Pal	Chemistry	Synthesis, structural elucidation, and application of Tetretylenes	Shabana Khan
49	Sarnobat Makarand Sanjay	Mathematics	Cohomology of representations and Langlands functoriality	A. Raghuram
50	Manoharan R.	Chemistry	Ruthenium(II)-and Cobalt(III)-catalyzed cyclization and alkenylation of substituted aromatics with π -components	M. Jeganmohan
51	Gunjan Verma	Physics	Dynamics of Bose-Einstein Condensate in linear and non-linear regime	Umakant Rapol
52	Soumendra Nath Panja	Physics	Magnetic and polar properties of some geometrically frustrated transition metal oxides	Sunil Nair
53	G. Shiva Shanker	Chemistry	Designing nanocrystal interfaces to improve charge transport for photo- and electro-catalytic solar energy applications	Angshuman Nag
54	Reman Kumar Singh	Chemistry	On the molecular understanding of protein stability in water, in chemical chaperone, and its intercalation to DNA	Arnab Mukherjee
55	Rabindranath Bag	Physics	Crystal growth and properties of some correlated metal oxides	Surjeet Singh
56	Praveen Kumar	Chemistry	Molecular simulations of structure and dynamics of neat and hydrated imidazolium ionic liquids	Arun Venkatnathan

A total of 94 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 are as below. Number of students is shown in circles.

Sources of Travel Grants secured by PhD Students

- ① CSIR
 - ② DBT, DBT-CTEP
 - ③ DST, DST-DESY Project
 - ② EMBO Short-Term Fellowship
 - ① Fulbright Nehru Doctoral Research (FNDR) Program
 - ③② Host/Organiser of the Conference
 - ⑦ IISER Pune
 - ① Indo French Centre for Promotion of Advanced Research (CEFIPRA)
 - ③⑦ Infosys Endowment Fund operated by IISER Pune
 - ① International Centre for Theoretical Sciences (ICTS), Bengaluru
 - ① Joint/Exchange Programmes
 - ① Newton Bhabha PhD Placement Programme
 - ⑨ SERB
-



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, 2019

TOTAL: 189



65
BIOLOGY



59
CHEMISTRY



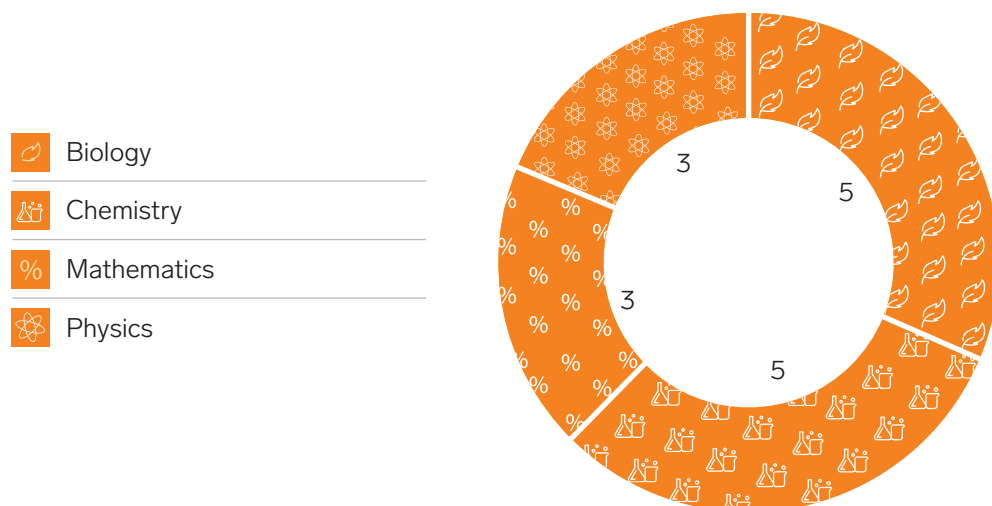
10
MATHEMATICS



55
PHYSICS

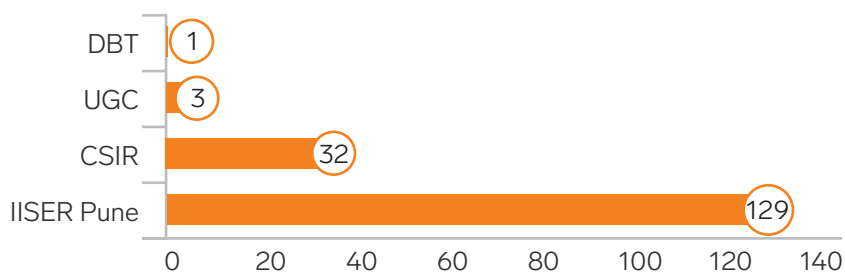
During the August 2018 session, 16 students took admission to post-BSc Integrated PhD programme: 5 in Biology, 5 in Chemistry, 3 in Mathematics and 3 in Physics. The list of enrolled students is available on the IISER Pune website.

INTEGRATED PhD STUDENT ENROLLMENT DURING AUGUST 2018 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, 2019 is 189 (Women: 73; Men: 116) with 65 students in Biology, 59 in Chemistry, 10 in Mathematics, and 55 in Physics.

Category-wise Numbers of Integrated PhD Students

Gender	GE	OBC	SC	ST	Total
Men	106	9	1	0	116
Women	71	2	0	0	73
Total	177	11	1	0	189

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 2016–18): Krishnendu Roy (Biology); Prakash Panwaria (Chemistry); Garima Agrawal (Mathematics); Diptabrata Paul (Physics)

In the 7th convocation held on May 26, 2018, 1 Integrated PhD student was awarded dual Master's and PhD degrees.

The following 09 students have successfully completed their requirements for the award of Integrated PhD degree (completed thesis defense on or before March 31, 2019):

Sr. No.	Student	Department	Thesis Title	Advisor
01	Supratik Sarkar	Physics	Trans-Planckian issues & Emergent Gravity: from BEC to analogue Black Holes	Arijit Bhattacharyay
02	Roopali Sainath Pradhan	Biology	Role of nuclear lamins as integrators of extranuclear signals and regulators of genome organization and function	Kundan Sengupta
03	Desai Aamod Vikas	Chemistry	Design and syntheses of neutral N-donor linker based Metal-Organic Frameworks (MOFs) towards environmental applications	Sujit K. Ghosh
04	Srikrishna Sekhar	Physics	Algorithms for improving sensitivity of radio interferometric images	Ramana Athreya
05	Santosh Kumar Singh	Chemistry	Exploring weak $n \rightarrow \pi^*$ noncovalent interaction: gas phase spectroscopy and quantum chemical calculations	Aloke Das
06	Abhishek Swarnkar	Chemistry	Traditional Quantum Dots to defect-tolerant cesium lead halide (CsPbX_3) perovskite nanocrystals for optoelectronics	Angshuman Nag
07	Labade Ajay Shankar	Biology	The role of the nucleoporin Nup93 sub-complex in regulating HOXA gene expression	Kundan Sengupta
08	Adarsh B. Vasista	Physics	Metal film based micro- and nano-cavities: Optical polarization and wavevector studies	G.V. Pavan Kumar
09	Mungi Chaitanya Vinayak Manjiri	Biology	Synthesis and characterization of informational molecules of Early Earth	Sudha Rajamani

A total of 49 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 are as below. Number of students is shown in circles.

Sources of Travel Grants secured by Integrated PhD Students

- ② CSIR
 - ① DBT, DBT-CTEP
 - ⑤ DST, DST-DESY Project
 - ①① Host/Organiser of the Conference
 - ① IISER Pune
 - ② Indo French Centre for Promotion of Advanced Research (CEFIPRA)
 - ② Indo-US Science & Technology Forum (IUSSTF)
 - ①⑧ Infosys Endowment Fund operated by IISER Pune
 - ② Joint/Exchange Programmes
 - ① Newton Bhabha PhD Placement Programme
 - ② SERB
-



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 2018–19 saw 227 students (173 boys and 54 girls) taking admission to the BS-MS programme. Of these, 161 were admitted through the state and central boards' stream, via the IISER Aptitude Test; 25 through the IIT-JEE stream; and 41 through the KVPY stream. The list of enrolled students is available on the IISER Pune website.

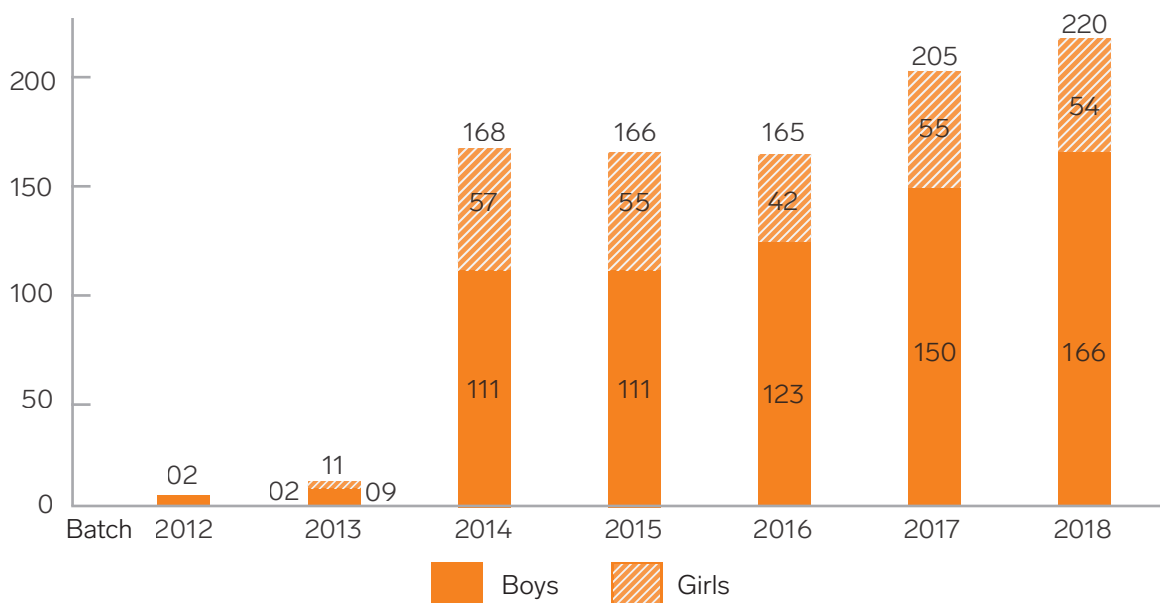
Category-wise Distribution of Students Enrolled in 2018

Gender	GE	OBC	SC	ST	PD	TOTAL
Boys	85	46	26	13	3	173
Girls	28	14	8	4	0	54
Total	113	60	34	17	3	227

Overall Category-wise Distribution of Existing BS-MS Students (as of March 31, 2019)

Gender	GE	OBC	SC	ST	PD	TOTAL
Boys	334	196	100	31	11	672
Girls	135	74	43	11	2	265
Total	469	270	134	42	13	937

TOTAL BS-MS STUDENT STRENGTH DURING 2018-19



Subsequent to admission, 07 students have discontinued from the programme, as they got admission in other courses, making the final number of students enrolled in 2018 to 220. In addition, from the previous batches, 09 students opted to discontinue the programme.

From the 2018 batch, 66 students were found eligible for receiving DST-INSPIRE scholarship and 40 students qualified for KVPY scholarship.

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

DST-INSPIRE=460, KVPY=154

FIFTH YEAR PROJECTS CARRIED OUT BY THE OUTGOING BATCH OF BS-MS STUDENTS DURING 2018–19

Department-wise



26
BIOLOGY



31
CHEMISTRY



07
EARTH AND
CLIMATE SCIENCE



10
INTERDISCIPLINARY



24
MATHEMATICS



43
PHYSICS

Host-wise

86
IISER PUNE

15
INTERNATIONAL

40
NATIONAL

141
TOTAL

Details of Fifth Year Projects carried out by the outgoing batch of BS-MS students during 2018–19

Sr. No.	Student	Host Institute	Supervisor	Project Title
BIOLOGY				
1.	Manil Kanade 20131005	IISER Pune	Gayathri Pananghat	Biochemical characterization of two prokaryotic small Ras-like GTPases and their common effector
2.	Komal Gupta 20141007	NCBS, Bengaluru	Sudhir Krishna	Targeting merkel cell polyomavirus t antigens using CRISPR system
3.	Aswathi K.T. 20141016	IISc, Bengaluru	Sridharan Devarajan	Neural mechanisms of human selective attention
4.	Sandeep Chowdhary 20141027	IISER Pune	Collins Assisi	Solving sudoku using inhibitory neural networks
5.	Neel Wagh 20141032	IISER Pune	Girish Ratnaparkhi	Understanding Caspar /D-FAF1 function In <i>Drosophila</i> development
6.	Shraddha Lall 20141046	IISER Pune	Sutirth Dey	Behavioural correlates of chronic stressors in outbred and dispersal selected <i>Drosophila melanogaster</i>
7.	Swastik Mishra 20141051	IISER Pune	M.S. Madhusudhan	Prediction of protein structure stability based on naturally occurring 3D structural motifs
8.	Sarthak Pravin Malusare 20141062	IISER Pune	Sutirth Dey	The effects of population size and environmental composition on the utilization of an unaccustomed niche
9.	Aboli Ektare 20141075	NIMHANS, Bengaluru	Shyam Sundar Arumugham	Transdiagnostic investigation of psychiatric disorders with transcranial magnetic stimulation

Sr. No.	Student	Host Institute	Supervisor	Project Title
10	Adikrishna K.K. 20141078	IISER Pune	Richa Rikhy	Functional analysis of mitochondrial targeted protein Ppr (Pentatricopeptide repeat) in oogenesis in <i>Drosophila melanogaster</i>
11	Sooraj S. Das 20141080	IISER Pune	Aurnab Ghose	Role of Fmn2 in axonal branching
12	Adwait Bhalchandra Salvi 20141088	IISER Pune	Kundan Sengupta	Role Of Nup93 subcomplex in HOXA gene regulation during NT2/D1 differentiation
13	Kannan Nivedhika 20141089	IISER Pune	Nagaraj Balasubramanian	How cells respond to changing matrix stiffness in 2D and 3D microenvironments: Role of Caveolin-1 and its phosphorylation
14	Raghuram H.V. 20141090	NIMHANS, Bengaluru	G. Venkatasubramanian	Neurobiological studies in schizophrenia
15	Anuvind K.G. 20141101	IISER Pune, ENS- Lyon	Kundan Sengupta	Regulatory crosstalk between Lamin and the circadian clock in the spatial organization of cancer-associated genes in the interphase nucleus
16	Gaurav Joshi 20141112	Centre for Molecular Biomedicine, Jena, Germany	Holger Bierhoff	Deciphering temporal order of epigenetic changes during lymphomagenesis
17	Sharvari Rajeev Tamhankar 20141114	NCBS, Bengaluru	Deepa Agashe	Mistranslation and stress tolerance in <i>E. Coli</i>
18	Shekhar Sanjay Jadhav 20141129	University of Warwick, UK	Mohan Balasubramanian	Prediction and experimental validation of potential residues that drive allostery in myosin head domain
19	Kaushik More 20141137	IISER Pune	Nixon M. Abraham	Olfactory information processing in a Parkinson's disease mouse model
20	Aditee Sanjay Kadam 20141140	NII, New Delhi	Soumen Basak	Exploring the role of NF-Kappab factors in transcriptional repression
21	Upadhyay Bhumika Sumesh 20141142	IISER Pune	Sagar Pandit	Exploring photosynthesis for power generation
22	Nida Farheen 20141146	NCBS, Bengaluru	Mukund Thattai	Frustration and fidelity in Influenza genome packaging
23	Rahul Iyer 20141154	IISER Pune	Milind Watve	Sustainability-based evaluation of people's plan of bamboo harvest in Pachgaon
24	Tamboli Suhel Tajmohammad 20141171	IISER Pune	Nixon M. Abraham	Role of olfactory bulb circuitry in airflow information processing
25	Basila M.A. 20141181	IISER Pune	Saikrishnan Kayarat	Mutational studies to identify regions that facilitate interaction between Mcrb and Mcrc

Sr. No.	Student	Host Institute	Supervisor	Project Title
26	Prashant Uniyal 20131058	IISER Pune	Sudhakaran Prabakaran	Investigation of novel Orfs in mouse cell line and human tissues



CHEMISTRY

01	Ashwini Anandrao Jadhav 20131118	IISER Pune	Nirmalya Ballav	Modulating the electrical conductivity in MOFs
02	Anupam Prasoon 20141001	IISER Pune	Nirmalya Ballav	Modulating electrical conductivity by activating open-metal sites in interfacially grown coordination polymer thin film
03	Vaibhav Singh 20141003	IISER Pune	Anirban Hazra	Interpreting pump - probe experiments on Dimethyl Methyl Phosphonate (DMMP)
04	Nenavath Parvathalu 20141005	IISER Pune	Gnanaprakasam Boopathy	Studies on intermolecular [2+2] cycloaddition towards Cephalosporin derivatives using photocatalysis under continuous flow
05	Deepraj Pandit 20141008	IISER Pune	Muhammed Musthafa	Fuel exhaling fuel cell for fuel purification and water desalination
06	K. Sravan Kumar 20141009	IISER Pune	R. Boomishankar	Polyhedral cages of N-donor functionalized silane ligands and their activity in electro-photo catalysis
07	Mohidh K.M. 20141014	CSIR-NCL, Pune	K. Krishnamoorthy	Surface modification of photoanodes by Hcl treatment to improve the efficiency of DSSC
08	A. Vamshi Krishna 20141019	IISER Pune	R. Vaidhyanathan	Developing conducting carbonaceous materials from framework solids for electrochemical applications
09	Yogesh Mahor 20141021	IISER Pune	Angshuman Nag	Yb-doped Cs ₂ AgInCl ₆ double perovskite microcrystals and nanocrystals
10	Ranjana Yadav 20141025	IISc, Bengaluru	Anshu Pandey	A study of I-III-VI ₂ semiconductor nanocrystals
11	Shweta Sunil Hiwase 20141035	IISER Pune	Shabana Khan	Synthesis of pyridine functionalized NHC Iron(II) complexes and their applications
12	Sharada Kailas Sarjane 20141038	IISER Pune	M. Jayakannan	Stimuli-responsive block copolymer nano- assemblies for drug delivery in cancer
13	Sarah Peneena K.J. 20141039	IISER Pune	Pramod Pillai	Tuning the electrostatic interactions in nanoionic precipitates for heavy metal ion detection
14	Harsha Gouda 20141041	University of Michigan Medical School, Ann Arbor, USA	Ruma Banerjee	Mitochondrial defects in B12 trafficking

Sr. No.	Student	Host Institute	Supervisor	Project Title
15	Rajat Patel 20141043	IISER Pune	H.N. Gopi	Selective nitrile oxide-alkene cycloaddition reactions for peptide conjugation
16	Bhaskar Saha 20141047	CSIR-NCL, Pune	B.L.V. Prasad	Binary nano crystal superlattices of semiconducting and metallic system
17	Devendra Singh 20141049	CSIR-NCL, Pune	M.V. Shelke	Development of electrode materials for electrochemical energy storage
18	M.B. Harsha 20141057	IISER Pune	Arnab Mukherjee	Development of inhibitors of TCF/B-catenin complex and their validation using molecular modeling techniques
19	Naman Kalra 20141074	C-MET, Pune	Bharat Bhanudas Kale	Nanostructured N@TiO ₂ /Carbon Composite for supercapacitor
20	Suraj Shrama 20141092	IISER Pune	Harinath Chakrapani	Synthesis and evaluation of hypervalent iodine compounds as antibacterials
21	Anurag Singh 20141106	IISER Pune	Pinaki Talukdar	Development of benzimidazole-based pro-transporters with photocleavable anion transport activity
22	Mrutyunjay Nair 20141110	IISER Pune	Harinath Chakrapani	Design and development of bacterial 3-Mercaptopyruvate Sulfurtransferase (3-MST) inhibitors
23	Godey Darmika Vagdevi Sree Keerthi 20141122	IISER Pune	Shabana Khan	Synthesis and catalytic application of 1,3,2- Diazastibolenes Triflate
24	Vimanshu Chanda 20141122	EPFL, Sion, Switzerland	Hubert Girault	Investigation of Titanium-Manganese-Vanadium electrolytes as catholyte for dual-circuit redox flow batteries
25	Rasika Virendra Daware 20141126	IISER Pune	M. Jayakannan	Fluoroprobe-tagged polysaccharide vesicles for drug delivery application
26	Samikshakiran Deepak Agham 20141128	IISER Pune	S.G. Srivatsan	Probing I-motifs in a cellular model using a responsive nucleoside probe
27	Goutham Sukumaran 20141148	IISER Pune	Partha Hazra	Exploring halloysite nanotube and halloysite nanotube-graphene oxide composite material as carriers for anticancer drugs
28	Amit Choudhary 20141151	CSIR-NCL, Pune	P.A. Joy	Spinel structured materials as efficient electrodes for supercapacitor applications
29	Arkendu Roy 20141152	Karlsruhe Institute of Technology, Germany	Christof Woll	Design and fabrication of surface anchored organic assemblies
30	Minal Wable 20141177	IISER Pune	Satishchandra Ogale	Silicon nanoparticle loaded Cav ₄ O ₉ microflowers for robust high capacity li-ion battery anodes

Sr. No.	Student	Host Institute	Supervisor	Project Title
31	Vivek Kumar 20141178	IISER Pune	H.N. Gopi	Design, synthesis and exploration of amphiphilic A/ Γ 4 hybrid helices as a potent antibacterial agent



EARTH AND CLIMATE SCIENCE

01	Meera Mohan 20141081	IISER Pune	Suhas Ettammal	Downstream and in-situ: two perspectives on initiation of monsoon low pressure systems over Bay of Bengal
02	Daman 20141082	IISER Pune	Suhas Ettammal	Multivariate regression based forecast model for intraseasonal oscillation
03	Tayade Lokesh Ashok 20141123	IIT Bombay	Shyam Rai	Kinematic implications of slickensides
04	Vrushali Rajesh Sarwan 20141125	IISER Pune	Utsav Mannu	Improvement of global earthquake forecasting using Epidemic Type Aftershock Sequence (ETAS) modelling
05	Sneha Manda 20141141	IIT Bombay	Jahnvi Puneekar	Experimental taphonomy: Towards quantification of dissolution effects on select planktic morphotypes
06	Shraddha Sanjay Bhurkunde 20141168	IIT Bombay	Jahnvi Puneekar	Assessment of dwarfing as a response to environmental stress buildup in the end cretaceous
07	Dilip V. 20141172	IISER Pune	Neena Joseph Mani	Understanding the integrated moisture transport in the monsoon domain



INTERDISCIPLINARY

01	Satendra Birana 20141029	IISER Mohali	Anu Sabhlok	Rural-urban interactions on the periphery of a planned city
02	Amit Singh Bhati 20141175	IISc, Bengaluru	Sanjit Chatterjee	A fully resilient, identity-based, efficient, non-interactive and decentralized key exchange protocol (FRIEND-KEP)
03	Jayanth Kumar N. 20141020	Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore	Sanjay Chotirmall	Investigating the respiratory microbiome in bronchiectasis through "integrative microbiomics"
04	Devika Varma 20141031	MARUM, University of Bremen, Germany	Kai-Uwe Hinrichs	High resolution, multiproxy analysis of mediterranean sapropels and its implications

