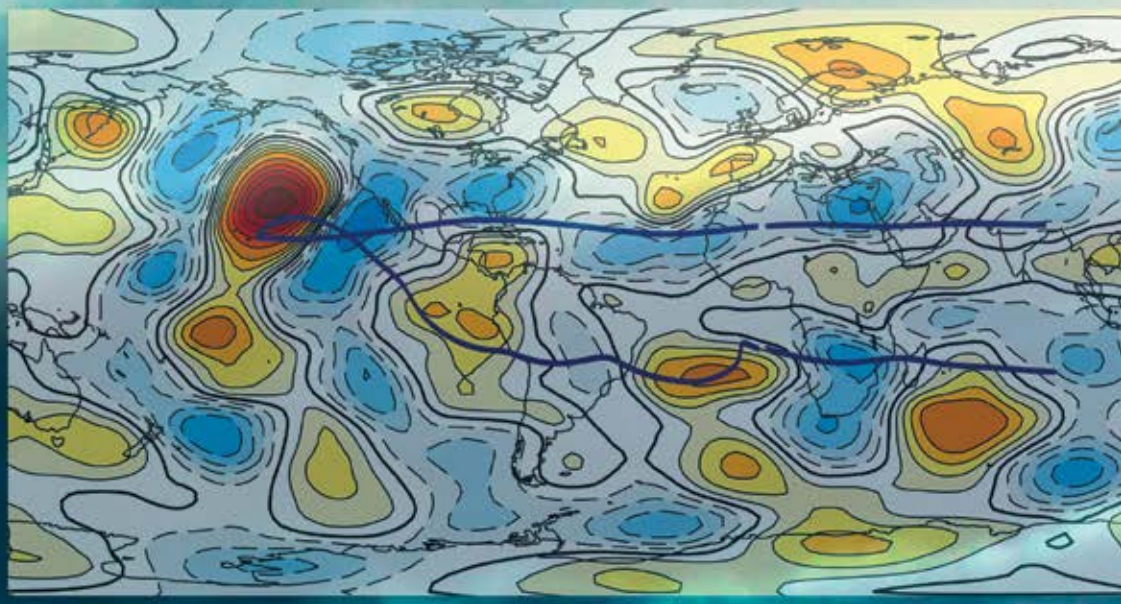

IISER PUNE

भारतीय विज्ञान शिक्षा एवं अनुसंधान संस्थान पुणे

वार्षिक प्रतिवेदन २०२१-२०२२

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH PUNE

Annual Report 2021–2022

On the Cover

El Niño influence on monsoon onset: The data image shows the teleconnection pathway that connects the Pacific and the Indian monsoon domain in the upper level circulation field (shaded contours). Overdrawn (solid thick lines) are the stationary Rossby wave guides as solved by Dr. Neena Joseph Mani's research group. Through this analysis, the group identified regions of the Indian subcontinent where the monsoon is influenced by the El Niño warming over the Pacific Ocean.