Sr. No.	Student	Host Institute	Supervisor	Project Title
05	Durga Makarand Parkhi 20141113	IISER Pune	Pranay Goel	To explore derivative-free 1st order methods of optimization
06	Ameya Pore 20141119	University of Glasgow, Scotland	Gerardo Aragon Camarasa	Curiosity driven robotic grasping
07	Sanjay N.S. 20141138	National Institute of Banking and Management Pune	Kedarnath Mukherjee	Implied volatility in Markov modulated GBM model
08	Sagar Gupta 20141189	IMPMC, Sorbonne University, Paris	Abhay Shukla	Titanium dichalcogenides: From synthesis to electronic phase transitions in 2D devices
09	Nitesh Verma 20141030	IISER Pune	Pushkar Sohoni	Material characterization and analysis of historic artillery pieces
10	Lakshman Teja M. 20131111	IISER Pune	Uttara Naik-Nimbalkar	Modelling value at risk



MATHEMATICS

01	Seethalakshmi K. 20141017	IISER Pune, IMSc, Chennai	Amritanshu Prasad	Sun Tzu's theorem for partitions: Uniqueness
02	Supriya Tiwari 20141018	Max Planck Institute for Informatics, Saarbrücken, Germany	Andreas Karrenbauer	Biclique partition with application to display optimization
03	Rahul Mistry 20141026	IISER Pune	Chandrasheel Bhagwat	P-Adic numbers and l-series
04	Bhargavi Parthasarathy 20141036	IISER Pune	Anupam Singh	Conjugacy classes of centralizers in algebraic groups
05	Nasit Darshan Prafulbhai 20141058	IISER Pune	Debargha Banerjee	Torsion points on elliptic curve over number fields
06	Dhameliya Hiren Jayantibhai 20141059	IISER Pune	Krishna Kaipa	The MDS conjecture and related questions in finite geometry
07	Joshi Chinmay Chandrashekhar 20141076	IISER Pune	Soumen Maity	Parameterized complexity of minimum neighbourhood problem
08	Mukul Rai Choudhuri 20141085	IISER Pune	Diganta Borah	A study of the Bergman Kernel and metric
09	Sukanya Pandey 20141087	IMSc, Chennai	Venkatesh Raman	Role colouring hereditary graph classes
10	Vishnu Vardhan V.M. 20141100	IISER Pune	Soumen Maity	Problems on temporal graphs

Sr. No.	Student	Host Institute	Supervisor	Project Title
11	Yash Arora 20141103	IISER Pune	Anupam Kumar Singh	Two generation of classical groups
12	Gunda Spoorthy 20141111	IISER Pune	Soumen Maity	Lossy kernels for few graph contraction problems
13	Sanyukta Deshpande 20141120	IIT Bombay	Milind Sohoni	Wages and utilities in a closed economy- A strategic analysis
14	Poornima B. 20141127	IISER Pune	Baskar Balasubramanyam	A study of some arithmetic properties of elliptic curves
15	Tilva Abhishek Kantilal 20141131	IISER Pune	Anindya Goswami	Stochastic analysis on Wiener space and applications to distributional asymptotics
16	Bhagwat Pankaj 20141135	University of Sherbrooke, Canada, and IISER Pune	Eric Marchand	Models and statistical inference for multivariate count data
17	Mitali Thatte 20141139	IMSc, Chennai	Meena Mahajan	Algorithms of matchings of various types
18	Shubham Vivek Pawar 20141157	TIFR, Mumbai	Jaikumar Radhakrishnan	Randomness and computing
19	Vrushali Kumbhar 20141158	IISER Pune	Anup Biswas	Martingale optimal transport and portfolio theory
20	Abhishek Ojha 20141162	IIT Bombay	V.S. Borkar	Online regression using reproducing Kernel Hilbert spaces
21	Ajinkya Ramdas Gaikwad 20141164	IISER Pune	Krishna V. Kaipa	The asymptotic information rate function in coding theory
22	Amol Sahebrao Hinge 20141165	IISER Pune	Chandrasheel Bhagwat	Spectral graph theory
23	Muluk Komal Dilip 20141179	IISER Pune	Soumen Maity	Parameterized complexity of fair feedback vertex set problem
24	Vishwajeet Bhoite 20141180	TIFR, Mumbai	A.J. Parameswaran	The topology of complex projective varieties



PHYSICS

01	Vivek Vishwakarma 20141010	ICTS, Bengaluru	Spenta R. Wadia	Studies in black hole physics
02	Amar Alok 20141013	Laboratoire Interdisciplinaire Carnot De Bourgogne, University of Bourgogne, Dijon, France	Nadine Millot	Tailoring shape, size and optical properties of gold and silver nanostructures for bio-medical applications

Sr. No.	Student	Host Institute	Supervisor	Project Title
03	Sruthy J. Das 20141015	IISER Pune and Institut De Physique Théorique – CEA/Saclay, France	Rajeev S. Bhalerao	Longitudinal fluctuations in ultra-relativistic heavy-ion collisions
04	Aditya Kar 20141023	IISER Pune	Nabamita Banerjee	Black hole membrane paradigm at large D
05	Aniket Khairnar 20141028	Chennai Mathematical Institute, Kelambakkam	Amitabh Virmani	BMS group at timelike infinity
06	Aanjaneya Kumar 20141034	IISER Pune	Deepak Dhar	Stochastic evolution and large deviations
07	Rushil Bala 20141048	IISER Pune	M.S. Santhanam	Many-body localisation and coupled kicked rotors
08	Sambit Ratha 20141053	IISER Pune	Deepak Dhar	Nonequilibrium statistical mechanics: Stochastic thermodynamics and heat conduction in low-dimensional systems
09	Vikram Ravindranath 20141055	IISER Pune	M.S. Santhanam	Coset CFT and bosonic string propagation in de sitter space-time
10	Bachimanchi S.S. Harshith 20141056	PRL, Ahmedabad	Goutam K. Samanta	Controlled generation of array beams of higher order orbital angular momentum and study of their frequency-doubling characteristics
11	Komal Sah 20141060	IISER Pune	Rejish Nath	Faraday patterns in spinor spin-1 Bose-Einstein condensates
12	Haritha S. Rajeev 20141063	IISER Pune	Surjeet Singh	Synthesis and physical characterization of pyrochlore oxides
13	Sumana Chetia 20141064	IIT Bombay	Hari M. Varma	A novel algorithm based on the principles of diffuse optics to reconstruct the location of optical properties in human tissue
14	Manoj M. Hegde 20141066	IISER Pune	Sreejith G.J.	QHE states surrounding different impurities in graphene
15	Sri Ramesh Chandra Ammanamanchi 20141067	IISER Pune	Sunil Mukhi	Modularity and crossing symmetry in conformal and superconformal field theories
16	Daspute Mangesh Pandharinath 20141069	IISER Pune	Ravi Kumar Kopparapu	Assessing the interior structure of the Super-Earth Exoplanet K2-18b
17	B. Kaarthik Abhinav 20141079	IISER Pune	Sreejith G.J.	Numerical studies of lattice systems with twisted boundary conditions
18	Aniruddha Vidyadhar Shirsat 20141083	IISc, Bengaluru; IMSc, Chennai	V. Ravindran, IMSc, Chennai	Calculation of higher order correction to the DY pair production from higher order operators
19	V. Sowmya 20141084	IISER Pune	M.S. Santhanam	Extreme events on complex networks

Sr. No.	Student	Host Institute	Supervisor	Project Title
20	Aayush Vijayvargiya 20141093	TIFR, Mumbai	Sandip Trivedi	Entanglement spectrum studies of topological phases
21	Shubhalakshmi S. 20141094	HRI, Allahabad	Ujjwal Sen	Theory and applications of quantum entanglement
22	Surabhi K.S. 20141095	Langevin Institute, Paris	Emmanuel Fort	Study of time-reversal in propagating waves
23	Anwesh Bhattacharya 20141096	Laboratoire Kastler Brossel, Ecole Normale Département De Physique, France	Christophe Salomon	Design of a stable optical system with an injection-locked laser to cool quantum gases to ultracold temperatures ?
24	Steenu Johnson 20141098	IISER Pune	Sourabh Dube	Electron classification using deep learning
25	Prajwal Udupa V. 20141099	IISER Pune	Arijit Bhattacharyay	Scale invariant power spectrum in inflationary model of analogue gravity
26	Aniket Bhagwat 20141102	Max Planck Institute For Astrophysics, Garching, Germany	Benedetta Ciardi	Cross-correlations between the 21cm and metal absorption lines in the high redshift universe
27	Sanchayeta Ranajit Mudi 20141105	IISER Pune	Surjeet Singh	Synthesis and properties of some metallic tri-layer nickelates structurally analogous to high- <i>t_c</i> cuprates
28	Ghosh Sourath Tarun 20141109	IUCAA, Pune	Sukanta Bose	Developing better signal-noise wave discriminators for gravitational signals from compact binary coalescences in a network of LIGO - like detectors
29	Sandeep Joy 20141115	IISER Pune	Sreejith G.J.	Coupled fractional quantum hall edges - connecting bosonic models with microscopic structure
30	Namitha Pradeep 20141116	IIT Madras	Prabha Mandayam	Entanglement properties of random quantum states and operators
31	Nishant Raina 20141117	IISER Pune	Prasad Subramanian	Filamentary magnetic fields in radio galaxy hotspots - observational signatures
32	Karanjekar Kshitij Narendra 20141124	JNCASR, Bengaluru	A. Sundaresan	Magnetism in non-magnetic materials
33	Chinmay Katke 20141134	CSIR-NCL, Pune	Ashish V. Orpe	Shear flow and mixing of cohesive and lubricated granular material
34	Danish Kaur Pannu 20141143	IISER Pune	Mukul Kabir	Ion-diffusion in perovskite solar cells
35	Kirtikesh Kumar 20141145	IIT Kanpur	Tapan K. Sengupta	Understanding vortex identification criteria
36.	Rahul Dhurkunde 20141155	IUCAA, Pune	Sanjeev Dhurandhar	Constructing an optimal chi-square discriminator for modeled glitches in interferometric data

Sr. No.	Student	Host Institute	Supervisor	Project Title
37	P.V.S. Pavan Chandra 20141159	IISER Pune	Arun M. Thalapillil	Astrophysical and terrestrial probes of exotic particles
38	Prakash Kumar 20141160	IISER Pune	Surjeet Singh	Synthesis and thermoelectric properties of some sulphides
39	B. Bharat Chand 20141163	IISER Pune	Sunil Nair	Synthesis and characterization of bulk and nano sheets of 4d and 5d based layered transition metal oxides
40	P. Sravya 20141166	IISER Pune	Bijay Kumar Agarwalla	Work fluctuations in periodically driven chaotic systems
41	Niranjana Thejaswi S 20141167	IISER Pune	Prasad Subramanian	The role of plasma heating and expansion in the energetics of solar coronal mass ejections
42	Chougule Megha Suryakant 20141174	IISER Pune	Satish Ogale	2D-2D and 2D-0D heterostructures of few layer phosphorene with transition metal chalcogenide (Snse) and organic molecules for optoelectronic applications
43	Kanishk Verma 20121051	SPPU, Pune	Shailesh Kulkarni	Asymptotic symmetries and conserved charges of Anti-De Sitter space

LIST OF COURSES

August 2018 Semester

Code	Course	Coordinator*/Instructor	Credits
Semester I			
BIO101	Introductory Biology I	Kundan Sengupta*, L.S. Shashidhara	3
CHM101	Chemical Principles I	Anirban Hazra*, Arnab Mukherjee	3
MTH100	Introduction to Proofs	Amit Hogadi	2
MTH101	Single Variable Calculus	Anupam Kumar Singh	3
PHY101	World of Physics I – Mechanics	Sudarshan Ananth	3
BIO121	Biology I	Krishanpal Karmodiya*, Tressa Jacob, Nixon M. Abraham, Nishad Matange	3
IDC101	Introduction to Computation	Bijay Kumar Agarwalla*, M.S. Santhanam, Umakant Rapol	3
Semester III			
BIO201	Introductory Biology III – Ecology and Evolution	Sutirth Dey	3
CHM201	Principles of Inorganic Chemistry	Nirmalya Ballav*, Moumita Majumdar	3
MTH201	Linear Algebra	Baskar Balasubramanyam	3
PHY201	World of Physics III – Electricity & Magnetism	Shivprasad Patil*, Sunil Mukhi	3
BIO221	Biology Lab III	Neelesh Dahanukar*, Sutirth Dey	3
CHM221	Chemistry Lab II	Shabhana Khan*, Ramanathan Vaidhyathan and Nirmalya Ballav	3

Code	Course	Coordinator*/Instructor	Credits
PHY221	Physics Lab II	Vijayakumar Chikkadi*, Atikur Rahman, Bhas Bapat, Surjeet Singh	3
HSS201	An Introduction to the History of Science, Technology and Medicine	John Mathew	2
ECS201	Earth System I	Gyana Ranjan Tripathy*, Shyam S. Rai	3

Code	Course	Coordinator*/Instructor	Credits
Semester V only			
BIO301	Lab Training/Theory Project	Collins Assisi	3
BIO311	Advanced Cell Biology	Nagaraj Balasubramanian*, Thomas Pucadyil	4
BIO313	Advanced Molecular Biology	Mayurika Lahiri*, Gayathri Pananghat	4
CHM301	Lab Training/Theory Project	Pramod Pillai	3
MTH301	Lab Training/Theory Project	Tejas Kalelkar	3
PHY301	Lab Training/Theory Project	Sourabh Dube	3
PHY330	Physics Lab IV	Aparna Deshpande*, Satishchandra Ogale, Mukul Kabir	03
ECS301	Lab Training/Theory Project	Neena Joseph Mani	3
HSS301	Lab Training/Theory Project	Pushkar Sohoni	3

Code	Course	Coordinator*/Instructor	Credits
Semester VII only			
BIO352	Animal Physiology II (NKN)	N.K. Subhedar*, Anand Krishnan	3
BIO401	Lab Training/Theory Project	Collins Assisi	3
BIO491	Literature Review	Aurnab Ghose*, Sudha Rajamani	3
BIO353	Advanced Immunology	Vineeta Bal*, Satyajit Rath	3
CHM401	Lab Training/Theory Project	Pramod Pillai	3
CHM410	Advanced Molecular Spectroscopy	Partha Hazra*, Pankaj Mandal	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	Pramod Pillai*, Angshuman Nag, Muhammed Musthafa, Alope Das	3
CHM431	Chemical Biology	Amrita Hazra	3
CHM432	Solid State Chemistry	Angshuman Nag	3
CHM445	Electrochemistry	Muhammed Musthafa	3
MTH401	Lab Training/Theory Project	Tejas Kalelkar	3
MTH410	Galois Theory (NKN)	Rabeya Basu	4
MTH412	Algebraic Topology	Tejas Kalelkar	4
MTH413	Algorithms	Soumen Maity	4
MTH415	Probability	Chandrasheel Bhagwat	4
MTH417	Ordinary Differential Equations	Diganta Borah	4
MTH421	Measure Theory & Integration	Debdip Ganguly	4
MTH414	Representation Theory of Compact Lie Groups	A. Raghuram	4
PHY401	Lab Training/Theory Project	Rejish Nath	3

Code	Course	Coordinator*/Instructor	Credits
PHY410	Physics Lab VI	T.S. Mahesh*, C.V. Dharmadhikari, Seema Sharma	4
PHY411	Condensed Matter Physics I	Sreejith G.J.	4
PHY412	Statistical Mechanics II	Deepak Dhar	4
PHY453	Computational Physics	Prasenjit Ghosh*, Apratim Chatterji	3
PHY461	Quantum Field Theory	Arun M. Thalapillil	3
ECS401	Lab Training/Theory Project	Neena Joseph Mani	3
ECS414	Physics of Geological Processes	Utsav Mannu	4
HSS401	Lab Training/Theory Project	Pushkar Sohoni	3

Code	Course	Coordinator*/Instructor	Credits
Semester V & VII			
BIO310	Biostatistics	Pranay Goel*, Raghav Rajan	4
BIO314	Bioinformatics	M.S. Madhusudhan	4
BIO315	Cellular Biophysics I	Chaitanya Athale	4
BIO316	Neurobiology I	Suhita Nadkarni*, Nixon M. Abraham, Aurnab Ghose, N.K. Subhedar	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
BIO431	Epigenetics (NKN)	Sanjeev Galande	3
BIO454	Structural Biology	Gayathri Pananghat* , Saikrishnan Kayarat, Jeetender Chugh	3
BIO415	Chemical Ecology	Sagar Pandit	4
CHM311	Physical Organic Chemistry	Hosahudya N. Gopi	4
CHM312	Main Group Chemistry	R. Boomishankar	4
CHM320	Symmetry and Group Theory	Jeetender Chugh	4
CHM331	Self-Assembly in Chemistry	Pinaki Talukdar	3
CHM332	Separation Principles and Techniques	S. Sandanaraj Britto	3
CHM340	Advanced Organic Chemistry Laboratory	Raghavendra Kikkeri*, Neeraja Dashaputre	3
MTH310	Group Theory	Ayan Mahalanobis	4
MTH311	Analysis	Ratna Pal	4
MTH312	Point Set Topology	Rama Mishra	4
MTH314	Statistical Inference (NKN)	Uttara Naik-Nimbalkar	4
MTH318	Combinatorics	Uday Sharma	4
MTH315	Numerical Analysis (NKN)	Anindya Goswami	4
PHY310	Mathematical Methods in Physics	Rajeev Bhalerao	4
PHY311	Classical Mechanics	Suneeta Vardarajan	4
PHY312	Electrodynamics	Arijit Bhattacharyay	4
PHY313	Quantum Mechanics I	Sachin Jain	4
PHY335	Electronics I	Sunil Nair	3
PHY340	Methods of Experimental Physics	Shouvik Datta	3
PHY452	Fluid Dynamics	Prasad Subramanian	3
ECS310	Numerical Computation using MATLAB	Suhas Ettammal	4
ECS312	Physics of Atmosphere & Ocean	Neena Joseph Mani	4
ECS313	Mechanics for Earth Sciences	Argha Banerjee	4
ECS330	Earth and Planetary Materials Lab	Shreyas Managave	3
ECS331	Earth and Planetary Materials	Shreyas Managave	3

Code	Course	Coordinator*/Instructor	Credits
ECS411	Exploration Seismology	Rahul Dehiya	4
ECS420	Satellite Data Analysis & Image Processing	Sudipta Sarkar	4
ECS415	Mineralogy & Petrology	Shreyas Managave*, Raymond Duraiswamy	4
ECS432	Field Geology	Shreyas Managave*, Sudipta Sarkar	3
HSS351	Technological Evolution of Cinema	John Mathew* (Anil Zankar)	3
HSS311	Introduction to Indian Writing in English: Prose and Poetry	Pooja Sancheti	4
HSS333	History of Architecture in India	Pushkar Sohoni	3
HSS342	Introduction to Paninian Grammar	Venketeswara R. Pai	3
HSS353	Law, Science and Society	Pushkar Sohoni* (Kalindi Kokal)	3

January 2019 Semester

Code	Course	Coordinator*/Instructor	Credits
Semester II			
BIO102	Introductory Biology II – Cellular and Molecular Biology	M.S. Madhusudhan*, Nagaraj Balasubramanian	3
BIO122	Practical: Biochemistry, Genetics	Sudha Rajamani*, Sagar Pandit, Tressa Jacob, L.S. Shashidhara, Girish Ratnaparkhi, Sanjeev Galande	3
CHM102	Chemical Principles II	Aloke Das*, Srabanti Chaudhury, Harinath Chakrapani	3
CHM121	Chemistry Lab I	Partha Hazra*, Nirmalya Ballav, Pankaj Mandal, Neeraja Dashaputre	3
HSS102	Critical Reading and Communication – Sciences and Society	Pooja Sancheti*, Pushkar Sohoni	2
MTH102	Multivariable Calculus	Krishna Kaipa	3
PHY102	World of Physics II – Waves and Matter	M.S. Santhanam	3
PHY121	Physics Lab I	Ramana Athreya*, Sourabh Dube, Satish Ogale, Diptimoy Ghosh	3
IDC102	Mathematical Methods	Sachin Jain*, Rajeev Bhalerao	3
Semester IV			
BIO 202	Introductory Biology IV – Biology of Systems	Aurnab Ghose*, Collins Assisi	3
CHM202	Principles of Organic Chemistry	Raghavendra Kikkeri*	3
CHM222	Chemistry Laboratory III	Neeraja Dashaputre*, S.G. Srivatsan, Sandanaraj Britto, Ramakrishana G. Bhat	3
ECS202	Earth System II	Neena Joseph Mani	2
MTH202	Probability & Statistics	Chandrasheel Bhagawat	3
MTH204	Basic Structures of Mathematics	Anupam Kumar Singh	2
PHY202	World of Physics IV – Quantum Physics	Rejish Nath*, Atikur Rahman	3
PHY 222	Physics Lab III	Vijaykumar Chikkadi*, Prasenjit Ghosh, Umakant Rapol, Prasad Subramanian	3
IDC202	Optics	G.V. Pavan Kumar*	2

Code	Course	Coordinator*/Instructor	Credits
Semester VI only			
BIO302	Lab/Theory Project	Krishanpal Karmodiya*, Kundan Sengupta	3
CHM360	Advanced Inorganic Chemistry Lab	Moumita Majumdar	3
CHM302	Lab Training/Theory Project	Pramod Pillai	3
ECS302	Lab Training Theory Project	Neena Joseph Mani	3
HSS302	Lab Training/Theory Project	Pushkar Sohoni	3
MTH302	Theory Project	Mousomi Bhakta	3
PHY320	Physics Lab V	Shivprasad Patil*, Arijit Bhattacharyay	4
PHY302	Lab Training/Theory Project	Mukul Kabir	3

Code	Course	Coordinator*/Instructor	Credits
Semester VIII only			
BIO420	Developmental Biology	Girish Ratnaparkhi*, Richa Rikhy	4
BIO351	Biology and Disease	Mayurika Lahiri*, Siddhesh Kamat	3
BIO402	Lab/Theory Project	Krishanpal Karmodiya*, Kundan Sengupta	3
CHM420	Structural Methods and Analysis	Boopathy Gnanaprakasam*, Pinaki Talukdar, Jeetender Chugh	4
CHM422	Statistical Thermodynamics	Anirban Hazra*, Srabanti Chaudhury	4
CHM423	Medicinal Chemistry	Harinath Chakrapani	4
CHM433	Photochemistry	Pramod Pillai*, Hosahudya N. Gopi	3
CHM441	Advanced Material Science	Ramanathan Vaidhyanathan	3
CHM442	Organometallic Chemistry	Ramakrishana G. Bhat	3
CHM402	Lab Training/Theory Project	Pramod Pillai	3
CHM437	Organotransition Metal Catalysis	Shabana Khan	3
ECS323	Structural Geology	Shreyas Managave, Durga Prasanna Mohanty	4
ECS452	Geophysics Field experiment and Data Analysis	Rahul Dehiya	3
ECS402	Lab Training Theory Project	Neena Joseph Mani	3
HSS402	Lab Training/Theory Project	Pushkar Sohoni	3
MTH420	Algebraic Number Theory	Supriya Pisolkar	4
MTH411	Functional Analysis	Anisa Chorwadwala	4
MTH422	Differential Geometry (NKN)	A. Raghuram	4
MTH426	Stochastic Processes (NKN)	Anup Biswas	4
MTH423	Commutative Algebra	Debargha Banerjee	4
MTH424	Partial Differential Equations	Mousomi Bhakta	4
MTH428	Topics Course: Elliptic Curves	Baskar Balasubramanyam, Vivek Mallick	4
MTH402	Theory Project	Mousomi Bhakta	3
PHY420	Atomic and Molecular Physics	T.S. Mahesh	4
PHY428	Advanced Optics	Shouvik Datta	4
PHY422	Nuclear and Particle Physics (NKN)	Arun M. Thalapillil	4
PHY430	Physics Lab VII	Sunil Nair*, Seema Sharma, Surjeet Singh	3
PHY402	Lab Training/Theory Project	Mukul Kabir	3
PHY463	Advanced Condensed Matter Physics	Mukul Kabir*, Sreejith G.J.	3
PHY557	Quantum Field Theory II	Sunil Mukhi	3
IPR501	Basic Course on Intellectual Property Rights	Vandana Gambhir, Sanjeev Galande	20 Hours

Code	Course	Coordinator*/Instructor	Credits
Semester VI & VIII			
BIO312	Animal Physiology I (NKN)	Nishikant Subhedar*, Nixon M. Abraham	4
BIO324	Introductory Immunology	Vineeta Bal*, Satyajit Rath	4
BIO412	Microbiology	Nishad Matange*, Gayathri Pananghat	4
BIO417	Advanced Biochemistry II	Thomas Pucadyil*, Amrita Hazra	4
BIO422	Evolution	Sutirth Dey*, Milind Watve, L.S. Shashidhara	4
BIO325	Animal Behaviour	Raghav Rajan*, Anand Krishnan, Nixon M. Abraham	4
BIO433	Applied Plant Biology	Anjan Banerjee	3
BIO451/IDC451	Data Science	Pranay Goel	3
BIO354	Neurobiology II	Suhita Nadkarni*, Raghav Rajan	3
BIO435	Cellular Biophysics II	Chaitanya Athale	3
BIO441	Genome Biology	Kundan Sengupta*, Krishanpal Karmodiya	3
BIO442/	Physical Biochemistry	Jayant Udgaonkar	3
CHM446			
CHM310	Quantum Chemistry	Arun Venkatnathan	4
CHM321	Organic Synthesis I	Srinivas Hotha	4
CHM322	Transition Metal Chemistry	Sujit K. Ghosh	4
CHM323	Fundamentals of Molecular Spectroscopy	Pankaj Mandal*, Partha Hazra	4
CHM334	Physical Chemistry of Solutions	Arnab Mukherjee	3
CHM351	Biorganic Chemistry	S.G. Srivatsan	3
ECS320	Digital Signal Analysis & Inverse Theory	Rahul Dehiya	4
ECS321	Atmospheric Dynamics	Suhas Ettammal	4
ECS322	Introduction to Geophysics	Shyam S. Rai	4
ECS424	Applied Mathematical Methods	Sarvesh Dubey	4
ECS421	Atmosphere and Ocean Chemistry	Gyana Ranjan Tripathy	4
ECS332	Geochemistry	Shreyas Managave	3
ECS333	Sedimentology & Stratigraphy	Sudipta Sarkar	3
ECS334	Hydrology	Argha Banerjee	3
HSS331	Development of Mathematical Astronomy in India	Venkateswara Pai	3
HSS323	Audio-Visual Communication of Science (non-fiction)	Anil Zankar	4
MTH320	Vector Spaces, Rings and Modules	Manish Mishra	4
MTH321	Complex Analysis	Diganta Borah	4
MTH322	Calculus on Manifolds	Tejas Kalelkar	4
MTH323	Graph Theory	Soumen Maity	4
MTH329	Cryptography	Ayan Mahalonobis	4
MTH340	Topics Course: Additive Number Theory	Kaneenika Sinha	3
PHY322	Statistical Mechanics I	Bijay Kumar Agarwalla	4
PHY321	Quantum Mechanics II	Deepak Dhar	4
PHY356	Group Theory in Physics	Sudarshan Ananth	3
PHY350	Electronics II	Aparna Deshpande	3
PHY351	Gravitation and Cosmology	Suneeta Vardarajan	3

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.

Mihir Shridhar Dingankar (Fall 2018)
Madheshvaran S. (Fall 2018)
Mihir Neve (Fall 2018)
P.B. Harita (Fall 2018)
Arijit Paul (Spring 2018)

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 3 to 8.

Saptarshi Soham Mohanta (Semester III, Fall 2018)
Sahiti Chebolu (Semester IV, Spring 2018)
Sriram Raghunath (Semester V & VI, Academic Year 2017–18)
Devika Varma (Semester VII & VIII, Academic Year 2017–18)

A total of 30 BS-MS students have been selected to receive Infosys Foundation Scholarship that allowed a full tuition fee waiver for January 2019.

During the 7th Convocation of the Institute held on May 26, 2018, 120 students graduated with BS-MS dual degrees.

Nabha Shah who secured a CGPA of 9.9 was awarded the Institute Gold Medal.

The following 22 students passed with distinction (CGPA>9.0):

Parijat Banerjee	Kumar Mekhala	Chhaged Shubham Sohanlal
Sharafudheen P.C.	Kadam Snehal Girish	Karthik Prabhu P.
Korwar Mrunal Prashant	Chaitanya Erady	Pund Rugved Prashant
Shreeya Behera	Datar Prathamesh Madhav	Bharath Krishnan
Amruta Priyadarshini Nayak	Kadam Saurabh Vasant	Nabha Shah
Tanushree Bharat Shah	Malpathak Shreyas Vijay	Moghe Prachiti Pradeep
Urmi Poddar	Arpith Ramakrishna Shanbhag	Kapshikar Upendra Shamrao
Jewel Ann Maria Xavier		

03

Conferences, Events, and Initiatives

96 / Conferences, Symposia, and Workshops

99 / News and Events

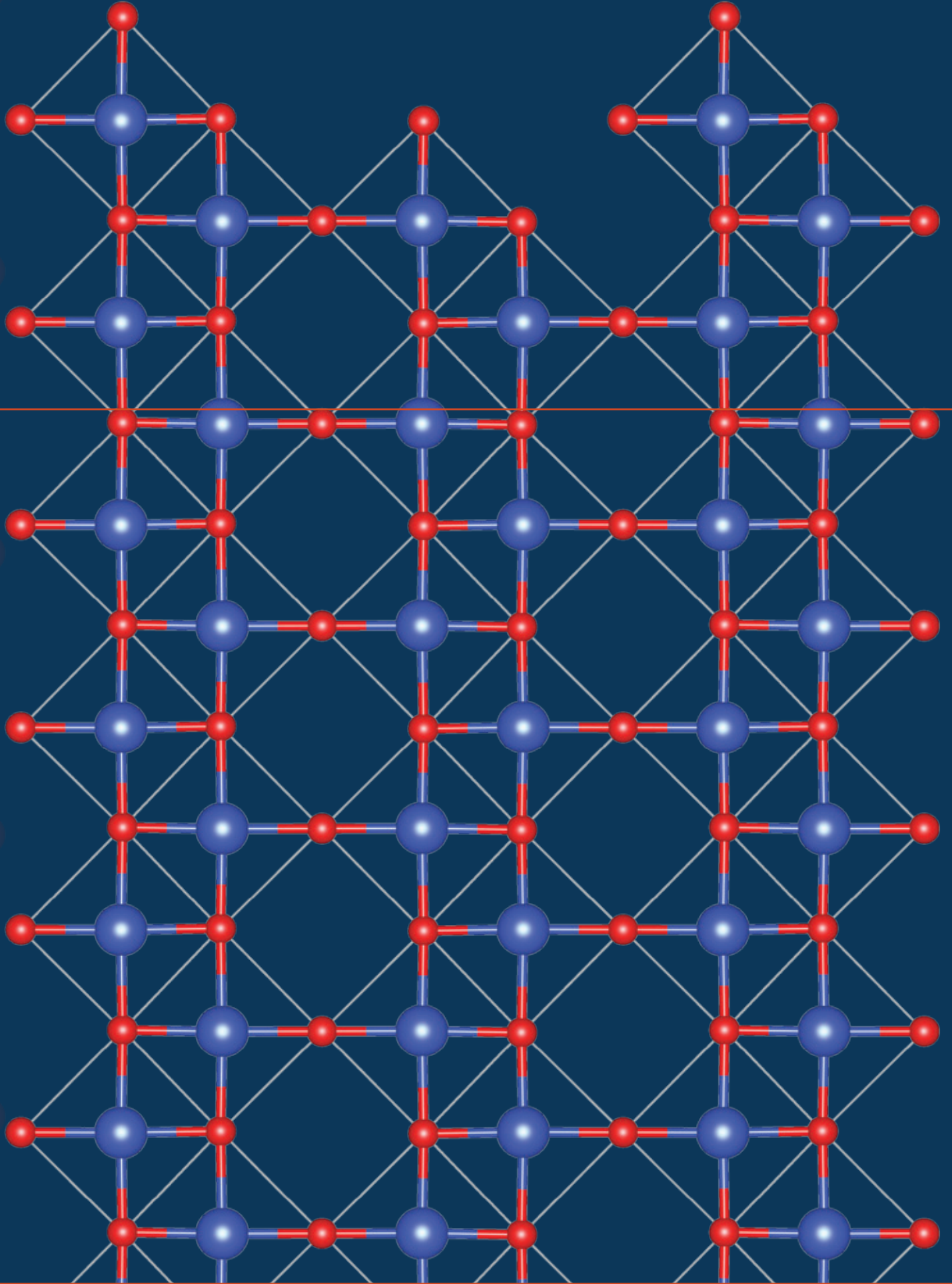
102 / Research Seminars and Public Lectures

103 / International Relations

105 / Industry Partnerships and Endowments

107 / Outreach Activities

03



The ladder subsystem in the structurally incommensurate composite quantum magnet $\text{Sr}_{14}\text{Cu}_{24}\text{O}_{41}$

Image Credit: Rabindranath Bag, Surjeet Singh

Phys. Rev. B 99: 054305, J. Phys.: Condens. Matter 31: 035801



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.

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

Conference on Innovations in Frontier Chemistry (IFC 2018)

May 08–09, 2018

Organisers S.G. Srivatsan, Pramod Pillai, B. Gnanaprakasam

Summer Camp for Rural Students

May 21–25, 2018

Organisers CoESME of IISER Pune; Vidnyan Vahini

Vigyan Jyoti Orientation Camp for Girl Students

May 21 – June 09, 2018

Organisers IISER Pune, under the Department of Science and Technology (DST)'s Vigyan Jyoti Scheme

Three-day Workshop for Rural School Teachers

June 07–09, 2018

Organisers CoESME of IISER Pune; Sakal NIE

Preparatory Workshop for School Teachers

June 14, 2018

Organisers CoESME of IISER Pune; Marathi Vidnyan Parishad

A Hands-on Physics Workshop for High School Teachers from Kendriya Vidyalayas

Batch I: July 04–06, 2018; Batch II: July 09–11, 2018

Organisers CoESME of IISER Pune; Indian Association of Physics Teachers (IAPT)

International Workshop on Mathematical Finance

July 12–16, 2018

Organisers Mrinal K. Ghosh (IISc, Bengaluru); Anindya Goswami (IISER Pune); Anup Biswas (IISER Pune); Sandeep Juneja (TIFR, Mumbai)

Mouse Sperm and Embryo Cryopreservation Course

July 17–20, 2018

Organiser National Facility for Gene Function in Health and Disease of IISER Pune

In-house Symposium "Energy Day 2018"

July 27, 2018

Organiser Nirmalya Ballav

Pedagogy Workshops for School Mathematics Teachers

August 07–11, 2018

Organiser CoESME of IISER Pune

4th Indo-British Advanced Master-Class in

Oncoplastic Breast Surgery & Breast Cancer Symposium

August 17–19, 2018

Organisers Centre for Translational Cancer Research, Training and Education set up by IISER Pune and Prashanti Cancer Care Mission

Mumbai Pune Quantum Condensed Matter Physics Meeting

September 01, 2018

Organisers Sreejit, G.J.; Bijay Kumar Agarwalla

Teacher's Day: One-day Workshop for School Science and Mathematics Teachers

September 06, 2018

Organisers CoESME of IISER Pune; NIE, Sakal

Royal Society of Chemistry Meet-the-Editor Programme

September 10, 2018

Organiser Dr. R. Boomi Shankar

Symposium on Chemistry and Physics of Advanced Materials – III

October 08–09, 2018

Organisers Arun Venkatnathan (IISER Pune); R. Vaidhyathan (IISER Pune); K.N. Ganesh (IISER Tirupati)

Workshop on Volume Conjecture and Related Topics in Knot Theory

December 17–21, 2018

Organisers Rama Mishra (IISER Pune); Tejas Kalelkar (IISER Pune); Abhijit Champanerkar (City University of New York)

International Conference on Polymer Science and Technology (SPSI-MACRO-2018)

December 19–22, 2018

Organisers Jointly hosted by IISER Pune, CSIR-NCL, Pune and SPPU, Pune; Chaired by M. Jayakannan (IISER Pune); Co-Chaired by Prakash P. Wadgaonkar (CSIR-NCL)

DST-INSPIRE Science Internship Camp 2018 (for students of Class XI)

December 24–28, 2018

Organiser IISER Pune

Conference on Facets of Photonics 2018

December 24–26, 2018

Organisers G.V. Pavan Kumar and his research group

Third State Level School Science and Mathematics Teachers' Congress

December 26, 2018

Organiser CoESME of IISER Pune; Marathi Vidnyan Parishad, Mumbai

Second IISER Pune Short-Term Course on Biostatistics

December 28–30, 2018

Organiser Sutirth Dey

Workshop on Molecular Modeling in Chemistry (MMC-2018)

December 28–29, 2018

Organisers Reman Kumar Singh; Avdhoot Datar; Subrahmanyam Sappati; Patrons: M. Jayakannan; Arnab Mukherjee

Meeting on Statistical Mechanics and Soft Matter

January 04–05, 2019

Organisers Srabanti Chaudhury (IISER Pune); Rajarshi Chakrabarti (IIT Bombay)

Workshops on Science Administration & Management, and Science Journalism for Women (Level 2)

January 07–08, 2019

Organisers CoESME of IISER Pune; Newton Bhabha Fund, British Council; Conducted by a team from Coventry University, U.K.

Number Theory Day

January 13, 2019

Organiser Baskar Balasubramanyam

Workshop on Research-based Pedagogical Tools (RBPTs) for Undergraduate Science Teachers (Level 2)

January 17–19, 2019

Organisers CoESME of IISER Pune; British Council; DBT, Govt. of India; Conducted by a team from Sheffield Hallam University, U.K.

Workshop for College Teachers on Generating Teaching Resources

Writers' Workshop for generating Resources on Research-based Pedagogical Tools (RBPTs) for Undergraduate Science Teachers

January 20–23, 2019

Organisers CoESME of IISER Pune; British Council; DBT, Govt. of India

Fifth Pune-Mumbai Number Theory Seminar

February 15–16, 2019

Organiser Debargha Banerjee

Mini-Symposium on the Emergence of Life: From Messy Chemistry to Ordered Networks

February 20, 2019

Organiser Sudha Rajamani

Parameterized Complexity 101: A Workshop on Parameterized Algorithms

March 02–04, 2019

Organiser Soumen Maity

Pune-Mumbai Collider Meet 2019

March 16, 2019

Organisers Sourabh Dube (IISER Pune); Diptimoy Ghosh (IISER Pune); Vikram Rentala (IIT Bombay); Tuhin Roy (TIFR, Mumbai); Seema Sharma (IISER Pune); Arun Thalapillil (IISER Pune)

International Conference on Structural and Inorganic Chemistry-II (ICSIC-II)

March 18–19, 2019

Organisers IISER Pune; CSIR-NCL; SPPU

IISER Pune-KPIT Shodh Awards and Energy & Mobility PhD Conference

March 22–23, 2019

Organisers IISER Pune; KPIT

Training of Trainer Workshop for Faculty Induction Programme

March 27–29, 2019

Organisers CoESME of IISER Pune, with University Grants Commission

NEWS AND EVENTS

8th Foundation Day

April 07, 2018

The Foundation Day Lecture was delivered by Dr. Shekhar Mande (the then Director, NCCS, Pune). He spoke about understanding the disease of tuberculosis. Director of IISER Pune, Prof. Jayant Udgaonkar, gave the Institute report. Student magazine *Kalpa 2018* and Disha's chronicle *Pahal 2018* were released. Foundation Day awards were given to students and staff in recognition of their academic and professional excellence.



Convocation 2018

May 26, 2018

During the 7th Convocation of the Institute held on May 26, 2018, 120 BS-MS students, 1 Integrated PhD student and 40 PhD students received their degrees. The Institute Gold Medal for the BS-MS Programme was presented to Nabha Shah. Xytel Best Thesis Awards were given to 4 BS-MS students (Prachiti Moghe, Shreyas Malpathak, Upendra Kapshikar, Nabha Shah) and 3 PhD students (Sudipta Tung, Maidul Islam, Rohit Joshi). Chief Guest Prof. Jayant Narlikar (Emeritus Professor, IUCAA Pune) delivered the convocation address during which he highlighted that one should strive to achieve excellence, whatever be the field.



In-house Research Symposia

Departmental in-house research symposia held during the year include Physics Day (April 08, 2018), ChemSymphoria (July 12–13, 2018), Bioconclave (August 10–11, 2018), and Mathematics Symposium (September 14–15, 2018) by the Physics, Biology, Chemistry, and Mathematics departments, respectively. The purpose of these events is to provide an overview of various research areas being pursued in each of the departments at the Institute, with students as the primary audience.

Hindi Fortnight Celebrations

September 14–28, 2018

The Hindi Fortnight started with 'Hindi Book Exhibition' organised by Srinivasa Ramanujan Library. Competitions were conducted for Hindi essay writing (Topic: Start up India, Stand up India), Hindi word knowledge, songs, letter writing, poetry writing and recitation. Drawing competition and cultural programmes



were also conducted for staff, faculty and students during the fortnight. Winners received prizes and certificates. Apart from this, at other times during the year, two Hindi workshops were held. These were on the topics of noting and drafting in official work (June 1, 2018) and on various forms of correspondence (March 11, 2019).

7th Inter-IISER Sports Meet (IISM) at NISER Bhubaneswar

December 15–20, 2018

The 7th Inter-IISER Sports Meet saw participation from all IISERs, Indian Institute of Science Bengaluru, NISER Bhubaneswar, and Center for Excellence in Basic Sciences (CEBS), Mumbai. The IISER Pune teams were declared champions in Table Tennis (Men) and Badminton (Mix); were at the third place in Basketball (Men) and Basketball (Women). IISER Pune members received 2 Gold, 2 Silver, and 4 Bronze medals in other athletic events.

Membership of the International Mouse Phenotyping Consortium (IMPC)

February 04, 2019

IISER Pune is now a member of the IMPC (International Mouse Phenotyping Consortium). This places IISER Pune in the league of 20 of the major mouse genetics centres worldwide and adds tremendous value to the Institute's research capabilities. This membership will provide IISER Pune access to transgenic and knockout lines and promote ways to share information and resources with the scientific community in India.

International Women's Day

March 08, 2019

Taking after the 2019 International Women's Day campaign theme of #BalanceforBetter, the following events were organised by the Internal Committee in association with Disha and Literary Club of IISER Pune. Prof. Meera Nanda spoke on the role of women in the history of science. A panel discussion on #BalanceforBetter and a play "Haan, mein Savitribai Phule!" by Sushma Deshpande on the life of Savitribai Phule was hosted as part of this event.

Theme-based Events

The Institute celebrated these events during the year: International Day of Yoga (June 21, 2018); Independence Day (August 15, 2018); Gandhi Jayanti, 150th birth anniversary of Mahatma Gandhi (October 02, 2018) and Swachhata Pledge (October 08, 2018); Vigilance Awareness Week (October 29 to November 03, 2018); National Unity Day (Rashtriya Ekta Diwas Pledge, October 31, 2018); and Republic Day (January 26, 2019).

Math Day or pi-day is celebrated around the world on March 14 every year owing to its resemblance to the pi value. Math Day at IISER Pune was held on March 16, 2019. The event was open to the public and included a colloquium

by Prof. Shobha Madan, IIT Goa; quizzes, treasure hunt, and other fun events. A documentary on 'Fermat's Last Theorem' by the BBC was screened.

Events by / for Student Teams

Python Innovation Day – Hackathon: (Sept 07, 2018) was organised by Intel, IISER Pune, and Amazon Web services with an aim to motivate and harness talent in the applicability of Python Programming to solve real world problems in the areas of Science and Technology. Originally kicked off in June 2018, the grand finale of the Hackathon was held on September 07, 2018 at IISER Pune. Of the 4043 registered teams, eight teams made it to the final round. Top three teams were felicitated by Padma Bhushan awardee and eminent scientist Dr. Vijay Bhatkar, and Dr. Suryachandra Rao, Project Director, IITM Pune.



Abhijit Gupta and Shubham Singh, both students from IISER Pune, won the first prize at this event.

GPU Application Hackathon 2018: (GAH - 2018) (Sept 17-21, 2018) was organised by IISER Pune along with OpenACC.org and in association with C-DAC and NVIDIA, under the aegis of National Supercomputing Mission (NSM). The aim of this event was to investigate and implement latest parallelisation and optimisation techniques for up-scaling scientific application on general-purpose graphics processing units (GPGPU's).

Nobel Evening 2018: The Science Club of IISER Pune organised Nobel Evening 2018 (Oct 22, 2018), a series of public talks on the discoveries that won the Nobel Prizes this year. Later during the year, in December 2018, the third edition of *Helicase*, a newsletter by the Science Club was released in association with an independent editorial team of students. This includes a compilation of various student-led events including talks, science club events, and workshops. The Science Club also organised an event titled *Entropy* (Mar 30, 2019) which included talks by IISER Pune faculty members on the concept and significance of entropy along with a game to understand Boltzmann distribution.

Techstars Startup Weekend 2018: Techstars Startup Weekend 2018 (Nov 16–18, 2018) was conducted on the campus by the Entrepreneurship and Innovation Cell of IISER Pune, powered by Google for Entrepreneurs. In the first 3 weeks of November, the event is hosted in 200+ cities across 80+ countries each year. This event brings together experienced entrepreneurs, professionals, students, and innovators.