Image Credit

Dr. Neena Joseph Mani

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IISER PUNE

भारतीय विज्ञान शिक्षा एवं अनुसंधान संस्थान पुणे

वार्षिक प्रतिवेदन २०२१-२०२२

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH PUNE

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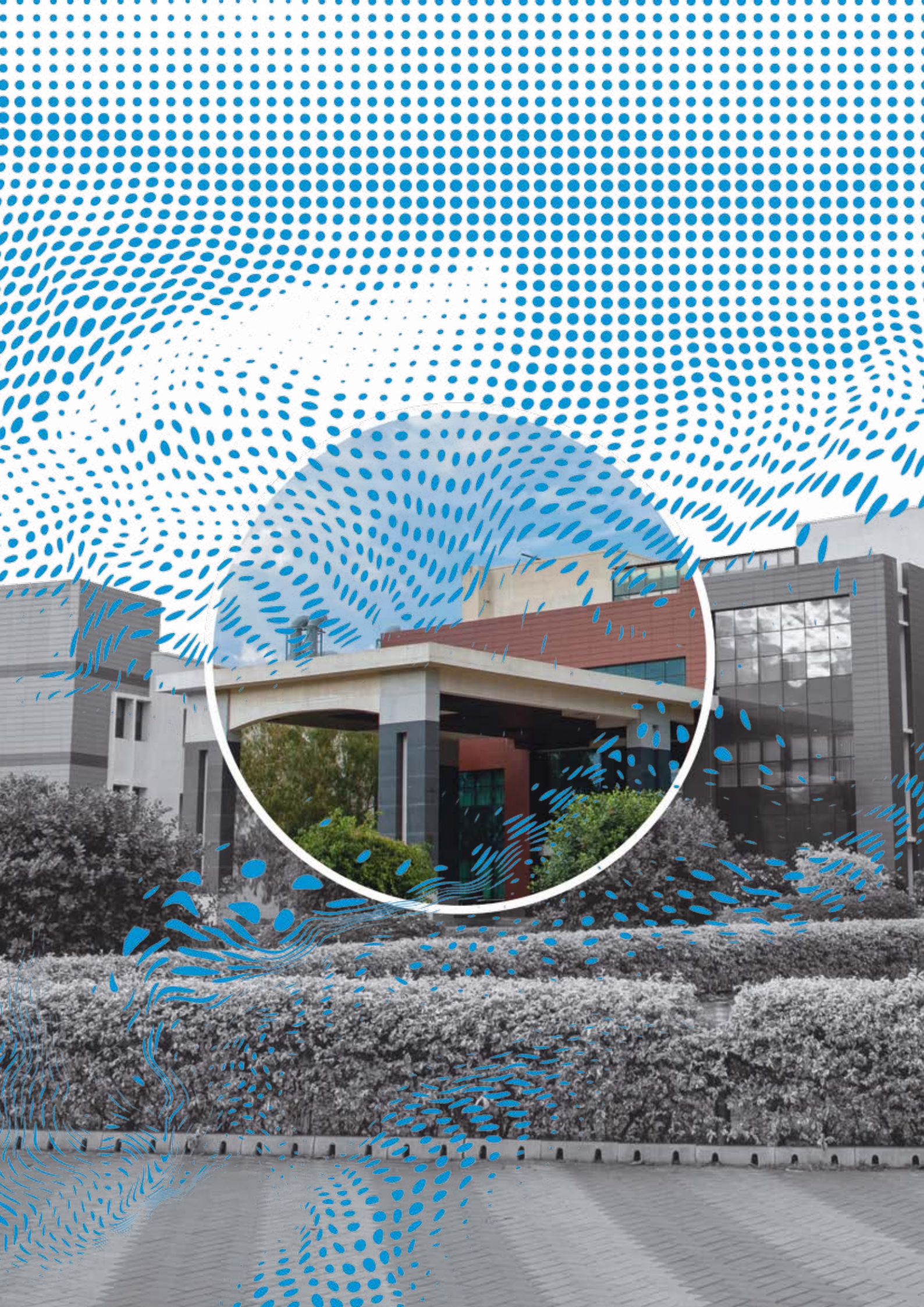
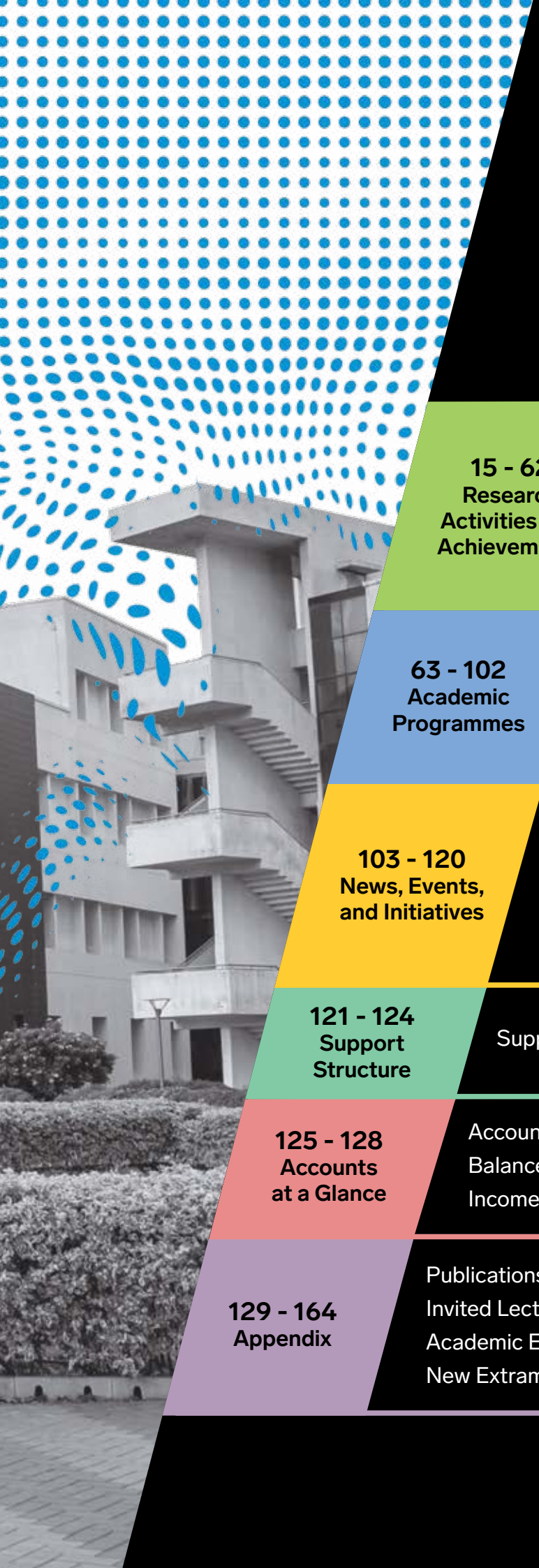




CONTENTS

IISER PUNE

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.

IISER Pune is an autonomous teaching and research organisation of the Ministry of Education, Government of India.

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

The Institute is ranked 24 in the Overall Category and 16 in the Research Category in the 2021 India Rankings of the National Institutional Ranking Framework (NIRF); 801-1000 in the 2022 Times Higher Education (THE) World University Rankings; and is listed 7th in India, 123rd in Asia-Pacific and 369th globally for research output by the 2022 Nature Index Tables.

HIGHLIGHTS 2021-22

51
New Extramural Grants Garnered

Online outreach sessions by Science Activity Centre
Over 2 lakh views

17
New MoU and Agreements
15 National
2 International

34
crores (in ₹) Extramural Funds Received

Patents
11 filed
7 published
5 granted

125
crores (in ₹) Funds Received from the Ministry of Education

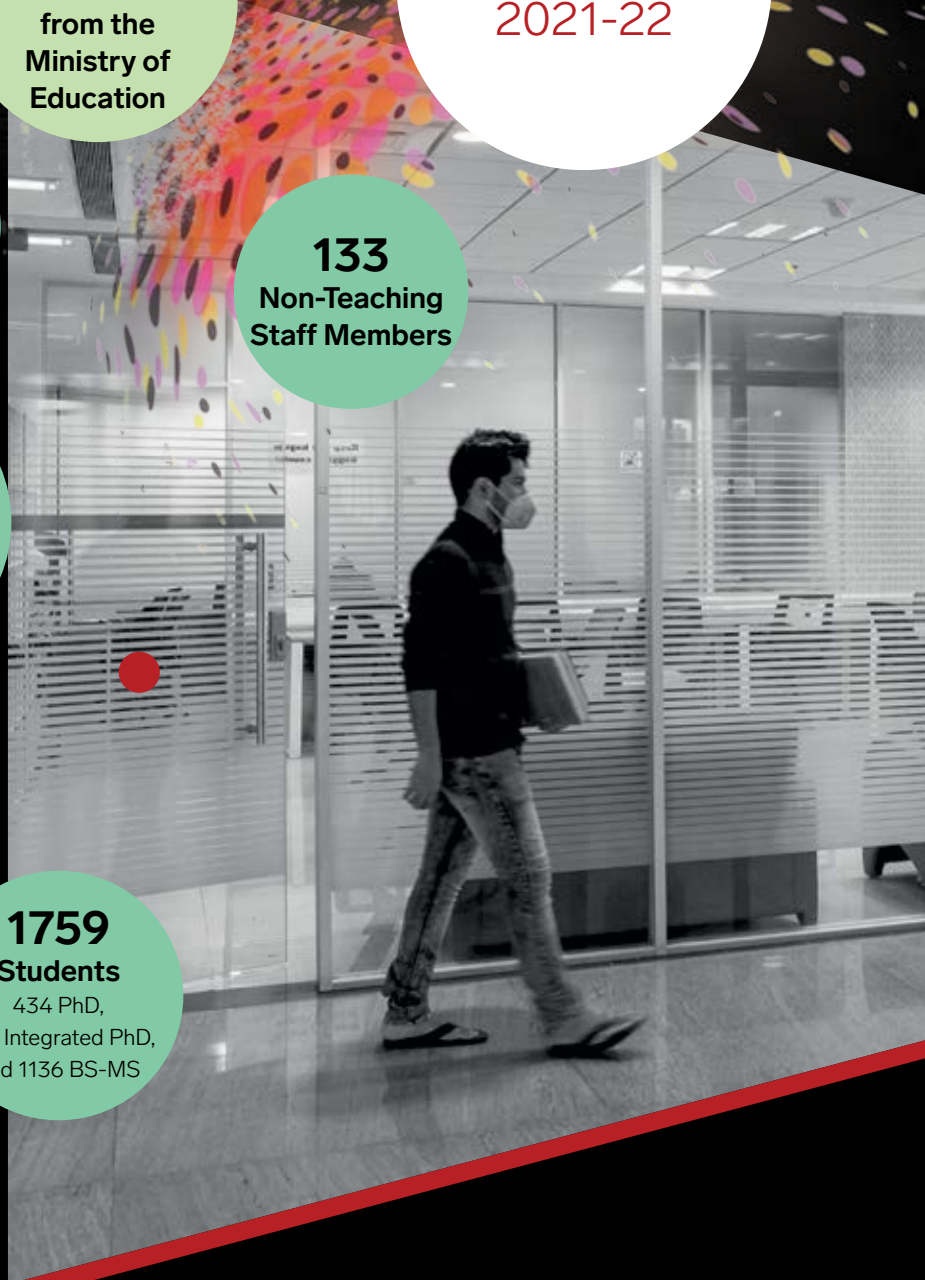
57
Postdoctoral Fellows

133
Non-Teaching Staff Members

136
Faculty Members
+ 21 visiting and emeritus faculty, and project scientists

547
Publications in 2021

1759
Students
434 PhD,
189 Integrated PhD,
and 1136 BS-MS



Numbers are as of March 31, 2022. Financial data rounded off to the nearest whole number.

Foreword

India celebrated its 75th Independence Day, its Azadi ka Amrut Mahotsav, with great enthusiasm this year. Given the progress made since independence, there is now a well-founded hope that India will do very well and join the league of developed nations in the near future.

One characteristic feature of a developed nation is that it has a well-developed and robust base of research in science and technology. This includes establishment of not only a scientific culture, but also of a scientific infrastructure that enables researchers to have accomplishments that are at the cutting edge of science and technology. This is important to scientists as individuals, but it is far more important for society, and for the development of the country. One measure of doing well is to have at least a few individuals doing exceptionally well, carrying out research that would qualify as being of Nobel Prize quality. India had several individuals of that level of accomplishment before independence, and there was one Science winner. After independence, there have also been a few of that level of accomplishment. GN Ramachandran was one who should certainly have received the big prize. But overall, there have been too few scientists of that calibre.

Our base for research in science was very small for the first fifty years of our independence. In the first twenty-five years, many new research institutes were started, a testimony to the realization of the people and the government that, even in a poor country, science and technology matter for economic and social development. Research institutes struggled to do well despite the paucity of funds, and it is a tribute to the scientists working then, that they managed to achieve some level of excellence. These scientists were committed and motivated individuals working hard, and they made things so much better for future generations. It was at this time that the first of what would now qualify as a mission program, the Atomic Energy program, took off. It was the first example of what self-reliance could achieve in the country, when science and technology received good government support.

The next twenty-five years were a kind of status quo. Very few new research Institutes were established. Universities in particular continued to struggle with even less funding for research than the newer Institutes. Going through some level of struggle is necessary for being successful, but this was struggle of the debilitating kind. The country continued to go through difficult times in terms of funding for science. A few scientists did very well only because of their own very strong commitment and self-motivation and persistence in the face of the problems they faced while dealing with the hassles of bureaucracy and insufficient funding. A second example of national self- reliance emerged with the development of the Space program, and there was some success in allied defense programs. It was again a sign that we Indians could work together as a team in mission mode, for achieving international success.

In the past twenty-five years, the base for research in science has been expanded dramatically. Many new institutes and universities have been started, including IITs and IISERs. Research in an undergraduate setting had been carried out in inadequately funded universities for decades, in some cases in almost a heroic manner. Now for the first time, research started being carried out in relatively well-funded undergraduate settings. In particular, IITs converted themselves into research universities from being previously focused primarily on education. Many private

universities have also been set up, and some seem to be very serious in their intention to establish well-funded research programs. It is important for the country that all research universities in the country, public and private, succeed in their endeavors, and government policies have to be implemented well to ensure that this happens. Very importantly, the country's scientists showed once again that they could deliver, this time at a time of crisis during the pandemic. The momentum has to be maintained.

The research base in the country is still far too small. For example, the number of research scientists in biology departments in all Indian research institutions and universities combined, with access to the facilities they require, is smaller than the number of research biologists in a single large university in other parts of the world. It is not too different in the case of other science departments. The number of Indian science PhDs per capita, an important benchmark of development, is much smaller in India than in any developed country. We hope that the economy will grow well enough in the near future that the country will be able to increase its financial commitment to research and technology development, to make it on par with funding in the developed world. The country will never be able to develop in the truest sense without a strong and robust research ecosystem.

What can we do at the Institute level? The Institute now receives funding more or less at par, when normalized against faculty/student strength, with that at other government-funded research universities. It is unlikely that our funding will improve dramatically in the very near future, and we have to do well within the financial constraints. The Institute was fortunate in receiving very generous funding for its first twelve years when it was in Project mode. We have been doing well; indeed, we had no excuse not to do well. We now have to show we can do even better, despite funding having become much tighter. While we often require state of the art equipment to do state of the art research, it is possible in many cases to think of different solutions to the research problems we attempt to solve. While ideally our research accomplishment should be limited only by our intellectual abilities, without any financial or other constraints whatsoever, this is practically never the case in nearly all parts of the world.

I am sure that with not too much struggle, and with a lot of perseverance, the Institute will do very well in the years to come. There are many challenges, which I am sure we will overcome. We need to set our sights high, discard our feelings of entitlement, and continue to show that as scientists we are no less than scientists anywhere else in the world. We should do well enough so that our Institute is counted in the top three research universities in the country in the very near future. It is very doable.