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

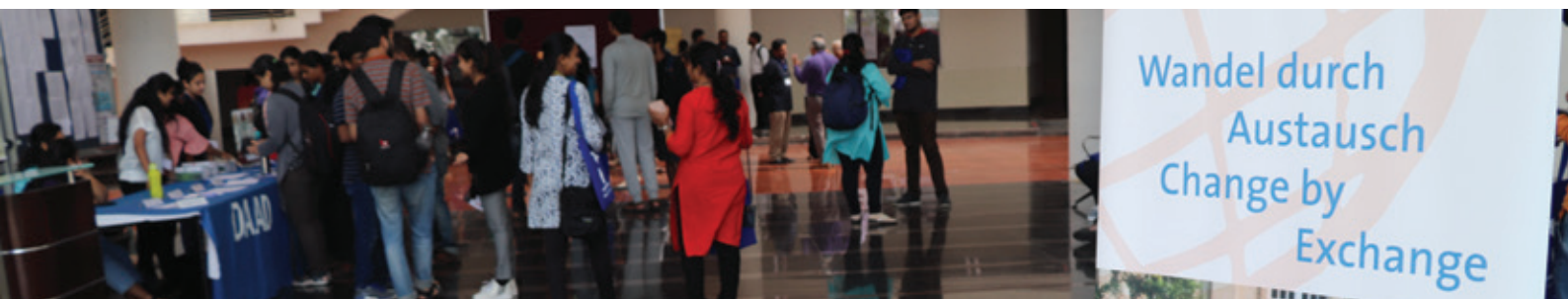
RESEARCH SEMINARS AND PUBLIC LECTURES

IISER Pune hosted a total of 216 research seminars during 2018–19. Apart from this, the Institute also hosted several public lectures on a diverse set of topics, some of these include named lectures. Information on other lectures and public science events is included in the *Outreach Activities* chapter of this report.

Date	Title of the Lecture	Speaker	Affiliation
August 07, 2018	Dawn of gravitational wave physics and astronomy	Prof. B. Sathyaprakash	Penn State University, U.S.A.
November 15, 2018	<i>Chance ki baat hai: How complexity arises in dynamical systems</i>	Prof. Ram Ramaswamy	Jawaharlal Nehru University, New Delhi
January 16, 2019 <i>Second P.M. Mukhi Memorial Human Rights Lecture</i>	Confronting human rights skepticism	Dr. Pratap Bhanu Mehta	Vice-Chancellor Ashoka University
January 28, 2019	Viewing the beginning of time from the most remote places on Earth	Dr. Zeeshan Ahmed	Kavli Institute for Particle Astrophysics and Cosmology and SLAC National Accelerator Laboratory, U.S.A.
February 25, 2019	The works of Michael Atiyah - Some glimpses	Prof. M.S. Raghunathan	Distinguished Visiting Professor, DAE-MU Centre for Excellence in Basic Sciences, Kalina, Mumbai
March 07, 2019 <i>As part of Manthan Leadership Talk series by PMO and MHRD</i>	A social security paradigm under the Government of India	Mr. Milind Kamble	Entrepreneur, Founder-Chairman Dalit Indian Chamber of Commerce and Industry (DICC)
March 29, 2019	What the world is made of? From the latest results of the Large Hadron Collider to physics outreach for schools and the general public	Prof. Arnulf Quadt	Georg August University, Goettingen, Germany

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 2018–19

Partner Organisation/s	Purpose
<i>Dec 05, 2018</i> Umbrella MoU and student exchange agreement with Sorbonne University, France	Promote and expand international academic and research programmes of mutual interest; partners can apply for funding schemes like Erasmus+
<i>Jan 30, 2019</i> B4 agreement with Institute of Bioinformatics and Applied Biotechnology, and Lakshmi Mittal & Family South Asia Institute, Harvard University, U.S.A., and Harvard Global Research Support Centre India	Enables IISER Pune to jointly run the "Building Bharat-Boston Biosciences (B4) Program". The programme has two primary objectives: 1) Through hands-on workshops (-2 weeks long) in India, provide an intensive introduction to topics in interdisciplinary life sciences to Indian undergraduate and graduate students who might not yet have had such exposure. 2) Enable doctoral/postdoctoral fellows from India for a year-long fellowship at leading institutions in the Boston area to pursue original work in the life sciences. The funding for this programme has been secured from DBT, India.

ACTIVITIES UNDER EXISTING MoUs

With University of Melbourne, Australia

Members from the University of Melbourne, Australia, including Dr. Alex Johnson, Associate Dean, International; Dr. Gulur Srinivas; and Mr. Andrew Drinnan visited the Institute during the year and discussions were held on the implementation of the Blended BSc programme and on possible research collaborations.

With Sorbonne University, France

Prof. Abhay Shukla from Sorbonne University visited and interacted with MS students to inform them about Erasmus+ funded mobilities for 6 months to carry out research work in the area of materials science.

With ENS Network

Prof. Shashidhara visited ENS Lyon as Professeur invité during April-May 2018; and two IISER Pune students carried out their summer internships at ENS Rennes and ENS Paris-Saclay, respectively.

With the University of Glasgow, U.K.

Discussions were held on the possible opportunities to further strengthen the cooperation including the student and staff mobilities funded by Erasmus+ programme. Application for upcoming call of Erasmus+ funding was discussed and submitted.

With CNRS

CNRS and IISER Pune committed resources to initiate a joint doctoral supervision programme. The students will be admitted to the respective doctoral programmes as per the host organisation's guidelines. One student from each side is assigned a co-supervisor from the partner. A call for joint-applications was made in March 2019.

With University of Göttingen, Germany

Prof. Arnulf Quadt, particle physicist from University of Göttingen gave a public lecture titled "What the world is made of? From the latest results of the Large Hadron Collider to Physics Outreach for Schools and the general Public" at IISER Pune (March 29, 2019).

NAMASTE+ Kick-off Meeting (March 29, 2019) initiated NAMASTE+, a mobility and research cooperation project between the University of Göttingen and 12 Indian Higher Education partner institutions. The project is financed for a period of 4 years (01 March 2019 – 28 February 2023) by DAAD and the German Ministry of Education and Research within the "A New Passage to India Programme".

University of Göttingen was a part of the proposal writing workshop organised by DAAD at IISER Pune (September 08, 2018). Other activities during the year under this partnership include visits and discussions pertaining to internationalisation of curriculum, and entrepreneurship, and innovation.

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 30 such visits (number of visits shown in parenthesis) from 10 countries: Australia (03); Canada (01); Finland (01); France (04); Germany (05); Japan (02); Russia (01); Switzerland (02); U.K. (08); and U.S.A. (03).

OTHER ACTIVITIES

IISER Pune hosted a workshop titled "In Otto Koeniger's footsteps – encouraging collaboration between cities and universities" organised by UCL Grand Challenges, University College London (May 11, 2018). One of the aims of the workshop was to discuss and provide conceptual frameworks for framing urban transformation initiatives as a collaborative initiative between cities and universities.

An interactive session regarding funding opportunities by Indo-German Science & Technology Centre (IGSTC) was organised for the faculty members (November 16, 2018).

OUTGOING STUDENTS

A total of 67 students (BS-MS, Integrated PhD, and PhD) from the Institute have undertaken summer internships / 5th year projects / collaborative research at various foreign institutes/universities.

Some of the universities/organisations where the students have taken up these activities include CERN (3); ENS Network, France (4); Glasgow University, U.K. (5); University of Göttingen, Germany (1); IPGP, France (1); Michigan University, Ann Arbor, U.S.A. (10); Nottingham University, U.K. (2); Sorbonne University, France (2); Temple University, U.S.A. (1); and Weizmann Institute of Science, Israel (5).

INCOMING STUDENTS

A total of 20 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 ENS Network, France (1); Glasgow University, U.K. (4); University of Göttingen, Germany (2); Michigan University, Ann Arbor, U.S.A. (1); Ontario India Network Program, Canada (1); Sorbonne University, France (3); and Weizmann Institute of Science, Israel (1).

INDUSTRY PARTNERSHIPS AND ENDOWMENTS

The Institute's efforts to build partnerships with the industry and to garner funds through endowments are closely tied in to the teaching and learning of science through research excellence. The Endowment and Investment Committee (EIC) of the Institute oversees these activities: outline the priority areas for endowment funds and the modes of raising such funds through donations and grants; and nurture and enhance research partnerships with the industry.

INDUSTRY – ACADEMIA COLLABORATION

The IISER Pune-Industry Conclave held on January 19, 2019 brought together industry leaders, professionals, and academics with a shared interest in scientific research and development. With participation from over 20 industry stalwarts and chaired by Dr. K. Venkataramanan, former CEO & MD, L&T Limited and former Chair, Board of Governors, IISER Pune, the Conclave encompassed short focused talks by IISER researchers and invited guests, highlighting common needs, interests, and avenues for partnership between academia and industry.

IISER Pune conducted a lecture series titled "Science to the Doorsteps of Technocrats" in association with industrialist Mr. P.V. Balasubramaniam. Held at the Symbiosis Infotech Campus, this series took scientists to an audience largely comprised of technology professionals.

In March 2019, IISER Pune and KPIT hosted the KPIT Shodh Awards and the Annual PhD Conference on Energy and Mobility, which brought together students and researchers from academia and the industry.

IISER Pune signed an MoU with Tata Consultancy Services under its Co-Innovation Network™ (COIN™).

TCS COIN™ brings together a network of experts from the start-up, research, academics, and corporate worlds to work on collaborative innovations.

Petroleum Experts Limited, a petroleum engineering and structural geology company, has donated their MOVE software suite to Earth and Climate Science Dept. at IISER Pune. The software is equivalent to £ 1,734,408-00. The industry standard software will equip the students with data analysis techniques used in the hydrocarbon industry.

The year saw visits from many industry stalwarts exploring the possibilities of research collaborations. Visitors include

- Warren Harris (CEO and MD, Tata Technologies)
- Ms. Marie-Noëlle Semeria, (Sr. VP & Group CTO) with Mr. Franck Eydoux, (MD, Marketing & Services Research Centre), and Team from Total, France
- Team from Tata Consultancy Services led by Dr. Ajay Nandgaonkar, Head (Research and Innovation)
- Team led by Dr. Y.K. Hamied, Mr. M.K. Hamied, Mr. Anurag Mishra and Ms. Preeti Majumdar from Cipla Ltd. along with Prof. Joseph Fortunak, Dr. Gunnar Aberg and Dr. A.V. Ramarao



At the IISER Pune-Industry Conclave held on January 19, 2019

PHILANTHROPIC AND CSR CONTRIBUTIONS

The administration of endowment funds received so far from the corporates has continued.

- In 2017, Bajaj Auto Ltd. committed a generous endowment towards construction of a hostel for women research scholars at the Institute. The construction of the Bajaj Hostel completed during the reporting period; the building is ready for occupation.
- Cipla Foundation's endowment in 2017 is enabling the construction of a modern chemistry research laboratory for undergraduate students. The construction of the building is almost complete. It is anticipated that the lab will be functional in the 2019–20 academic year. The research, teaching, and outreach lab called as 'Cipla Centre' has been envisioned to align chemistry education at undergraduate level towards the present and future healthcare needs.
- Through the Infosys Foundation Endowment Fund, during the period 2018–19, 30 BS-MS students have been given tuition fee waivers whereas 55 students received travel grants. Thus, since its inception till March 2019, tuition fee waiver has been extended to 87 BS-MS students and 8 Integrated PhD students under the Infosys Foundation Endowment Fund whereas 129 students have received Infosys Foundation Travel Awards.
- An endowment from Integrated Decisions and Systems (India) Private Limited (IDeaS), an information technology company at Cyber City, Pune is offering scholarships to meritorious students who have achieved academic excellence. A full tuition waiver for Fall 2018 was given to 10 BS-MS students, 4 Integrated PhD students, and 5 PhD students.
- As the building plans are drawn out for Smt. Indrani Balan Science Activity Centre with endowment from the Balan Group, hands-on science activities envisaged for school and college students at the building have been underway.
- During 2018–19, three outstanding students, one each from Biology, Chemistry, and Mathematics were awarded Xytel Best PhD Thesis Award. Four BS-MS students were awarded Xytel Best Master's Thesis Award. The awards have been instituted from an endowment from Xytel India Private Limited.

NEW CONTRIBUTIONS RECEIVED DURING 2018–19

- Eppendorf India Pvt. Ltd. gave an endowment of Rs. 7,52,000 for conducting molecular biology training programme for school and undergraduate students.
 - Forbes Marshall Foundation and Persistent Foundation have contributed an amount of Rs. 5 lakhs each for conducting year-long activity by Exciting Science Group of IISER Pune. The Exciting Science Group comprises of scientists from CSIR-NCL and IISER Pune. The initiative is aimed at conveying the excitement of science and technology to school students.
 - The association with IDeaS continued with the company continuing in the year 2019 to support scholarships to meritorious students through an endowment of Rs. 5 lakhs.
 - Siemens Industry Software India Pvt. Ltd. donated an amount of Rs. 9 lakhs towards corpus for supporting PhD fellowship.
 - In a new partnership with Tata Technologies, IISER Pune has initiated the STEP for STEM programme through which, over the next two years, 200 teachers and 1000 students will directly benefit from training on activity-based STEM learning. Tata Technologies has committed a grant of Rs. 1.69 crores towards this purpose.
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OUTREACH ACTIVITIES

The overall goals of educational and social outreach activities at IISER Pune include improving education and 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 2018–19, over 3,000 visitors from 65 institutes visited IISER Pune from different parts of the country. Of these, 2,340 visitors were from Maharashtra. The rest were from other parts of the country such as Rajasthan, Tamil Nadu, Karnataka, and Kerala. Among the visitors were 1,155 school students accompanied by 85 teachers and 1,866 college students accompanied by 213 teachers.

Science Media Centre (SMC)

Established in 2012, the SMC has been actively working on preparing audio-visual content for science communication and popularisation, producing electronic study materials in science disciplines, and training people in various aspects of science media production.



In the year 2018–19, taking a step towards disseminating research being done at the Institute, the SMC has produced and published three research highlight videos representing the work of IISER Pune faculty members Dr. Rejish Nath, Dr. Siddhesh Kamat, and Dr. Sourabh Dube on its official YouTube channel. SMC is involved in video production of courses being made by IISER Pune faculty members for National Programme on Technology Enhanced Learning (NPTEL). Three such courses have been produced in

this year. These include Medicinal Chemistry by Dr. Harinath Chakrapani, Chemical Principles by Dr. Arnab Mukherjee, and Introduction to History of Architecture in India by Dr. Pushkar Sohoni.

SMC has also provided videography and photography coverage, including a feedback video, to two NPTEL lab courses in chemistry that were conducted at the Institute. In 2018–19, SMC has also designed promotional material for some of the events organised at IISER Pune. SMC has also helped a number of faculty members at IISER Pune in the creation of high-quality graphical abstracts and cover arts for research articles published.

SMC has received a grant for conducting eight workshops per year, i.e., twenty-four workshops in the next three years from National Council for Science & Technology Education, Department of Science & Technology. The theme of these workshops will be based on different aspects of science communication such as science writing, science video production, science blogging, etc. SMC is also looking forward to produce documentaries on many eminent scientists of India who have made enormous contribution to research. Along with that, SMC is eager to promote women in science by highlighting research of Indian women scientists in the near future.

Centre of Excellence in Science and Mathematics Education (CoESME)

CoESME has been functioning at IISER Pune under MHRD's Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNMTT) scheme since October 2015. The Centre aims to strengthen science education in India by engaging teachers of school and undergraduate level science and mathematics, and motivating students and teachers of all age groups towards science. Independently and in partnership with government and non-government agencies, CoESME has focused on the following aspects of educational outreach in 2018–19:

1. Teaching/learning of scientific concepts:

- A. School Teachers: 319 school teachers participated in five activities. Some of these were workshops that dealt with teaching of a specific subject, while others provided a platform for teachers to present their pedagogical innovations.
- B. College Teachers: Twelve training activities were conducted at 8 different locations for 853 college teachers from all over India. Majoriy of these were part of an ongoing series of workshops on Research-based Pedagogical Tools (RBPTs) that help students learn the process of science and not just facts.



The workshops, conducted in partnership with Sheffield Hallam University (U.K.), are of different types – national level workshops; workshops on resource creation and training of trainers for selected teachers; and regional workshops where previously trained teachers are resource persons. In addition, two rounds of month-long Induction Training Programme for newly recruited college teachers were conducted to orient participants on various aspects of teaching-learning. CoESME also helped develop modules for UGC's induction programme to be implemented country-wide for all new college teachers. Through its National Resource Centre (NRC), CoESME has produced and run a SAWAYAM course for teachers on climate change education.

2. *Professional development:* Four training programmes for 240 educators and other professionals on capacity building for skills in areas such as science journalism, science policy, and science administration were conducted in the past year.
3. *Enthusiating and motivating school students:* Five science camps were conducted to introduce 377 school students to the joys of science through hands-on sessions, talks, and interactions.
4. *Smt. Indrani Balan Science Activity Centre:* This Science Centre, established under the broad aegis of CoESME, develops innovative science toys with easily available material, to give students a hands-on flavour of the subject. Between April 2018 to March 2019, more than 30,000 people including students, teachers and other visitors, visited the Centre. Two major public engagement events were held: Jigyasa Science Exhibition attended by more than 13,000 visitors; and National Science Day where more than 2,500 people visited the Centre. Recently, IISER Pune has joined hands with Tata Technologies for training school teachers in STEM pedagogy. This project will train ~220 school teachers to use activity-based teaching tools, over a period of 18 months and in two phases. The first phase has commenced in January, with teachers regularly attending workshops on teaching of various STEM topics and preparing science kits for using in their classroom.



(Left) Teachers trying their hand at experiments; (Right) Paper folding to learn mathematics at the Indrani Balan Science Activity 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 NCL Innovation Park) moved to IISER Pune in 2017. Since its inception, ESG has reached 17,000

students through popular science talks by leading researchers, conducted 230 weekly science clubs at selected PMC schools for over 1400 students, mentored 14 PMC and four other school students for national level innovation competitions and science fairs, and has conducted hands-on training workshops for over 1600 students.

In 2018–19, Exciting Science Group expanded the science club programme to eight schools, conducting sessions every weekend on campus. This programme, which culminated in a research idea competition, was attended by 160 students from Class IX. Over 2,200 students attended the monthly science talks and over 225 students attended hands-on science workshops. This year, the sixth edition of “ESG Science and Art competition” for Class V-X students received more than 350 entries. The Indian Science and Engineering (INSEF) Regional Fair organised by the ESG for the second consecutive year in partnership with Science Society of India got 67 entries of science, technology, and engineering projects from Class V-XII students.



(Left) 2200+ students participated in the monthly ESG Popular Science Talks organised in 2018–19; (Right) 300+ students participated in the “ESG Science & Art Competition”

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, a student run outreach organisation, is a platform for members of IISER Pune to contribute towards society. Disha works for making education accessible for children from underprivileged and marginalised communities from nearby localities through their programmes such as:

Abhyasikas or study sessions are held by student volunteers on weekday evenings at a nearby basti (Lamanvasti) to help ~30 local children from Class I-VIII with mathematics and language. Abhyasika students who showed a high interest in studies were enrolled in a new programme **Pradnya** to help them develop further by giving individual attention and creating a favourable study atmosphere.

The annual **Vigyan Mela** was held on April 13, 2019 to expose Abhyasika students to IISER Pune’s environment and motivate them to continue studying. This included a talk by Dr. Nishikant Subhedar, hands-on science experiments and sports.

Under the **Mindspark** (Class VII–VIII) and **Prerana** (Class XI–

XII) programmes, students are provided help with language and mathematics, in preparation for competitive exams. Thirty students from nearby municipal schools attend Mindspark sessions on weekends, while 20 students participate in Prerana. Three students from 2017 batch of Prerana scored around ~80 percentile in the recent JEE Mains, and two were selected for JEE Advanced.



Science Nurture Programme funded by MHRD's Rashtriya Avishkar Abhiyan, aims at popularising science among students from Class VIII and IX studying in municipal schools. In 2018–19, this programme reached 40 students, with events such as learning science through fun activities, making and presenting scientific models, and visits to other research institutes.

Continuing its annual activity of **Spread the Smile**, Disha volunteers visited nearby villages in January 2019 to interact with the community and conduct fun scientific activities and experiments, sky-watching, career guidance sessions, and more. Over three weekends, ~170 students from IISER Pune and other colleges visited seven villages around Pune in groups of 10 to 12 to carry out these sessions, which were attended by around 500 students.

Talk for Twenty, a platform for speakers to talk about topics they are passionate about, continued in 2018–19. There were talks on issues ranging from gender in popular culture, risks of Artificial Intelligence, feminism and law, inclusivity in education, and more.

A 5-day **camp for school students** was conducted at Chikhhalgaon, Ratnagiri by six Disha members, focusing on science beyond textbooks, critical thinking, and career guidance.

Disha also published its annual magazine **Pahal** for 2018 showcasing all its activities and events.

Prutha, a green initiative by IISER Pune students, works to create awareness about issues related to the environment and promotes a clean campus. In 2018–19, Prutha has continued many previous initiatives like Vastrasamman (clothes-donation drive), campus clean up drives, bird watching, nature walks and clean-up treks to nearby hills, paper sorting to reuse and recycle

waste paper, and creating environmental awareness through humour by displaying 'Ecotism' cartoons on digital notice boards. Prutha volunteers also contributed to the large-scale tree-plantation drive on campus. Other events included an awareness session on menstrual hygiene and eco-friendly options to sanitary pads and tampons; photography competitions on aesthetics of trash and campus biodiversity; and screening of the documentary – An Inconvenient Truth. Earth Hour was observed on March 30, 2019 to sensitise the IISER Pune community towards the environment. A talk by representatives from the Jeevitnadi Programme on restoration of the local Ramnadi river, which is adversely effected by pollution and encroachment of river land, was also organised.



04

Support Structure

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04





Dr. Pushkar Sohoni's book "The Architecture of a Deccan Sultanate" offers a nuanced socio-political analysis of the deccan sultanate.

Image Credit: Pushkar Sohoni

SUPPORT STRUCTURE AND FACILITIES

IISER Pune has set up institutional policies and procedures to facilitate smooth functioning of the Institute. 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 internal committees.

The internal 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 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 the 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 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.

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.

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 24,200 print books, 3000 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. Over 1270 print books and several online resources have been added to the collection during 2018–19. A large part of the journals and online resources' subscription is through 'IISER Library Consortium' and e-ShodhSindhu, a national consortium for higher education e-resources formed by Ministry of Human Resource Development (MHRD), Govt. of India. The library also facilitates the generation of similarity reports for theses and research publications through Turnitin, a plagiarism detection web tool. A Digital Repository (DR) has been set up to preserve and provide instant access to knowledge generated within IISER Pune. It covers full-text resources like faculty and students publications, theses, dissertations, etc. Metadata records of the repository are also integrated with National Digital Library of India.

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 145 faculty members (121 regular faculty members + 24 faculty fellows, independent scientists, and visiting faculty); 119 non-teaching staff members; 57 postdoctoral fellows; 1435 students (309 PhD, 189 Integrated PhD, and 937 BS-MS); and 135 research and management staff recruited through extramural projects. The numbers are as of March 31, 2019.

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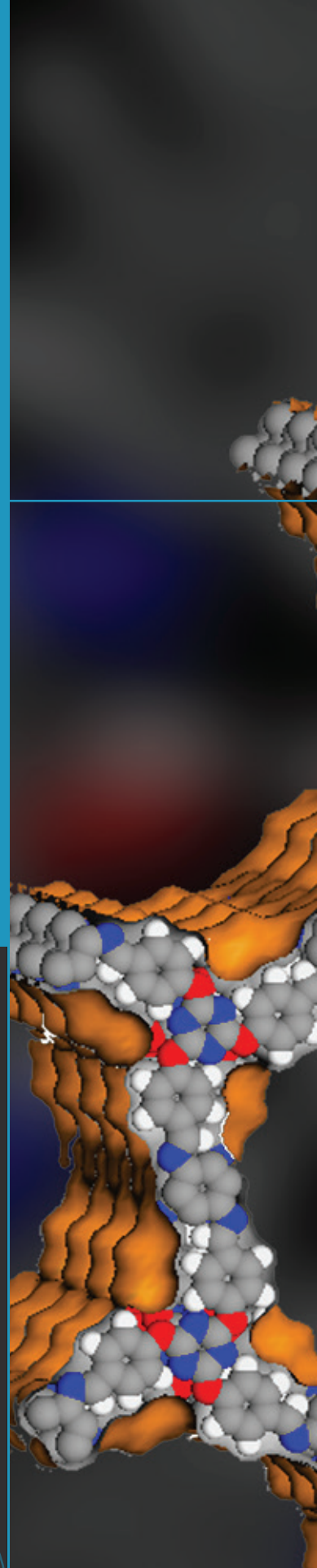
Accounts at a Glance

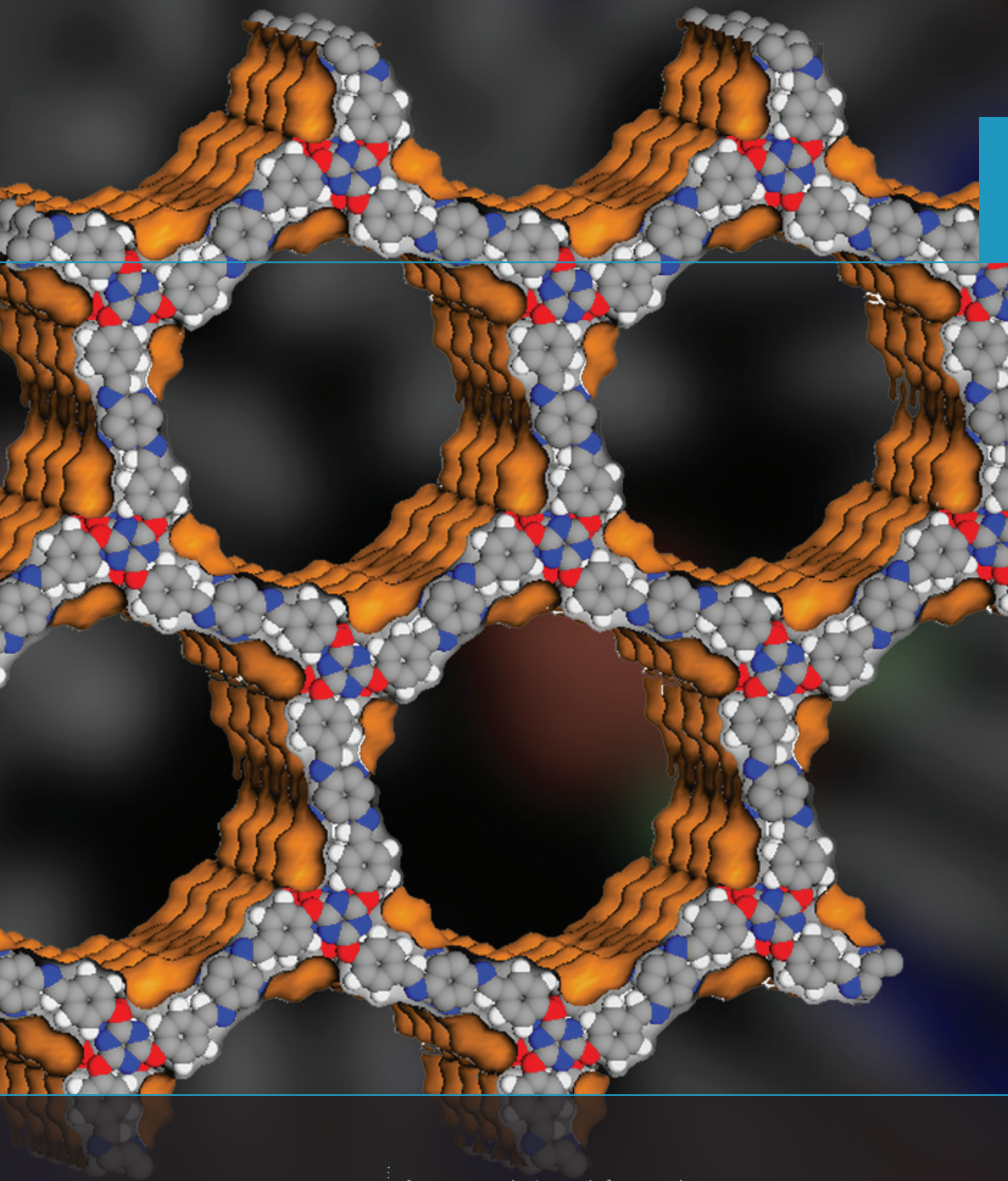
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121 / Balance Sheet

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05





A porous covalent organic framework

Image Credit: Dr. R. Vaidyanathan's Group

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 24, 2019. The annual audit for the Financial Year 2018–19 was carried out during June 10–28, 2019. The balance sheet and the income and expenditure statement for the Financial Year 2018–19 are given in the following pages.

FUNDS RECEIVED FROM MHRD

During the Financial Year 2018–19, IISER Pune received an amount of Rs. 94.85 crores from the MHRD under the budget heads revenue, capital, and salary. The break-up across the three budget heads is as below.



CORPUS FUND

The cumulative corpus fund as on March 31, 2019 from the Internal Revenue generated is Rs. 49.58 crores. The Institute generated an amount of Rs. 12.69 crores during the Financial Year 2018–19 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 2018–19, a total of Rs. 43.87 crores have been received by the Institute via extramural grants. New grants initiated during the Financial Year 2018–19 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 Infosys Foundation, the Balan Group, Bajaj Auto Ltd., Precision Wires Ltd., Cipla Foundation, Xytel India, Forbes Marshall Foundation, K.N. Krishnan Lecture Endowment, ONGC, Persistent Foundation, Eppendorf, Siemens, Tata Technologies, and IDEaS. The Institute has received an amount of Rs. 67.51 crores via endowments up to March 31, 2019.

BALANCE SHEET

as on March 31, 2019

Amount in ₹

Sources of Funds	Schedule	Current Year 2018-19	Previous Year 2017-18
Corpus/Capital Fund	1	6,29,46,63,458	5,47,35,21,215
Designated/Earmarked/Endowment Funds	2	14,64,60,231	38,42,13,045
Current Liabilities and Provisions	3	93,44,42,301	89,57,10,587
Total		7,37,55,65,989	6,75,34,44,847

Application of Funds	Schedule	Current Year 2018-19	Previous Year 2017-18
Fixed Assets	4		
Tangible Assets		5,59,38,72,936	4,85,44,62,448
Intangible Assets		4,30,27,552	23,68,445
Capital Works-In-Progress		16,19,89,076	25,79,26,871
Investments From Earmarked / Endowment Funds	5		
Long Term		-	-
Short Term		17,62,18,571	35,05,97,055
Investments - Others	6	93,19,10,094	66,95,69,875
Current Assets	7	17,85,32,480	19,07,89,954
Loans, Advances and Deposits	8	29,00,15,278	42,77,30,196
Total		7,37,55,65,989	6,75,34,44,847

Significant Accounting Policies 23

Contingent Liabilities and Notes to Accounts 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 06, 2019

INCOME AND EXPENDITURE STATEMENT

For the year ended March 31, 2019

Amount in ₹

Particulars	Schedule	Current Year 2018-19	Previous Year 2017-18
Income			
Academic Receipts	9	4,54,50,987	4,10,70,412
Grants/Subsidies	10	81,85,00,000	90,85,00,000
Income from Investments	11	2,14,09,747	1,12,90,121
Interest Earned	12	-	-
Other Income	13	5,97,97,059	5,15,98,680
Prior Period Income	14	2,03,011	1,86,831
Total (A)		94,53,60,804	1,01,26,46,044
Expenditure			
Staff Payments and Benefits (Establishment Expenses)	15	48,01,34,526	47,01,41,451
Academic Expenses	16	13,81,25,594	11,34,24,311
Administrative and General Expenses	17	24,41,54,099	29,18,11,577
Transportation Expenses	18	52,03,634	47,53,482
Repairs and Maintenance	19	4,98,63,643	5,64,77,348
Finance Costs	20	1,87,389	1,72,330
Depreciation	4	33,02,40,426	49,46,26,369
Other Expenses	21	69,62,230	76,32,113
Prior Period Expenses	22	22,99,699	1,10,04,103
Total (B)		1,25,71,71,240	1,45,00,43,084
Balance being excess of Income over Expenditure (A-B)		(31,18,10,436)	(43,73,97,040)
Less: Transfer to Designated Fund			
Others - Institute Reserve Fund (Sch 9 + Sch 13)		(10,52,48,046)	(9,26,69,092)
Transfer to Capital Fund (Depreciation)		33,02,40,426	49,46,26,369
Over Utilisation of Grant in Aid for Revenue Exps (Schedule 3C)		(8,68,18,056)	(3,54,39,763)
Under Utilisation of Grant in Aid for Revenue Exps (Schedule 3C)			
Significant Accounting Policies		23	
Contingent Liabilities and Notes to Accounts		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 06, 2019



Appendix

126 / Publications in 2018

143 / Invited Lectures

151 / Academic Events Organised

152 / New Extramural Grants Received





"Out of balance" – The Glaciology group at IISER Pune is studying the shrinking glaciers in the Himalaya.

Photo Credit: Glaciology Group, IISER Pune



BIOLOGY

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CHEMISTRY

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Addendum: Publications in 2018

The following publications were missed from the list shown on pages 126–142 of this report and these also do not appear in the original set of print copies. To rectify the inadvertent omission, the present Addendum has been included in the soft copy. Corresponding corrections to the numbers of publications have been incorporated on pages 9, 16, and 54 of this report.



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1. **Ahaley, S.S.** (2018). Synaptojanin regulates Hedgehog signalling by modulating phosphatidylinositol 4-phosphate levels. *Journal of Biosciences* 43 (5): 867–876.
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83. James, T. and **Subramanian, P.** (2018). Energetics of small electron acceleration episodes in the solar corona from radio noise storm observations. *Monthly Notices of the Royal Astronomical Society* 479 (2): 1603–1611.
84. Ansari, S.M., **Suryawanshi, S.R.,** More, M.A., Sen, D., Kolekar, Y.D., Ramana, C.V. (2018). Field emission properties of nano-structured cobalt ferrite (CoFe₂O₄) synthesized by low-temperature chemical method. *Chemical Physics Letters* 701: 151–156.

85. Das, A., Konar, P. and **Thalapillil, A.** (2018). Jet substructure shedding light on heavy Majorana neutrinos at the LHC. *Journal of High Energy Physics* 2018: 83.
 86. Korwar, M. and **Thalapillil, A.M.** (2018). Finite temperature Schwinger pair production in coexistent electric and magnetic fields. *Physical Review D* 98 (7): 076016.
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Invited Lectures

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

Nixon M. Abraham

Brain functions: How do we unravel the mysteries National Seminar on Advanced Functional Materials for Energy Production and Medicinal Applications, Christ College, Irinjalakuda, Kerala, July 27–28, 2018 • *Sniffing towards accurate decisions* IISER Thiruvananthapuram, July 12, 2018 • *Neural basis of behaviour* RGCB, Thiruvananthapuram, India, July 11, 2018 • *Interdisciplinarity in Neuroscience* Savitribai Phule Pune University, Pune, India, August 24, 2018 • *Olfaction: An ideal tool to study brain in health and disease* University of Heidelberg, Germany, December 10, 2018

Bijay Kumar Agarwalla

Quantum Thermodynamics and bounds National meeting on Quantum Condensed Matter (Q-Mat) Physics, IISER Mohali, July 25, 2018 • *Thermodynamic Uncertainty relation in Markovian and Non-Markovian Regime* Indian Statistical Physics Meeting, ICTS Bengaluru, February 15, 2019 • *Talk on Non-equilibrium Physics for small quantum systems: Transport and fluctuations in Non-Markovian regime* National University of Singapore, Singapore, August 29, 2018 • *Quantum Transport and thermodynamic uncertainty in Markovian and Non-Markovian regimes* Physics Department of Technical University (TU) Berlin, July 19, 2018 • *Quantum Thermodynamics in the Non-Markovian regime: transport, fluctuations and thermodynamic uncertainty relations* S N Bose National Centre for Basic Science (SNBNCBS), Kolkata, October 11, 2018 • *Out-of-equilibrium quantum systems: Fluctuation relations and bounds* Indian Institute for the Cultivation of Science (IACS), Kolkata, December 04, 2018 • *Talk on Engineered light-matter quantum systems* Max Planck Institute for the Science of Light, Germany, July 13, 2018 • *Thermodynamic Uncertainty relation in Non-Markovian Regime* Soft Matter and Statistical Mechanics Meeting, IISER Pune, January 04–05, 2019

G. Ambika

Time scales and topology on dynamics of complex networks IC2DN ISI, Kolkata, October 03–05, 2018 • *Degree weighted recurrence networks for the analysis of time series data* CNSD JNU, New Delhi, October 10–15, 2018 • *Geometry of Nature* DST INSPIRE Camp- KL University, Guntur, November 14, 2018 • *Fractals and their geometry* DST INSPIRE Camp, Loyola Degree College, Kadapa, Andhra Pradesh, December 09, 2018 • *Complex network measures and Dynamics of stars from light curves* University of Melbourne, Melbourne, Australia, January 29, 2019 • *Multiple Time scale phenomena on complex networks* ISPCM-ICTS, Bengaluru, February 14–16, 2019 • *Science Day Lecture*, Annamacharya Institute of Technology and Science, Kadapa, Andhra Pradesh, February 27, 2019

Sudarshan Ananth

Gravitation and quadratic forms Max Planck Institute for Gravitational Physics, Potsdam, Germany, December 2018 • *Hidden symmetries in quantum gravity* International Workshop on Exceptional Quantum Gravity, Palma de Mallorca, Spain, April 2018

Collins Assisi

Mechanisms of sequence generation in spatial navigation Bengaluru Cognition Workshop, CNS, Indian Institute of Science, Bengaluru, June 2018 • *Mechanisms of sequence generation in spatial navigation* Computational and Mathematical Approaches to Plasticity, NCBS, Bengaluru, July 2018 • *A theoretical perspective on the coding capacity of olfactory networks* Understanding Behavior, IISER Kolkata, February 2019 • *Patterns in inhibitory networks* Saturday lecture series, Center for Modeling and Simulation, Savitribai Phule Pune University, March 2019

Chaitanya Athale

Cellular Nanoscience Lab, Centre for Molecular Biology of Plants (ZMBP), University of Tuebingen, Germany, March 25, 2019

Nagaraj Balasubramanian

Cell adhesion and cancer. What we know and what we don't National Conference on Cellular and molecular basis of cancer: Molecules to

mechanisms (CMBC-2019) Pune, February 07–09, 2019 • *Online tools in teaching* Second Induction Programme organised by Centre of Excellence in Science and Mathematics Teaching (CoESME), IISER Pune under MHRD's Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNMTT), December 12, 2018

Baskar Balasubramanyam

Special values of Asai L-functions IISER Tirupati, November 15, 2018; Number Theory Day, IISER Pune, January 13, 2019; Algebra Seminar, Indian Institute of Technology Madras, March 12, 2019 • *Iwasawa theory and p-adic automorphic forms* Conference in Shanghai Centre for Mathematical Sciences, December 12, 2018

Nirmalya Ballav

Capturing interesting interfacial effects at solid-solid and solid-liquid interfaces IISER Bhopal, July 09, 2018 • *Graphene-Based supercapacitors* Energy Day 2018, IISER Pune, July 27, 2018 • *Capturing interfacial effects at solid-solid and solid-liquid interfaces* Indian Institute of Technology Delhi, November 14, 2018 • *Exploring solid-liquid and solid-solid interfaces: How interesting interface is?* INST Mohali, November 28, 2018 • *Capturing interesting interfacial effects at solid-liquid and solid-solid interfaces*, FICS 2018, Indian Institute of Technology Guwahati, December 06, 2018 • *Conducting polymer guest in porous coordination polymer host* SPSP-MACRO 2018, December 21, 2018 • *Chemically derived reduced graphene oxide for energy applications* RMC 2019, Savitribai Phule Pune University, February 14, 2019 • *High-level supercapacitive performance of chemically derived reduced graphene oxide*, IMC-MRSI-AGM 2019, February 15, 2019

Argha Banerjee

Dynamic glaciers and the Himalaya Indian Institute of Technology Gandhinagar, March 18, 2019

Debargha Banerjee

Arithmetic self-intersection numbers Number Theory Seminar, Sorbonne University, Paris, April 2018 • *Eisenstein cycles for Bianchi modular forms* Conference on p-adic Automorphic Forms and Iwasawa Theory, Fudan University, Shanghai, China, December 11–15, 2018 • *Eisenstein cycles and Manin-Drinfeld property* International Conference on Number Theory, IISER Thiruvananthapuram, March 2019 • *Generalized Ogg's conjecture* Indian Statistical Institute, Kolkata

Deepak Barua

Fast-and-furious vs. slow-and-steady: Resource use strategies in tropical trees Symposium on Evolutionary Biology, Indian Institute of Technology Bombay, March 03, 2019 • *Plants and people: Shared history and joint futures* Evolution and Society Lecture Series, Society for Indian Evolutionary Biology, IISER Pune, January 25, 2019 • *Tropical forest responses to global warming* Kerala Forest Research Institute (KFRI), Peechi, Kerala, January 07, 2019 • *The upper thermal limits of plant function* Plant Ecology and Ecophysiology - India Workshop (PEEP-In), Sirsi, Karnataka, India, September 17–22, 2018 • *The biological impacts of global warming* Online video lecture for orientation course on Climate Change for higher education faculty, NRC, IISER Pune, SWAYAM, October 2018

Rabeya Basu

Three lectures & three tutorials at "AIS School on Projective Modules", Indian Institute of Technology Bombay, May 2018 • *Algebra and Lie theory* Conference UHA, Mulhouse, France, June 20–23, 2018 • Seminar: ISI Delhi, September 03, 2018 • Seminar: Chebyshev Laboratory, St. Petersburg State University, Russia, September 12, 2018 • Seminar: ICTS Bengaluru, December 19, 2018

Mousomi Bhakta

Introduction to nonlocal elliptic equations Regional Conference of Indian Women and Mathematics (IWM), TIFR-HBCSE, Mumbai, February 2019 • *Boundary value problems with measure for nonlocal elliptic equations* Indian Institute of Technology Gandhinagar, Ahmedabad, October 2019 • *Dynamical systems and differential equations, Nonlocal scalar field*

equations 12th AIMS Conference Taipei, Taiwan, July 5–9, 2018 • *Nonlocal scalar field equations* Masaryk University, Brno, Czech Republic, May 2018

Rajeev Bhalariao

The Big Bang and the Little Bang --- The hot stuff Workshop on Particle Phenomenology, Thapar Amateur Astronomers Society (TAAS), Thapar Institute of Engineering and Technology, Patiala, January 06, 2019

Arijit Bhattacharyay

Brownian motion with coordinate dependent diffusivity and damping Conference on Soft Matter and Statistical Mechanics – 2019, IISER Pune, January 04–05, 2019

Anup Biswas

40th Conference Stochastic processes and their applications, Sweden, June 11–15, 2018 • IMS Asia Pacific Rim Meeting 2018, Singapore, June 26–29, 2018

R. Boomi Shankar

Ferroelectric materials derived from p(v) scaffolds for potential mechanical energy harvesting Energy Day, IISER Pune, July 27, 2018 • *Ferroelectric metal-organic materials from amino-P(V) ligands* 43rd International Conference on Coordination Chemistry (ICCC 2018), Sendai International Centre, Sendai, Japan, July 31 – August 04, 2018 • *Molecular ferroelectric materials from organo-phosphorus (V) Scaffolds*, Chemistry and Physics of Advanced Materials-III IISER Pune, October 09–10, 2018 • *Ferroelectric materials from amino-phosphorus (v) scaffolds, main group molecules to materials* Indian Institute of Science, Bengaluru, October 29–31, 2018 • *Imido-P(V) trianion supported enantiopure neutral tetrahedral Pd(II) cages* National Symposium on Emerging Trends in Chemical Sciences (NSETCS-2018), Banaras Hindu University, November 17–18, 2018 • *Ferroelectric organic and metal-organic materials derived from P(V) scaffolds* Frontiers in Chemical Science-2018, Indian Institute of Technology Guwahati, December 06–08, 2018 • *Organic and organo-inorganic hybrid ferroelectric materials supported by amino-phosphorus (V) scaffolds* MRSI-AGM, 1st Indian Materials Conclave: Multiferroic Materials, Indian Institute of Science, Bengaluru, February 12–16, 2019

S. Sandanaraj Britto

Rational design of stimuli-responsive supramolecular protein complexes SPSI Macro Conference 2018, Pune, December 21, 2018; Novartis Institutes for Biomedical Research, Inc, Cambridge, U.S.A., November 02, 2018; Takeda Pharmaceuticals, Inc, Cambridge, Massachusetts, U.S.A., November 01, 2018; Chemical Engineering Department – NCL Pune, September 29, 2018 • *Novel chemical technologies for applications in the area of functional protein nanotechnology and molecular imaging* Department of Chemistry, University of Massachusetts, Amherst, October 30, 2018 • *Accurate design of next generation supramolecular protein assemblies with advanced functions* Spinco Biotech Pvt Ltd, Chennai, August 28, 2018

Harinath Chakrapani

Redox chemical tools to interrogate host-pathogen interactions IISER-WIS Conference on Chemical Biology, Pune, January 17–19, 2018 • *Redox-guided antibiotic discovery* National Conference on Chemical Science: An Interdisciplinary Approach, Modern College, Pune, January 18, 2018 • *Controlled fragmentation of organosulfur compounds* Kaleidoscope: A Discussion Meeting in Chemistry, International Centre, Goa, July 05–08, 2018 • *Redox chemical biology tools to understand antibiotic resistance* Chemical Frontiers, 2018 Goa, August 19–22, 2018 • *Redox-based chemical tools to interrogate antibiotic resistance* Indo-German Chemistry Meeting INST Mohali, Punjab and Kasauli, Himachal Pradesh, October 04–07, 2018 • *Redox-guided chemical probes to address antibiotic resistance* Chemistry and Physics of Advanced Materials – III IISER Pune-Temple University Meeting, October 08–09, 2018 • *The many facets of oxygen in life* Simply Science Lecture Series, British Council, Pune, August 08, 2018 • *Strategies towards addressing antibiotic resistance* Alard College of Pharmacy, Pune, January 12, 2019

Apratim Chatterji

Bacterial chromosome organization: Few special cross-links, cell confinement, and molecular crowders play the pivotal roles, SPSI-Macro, IISER Pune, December 19–22, 2018

Srabanti Chaudhury

Non-equilibrium effects of polymer translocation through a nanopore iConChem 2018, IISER Tirupati, May 24–26, 2018 • *Role of polymer-pore interactions in translocation* SPSI-Macro 2018, IISER Pune, December 19–22, 2018 • *Multiscale simulation and mathematical modeling of complex biological systems* JNU Delhi, January 30 – February 01, 2019 • *Non-equilibrium effects of polymer translocation through a nanopore* Theoretical Chemistry Symposium, BITS Pilani, February 13–16, 2019