Jayant B. Udgaonkar
Director, IISER Pune
September 03, 2022

Director's Report

I present here the Annual Report of the Institute for the duration April 2021 to March 2022. After the pandemic related disruptions of 2021, the year 2022 has been a better year, and with all students back at the Institute, vibrancy and all sorts of activities have returned to the campus. It is only through the hard work put in by the Institute COVID-19 Task Force, that there is now a more normal life on campus. Hopefully, the Institute will be back to complete normalcy very soon.

The year 2021-22 was an important year in the genesis of the Institute. The new Department of Data Science got off the ground with faculty members joining it. It will surely grow well. The Department of Science Education has also been established, and it is expected that it too will grow well, once the Institute is once again allowed to hire new faculty members. These new academic activities, along with a greater appreciation of the importance of the Humanities and Social Sciences at the Institute, will ensure that students at IISER Pune receive a well-rounded education that prepares them well for their future life once they leave the Institute.

The Institute now has 136 faculty members in eight departments. There are also 1136 BS-MS students, 189 Integrated PhD students, and 434 PhD students.

An Institute grows well when its new faculty members do well. They bring in new ideas, new enthusiasm and new energy. The Institute welcomed seven new faculty members to its teaching and research programmes during the last year. They include Professor Amit Apte (Data Science), Professor Rajesh Gokhale (Biology), Dr. Leelavati Narlikar (Data Science), Dr. Kalika Prasad (Biology), Dr. Ashish Arora (Physics), Dr. Arka Banerjee (Physics), and Dr. Susmita Adhikari (Physics).

Research at the Institute continues to flourish. Faculty members and students published 547 papers during the 2021 calendar year. Eleven patent applications were filed, 7 published, and 5 patents granted to faculty members during the same period of time.

Over the past year, faculty members secured extramural funding for 51 new projects. Among these were three new DBT/Wellcome Trust India Alliance grants, and grants under two new schemes, namely, the SUPRA (Scientific and Useful Profound Research Advancement) scheme of the Science and Engineering Research Board, and the Team Science scheme of the DBT/ Wellcome Trust India Alliance. The Chemistry department received its second FIST Grant. The interdisciplinary Centre for Water Research established in 2020 had several activities through the year, including consultations with key stakeholders, talks and meetings.

The Institute now hosts two Section 8 companies dedicated to promoting innovation on campus. The technology business incubator, AIC-SEED, is supported by the Atal Innovation Mission, NITI Aayog, Govt. of India, and was inaugurated in April 2021. The I-Hub Quantum Technology Foundation was set up earlier during 2020-21 with support from the Department of Science and Technology. I am sure that, in the coming years, these two companies will play a proactive role in making the IISER community think seriously about translating their research and ideas into products useful for society.

In the 2021 India Rankings of the National Institutional Ranking Framework (NIRF), which considers all universities and national institutes in India, IISER Pune was ranked at the 24th position in the overall category, and at the 16th position in the research category.

The research accomplishments of faculty members have been recognised by various prestigious awards. Prof. Deepak Dhar was selected to receive the prestigious Boltzmann Medal for 2022; Prof. Srinivas Hotha and Prof. Ramanathan Vaidhyanathan were named Fellows of the Royal Society of Chemistry, U.K; Prof. Ramanathan Vaidhyanathan was appointed as an Associate Editor of the journal *Chemistry of Materials*; Prof. Sutirth Dey and Prof. R. Boomi Shankar received the SERB-STAR Award for 2021; Dr. Srabanti Chaudhury and Prof. R. Boomi Shankar received the Bronze Medals of the Chemical Research Society of India for 2022; Dr. Nishad Matange was selected for the 2021 eLife Ben Barres Spotlight Award; Dr. Mousomi Bhakta and Dr. Siddhesh Kamat were selected for SwarnaJayanti Fellowships for 2020-25; Dr. Raghav Rajan has been selected for the Senior Fellowship awarded by the DBT-Wellcome Trust India Alliance; Prof. Shyam S. Rai received the Raja Ramanna Fellowship; Dr. Sudipta Sarkar was elected as a Fellow of Geological Society of London; Dr. Sagar Pandit was elected as a Life Fellow of the Royal Entomological Society, U.K.; Dr. Amrita Hazra has been nominated for ChemBioTalents 2022 by *ChemBioChem* journal; Dr. Gnanaprakasam Boopathy received Acharya P.C. Ray Flow Chemistry Technology Award (2021); Prof. Satishchandra Ogale received the CNR Rao Prize Lecture award in Advanced Materials for the year 2021 from the Materials Research Society of India; and Prof. Rajesh Gokhale was appointed as the Secretary of the Department of Biotechnology. Further, several of our faculty members serve on editorial boards of scientific journals and contribute to the peer-review process within the community.

After successfully running a COVID-19 testing centre with the help of volunteers from amongst students, staff, and faculty members during 2020, the Institute ran a COVID-19 vaccination centre during 2021, where a total of 4405 individuals received their vaccines. The doctors and nurses of the campus Wellness Clinic, as well as the counsellors played an important role, often going beyond the call of duty, in keeping the campus safe and healthy.

Another major contribution towards tackling COVID-19 came from genome sequencing efforts at the Institute. IISER Pune became a member of the Indian SARS-CoV-2 Consortium on

Genomics (INSACOG), a consortium of National Laboratories established by the Ministry of Health and Family Welfare and the Department of Biotechnology. The Institute is also part of a consortium led by CSIR-CCMB, Hyderabad for SARS CoV-2 genome sequencing and environmental surveillance across four major Indian cities (Hyderabad, Bengaluru, Pune and Delhi). IISER Pune, the Pune Knowledge Cluster and NCL Pune represent Pune city in the consortium. The bulk of the clinical samples and all the environmental surveillance samples from Pune city are sequenced at IISER Pune. The SARS-CoV-2 genome sequencing effort at IISER Pune is currently supported by the Rockefeller Foundation, the Villoo Poonawalla Foundation (VPF) and the Jankidevi Bajaj Gram Vikas Sanstha. Faculty members Krishanpal Karmodiya, Aurnab Ghose and Joy Merwin Monteiro are coordinating this initiative.

Several of the Institute students received accolades for their performance in academics and innovation. Curem Biotech, the first student-led start-up of IISER Pune, was incubated at the Atal Incubation Centre on the campus. The team won BIRAC's Biotechnology Ignition Grant and the iGEM Startup Showcase. A team of students from IISER Pune won a gold medal at the 2021 iGEM Synthetic Biology Competition. BS-MS student Chirag Gupta was among the toppers of CAT2021.