Anisa Chorwadwala

A glimpse of shape optimisation problems Department of Mathematics, University of Lucknow, Lucknow, February 11, 2019 • **3** lectures on *Classical surface theory* National Workshop on Glimpses of Differential Geometry, Department of Mathematics, Central University of Kerala, January 30 – February 02, 2019 • Panel Member *Bridging the gap between school and college mathematics* Inaugural Conference of Mathematics Teachers' Association – India, Homi Bhabha Centre for Science Education, January 03–05, 2019 • *Why are soap bubbles approximately spherical?* Under the banner of Higher Studies in Mathematics and Statistics, Department of Mathematics and Statistics, R.D. & S.H. National College and S.W.A. Science College, Mumbai, September 29, 2018 • *An eigenvalue optimisation problem* Departamento de Matemática, Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción, Chile, August 31, 2018; Topology/Geometry session of the Inter IISER-NISER Mathematical Meeting (IINMM) 2018, IISER Bhopal, July 07–08, 2018; Discussion Meeting on Symmetry Questions for Elliptic Eigenvalue Problems, TIFR-CAM, Bengaluru, July 05, 2018 • *Another eigenvalue optimisation problem* in ICM 2018, Rio de Janeiro, Brazil, August 02, 2018

Jeetender Chugh

The dynamical basis of shape-dependent dsRNA-recognition by dsRNA-binding domains DBT National Symposium on Applied Spectroscopy: Biology and Medical Science, Udai Pratap College, Varanasi, February 18–20, 2019; Conference on Magnetic Resonance in Medicine and 25th National Magnetic Resonance Society Meeting, Indian National Science Academy (INSA), New Delhi, February 13–16, 2019 • *NMR based metabolic signatures in glucotoxic, lipotoxic, and glucolipotoxic stresses in pancreatic beta cells* Advanced Omics Technologies & Approaches, Orchid Hotel, Mumbai, India, January 17–18, 2019 • *Dynamical modes in RNA binding protein allow for shape-dependent RNA recognition* 4th NMR Meets Biology Meeting, Khajuraho, India, December 16–21, 2018 • *SSC program, IISER Pune and RNA-Protein interactions* 1st Sakura Science Club Alumni Meeting, Embassy of Japan, India, October 05, 2018 • Resource Person *Applications of NMR in drug-design/discovery* Refresher Course in Natural Sciences, Department of Botany, Savitribai Phule Pune University, August 16 – September 05, 2018 • *Understanding the complexity of ligand binding interactions prevailing in protein-RNA complexes* Expanding Horizons of NMR, TIFR Mumbai, May 12, 2018

Aloke Das

Session Chair, 16th Discussion Meeting Spectroscopy and Dynamics of Molecules and Clusters, Koti Resorts, Shimla, February 21–24, 2019 • *Water mediated Selenium hydrogen bonding interactions in proteins: PDB analysis and gas phase spectroscopy of model complexes* National Symposium on Radiation and Photochemistry (NSRP) 2019, Visva-Bharati University, Bolpur, West Bengal, February 07–09, 2019 • *Exploring $n \rightarrow \pi^*$ interaction in the monomeric building block of collagen* Interdisciplinary Explorations in Chemistry (I-DEC 2018), IISER Bhopal, December 06–08, 2018

Rahul Dehiya

3D inversion of marine controlled-source electromagnetic data 40th Annual Convention, Seminar and Exhibition, Association of Exploration Geophysicists, Indian Institute of Technology Bombay, Mumbai, November 02, 2018

Aparna Deshpande

Influencing topological insulator surface with metal phthalocyanine molecules ICCFM 2018, Kolkata, December 16, 2018 • *On-surface molecular doping – a nanoscale perspective* Physics Department, Indian Institute of Technology Kanpur, January 04, 2019 • *Exploring topological insulator surface state upon molecular doping* March Meeting, JNU, March

09, 2019

Sutirth Dey

Is this how it feels to be like a rolling stone? Interdisciplinary approach to Science Research and Innovation Savitribai Phule Pune University, August 17, 2018 • *Biostatistics for beginners Interdisciplinary approach to Science Research and Innovation*, Savitribai Phule Pune University, August 17, 2018 • *Evolution of dispersal: The Drosophila story* Indo-Swiss Collaboration Primer in Evolution and Ecology, University of Zurich, September 08–20, 2018 • *Evolution of dispersal: The Drosophila story; Research methodology* DBT-sponsored invited lecture, New Science College, Ahmednagar, January 19, 2019 • *Evolutionary theory in the modern era* Seminar Series, Understanding Evolution: In Biology and Beyond, MES Boy's High School, Pune, February 01, 2019

Deepak Dhar

Simple models of complex systems Physics Day, IISER Pune, April 08, 2018 • *Phase transitions in a 1-d model of hard rods* IISER Mohali, May 16, 2018 • *Some points to ponder* Induction Programme for College Teachers, Center for Excellence in Science and Mathematics Education, IISER Pune, May 26, 2018 • *Self-organized Criticality* 3 lectures at National Summer School in Statistical Physics, S.N. Bose National Center for Basic Sciences, Kolkata, June 04–15, 2018 • *Polymers in random media* Mumbai-Pune area Soft-matter Meeting, National Chemical Labs, Pune, June 23, 2018 • *Phase transitions in hard-core models* Course of 6 lectures in the summer school "The Collective Behavior of Quantum Matter", International Center for Theoretical Physics, Trieste, August 27–September 14, 2018 • *Phase transitions in a model of hard rods* Institute Josef Stefan, Ljubljana, September 04, 2018 • *Co-action Minority games* Course of 8 lectures in the School Lectures in Probability and Statistics XIII, Indian Statistical Institute, Bengaluru, December 07–11, 2018 • *Polymers in random media* Puri Polymer Meeting 2018, Puri, December 12–14, 2018 • *States of Matter* J.L. Nehru Planetarium, Bengaluru, under the program 'Kaapi with Curiosity' run by ICTS-TIFR, December 09, 2018 • *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* ICTS, Bengaluru, February 07, 2019 • *Self-organized criticality* Course of 9 lectures for Spring College on the Physics of Complex Systems, ICTP, Trieste, February 24–March 08, 2019

Sourabh Dube

Rocking the seesaw at CMS Colloquium, NISER Bhubaneswar, April 02, 2018 • *Experimental particle physics* DST-INSPIRE Camp, Millennium National School, Karvenagar, Pune, January 09, 2019 • *Fundamental particles and finding them* Learn AC Seminar Series, February 24, 2019 • Invitations as Chief Guest at Events: Dabke Trust Scholarship for PG dissertations, April 26, 2018; Unveiling the Cosmos, Exhibition by AstroClub, Fergusson College, Pune, September 04, 2018; WE-GYAN an Inter-Collegiate Exhibition and Competition, Marathwada Mitra Mandal College, December 22, 2018

Suhas Ettammal

Characterizing mixed Rossby Gravity waves under different background conditions Cochin University of Science and Technology (CUSAT), Kochi, Kerala, February 22, 2019

G.V. Pavan Kumar

Physics Day, Experimental Physics, April 08, 2018 • *Soft plasmonics* Dijon, France, June 22, 2018 • *Thermoplasmonics* P. Island, France, June 29, 2018 • *Nanophotonics and Energy* IISER Pune, July 27, 2018 • Experimental Physics, CoEP, Pune, September 30, 2018 • *Soft plasmonics* Compflu, Indian Institute of Technology Roorkee, December 06, 2019 • *Soft plasmonics* Global Nanophotonics, TIFR Mumbai, December 11, 2018 • IUCAA Public Lecture for Science Day, Pune, Nobel Prize in 2018, February 28, 2019

Debdip Ganguly

On the equivalence of Heat Kernels Conference at the Department of Mathematics, Politecnico Di Torino, Italy, June 22, 2018; PDE and Applied Mathematics Seminar, Department of Mathematics, Technion Israel, May 29, 2018

Aurnab Ghose

Formin'-links between the actin and microtubule cytoskeletons: Implications for neuronal pathfinding NISER, Bhubaneswar, April 14, 2018 • *A nose for food: Sensory gating of olfaction by nutritional states* Indian Zebrafish Investigators Meeting 2018 (iZIM2018) CCMB, Hyderabad, June 03, 2018 • *How to wire up the nervous system*, *Interdisciplinary approach to science research and innovation* Savitribai Phule Pune University, Pune, March 2018 • *Mechanics of wiring up the brain* Lecture workshop on Neuroscience, IWSA, Mumbai, India, August 03, 2018 • *Cytoskeletal dynamics in neurons* Science Club and Maharashtra Biotech Day Lecture, IBB, Savitribai Phule Pune University, Pune, November 03, 2018 • *Fmn2 in neuronal remodelling: Coordinating actin and microtubule cross-talk* EMBO Workshop Mechanisms of Neuronal Remodelling Ein-Gedi, Israel, December 10, 2018 • *Introduction to behavioural analysis in zebrafish* Lady Tata Memorial Trust Workshop, Sophia College, Mumbai, January 19, 2019 • *Wiring up the brain with Formin-2* IISER Mohali, India, February 01, 2019 • *Wiring up the brain with Formin-2: Adhesion stability and actin-microtubule crosstalk* Mechano-developmental Biology Meeting, Orange County, Coorg, India, March 02, 2019 • *Evolution of nervous systems and behaviour* Evolution and Society Series, IISER Pune, March 15, 2019

Diptimoy Ghosh

B-meson charged current anomalies - Theoretical status Korea Advanced Institute of Science and Technology (KAIST), South Korea, February 21, 2019 • *Beyond the Standard Model interpretations of R_D and R_{D^*}* Workshop on LHCb and Belle II Opportunities for Model Builders, Mainz Institute for Theoretical Physics, Germany, January 28, 2019

Prasenjit Ghosh

Atomistic modelling of materials National Institute for Material Science, Tsukuba, Japan, May 14, 2018 • *Hydrogen production and purification: What can we learn from theory?* Energy Day 2018, IISER Pune, July 27, 2018 • *Modelling solid-liquid interfaces* Energy Translation Technology Summit, Shell Technology Centre, Bengaluru, September 05–06, 2018 • *Membrane based hydrogen purification: Microscopic understanding of hydrogen permeation through a model PdCu membrane* EESTER 2018, SRMIST and Indian Institute of Technology Madras, September 11–15, 2018 • *Modelling solid-liquid interfaces* Indo-UK School on Modelling and Simulations of Materials for Energy and Environment, JNCASR, Bengaluru, India, December 12–14, 2018 • *Descriptors for predicting efficient dye-sensitized semiconductor photocatalysts for hydrogen evolution reaction* National Conference on Electronic Structure, 2018, SRMIST, Kancheepuram District, Tamil Nadu, December 17–19, 2018

Sujit K. Ghosh

Water-stable Metal–Organic Frameworks (MOFs) for sensing applications Dr. A.V. Rama Rao Young Scientist Award-2018 Lecture, IICT Hyderabad, India, May 11, 2018 • *Functional Metal–Organic Frameworks (MOFs) for sensing and sequestration of environmental pollutants 43rd* International Conference on Coordination Chemistry (ICCC 2018), Sendai, Japan, July 30 – August 04, 2018 • *Water-stable Metal–Organic Frameworks (MOFs) for sensing and sequestration of environmental pollutants* International Symposium of Advanced Functional Materials, IISER Thiruvananthapuram, India, July 12–14, 2018 • *Functional Metal–Organic Frameworks (MOFs) for sensing and sequestration of environmental pollutants* Metal-Organic Frameworks and Open Framework Compounds (MOF2018), Auckland, New Zealand, December 09–13, 2018

Sreejith G.J.

Temporal order in periodically driven spins in small NMR spin clusters American Physical Society March Meeting 2019, Boston, U.S.A., March 07, 2019 • *Exact local hamiltonians for general fractional quantum hall states* Topological Aspects of Quantum Matter, TIFR, Mumbai, December 17, 2018; Seminar, Harishchandra Research Institute, Allahabad, December 27, 2018; Young Investigator Meet on Quantum Condensed Matter Theory, SN Bose Institute, Kolkata, November 22, 2018; National Conference on Quantum Condensed Matter, IISER Mohali, July 26, 2018 • *Variational wavefunctions for FQH states: New results* Department of Atomic Energy - Solid State Physics Symposium, Hisar, Haryana, December 21, 2018 • *Chaos and fractals* Lecture as a part of a course on science and the arts, Symbiosis School for Liberal Arts, Pune, October 23, 2018 • *Crystal symmetries, tessellations and M C Escher* Lecture as a part of a course on science and the arts, Symbiosis School for Liberal Arts, Pune, October

23, 2018

Boopathy Gnanaprakasam

Enabling rapid and safer C-H functionalization through continuous-flow chemistry Chemsymphoria 2018, IISER Pune, July 12–13, 2018 • *C-H bond functionalization and molecular rearrangement using batch/continuous flow mode* Pondicherry University, Pondicherry, February 14, 2019 • *A modern approach to sustainable chemical transformations using continuous-flow technology* National Seminar on Recent Trends in Sustainable Chemical Transformations, Krishnaswamy College of Science, Arts and Management, Cuddalore, February 14, 2019

Anindya Goswami

Recent development in derivative pricing in regime switching market Inter IISER-NISER Math Meet 2018, IISER Bhopal, July 05, 2018 • *Optimization in finance* Conference on Statistical Methods in Finance, CMI, Chennai, December 17, 2018

Amrita Hazra

The molecular basis and consequences of nucleobase specificity Kaleidoscope: A Discussion Meeting in Chemistry, International Center, Goa, July 05–08, 2018 • *The molecular basis of nucleobase selectivity in flavin biosynthesis* West Coast Bacterial Physiologists Conference, Asilomar, CA, U.S.A., December 14–16, 2018 • *Why we eat what we eat* National Science Day, Adarsh Balak Mandir High School, Urur Islampur, India, February 28, 2019

Anirban Hazra

Understanding photo-isomerization of ortho-nitrotoluene, a model for photo-labile caged compounds Indian Institute of Science, Bengaluru, April 13, 2018 • *How to think like a scientist?* Summer Camp for students, IISER Pune, April 21, 2018 • *Flipped classroom* Induction programme for newly recruited college teachers, Centre of Excellence in Science and Mathematics Teaching, IISER Pune, May 10, 2018; November 21, 2018 • *Solvation driven keto to enol tautomerization of the prebiotic nucleobase barbituric acid* Chemistry and Physics of Advanced Materials - III, IISER Pune, October 08–09, 2018 • *What's behind every change that happens in nature?* British Council Library Pune, October 12, 2018 • *Tautomerization and photophysics of barbituric acid, a prebiotic nucleobase* Spectroscopy and Dynamics of Molecules and Clusters (SDMC), Shimla, February 21–24, 2019

Partha Hazra

Establishing structure-property relationship of solid state multi-stimuli responsive materials and activation of centrosymmetrically packed organic luminogens to external stimuli 4th International Conference on Aggregation Induced Emission, Adelaide, Australia, January 20–26, 2019 • *Establishing structure-property relationship of solid state multi-stimuli responsive materials and activation of centrosymmetrically packed organic luminogens to external stimuli* Chemistry and Physics of Advanced Materials – III Meet, IISER Pune, October 08–09, 2019 • *Fluorescence spectroscopy* Department of Biotechnology, Savitribai Phule Pune University, November 01, 2018

Mukul Kabir

Gate-dependent vacancy diffusion in graphene Oxford Materials, University of Oxford, June 01, 2018 • *Kondo screening in two-dimensional semiconducting phosphorene?* Department of Materials, Imperial College, United Kingdom, June 11, 2018 • *Vacancy diffusion in graphene* Nano-Micro Conference, Jeju Island, South Korea, December 17–20, 2018 • *Defect magnetism in graphene* Recent Trends in Condensed Matter Physics: Theory and Experiment, Indian Association for the Cultivation of Science, Kolkata, January 05, 2019 • *Phosphorene as two-dimensional photocatalyst?* First Indian Materials Conclave, Indian Institute of Science, Bengaluru, February 12–15, 2019 • *Ferromagnetism in nitrogen-doped graphene* Workshop and Symposium on Advanced Simulation Methods: DFT, MD and Beyond, Indian Institute of Technology Delhi, March 06–10, 2019

Tejas Kalelkar

Taut foliations in compact 3-dimensional manifolds with constrained boundary slopes Colloquium, Tokyo University of Science, Japan, June 01, 2018 • *Taut foliations of 3-manifolds* Inter IISER NISER Math Meet, IISER

Bhopal, July 08, 2018 • *Taut foliations in compact 3-manifolds* Diamond Jubilee Symposium, Indian Institute of Technology Bombay, January 04, 2019

Siddhesh S. Kamat

Enzyme function annotation using an integrated chemical proteomics and metabolomics approach 10th Annual Proteomics Society of India Meeting, NCCS Pune, December 13, 2018 • *Indo-US workshop Understanding cell biology through proteomics and metabolomics* NCCS Pune, December 11, 2018

Krishanpal Karmodiya

Next Generation Sequencing and personalised medicine National Conference on Innovations in Health Care, Dr. D.Y. Patil University, Navi Mumbai, September 28, 2018 • *Transcriptional regulation of drug resistance generation in P. falciparum* International Symposium on Malaria Biology, School of Life Sciences, University of Hyderabad, November 01–03, 2018 • *Transcriptional regulation of the stress responses and artemisinin-resistance in Plasmodium falciparum* Recent trends in Biology, Department of Zoology, Savitribai Phule Pune University, March 08–09, 2019

Shabana Khan

Chemical Frontiers-2018, Goa, August 19–22, 2018 • *International Conference Phosphorus, Boron and Silicon*, PBSi-2018, Barcelona, December 10–12, 2018 • *Main Group Molecules to Materials (MMM)*, Indian Institute of Science, Bengaluru, October 28–31, 2018 • *Diamond Jubilee Chemistry Symposium*, Indian Institute of Technology Bombay, February 25–28, 2019

Anand Krishnan

Acoustic niches in Asian Birds 13th Western Pacific Acoustics Conference, New Delhi, India, November 11–15, 2018

Mayurika Lahiri

DNA-dependent protein kinase plays a central role in transformation of breast epithelial cells following alkylation damage Indo-Canada-Israel Joint Conference, Phenotypic Heterogeneity as a Driver of Cancer Progression, Indian Institute of Science, Bengaluru, India, January 05–08, 2019; 7th International Conference Molecular Signalling (ICMS 2019), Department of Zoology, Savitribai Phule Pune University (SPPU) and National Center for Cell Science (NCCS), Pune, India, January 23–25, 2019; *National Conference on Cellular and Molecular Basis of Cancer: Molecules to Mechanisms*, Department of Biotechnology, Savitribai Phule Pune University, Pune, India, February 07–09, 2019

Moumita Majumdar

Germanium chemistry: From molecules to materials 1st International Symposium Main-Group Molecules to Materials, Indian Institute of Science, Bengaluru, October 29, 2018 • *Germanium chemistry: Catalysis and energy applications* International Conference on Organometallics and Catalysis, Goa, December 14, 2018 • *Genial Germanium and Tin tweaks for catalysis and energy applications* International Conference on Structural and Inorganic Chemistry-II, Pune, March 19, 2019

Vivek Mohan Mallick

Multifiltrations Inter IISER-NISER Math Meet, IISER Bhopal, July 07, 2018 • *Nonsingular algebraic varieties* AIS School on Basic Algebraic Geometry, IISER Pune, July 09–14, 2018

Manish Mishra

Seminar, Ramakrishna Mission Vivekananda Educational and Research Institute, Kolkata, March 2019 • *Self-dual cuspidal representations* Mumbai-Pune Number Theory Seminar, IISER Pune, September 2018; ISI, Bengaluru, September 2018

Arnab Mukherjee

Probing viscosity dependence of rate: Internal friction or the lack of friction? Kaleidoscope, Goa, July 05–08, 2018 • *Predicting DNA structure from its sequence using base-step free energy and machine learning* Biophysics Paschim, ARCTREC, Mumbai, December 16, 2018 • *Internal friction or just the memory effect? Investigating the viscosity dependence of rate using model systems* Theoretical Chemistry Conference (TCS), BITS-

Pilani, Pilani, February 12–16, 2019 • *Understanding internal friction using simple model systems* Dynamics at the Interface of Chemistry and Biology (DICB-2019), SSCU, Indian Institute of Science, Bengaluru, February 18–20, 2019 • *Understanding internal friction in protein folding using simple model systems* Peptide Society Conference, BITS-Pilani, Hyderabad, February 27–28, 2018 • *DNA structure from its sequence using base-step free energy and machine learning* Advanced Simulation Method, Indian Institute of Technology Delhi, March 08–10, 2019 • *Metadynamics* Free Energy Workshop, Indian Institute of Technology Kanpur, March 23, 2019

Sunil Mukhi

Technical Talks: *Exotic rational CFT and the modular bootstrap* King's College London, May 16, 2018; Oxford University, May 12, 2018; Queen Mary College London, May 30, 2018 • *Holomorphic bootstrap for rational CFT in 2D* Yukawa Institute for Theoretical Physics, Kyoto University, Kyoto, Japan, July 05, 2018 • *Classification and solution of rational conformal field theories* IBS Symposium: Quantum Field Theory, String Theory and M-Theory: A Perspective on the Future, Seoul, August 09, 2018 • *Fermions on replica geometries and theta-theta relations* International Workshop on Arithmetic Geometry and Quantum Field Theory, KIAS, Seoul, August 12, 2018 • *Classification of rational conformal field theories in 2D* NISER, Bhubaneswar, October 04, 2018 • *Curiosities above $c=24$* Indian Strings Meeting, IISER Thiruvananthapuram, December 17, 2018 • *Conference summary and perspectives* Indian Strings Meeting, IISER Thiruvananthapuram, December 21, 2018 • *Towards a classification of conformal field theories with two characters* IMSc Chennai, February 11 and 12, 2019 • *New results in the rational modular bootstrap* Workshop on String Theory and Quantum Field Theory, Fudan University, Shanghai, March 11, 2019; Workshop on String Theory and Cosmology, NISER Bhubaneswar, March 30, 2019

Non-technical/Policy/Popular Talks: *The sum of it all* Physics Day, IISER Pune, April 08, 2018 • *Publication ethics and research integrity* Taylor and Francis Focus Group, New Delhi, April 13, 2018 • *Current trends in physics* MIT Academy of Engineering, Alandi, October 10, 2018 • *String theory and the experiments that led to it* NISER Bhubaneswar; October 05, 2018; IISER Pune, November 12, 2018; Ashoka University, January 23, 2019 • *Let's not lose our temper! The value of science* BITS Pilani, Hyderabad, February 28, 2019

Muhammed Musthafa

Advanced energy systems for defence applications Naval Materials Research Laboratory, Mumbai, March 13, 2019 • National Conference on Recent Trends in Chemistry and Materials Science (RTCMS-2019), Shivaji University, Kolhapur, February 09, 2019 • International Conference on Advances in Materials Science & Applied Biology (AMSAB), SVKM's, NMIMS (Deemed-to-be University) Mumbai, India, January 08–10, 2019 • Indo-UK workshop on Electrochemical Routes to Energy Storage/ Conversion and Fuel Production, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bengaluru, India, December 10–13, 2018

Suhita Nadkarni

Multiple lives of calcium in synaptic transmission and plasticity: In silico experiments on small hippocampal synapses From synapses to memory: RNA based regulatory mechanisms, India EMBO symposium, NBRC, October 15–18, 2018 • *Lectures on synaptic transmission and synaptic plasticity in computational approaches to memory and plasticity* National Center for Biological Science, Bengaluru, July 20, 2018 • *Mechanisms of memory* Brain Camp, targeted at 10th–12th graders, Sophia College, Mumbai, September 2018 • *Eavesdropping on the chitter-chatter in the brain* Vigyan Jyoti – a Basic Science and Engineering Camp for High School Girls, Department of Science and Technology, Government of India, Indian Institute of Technology Bombay, May 2018

Angshuman Nag

B-site doping in perovskite nanocrystals Kaleidoscope: A Discussion Meeting in Chemistry, Goa, July 05–08, 2018; Colloidal Semiconductor Nanocrystals, Gordon Conference, Bryant University, U.S.A., July 15–19, 2018; Duke University, U.S.A., July 20, 2018; IISER Pune Energy Conference, IISER Pune, July 28, 2018 • *Pb-free metal halide perovskite nanocrystals* International Seminar on Advanced Materials Research (ISAMR), Shanghai, China, August 02–05, 2018 • *Plasmonic and magnetically codoped ITO nanocrystals* Advanced Materials Synthesis, Characterization and Applications (AMSCA-2018), Savitribai Phule Pune University, December

14–15, 2018 • *Possibility of dual bandgap in organic-inorganic Pb-halide layered perovskite* MRSI-First Indian Materials Conclave, Indian Institute of Science, Bengaluru, February 12–15, 2019

Rejish Nath

Quantum droplets in doubly dipolar Bose gas Conference on Ultra cold Rydberg Atoms-2018, IISER Bhopal, Bhopal, October 22, 2018 • *Periodically driven array of single Rydberg atoms* LPL, University of Paris-13, France, June 29, 2018

A.A. Natu

Outreach Lectures: *Opportunities in Basic Sciences:* January 2019 INSPIRE Camp, Millennium School, Pune; Asha Foundation, Jalgaon; Shri Chaitanya Techno School, Wagholi; Moving Academy of Sciences, Eklavya Science Con, Pune • February 2019 Madhyamik and Uchha Madhyamik Vidyalay, Pune; Cognizant-YTS Foundation; Haryana Academy of Sciences, GJ University, Hissar; Rani Lakshmi Bai Sainik School and Junior College • March 2019 Dondumama Sathe Junior College, Pune; North Maharashtra University, Jalgaon; INSPIRE Camp, IISER Pune; Akshar Nandan School, Pune; Gyan Prabodhini • December 2018 Ryat Science Congress, Mumbai; Sriram High School and Junior College, Karnagi, Satara; Samarth campus, Belhe district, Pune; INSPIRE Camp, Dayanand College, Latur; Nobel Woman, INSPIRE Camp, Pune; SM College, Kankowli; Shri Shivaji High School, Pandur; Delhi Public School, Pune • November 2018 YC College, Satara; GG International School, Pune October 2018 SIR Foundation, Akkalkot; VA Academy, Pandarpur; Lokseva Academy, Pune • September 2018 SSPMS College, Pune; MG Vidyalaya Manchar, Ambegaon; Vidya Pratishthan, Baramati; INSPIRE Camp, Patna • August 2018 Science Conclave organised by Panchaganga Bank, Kolhapur; Sindhu Education Expo, Kudala; Mahesh Vidyalay, Kothrud; Dhempe College, Goa; NIE Programme, Akurdi • July 2018 Fergusson College • June 2018 BMCC (Bruhan Maharashtra College of Commerce, Pune); Suyash Gurukul, Solapur; YASHADA, Pune • April 2018 Jyan Prabodhini, Nigdi; Society for Social Innovation and Development, Pune; K.M.E. School & Dr VK Toraskar Junior College, Banda; SMG High School, Devgad, Sindhudurg; Shri Devi Satori High School, Vengurla • **Other Lectures:** January 2019 *Emerging trends in science education* 59th National Cost Convention, Pune • February 2019 *Greener perspective of drug discovery* VG Bhide Memorial Lecture, organised by Maharashtra Academy of Sciences, Pune; *IISER, a new experiment in science education* Lonar Science Conclave; Indian Peptide Society Annual Conference, Hyderabad; *Intellectual property rights*, India scenario DY Patil College, Pimpri • March 2019 *Emerging trends in science education* SP College, Pune; *Interdisciplinary Sciences* Microbiology Department, SPPU • December 2018 *Misconduct in science* Vandodkar College, Thane; National Bioorganic Chemistry Symposium, Bhubaneswar • October 2018 Microbiology Department, SPPU, Drug discovery; Modern College, Advances in Drug Discovery • August 2018 Interdisciplinary talk at SP College, Pune; *Drug discovery*, Dhempe College, (Panaji?) Goa; *Soft power as a tool* CoEP, Pune • July 2018 MHRD Induction Programme for College Teachers: Participation in extension activities; Advanced methods of evaluation for teachers Tilak Maharashtra Vidyapeeth; *Career opportunities in Chemistry and Biology* Modern College, Pune • June 2018 *Drug discovery* Wadia College; *Bioactive compounds: Challenges and opportunities* Khalsa College; Teaching and research processes in science education HB Desai College, Pune • April 2018 *Higher education in Pune* ICC Towers, Pune; *DNA Diagnostics* HB Desai College, Microbiology Department, Pune

Venketeswara R. Pai

Development of number system Public lecture, Al-Ameen College, Edathala, Kerala, July 26, 2018 • Lectures as part of Workshop on Ancient Indian Mathematics, Department of Mathematics, Savitribai Phule Pune University, August 07–12, 2018: *An Overview of Grahagaṇita of Bhāskara*; *Obtaining mean longitude of the planets as given in Grahagaṇita of Bhāskara*; *A Brief overview of the Development of Rsine from Āryabhaṭa to Kerala School*; *Instantaneous velocity: An example from Vāsanābhāṣya of Bhāskara* • *Three systems of numeration and application of continued fraction in Indian Astronomy* National Seminar Algebraic Geometry and Number Theory 2018, Department of Mathematics, Al-Ameen College, Edathala, September 14, 2018 • *An overview of Ḍṛkaraṇa Seminar Contributions of Prof. K.V. Sarma to the study of Indian Astronomy and Mathematics* KVSRF, Adyar, October 27, 2018 • *Dhruvasaṃskāra in Vākyakaraṇa of Pārameśvara* Conference on History and Development of

Mathematics (CHDM) jointly organised by ISHM and SCSVMV University, Enathur, November 29, 2018 • *Mādhava: A genius from Irinjalkkuda* Special Talk in MATHLET series, Government College, Chalakkudy, December 10, 2018 • *Vākyaśodhana: A correction procedure for Mādhava-vākyas* Special talk during the reception of Mādhava Mathematics Award, National Mathematics Day, Mādhava Gaṇita Kendra, Irinjalkkuda, December 22, 2018 • *Continued Fraction in Dṭkkaraṇa*, International Conference on Astral Sciences in Asia, Indian Institute of Technology Bombay, Mumbai, January 24, 2019 • Three lectures *Mathematical concepts laid down in Sanskrit verses; Mathematical Ideas explained through Sanskrit Prose; Mathematical Ideas expressed through Sanskrit Phrases*: Department of Mathematics, Shivaji University, Kolhapur, March 08–09, 2019

Gayathri Pananghat

Pushing and pulling by protein filaments Vigyan Jyoti, Indian Institute of Technology Palakkad, May 06, 2018 • *X-Ray diffraction and the story of DNA* Vigyan Jyoti, Indian Institute of Technology Bombay, Mumbai, May 31, 2018 • *Molecular basis of cytoskeleton-based shape determination in a helical bacterium* Electron Microscopy Society of India Meeting, 2018, Bhubaneswar, July 18–20, 2018 • *Visualization of filaments of the cytoskeleton* Pre-conference workshop, Electron Microscopy Society of India Meeting, 2018, NISER Bhubaneswar, July 17, 2018 • *Mechanism of polarity oscillations in Myxococcus xanthus* Laboratoire de Chimie Bacterienne, CNRS Aix-Marseille University, Marseille, France, September 27, 2018 • *Molecular basis of cytoskeleton-based shape determination in a helical bacterium* University of Bordeaux, Bordeaux, France, September 20, 2018 • Lectures in *Structural Biology* Vikram Sarabhai Centre for Cell and Molecular Biology, MS University, Baroda, March 05–06, 2019

Shivprasad Patil

National Workshop on Fluorescence Correlation Spectroscopy, School of Physical Sciences, JNU, Delhi, November 12–17, 2018

Pramod Pillai

Regulation of interparticle forces for advanced nanoparticle functions 1st Indian Materials Conclave and 30th Annual General Meeting of MRSI, Indian Institute of Science, Bengaluru, India, February 12–15, 2019 • *Regulation of interparticle forces for advanced nanoparticle functions* Humboldt Kolleg 2019, Kashid, Maharashtra, India, January 31–February 02, 2019 • *Regulation of interparticle forces for advanced nanoparticle functions* International Conference Chemistry and Physics of Advanced Materials – III, IISER Pune, India, October 08–09, 2018

Supriya Pisolkar

Hilbert's theorem -90 for a ring Witt vectors Group Theory Workshop, IISER Pune, February 22–23, 2019 • *Lecture Series on Rings, Matrix groups and Bilinear forms* 8 Lectures, Annual Foundation School, Bhaskaracharya Pratishthana, Pune, December 2018

Thomas Pucadyil

Reconstitution of membrane fission Mechanobiology after 10 years – The promise of Mechanomedicine, Mechanobiology Institute, Singapore, November 10, 2018 • *Membrane fission: Diverse players, convergent mechanisms* Princeton University, U.S.A., September 07, 2018; HHMI International Research Scholar's Review Meeting, Janellia Farms Research Campus, U.S.A., September 04–06, 2018

A. Raghuram

From calculus to number theory Department of Mathematics Colloquium, Indian Institute of Technology Kanpur, March 2019 • *The art of research* Department of Mathematics Special Seminar, Indian Institute of Technology Kanpur, March 2019 • *Arithmetic of automorphic L-functions* ICTS workshop Algebraic and Analytic Aspects of Automorphic Forms, March 2019 • *From calculus to number theory* Institute Colloquium, IISER Tirupati, February 2019 • *From calculus to number theory* Public Lecture on their Fermat Day, Indian Institute of Technology Guwahati, August 2018 • *Arithmetic of automorphic L-functions* IAS-Princeton University Number Theory Seminar, Princeton, U.S.A., April 2018 • *Special values of automorphic L-functions*, Simons Symposium *Relative trace formulas* Schloss Elmau, Germany, April 2018

Atikur Rahman

Nature-inspired nanotechnology 7th Annual Symposium, Department of

Physics (SYMPHY), Indian Institute of Technology Bombay, March 16–17, 2019

Raghav Rajan

From perception to action: How does the brain do it? Exciting Science Group Seminars, October 04, 2018 • *Where's my cheese and other neuroscience stories* Learnac Seminar Series, Dr. Ninad Sheode's Physics Classes and Learnac, January 20, 2019 • *Using birdsong to understand how the brain initiates learned movements* Training in Bioacoustics, IISER Tirupati, March 14, 2019

Umakant D. Rapol

LIGO Newton-Bhabha Partnership Meeting, Glasgow, July 18–20, 2018 • Training lab development for LIGO India, Conference on Multi-messenger Astronomy in the Era of LIGO-India, Khandala, January 15–18, 2019 • Popular Science talk: *Understanding science behind Nobel work: Optical tweezer* Bharatiya Vidya Bhavan's Auditorium, Pune, February 09, 2019

Girish Ratnaparkhi

SUMO regulates innate immune signalling New Tools and Technologies for Health and Agriculture, Tata Institute of Genetics and Society, InSTEM, NCBS, Bengaluru, October 24–25, 2018 • *SOD1 activity threshold and TOR signalling modulate VAP(P58S) aggregation via ROS-induced proteasomal degradation in a Drosophila model of Amyotrophic Lateral Sclerosis* Biennial Indian Society of Developmental Biology (InSDB) Meeting, Indian Institute of Technology Kanpur, December 11–15, 2018; Asia-Pacific Drosophila Neuroscience Conference (APDNC), Academia Sinica, Taipei, Taiwan, January 16–20, 2019 • *Regulation of neuroaggregates by ROS* Biophysics Paschim, ACTREC, Navi Mumbai, December 16, 2018

Richa Rikhy

Onset of polygonal epithelial like architecture in syncytial Drosophila embryos EMBO workshop: The Molecular and Developmental Biology of Drosophila, Crete, Greece, June 24–30, 2018 • *Onset and function of polygonal epithelial like architecture in syncytial Drosophila embryos* EMBO workshop: Size and Shape, NCBS, Bengaluru, India, September 04–08, 2019 • *Mitochondrial morphology control of differentiation* Targeting mitochondria for health and disease, CDRI, Lucknow, India, November 28–30, 2018 • *Sub cellular organelles in inheritance, development and disease* From Health to Well Being: An Interdisciplinary Approach from Fundamental Sciences to Translational Medicine, St. Xavier's College, Mumbai, India, January 09–11, 2019 • *Onset of polygonal plasma membrane architecture in the syncytial Drosophila embryo* Orange County, Coorg, Mechano-developmental Biology, February 28–March 03, 2019 • *Sub cellular organelles in inheritance, development and disease* Recent Trends in Cell and Molecular Biology, University of Kashmir, Srinagar, March 19–20, 2019

Pooja Sancheti

Sessions on *Official communication skills and teaching skills* Induction Program of newly recruited college teachers, IISER Pune, May 11–12 2018 and November 22, 2018 • Sessions on *Storytelling, and confidence in public speaking for school children* Vigyan Jyoti Orientation Camp, IISER Pune, May 21, 2018 • *The basic fundamentals of research* Deccan College, Pune (as part of the UGC mandated Research Methodology course), July 23, 2018 • *Lecture on great women scientists* Exciting Science series, IISER Pune, July 29, 2018 • *The basics on research* Smt. Kashibai Navale College of Architecture (Sinhgad College affiliate), Pune, February 25, 2019 • Panel discussion on "Innovative Teaching Methods and Strategies for FIP" as part of the Orientation of Trainers for UGC-Faculty Induction Programme organised by CoESME, IISER Pune, March 29, 2019

Sudipta Sarkar

Concepts of tectonics associated with opening of new oceanic basin Structural Geology and Tectonics Workshop (funded by Elsevier), St Xavier's College, Mumbai, July 01, 2018

Kundan Sengupta

Genome organization in cells on softer matrices Chemference 2018, Department of Chemical Engineering, Indian Institute of Technology Bombay, Mumbai, May 19, 2018 • *Nuclear architecture and function in*

cells on softer matrices Genome Biology 2018: Impact on Human Health and Disease, Department of Biochemistry, Indian Institute of Science, Bengaluru, July 13, 2018 • *Role of Nuclear pore complex Nup93 in the organization and function of the HOXA gene cluster* Transcription Meeting, Center for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad, July 26, 2018 • *Annual Talks Nucleolar dynamics and function* Department of Biological Sciences, Tata Institute of Fundamental Research, Mumbai, August 10, 2018 • *Twist1 overexpression induces genome instability in colorectal cancer cells* National Center for Cell Sciences, Pune, Indo-Australian Symposium Epithelial-Mesenchymal Transition, October 24, 2018 • *Genome organization in cells on softer matrices* Asia Chromatin Meeting (ACM), JNCASR, Bengaluru, November 15, 2018 • *Genome organization and nuclear architecture* International Conference Genome architecture and cell fate regulation, University of Hyderabad, December 03, 2018 • *Divided we stand, united we fall – regulation of nucleolar structure and function*, Center for Cellular and Molecular Biology (CCMB), Hyderabad, February 08, 2018 • *Nuclear structure-function relationships in cancer cells* Recent Trends in Cell and Molecular Biology, Department of Biotechnology, University of Kashmir, Srinagar, March 19, 2019

S. Sivaram

Aliphatic polyesters: A platform for the design of sustainable polymers University of Montpellier, Montpellier, France, March 13, 2019 • *Porous functional polymers as separators for lithium ion batteries* LCPO, University of Bordeaux, Bordeaux, France, March 11, 2019 • *Approaches to the preparation of few-layer graphenes by exfoliation of graphite and their nanocomposites with natural and synthetic rubbers* Seventh R&D Advisory Committee Meeting, Apollo Tires, Amsterdam, March 07, 2019 • *The evolution of science, technology and public policy: Past, present and future* Science Day Lecture, Aditya Birla Science and Technology Private Limited, Talaja, Navi Mumbai, March 01, 2019 • *The future of colors: Science, Technology and Applications, Convention on Colours* Mumbai, February 28, 2019 • *Aliphatic polyesters: A platform for the design of sustainable polymers* International Conference *Direct digital manufacturing and polymers* Karnatak University, Dharwad, February 20, 2019 • *The periodic table: Chemistry's gift to science, International year of the periodic table of elements* Homi Bhabha National Institute, BARC, Mumbai, February 16, 2019 • *Scientific innovation and entrepreneurship in India: A retrospective and perspective* Indian Institute of Science Education and Research, Kolkata and Leadership for Academician Programme (MHRD), Kolkata, February 12, 2019 • (a) *Graphene - Elastomer functional nanocomposites: Structure and properties* and (b) *Functional elastomers and their relevance to elastomer composites* Reliance Technology Centre, Navi Mumbai, February 07, 2019 • *Plastics at the crossroads: Where do we go from here?* Pune Plastics Manufacturer's Association Seminar on 'EPR: The Way Forward', Pune, February 08, 2019 • *Plastics at the crossroads: Where do we go from here?* Mrs. S.M. Thakkar Memorial Lecture, IPI, Mumbai, January 31, 2019 • *Porous functional polymers and their applications in charge storage devices* EFCS 2018, Farook College, Calicut, November 23, 2018 • *Aliphatic polyesters: A platform for design of sustainable materials* KASAM 2018, Kathmandu, Nepal, October 28, 2018 • *Graphene- Elastomer functional nanocomposites: Structure and properties* Polymer Society of Korea National Meeting, Gyeongju, S. Korea, October 12, 2018 • *Intellectual property management in the national innovation systems: Issues, challenges and opportunities* IP & Technology Transfer Training Programme HEQEP Program, Bangladesh, September 26, 2018 • *Emerging Indian ecosystem for S&T based entrepreneurship, science and research opportunities in India* Young Investigators Meeting, Chicago, U.S.A., September 09, 2018 • *The science of polymers: Glorious past, present challenges and exciting future* Somaiya Vidyavihar, Mumbai, September 06, 2018 • *The evolution of science, technology and public policy in India: Past, present and future* Indian Institute of Science Education and Research, Kolkata, August 30, 2018 • *Sustainable chemistry: Challenges and implication to research and education* Indian Institute of Science Education and Research, Kolkata, August 28, 2018 • *Polyethylene by metal catalyzed polymerization: Catalyst structure and polymer properties* TCG Life Sciences Pvt Limited, Innovation Center & Haldia Petrochemicals Ltd, August 10, 2018, Haldia Petrochemicals Limited, Haldia • *PhD Training in Indian institutions: Strengths, weaknesses and an agenda for transformation, transformative research agenda for Indian institutions: Science revolution 2.0* IISER Bhopal, August 04, 2018 • *Porous functional polymers in energy applications: Challenges and opportunities* Reliance Technology Group, Vadodara, August 02, 2018 • *Sustainable chemistry:*

The only way forward Nimkar Foundation Endowment Lecture, ICT, Mumbai, June 19, 2018 • *Emerging Indian ecosystem for S&T based entrepreneurship* Science and Research Opportunities in India, Young Investigators Meeting, Chicago, U.S.A., September 09, 2018 • *Polymers with intrinsic porosities: Synthesis, structure, properties and applications* 67th National Meeting of Society of Polymer Science, Japan, Nagoya, Japan, May 24, 2018 • *Graphene- Rubber functional nanocomposites: Structure and properties* Visions in Polymer Science- A Symposium in honour of Professor J.P. Kennedy, University of Akron, College of Polymer Science and Engineering, Akron, OH, U.S.A., May 09, 2018

Pushkar Sohoni

Foundation myths of Indian cities: Types and tropes with special reference to the foundation of Mumbai The 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 • *Sultanate cities of Medieval South Asia* Virginia Commonwealth University (VCU) – Qatar, Doha, November 18, 2018 • *History of temple architecture, two lectures [(i) The development of the Hindu Temple and (ii) Maratha Temple Architecture]* Jnanapravaha, Mumbai, October 20 and 27, 2018 • *Volcanic basalt and the architecture of Maharashtra workshop Mahārāṣṭrātila Vāstukalā: paramparā āṇi vāṭacāla*, Centre for Developing Societies and Activities (CDSA), Pune, July 21, 2018 • *Retelling old tales: The mythical origins of Mumbai* on the panel New Wine in Old Bottles: Narrative Strategies in Early Modern India, AAS-in-Asia Conference, Ashoka University, Delhi, July 07, 2018

S.G. Srivatsan

Probing mood (structure) swings in nucleic acids 43rd Indian Biophysical Society Meeting, IISER Kolkata, India, March 15–17, 2019 • *Probes for understanding mood (structure) swings in nucleic acids* Humboldt Kolleg, Kashid, India, January 31–February 02, 2019 • *Probing non-canonical nucleic acid structures in live cells using multi-functional nucleoside tool box* 1st International Conference in Chemistry (iConChem2018), IISER Tirupati, India, May 24–26, 2018 • *Probing nucleic acid structure and recognition using multi-functional nucleoside tool box* Fluorescent Biomolecules and their Building Blocks–Design and Applications (FB3), University of Glasgow, UK, June 30–July 03, 2018 • *Probing nucleic acid structure and recognition using functionalized nucleoside tool box* National Conference on Advanced Perspectives in Chemistry Savitribai Phule Pune University, February 24–25, 2018

Pinaki Talukdar

Synthetic chloride transporters for targeting cancer 23rd CRSI National Symposium in Chemistry - Indian Institute of Science Education and Research, Bhopal, July 13–15, 2018 • *Synthetic chloride transporters for targeting cancer* XIX NOST-Organic Chemistry Conference (XIX-NOST-OCC), 30th Anniversary Edition, Goa, India, September 06–09, 2018 • *Synthetic chloride transporters for targeting cancer* 6th INDIGO Research Conference, Hyderabad, India, November 25–27, 2018 • *Self-assembled ion channels for transmembrane Cl⁻ transport* International Conference on Polymer Science and Technology (SPSI-MACRO) 2018, Pune, India, December 19–22, 2018 • *Synthetic molecular machineries for transmembrane chloride transport* Application of Supramolecular Chemistry in Water Treatment, Tata Steel, Jamshedpur, India, February 04–05, 2019 • *Synthetic chloride transporters for targeting cancer* Advances in Chemical Biology & Biologics, CSIR-IICT, Hyderabad, India, February 28–March 02, 2019

Gyana Ranjan Tripathy

Re-Os geochronology of organic rich sediment art rock National Workshop Isotopes in Earth, Ocean and Atmospheric Sciences organized jointly by Inter-University Accelerator Centre, Delhi and NIO, Goa held at NIO, Goa, February 20, 2019 • *Dissolved boron in a tropical coastal lagoon system: Sources and behavior* Scientific meet organized by CSIR-National Institute of Oceanography, Goa, Venue-NIO, Goa, October 04, 2018