IISER students had to spend a good part of the year attending classes online from home, and this meant limited opportunity to pursue extracurricular activities. Nevertheless, they made the most of this difficult situation, and adapted some extracurricular activities to the online mode. The students participated in the Inter-IISER virtual games and sports fest – Tenacity conducted by IISER Kolkata, conducted the Mimamsa annual science quiz online, and took part in the cultural events conducted by IISERs Pune and Berhampur as part of the Ek Bharat Shrestha Bharat programme. Prutha, the green club, organised events on the campus such as counting of bird species and recording biodiversity on the campus. Returning to campus earlier this year allowed students to participate in the IISER Premier League cricket tournament.

During 2021-22, the Institute received financial commitments of Rs 3.14 crores from companies and individuals to support various activities. Funds were raised towards research and outreach activities, and for providing financial assistance to students.

Through generous support from Integrated Decisions and Systems (India) Private Limited (IDeaS), Innoplexus Consulting Services Pvt. Ltd., Alta Laboratories Ltd., Twenty Twenty Interior Design Software (I) Pvt. Ltd., Xytel India Pvt. Ltd., and Trimurti Fabricators Pvt. Ltd., financial assistance has been extended to 133 students belonging to the economically weaker section.

Tuition-fee waivers and travel grants from Infosys Foundation Endowment Fund were extended to 48 BS-MS students and 4 Integrated PhD students whereas the travel grant is availed by 7 PhD and Integrated PhD students. Eight of our exceptional students were recognised for their innovative research in various disciplines through Best Thesis Awards supported by Xytel Ltd.

The Institute mourned the sad demise of Shri Rahul Bajaj, a long-time benefactor of IISER Pune, in February this year. Through the endowment instituted by him, in 2021, three faculty members, Dr. Mousomi Bhakta, Prof. Pinaki Talukdar, and Prof. Thomas Pucadyil, were recognised for their academic achievements through Chair Professorships named after Shri Rahul Bajaj.

The Institute engaged with 22 organisations from industry and academia in India and elsewhere towards building research partnerships. Considering the strong research collaboration in the area of Chemistry, and also the Dual Masters and Doctoral Degree (DMDD) programme, the MoU for academic and research collaboration between IISER Pune and Temple University, Philadelphia, U.S.A. was renewed for the next five years. The Institute signed a MoU with Durham

University as the first milestone in developing a collaboration for a virtual Centre for Teaching Excellence and Pedagogy (vCTEP) along with international partners. A MoU with the Institut de Physique du Globe de Paris (IPGP), France was renewed for four years towards a Dual Master's degree programme in Earth Sciences. A joint workshop series has been initiated with the School of Education, University of Glasgow, U.K. Based on the results of these workshops, a course for training teachers will be co-developed by the University of Glasgow's School of Education and IISER Pune.

During the COVID-19 pandemic, the Science Activity Centre started a Sunday live lecture and demonstration series. The total number of views surpassed 2,22,300 in the last year. The Centre also organised Wednesday live demo sessions, Toycathon, children's day and science day celebrations, all of which allowed the Institute to reach out to the wider student and teacher community. The iRISE and MS-DEED projects hosted at the Institute are reaching out to the teacher and researcher community via capacity building training activities.

In July 2021, a major fire damaged some of the laboratories in the Chemistry wing, resulting in the loss of reagents and equipment, and disrupting the work of several research students. The restoration work of these laboratories was started immediately after the fire incident by the Institute Engineering Section and the majority of this work has been completed.

The Institute has benefited tremendously from the smooth functioning of its statutory committees, the Senate, the Building and Works Committee, the Finance Committee, and the Board of Governors. The advice and guidance of all members of the Board of Governors have been invaluable, especially that of its Chairperson, Shri Sudhir Mehta.

Jayant B. Udgaonkar
Director, IISER Pune

Governance

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SENATE

List is as of March 31, 2022; changes during the year not shown here

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Prof. Sudarshan Ananth	*Chair, Physics*
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Prof. Bhas Bapat	*Professor*

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Shri. P.M. Kanvinde	*Architect and Former Principal, Abhinav K.M. & College of Architecture, Pune*
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Shri. Mohan Khemani (from 25/05/21)	*Chief Engineer - Electrical (Retd.), CPWD, Delhi*
Prof. Srinivas Hotha (from 25/03/2022)	*Professor and Dean (Planning and Communications), IISER Pune*

Secretary

Col. G. Raja Sekhar (Retd.)	*Registrar and Engineer-in-Charge, IISER Pune*

Research Activities and Achievements

RESEARCH REPORT

Publications in 2021
TOTAL: 547

113
BIOLOGY

123
CHEMISTRY

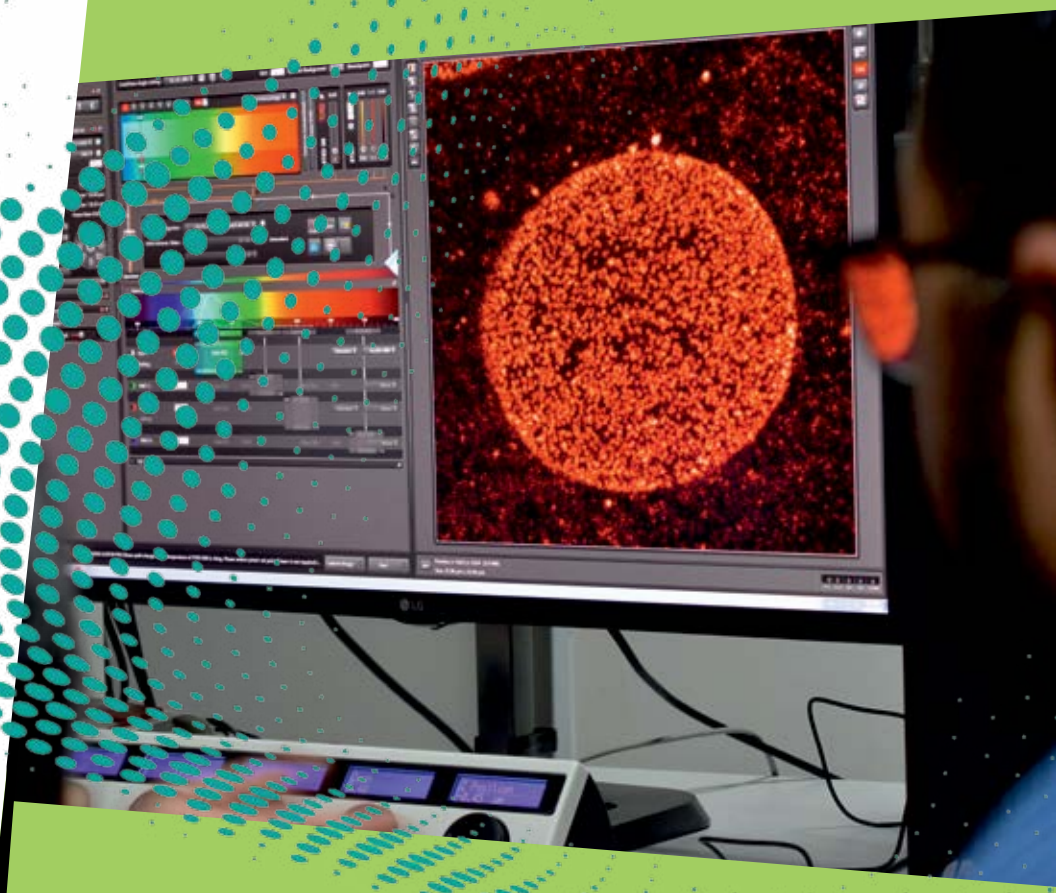
01
DATA SCIENCE

15
EARTH AND CLIMATE SCIENCE

07
HUMANITIES AND SOCIAL SCIENCES

45
MATHEMATICS

243
PHYSICS



Research at IISER Pune aims to reach a fundamental understanding of how the physical world works. Research is carried out through the departments of biology, chemistry, data science, earth and climate science, humanities and social sciences, mathematics, and physics.

The year 2021-22 saw two new research departments being initiated. The Data Science department began its operations with the joining of two new faculty members, and the setting up of a new department of Science Education has been initiated by a coordination committee.

With 547 papers during 2021, IISER Pune has performed consistently in terms of obtaining research publications from work carried out at the Institute. During the 2021 calendar year, IISER Pune filed 11 patent applications, had 07 patents published, and 05 patents granted.

Read through the pages of our research report across our departments for a glimpse of the diverse areas of work being pursued.

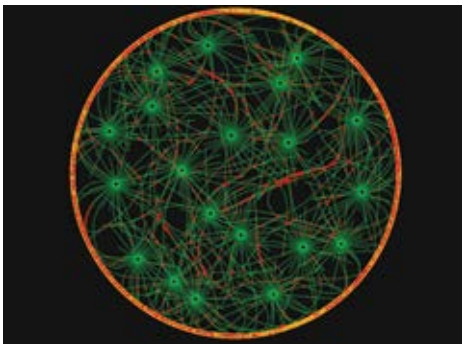
1. BIOLOGY

1.1 BIOCHEMISTRY AND BIOPHYSICS

Self-organisation and cell morphogenesis

Research in Dr. Chaitanya Athale's group focusses on cytoskeletal mechanics and molecular motors in determining cell shape. The group has examined the role of kinesin-5 motors in segregation of multiple MT asters in a marine Ascidian. In collaboration with a lab in the Marine Observatory in Villefranche, France, they have shown that the microtubule-patterns can be explained by simulations, suggesting a novel intracellular compartmentalisation mechanism. They have also used a combination of microscopy, image-analysis and modelling to demonstrate how the physics of intracellular fluid properties constrains spindle dynamics in *Caenorhabditis elegans*, in collaboration with a research group in ENS Lyon, France. The group has recently demonstrated that mung (Vigna sp.) tubulin polymerisation diverges from brain tubulin and this can help us better understand the relative effect of kinetic diversification and function in cells.

Figure 1:
The simulation of multiple microtubule asters in a circular boundary that can spontaneously undergo rotational motion. Khetan & Athale (2020) Soft Matt. (Dr. Chaitanya Athale's Group)



Biological mechanisms of lipid signaling pathways

While there are several established high throughput platforms to study DNA (genomics), RNA (transcriptomics) and proteins (proteomics), there is a large disconnect in terms of biochemical technologies available that relate protein activities (in particular, enzyme activities) to their endogenous substrates and products. Assigning biochemical and cellular functions to proteins is critical to achieve a deeper mechanistic understanding of pathological disorders that have a genetic basis but mechanistic roles of the proteins involved are not known.

Dr. Siddhesh Kamat's group is working to build on emerging biochemical platforms to enable us to identify and understand as-of-yet uncharacterised lipid signalling pathways in vivo, annotate their metabolic enzymes and cognate receptors that regulate their biology, and provide new physiological insights and treatment paradigms for orphan and/or emerging human neurological and immunological diseases.

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.

A few highlights of this year's achievements are listed below:

- The group has determined the structure of HPT domain of FrzE, a component of the chemosensory pathway in *Myxococcus xanthus*. Currently studies are underway to characterise its enzymatic activity and interaction with other partners such as FrzCD, FrzA and FrzB.

- Characterisation of interaction between RomRX and MglAB components of *Myxococcus* polarity determinants are in progress.
- Characterisation of FtsZ from the cell wall less organism *Spiroplasma* have helped us understand the factors determining the domain swap of FtsZ, and thereby its filament dynamics. Further, drug resistance mechanisms of FtsZ against PC197203 have been identified based on sequence and structure analysis.
- Characterisation of filament dynamics of MreB of *Spiroplasma* has led to the identification of its modulation by nucleotide dependent membrane binding.
- Sequence analysis of FtsZs from cell wall less bacteria has helped us identify FtsZs that are capable of direct membrane binding in certain mycoplasmas.

1.2 CELL, ORGANISMAL, AND DEVELOPMENTAL BIOLOGY

Cell adhesion and regulation of membrane trafficking by cell adhesion

Integrin-mediated adhesion regulates the trafficking and plasma membrane localisation of raft microdomains to control anchorage-dependent signalling. Their endocytosis is regulated by Caveolae and its phosphorylation (tyrosine-14 residue-pY14Cav1) and exocytosis through the RalA-Arf6-exocyst complex. Dr. Nagaraj Balasubramanian's ongoing work studies the AURKA-RalA crosstalk in Ras-dependent and independent cancers using nanovesicle encapsulated AURKA inhibitor Alisertib (MLN8237) to target anchorage-independent signalling. They further studied the role and regulation of pY14Cav-1 in regulating adhesion-dependent signalling across 2D and 3D microenvironments of varying stiffness. The lab is also interested in understanding how adhesion regulates Golgi and mitochondria organisation and function. Work from the group revealed integrin-mediated adhesion to regulate Golgi organisation and mitochondrial potential, supporting a possible role for this regulation in anchorage-independent cancers. The lab is also interested in understanding the role organelle heterogeneity has in regulating cancer phenotypes. In studies done as a collaboration with companies making dental implants, the group used their expertise in 3D cell culture and imaging to develop an assay to understand cellular behaviour around dental implant surfaces. Their studies further aim to understand how matrix architecture is altered by cells in proximity to implants.