Ramanathan Vaidhyanathan

Delivered a medal lecture in the 24th Chemical Research Society of India Meeting, Central Leather research Institute (CLRI), Chennai, India, January 08–10, 2019 • Delivered a medal lecture in the first Indian Materials Conclave held by the Materials Research Society of India Meeting, Indian Institute of Science, Bengaluru, India, February 12–15, 2019 • *Covalent organic framework derived light-weight nanomagnet* 5th International Workshop on Novel Magnetic and Multifunctional Materials (5thIWNMMM), Hanoi, Vietnam, January 09–12, 2019 • *Covalent organic framework: Near-crystalline organic polymers for energy applications* 6th International Conference on Metal-Organic Frameworks and Open Framework Compounds, Auckland, New Zealand, December 09–13, 2018

Arun Venkatnathan

Application of molecular dynamics Bharathiyar University, Coimbatore, Tamil Nadu, May 25, 2018 • *Molecular dynamics simulations of carbon dioxide absorption and lithium ion battery electrolytes* Periyar University, Salem, Tamil Nadu, May 31, 2018 • *Decoding structure, stability and ionic conductivity in a lithium ion co-crystalline battery electrolyte* Energy Day, IISER Pune, July 27, 2018 • *Nanostructure and dynamics of polymer electrolyte membranes: Insights from molecular dynamics simulations* SPSI Macro Conference, IISER Pune, December 19–22, 2018 • *Structure and dynamics in polymer electrolyte membranes for fuel cells: Insights from molecular dynamics simulations* Centre for Modeling and Simulation, Savitribai Phule Pune University, Pune, March 05, 2019 • *Mechanism of surface melting and ion conduction in soft-solid co-crystalline electrolytes for lithium ion batteries* in ASM 2019, Indian Institute of Technology Delhi, March 09, 2019

Academic Events Organised

Bijay Kumar Agarwalla

Mumbai-Pune Condensed Matter Physics Meeting, jointly organised with Dr. G.J. Sreejith, Physics Department, IISER Pune, September 01, 2018

Baskar Balasubramanyam

Number Theory Day, IISER Pune, January 13, 2019

Nirmalya Ballav

Convener, ChemSymphoria 2018, IISER Pune • Convener, Energy Day 2018, IISER Pune, July 27, 2018 • Organising Committee Member, SPSI-MACRO-2018, IISER Pune, December 19–22, 2018 • Co-Convener, International Conference on Structural and Inorganic Chemistry-II (ICSIC-II), IISER Pune, March 18–19, 2019

Debargha Banerjee

Pune-Mumbai Number Theory Seminar, IISER Pune, February 15–16, 2019

Deepak Barua

Co-organiser, Workshop on Plant Ecology and Ecophysiology, India, PEEP-2018, Sirsi, Karnataka, September 17–22, 2018

Mousomi Bhakta

Special session titled Recent Trends in Nonlocal Nonlinear PDEs in the 12th AIMS (American Inst. of Mathematical Science) Conference on Dynamical System and Differential Equations, Taipei, Taiwan, July 5–9, 2018 • In-house Math Symposium, IISER Pune, September 14, 2018

Rajeev Bhalerao

Member, International Advisory Committee, 63rd DAE-BRNS International Symposium on Nuclear Physics, BARC, Mumbai, December 10–14, 2018

Anup Biswas

Workshop on Mathematical Finance, IISER Pune, July 12–16, 2018

R. Boomi Shankar

Convener, International Conference on Structural and Inorganic Chemistry-II (ICSIC-II), IISER Pune, March 18–19, 2019

S. Sandanaraj Britto

Organising Committee Member, SPSI-MACRO-2018, IISER Pune, December 19–22, 2018

Srabanti Chaudhury

Conference on Statistical Mechanics and Soft Matter, IISER Pune, January 04–05, 2019

Anisa Chorwadwala

Co-organiser, Mathematics Day 2019, IISER Pune, March 16, 2019 • Co-organiser, In-house Math Symposium 2018, IISER Pune, September 14–15, 2018

G.V. Pavan Kumar

Facets of Photonics 2018, IISER Pune, December 24–26, 2018

Debdip Ganguly

Organising Committee Member, In-house Math Symposium, IISER Pune, September 14–15, 2018

Aurnab Ghose

Co-organiser, Mechano-developmental Biology Meeting, Coorg, India, February 28–March 03, 2019 • National Advisory Committee, National level workshop on Microscopy Image Analysis, NCCS, Pune, India

Sreejith G.J.

Mumbai Pune Quantum Condensed Matter Theory Meeting, IISER Pune, September 01, 2018

Anindya Goswami

Workshop on Mathematical Finance, IISER Pune, July 12–6, 2018
• Workshop on Python, IISER Pune, August 11–12, 2018

Tejas Kalelkar

Co-organiser (with Dr. Rama Mishra), Workshop on the Volume Conjecture and Related Topics in Knot Theory, IISER Pune, December 17–21, 2018.

Siddhesh S. Kamat

10th Annual Proteomics Society of India Meeting, NCCS Pune, December 12–14, 2018

Shabana Khan

Co-organiser, International Conference on Structural and Inorganic Chemistry-II, IISER Pune, March 18–19, 2019

Anand Krishnan

Co-organiser (with Samira Agnihotri), Workshop on BioAcoustics in Conservation at the Student Conference in Conservation Science (SCCS), Bengaluru, September 27–30, 2018

Soumen Maity

Workshop on Parameterized Complexity, IISER Pune, March 02–04, 2019

Moumita Majumdar

Co-organiser, International Conference on Structural and Inorganic Chemistry-II, IISER Pune, March 18–19, 2019

Vivek Mohan Mallick

Annual Foundation School-I, IISER Pune, May 07–July 02, 2018

Sunil Mukhi

Co-organised (with Nabamita Banerjee, Shamik Banerjee, Sachin Jain) Stringy Days IV: Soft Holography, IISER Pune, March 02–04, 2019

Richa Rikhy

Young Investigator's Meeting 2019, Guwahati, March 06–10, 2019

S.G. Srivatsan

Innovations in Frontier Chemistry (IFC 2018), IISER Pune, May 08–09, 2018

Arun M. Thalapillil

Organising Committee Member, Pune-Mumbai Collider Meet 2019, IISER Pune, March 16, 2019

Ramanathan Vaidhyanathan

Co-convener, International Conference on Structural Inorganic Chemistry-II (ICSIC-II), IISER Pune, March 18–20, 2019

Arun Venkatnathan

Organiser, IISER Pune-Temple University Joint Symposium titled Chemistry and Physics of Advanced Materials – III, IISER Pune, October 08–09, 2018 • Organising Committee Member, SPSI-MACRO Conference, IISER Pune, December 19–22, 2018

New Extramural Grants Received

(₹ in Lakhs)

	Name of the Project	Project Leader	Project Code	Funding Agency	Period From-To	Funds Received During the Year
1	AYUSH-Centre of Excellence	Dr. Mayurika Lahiri	GAP/SPPU/BIO-18-352	SPPU	19.04.2018 18.04.2021	5
2	Study of nonlocal scalar field equations - MATRICS	Dr. Mousomi Bhakta	GAP/SERB/MTH-18-358	SERB	12.06.2018 11.06.2021	2.2
3	Computations in the groups of lie type - MATRICS	Dr. Anupam Kumar Singh	GAP/SERB/MTH-18-359	SERB	13.06.2018 12.06.2021	2.2
4	Low dimensional topology – MATRICS	Dr. Tejas Kalelkar	GAP/SERB/MTH-18-360	SERB	13.06.2018 12.06.2021	2.2
5	Classical L theory for module finite rings and graded algebras-MATRICES	Dr. Rabeya Basu	GAP/SERB/MTH-18-361	SERB	12.06.2018 11.06.2021	2.2
6	Hecke algebras and the Langlands program - MATRICS	Dr. Manish Kumar Mishra	GAP/SERB/MTH-18-366	SERB	13.06.2018 12.06.2021	2.2
7	Families of adjoint L-functions and selmer groups for Hilbert modular forms - MATRICS	Dr. Baskar Balasubramanyam	GAP/SERB/MTH-18-368	SERB	13.06.2018 12.06.2021	2.2
8	Molecular and chemical ecology of the biological control of diamondback moth revealing the significance of the infochemical communication between bottom up and top down factors	Dr. Sagar Pandit	GAP/SERB/BIO-18-370	SERB	27.07.2018 26.07.2021	6.96372
9	Women Scientist Scheme (WOS-A) Solid phase synthesis of oligo arabinofuranosides	Dr. Madhuri Vangala	GAP/DST/BIO-18-371	DST	02.08.2018 01.08.2021	12.05
10	Group of extra twist beyond GL ₂ Q - MATRCS	Dr. Debargha Banerjee	GAP/SERB/MTH-18-373	SERB	06.08.2018 05.08.2021	2.2
11	Around the volume conjecture in knot theory - MATRICS	Dr. Rama Mishra	GAP/SERB/MTH-18-374	SERB	27.07.2018 26.07.2021	2.2
12	Women Scientific Scheme A (WOS-A) - Macrocyclic furans a route to diverse cyclic oligophenylenes	Dr. Sunita Khanderao Gadak	hGAP/DST/CHE-18-375	DST	10.08.2018 09.08.2021	10.59
13	Microtubule based mechanisms	Dr. Chaitanya Athale	GAP/SERB/BIO-18-378	SERB	17.08.2018 16.08.2021	10.3154
14	Ph-Free metal halide perovskite nanocrystals for optoelectronic applications	Dr. Angshuman Nag	GAP/SERB/CHE-18-384	SERB	24.09.2018 23.09.2021	29.0693
15	Generation of Tnt1 (retrotransposon) insertional mutant population of Moss and characterization of putative mutants defective in gametophore development	Dr. Anjan Banerjee	GAP/SERB/BIO-18-385	SERB	24.09.2018 23.09.2021	22.596
16	Synthesis characterization and application of Nsi(II) N-based pincer ligands	Dr. Shabana Khan	GAP/SERB/CHE-18-386	SERB	24.09.2018 23.09.2021	16.28435
17	Locally risk minimizing option pricing in semi markov modulated market model - MATRICS	Dr. Anindya Goswami	GAP/SERB/MTH-18-387	SERB	17.09.2018 16.09.2021	2.2
18	Investigating mechanical tension in neuronal axons quantitative evaluation and cytoskeleton origins	Dr. Aurnab Ghose	GAP/SERB/BIO-18-388	SERB	24.09.2018 23.09.2021	40.35
19	Understanding the behavioural and neural basis for song changes in response to social context in the adult male zebra finch	Dr. Raghav Rajan	GAP/DST/BIO-18-394	DST	03.11.2018 02.11.2021	31.296

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20	Ramanujan Fellowship Award -	Dr. Diptimoy Ghosh Dr. Diptimoy Ghosh	GAP/SERB/PHY-18-395	SERB	03.11.2018 02.11.2023	7.6
21	Spin injection, interaction and manipulation in puckered 2D material: Designing materials for nano spintronics	Dr. Mukul Kabir	GAP/SERB/PHY-18-396	SERB	12.11.2018 11.11.2021	21.75
22	Women Scientist Scheme A (WOS-A) - Phase behaviour and directed transport in active colloidal system	Dr. Antina Ghosh	GAP/DST/PHY-18-398	DST-Kiran Division	22.11.2018 21.11.2021	9.22
23	Bird communication and signal propagation in dynamic soundscapes integrating behavior physics and community ecology	Dr. Anand Krishnan	GAP/DST/BIO-18-399	SERB	27.11.2018 26.11.2021	19.7035
24	Gold catalysed synthesis of foundaparinux and other glycosaminoglycans	Dr. Srinivas Hotha	GAP/SERB/CHE-18-401	SERB	16.11.2019 15.11.2022	33.3
25	Reversal of wrong decisions: Dissecting the neural mechanisms	Dr. Nixon Abraham	GAP/DST/BIO-18-403	DST	05.02.2019 04.02.2023	41.7
26	Women Scientist Scheme A (WOS-A) - Quest for experimental discovery of new topological semimetal candidates	Dr. Luminita Harnagea	GAP/DST/PHY-18-404	DST	28.02.2019 27.02.2022	9.35
27	Teachers Associateship for Research Excellence (TARE) to Dr. Aniruddha Mitra, Shoolini University of Biotechnology and Management Science, Himachal Pradesh	Prof. L.S. Shashidhara	GAP/SERB/BIO-18-406	SERB	15.11.2018 14.11.2021	3.35
28	Teachers Associateship for Research Excellence (TARE) to Dr. Vivek Vishwanath Antad, Modern Education Society's Nowrosjee Wadia College, Pune, MS	Dr. Shivprasad Patil	GAP/SERB/PHY-18-407	SERB	28.02.2018 27.02.2021	3.35
29	Training programmes enabling effective science communication by IISER Pune	Dr. Harinath Chakrapani	GAP/DST/CHE-18-408	SERB	12.03.2019 11.03.2022	17.38
30	Machine learning driven new physics probes through novel kinematic and substructure variables	Dr. Arun Thalapillil	GAP/SERB/PHY-18-409	SERB	11.03.2019 10.03.2022	19.66237
31	Covering arrays on graphs and hypergraphs - MATRICS Grant for Dr. Soumen Maity	Dr. Soumen Maity	GAP/SERB/MTH-18-411	SERB	14.03.2019 13.03.2022	2.2
32	Arithmetic properties of automorphic L-functions-MATRICES	Prof. A. Raghuram	GAP/SERB/MTH-18-412	SERB	14.03.2019 13.03.2022	2.2
33	Teachers Associateship for Research Excellence (TARE) to Dr. Sunil Patil College of Engineering, Pune	Dr. Arnab Mukherjee	GAP/SERB/CHE-18-413	SERB	14.03.2019 13.03.2022	3.35
34	Women Scientist Scheme A (WOS-A) entitled "Screening of charged colloids in an inner salt (Zwitterion)	Dr. Sheelan Sengupta	GAP/DST/PHY-18-414	DST	20.03.2019 19.03.2022	13
35	Scientific analysis of historic lime mortars and other building materials	Dr. Pushkar Sohoni	GAP/DST/HSS-18-416	DST	07.03.2019 06.03.2021	9.4
36	MATRICES-Topics on integro differential operators	Dr. Anup Biswas	GAP/SERB/MTH-18-418	SERB	12.03.2019 11.03.2022	2.2
37	MATRICES-Witt vectors of associative rings	Dr. Supriya Pisolkar	GAP/SERB/MTH-18-419	SERB	14.03.2019 13.03.2022	2.2
38	Hecke algebras associated to simple bernstein blocks	Dr. Manish Kumar Mishra	GAP/SERB/MTH-18-420	SERB	30.03.2019 29.03.2022	8.49867

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39	MATRICES - Solving the elliptic curve discrete logarithm problem	Dr. Ayan Mahalanobis	GAP/SERB/MTH-18-421	SERB	14.03.2019 13.03.2022	2.2
40	MATRICES-Arithmetic theory of motivic and automorphic L functions	Dr. Chandrasheel Bhagwat	GAP/SERB/PHY-18-422	SERB	25.03.2019 24.03.2022	2.2
41	Exotic non abelian edge states at FQHE-superconductor interfaces microscopic modeling	Dr. Sreejith G.J.	GAP/SERB/PHY-18-423	SERB	22.03.2019 21.03.2022	21.30407
42	Computer simulations on structure and molecular transport in ionic liquid doped polymer electrolyte membranes for high temperature fuel cell technologies	Dr. Arun Venkatnathan	GAP/SERB/CHE-18-425	SERB	30.03.2019 29.03.2022	39.797
43	Polycationic silicon(II) and Germanium(II) centered ligands for Lewis Acid catalysis	Dr. Moumita Majumdar	GAP/SERB/CHE-18-426	SERB	30.03.2019 29.03.2022	11.996
44	Establishment of a Pune Biotech Cluster	Prof. Jayant Udgaonkar	GAP/DBT/BIO-18-363& 364	DBT	29.06.2018 28.06.2021	962.62
45	In vivo screening and analysis of BAR domain family in membrane-cytoskeletal interactions in epithelial morphogenesis and synaptic membrane remodelling in <i>Drosophila</i>	Dr. Richa Rikhy	GAP/DBT/BIO-18-367	DBT	04.07.2018 03.07.2021	23.228
46	J C Bose Fellowship for Prof. Jayant Udgaonkar	Prof. Jayant Udgaonkar	GAP/SERB/CHE-18-365	SERB	01.06.2017 31.05.2022	36
47	A novel phototherapeutic approach exploiting proton / chloride (H/Cl) co transport to combat breast cancer - National Bioscience Award for Career Development 2016	Dr. Pinaki Talukdar	GAP/DBT/CHE-18-372	DBT	18.07.2018 31.07.2021	10
48	Investigating Mycobacterial responses to endogenous peroxy nitrite	Dr. Harinath Chakrapani	GAP/DBT/CHE-18-379	DBT	13.08.2018 12.08.2021	20.05
49	Immunomodulation of STn antigens with biomaterials for cancer therapy	Dr. Raghavendra Kikkeri	GAP/DBT/CHE-18-382	DBT	17.09.2018 16.09.2021	40.616
50	Investigating the secret role of miRNA166 in local and systemic defense responses during potato <i>Phytophthora infestans</i> interaction	Dr. Anjan Banerjee / Co-PI-Prof. Sanjeev Galande	GAP/DBT/CHE-18-383	DBT	20.09.2018 19.09.2021	40.4
51	Development of a stable and inducible CRISPR cas9 system for high throughput site specific genome editing in <i>Plasmodium falciparum</i>	Dr. Krishanpal Karmodiya	GAP/DBT/BIO-18-391	DBT	11.10.2018 10.10.2021	36.75
52	Understanding diversification of Impatiens species in the Northern Western Ghats	Dr. Deepak Barua	GAP/DBT/BIO-18-392	DBT	24.09.2018 23.09.2021	8.38181
53	Molecular and chemical ecology of the biological pest control plant mediated RNAi based investigation of counteradaptations of diamondback moth and its parasitoid against brassicaceae's glucosinolate myrosinase defense system	Dr. Sagar Pandit	GAP/DBT/BIO-18-405	DBT	21.02.2019 20.02.2022	58.0528
54	Manav-Human Atlas Initiative	Dr. Nagaraj Balasubramanian / Dr. Gopal Chandra Kundu, NCCS Pune	GAP/DBT/BIO-18-410	DBT	27.02.2019 26.02.2022	164
55	Structural biology of membrane associated cytoskeletal filaments involved in shape determination and motility of a helical millicute <i>Spiroplasma</i>	Dr. Gayathri Pananghat / Co-PI-Dr. Saikrishnan Kayarat	GAP/DBT//BIO-18-415	DBT	19.03.2019 18.03.2022	29.6064

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56	Derivatives pricing and portfolio optimization in financial market models with age dependent switching	Dr. Anindya Goswami	GAP/DAE/MTH-18-427	DAE-NBHM	24.01.2019 23.01.2022	0.98
57	Ramanujan Fellowship Award - Dr. Sachin Jain	Dr. Sachin Jain	GAP/SERB//PHY-18-354	SERB	05.06.2018 04.06.2023	7.6
58	INSPIRE Faculty Award - Dr. Debdeep Ganguly	Dr. Debdeep Ganguly	GAP/DST/MTH-18-362	DST	14.05.2018 13.05.2023	7
59	INSPIRE Faculty Award- Sarvesh Kumar Dubey - IFA17-EAS66	Dr. Sarvesh Kumar Dubey	GAP/DST/ECS-18-369	DST	01.08.2018 31.07.2023	19
60	AOARD 17IOA121- Covalent Organic Framework supported nanoparticles as light weight nanomagnet	Dr. Ramanathan Vaidhyathan	AOARD/CHE-18-357	Asian Office of Aerospace R & D (AOARD)	16.05.2018 14.02.2020	22.69071
61	AOARD - Resonant light scattering from optically aligned plasmonic nanowire architectures in fluids	Dr. G.V. Pavan Kumar	GAP/AOARD/PHY-18-397	Asian Office of Aerospace R & D (AOARD)	21.09.2018 20.09.2020	35.71822
62	Unnat Bharat Abhiyan (UBA)	Dr. V.S. Rao	GAP/IITDelhi/-18-350	IIT Delhi	03.04.2018 31.03.2019	1.75
63	PMMMNMTT Centre of IISER Pune for holding Academic Council meetings of National Resource Centre (NRC) for the discipline Climate Change during the financial year 2018-19	Prof. L.S. Shashidhara	GAP/MHRD/ECS-18-389	MHRD	14.09.2018 31.03.2019	5
64	Induction Programme at CoESME, IISER Pune	Prof. L.S. Shashidhara	GAP/MHRD/BIO-18-393	MHRD	05.05.2018 04.05.2019	60.6
65	To develop cost effective primary lithium battery for Defence application	Dr. Nirmalya Ballav / Dr. Satishchandra Ogale	GAP/DRDO/CHE-18-400	DRDO	16.01.2019 15.01.2021	38.03024
66	Improved description of the water cycle in the upper ganga catchment using isotopic, geochemical data and model simulations	Dr. Argha Banerjee	GAP/MoES/ECS-18-390	MoES	29.09.2018 28.09.2021	8.652
67	INSPIRE Faculty Award - IFA18-EAS71	Dr. Utsav Mannu	GAP/DST/ECS-18-377	DST	09.08.2018 08.08.2023	19
68	A novel compensation model to mitigate crop damage by wild herbivores around protected areas	Prof. Milind Watve	GAP/MEFCC/HSS-18-355	Ministry of Environment, Forest and Climate Change -Wildlife Division	29.05.2018 28.05.2020	19.47
69	Sunrise Project / Strategic University Network to revolutionize Indian solar energy	Prof. Satishchandra Ogale / Dr. Atikur Rahman	EPSRC/PHY-18-356	The Engineering and Physical Sciences Research Council	01.04.2018 31.03.2021	8.78611
70	IUCAA-IISER Joint Centre for Gravitational Physics and Astronomy (CGPA) LIGO India related to training activities	Prof. Sunil Mukhi	GAP/IUCAA/PHY-18-376	IUCAA	13.08.2018 12.08.2021	65
71	National Programme on Technology enhanced learning	Dr. Harinath Chakrapani, Arnab Mukherjee, Pushkar Sohoni	GAP/NPTEL/CHE-18-381	NPTEL-IIT Madras	01.01.2019 30.06.2019	22
72	Systematic editing of the <i>Drosophila</i> genome by Crispr/Cas9 to uncover biological roles for SUMOylation in the immune response	Dr. Girish Ratnaparkhi	GAP/DBT/BIO-18-380	DBT	23.08.2018 22.08.2021	35.43

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73	PMMMNTT scheme for conducting online refresher courses through SWAYAM MOOCs platform for the faculties of all educational institutions - 2018-19	Prof. L.S. Shashidhara	GAP/MHRD/ECS-18-389	AICTE	29.10.2018 31.03.2019	14.7
74	Raja Ramanna Fellowship to Prof. Satish Ogale	Prof. Satishchandra Ogale	GAP/DAE/PHY-18-402	DAE	01.02.2019 31.01.2022	
75	2017 Newton Prize-India Winning Project: Advancing the efficiency and the production potential of excitonic solar cells (APEX)-II	Prof. Satishchandra Ogale	GAP/BRUNEL UNIV	Brunel University London	01.01.2019 31.10.2019	



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