Chromosomal segregation during cell division

Dr. Mridula Nambiar's research focuses on understanding the molecular mechanisms underlying errors in chromosomal segregation during cell division. The group is using the genetically tractable fission yeast *Schizosaccharomyces pombe* as an experimental model to investigate the role of aberrant DNA recombination at centromeres in generating segregation errors during meiosis. Their recent data suggests a predominant increase in non-disjunction events at meiosis I in mutants proficient for centromeric recombination, compared to other error types. They have successfully been able to adapt a fluorescence-based assay in *S. pombe* to monitor various types of chromosomal segregation errors at the end of meiosis. They are also exploring the molecular interactions responsible for loading the ring-shaped cohesin complexes at the centromeres and the surrounding heterochromatin, since centromeric cohesion is essential to maintain accurate chromosomal segregation fidelity both in meiosis and mitosis. The composition of cohesin complexes varies at the centromeres and the chromosomal arms in meiosis, but interestingly there is only one cohesin loading complex. Their results suggest that there are certain rules with respect to different cohesin subunits forming a functional complex inside cells and consequently getting loaded at the centromeres. The group is currently trying to determine the molecular mechanisms for explaining the observations.

Stem cell, regeneration and patterning in plants

Totipotency is a hallmark of plants, where shoots or roots can be formed de novo from undifferentiated callus. During de novo shoot organogenesis, the entire shoot arises from a few initial cells. How these initials are selected and what governs their progression to a patterned organ system remain unresolved. Dr. Kalika Prasad's ongoing studies show that shoot meristems arise only from one type of initials, termed 'productive progenitors.' Although both productive and pseudo-progenitors express stem cell marker, only the former adopts a unique cell polarity regime that correlates with low auxin levels. A shell of cells surrounding the productive progenitors expresses a cell wall loosening enzyme, thus generating a juxtaposition of cells with different mechanical properties. This mechanical conflict instructs the polarity regime and meristem formation. Their findings reveal a simple model that accounts for de novo organogenesis in the absence of tissue-dependent patterning cues.

Regulatory processes that govern growth and development in bacteria

The primary focus of Dr. Sunish Radhakrishnan's group is to understand the fundamental regulatory processes that govern growth and development in bacteria. They are interested in understanding how bacterial cells perceive changes in the environment and relay it to the regulatory signalling processes that control growth and proliferation. Work from the group had demonstrated that the cytoplasm of the bacterial model, *Caulobacter crescentus*, remains oxidised during specific stages of the cell cycle. Furthermore, they discovered that the change in cytoplasmic redox influence the activity of key developmental proteins during the cell cycle. The group has recently found that the change in cytoplasmic redox likely reflects the metabolic state of the cell and could very well be a means by which bacteria integrates cellular metabolism to development and growth. Going ahead, they are invested towards teasing out the underlying mechanisms that help bacterial cells to utilise the dynamic cytoplasmic redox to pause, progress, or fine-tune, the cell cycle in response to nutrient availability and environmental changes.

Molecular principles underlying animal development and disease

Molecular mechanisms underlying the development of organisms are remarkably conserved. Many developmental paradigms and their underlying genetic networks were first elucidated in *Drosophila* and have provided insights into the development processes governing other organisms, including humans. In Dr. Girish Ratnaparkhi's research group, they utilise *Drosophila melanogaster* as a model organism to study the regulation of cellular signalling in the context of development and its mis-regulation in disease.

1. Signalling in the innate immune response. In *Drosophila*, the Toll/NFkB and IMD/NFkB signalling cascades are the major facilitators of the host-defence response to pathogens. They are interested in uncovering new mechanisms and players that fine-tune the immune response; these include studying SUMO conjugation of proteins in the cascade and uncovering roles for orphan serine hydrolases in the immune signalling.

2. Signalling mechanisms regulate disease progression in a *Drosophila* model for Amyotrophic Lateral Sclerosis 8 (ALS8). ALS8 is caused by a mis-sense mutation in VAPB, an ER resident protein that maintains membrane contact sites. The group has generated a fly model for ALS (VAPALS8) that shows large inclusions in the brain, has a shortened lifespan and shows progressive motor deterioration with age. This disease model has given us novel insights into roles for glial inflammation in disease progression and important roles for proteasomal clearance mechanisms in neurons.

1.3 CHROMOSOME BIOLOGY AND EPIGENETIC REGULATION

Epigenetics and transcriptional regulation in *Plasmodium falciparum*

Plasmodium falciparum infects millions and kills thousands of people annually the world over. It has been identified to possess a tightly regulated gene expression profile which is integrally linked to its timely development during the intraerythrocytic stage. Epigenetic modifiers of the histone acetylation code have been identified as key regulators of the parasite's transcriptome. Dr. Krishanpal Karmodiya's group characterised the solitary Class I histone deacetylase PfHDAC1 and demonstrated that it binds to and regulates parasite genes responsible for housekeeping and stress-responsive functions. They found that PfHDAC1 activity in parasites is crucial for normal cell cycle progression/morphological development and its cellular abundance is correlated with parasitemia progression. They further show that PfHDAC1 has differential abundance and genomic occupancy in artemisinin drug resistant vs sensitive parasites and inhibition of its deacetylase activity can modulate the sensitivity of parasites to the drug. Collectively, their results demonstrate PfHDAC1 to be an important regulator of basic biological functions in parasite while also deterministic of responses to environmental stresses like antimalarial drugs.

1.4 ECOLOGY AND EVOLUTION

Ecology of plants

Work in Dr. Deepak Barua's group examines the functional ecology of plants, to understand how integration of anatomical, morphological and physiological traits translates to plant performance under varying environmental conditions, and determines species interactions and distributions. Ongoing work investigating the physiological mechanisms underlying plant responses to high temperatures and drought is focused on elucidating responses of tropical trees to future global warming and climate change. They have characterised the tolerance to high temperature and drought in trees from the Western Ghats of peninsular India including seasonally dry forests in the North to more evergreen forests in wetter sites in the Central and Southern Western Ghats. Recent work extends this to mangrove ecosystems in the coastal regions. In this work they examine the underlying mechanisms for temperature and drought, and plan to scale up to community level responses to determine how future climates will affect ecosystem dynamics and function in tropical forests. Other projects recently initiated include studies to determine the spatial and temporal patterns in distribution of invasive plants, and consequences of invasion for the native plant communities in the Northern Western Ghats.

Population dynamics

Prof. Sutirth Dey's group investigated ecological specialisation using experimental evolution with *Escherichia coli* in several constant and fluctuating environments at multiple population sizes. The group found that in fluctuating environments, smaller populations paid significant costs, but larger ones avoided them altogether. Contrastingly, in constant environments, larger populations paid more costs than the smaller ones. Overall, large population sizes and fluctuating environments led to cost avoidance only when present together. Mutational frequency distributions obtained from whole-genome whole-population sequencing revealed that the primary mechanism of cost avoidance was the enrichment of multiple beneficial mutations within the same lineage.

Stress can serve as both a cause and a cost of dispersal. By modulating water and rest available to populations of the common fruitfly, they asked whether (a) dispersers are individuals that are

more susceptible to desiccation stress, (b) dispersers pay a cost in terms of reduced resistance to desiccation stress, (c) dispersal evolution alters the desiccation cost of dispersal, and (d) females pay a reproductive cost of dispersal. The group found that desiccation was a clear cause of dispersal in both sexes, as both male and female dispersal propensity increased with increasing duration of desiccation. However, the desiccation cost of dispersal was male biased, a trend unaffected by dispersal evolution. Instead, females paid a fecundity cost of dispersal.

1.5 NEUROBIOLOGY AND COMPUTATIONAL BIOLOGY

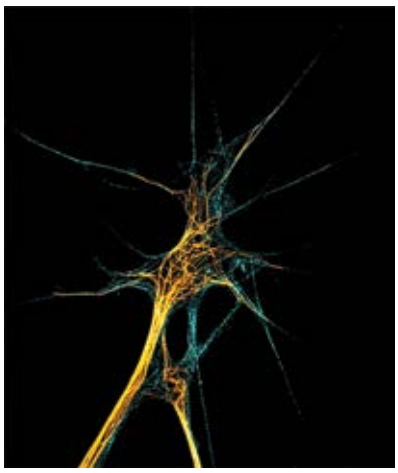
Olfactory information processing and decision-making

Decision-making requires sensory information processing as well as cognitive control that lead to behavioural responses, which entails making choices in various situations. This is a complex process that evaluates various physical, emotional, and social criteria and contributes to choice selection by favouring one option over many other viable options. Sensory information that leads to percept formation in real life is often noisy and changes continuously raising the questions of how and how quickly are accurate complex decisions made? Making decisions are intricately linked to reversal of wrong decisions. If the wrong decisions are made, how do our brains revert these? Dr. Nixon Abraham's group studies these questions at Laboratory of Neural Circuits and Behaviour using rodent olfactory system as the model. Investigation of the olfactory perception limits by combining experimental data with mathematical approaches concluding that humans can discriminate one trillion odors, is now challenged. In case of rodents, when the group trained mice to discriminate binary mixtures that were mixed in gaseous phase and liquid phase, animals had difficulties in discriminating certain mixtures and the patterns evoked by these mixtures were not separated by the olfactory bulb circuits. These observations raise the question about the limits of olfactory perception. Therefore, detailed analysis of the perceivable complexity of olfactory stimuli by looking at the animals' decisions and reversals under different contexts is essential.

Development and functional plasticity of nervous systems

Neural circuit outputs are constrained by their physical architecture and are modifiable by neuromodulators to generate a diversity of outcomes. Dr. Aurnab Ghose's group investigates these areas using quantitative cell biology, biophysical measurements, activity imaging and behavioural analysis. In the context of development, this work underscores the role of precise cytoskeleton remodelling in various aspects of neuronal morphogenesis and circuit formation. In addition to identifying novel cellular processes, these studies have begun to uncover the mechanistic underpinnings of poorly characterised cytoskeleton regulators associated with neurodevelopmental disorders. Neural circuits underlying innate behaviours need to be re-configured flexibly to match them with prevailing physiological states. The group has identified specific biochemical signalling by neuropeptides that generate nutritional state-dependent circuit plasticity. Ongoing work focuses on peptidergic modulatory mechanisms that adaptively prioritize behaviours in response changes in nutritional states.

Figure 2:
STED nanoscopy of spinal neuron growth cones isolated from a chick embryo with labelled microtubules (gold) and F-actin (cyan). Kundu, Dutta et al, (2021) J Cell Sci (Dr. Aurnab Ghose's Group).



Neural mechanisms underlying movement initiation in songbirds

Animals, including humans, produce many complex behaviours consisting of sequences of movements. These behaviours involve the co-ordination of multiple muscles in the body and can be triggered by external and/or internal stimuli. The goal of Dr. Raghav Rajan's laboratory is two-fold: (1) to understand the neural events that connect the stimulus (internal or external) to the appropriate behavioural response and (2) to understand how the brain controls the order of movements within the behavioural response.

Given an interest in natural, ethologically relevant behaviours, the group uses songbirds as their model system. The song of an adult songbird consists of a sequence of sounds interleaved by silent gaps. Each sound is the result of coordinated activity of vocal (syringeal) and respiratory muscles. Song is part of a courtship ritual triggered by the presence of a female bird. Birds also produce song when they are alone without any external stimulus. Thus song is an excellent example of a complex, natural behaviour (consisting of a sequence of movements) that is triggered by external or internal stimuli.

What are the neural events that lead up to song initiation and what are the neural mechanisms that determine the order of sounds within a song? The Rajan Lab uses a variety of tools, including electrophysiological recordings, pharmacological infusions and behavioural experiments in awake, singing birds to address these questions.

2. CHEMISTRY

2.1 ORGANIC CHEMISTRY AND CHEMICAL BIOLOGY

Synthesis of heterocyclic and macrocyclic compounds

The primary goal of Dr. Gnanaprakasam's research group is to develop step-economy and sustainable annulation/cyclisation reaction for the synthesis of heterocyclic and macrocyclic compounds. To this direction, a base-free and acceptorless Ru-catalysed dehydrogenative approach for the synthesis of N-heterocycles by using 1,3-dicarbonyls and amino alcohols through a domino sequential enamine formation and intramolecular oxidative cyclization strategy has been developed. This protocol is general for the synthesis of varieties of biologically important scaffolds such as, tetrahydro-4H-indol-4-one, 3,4-dihydroacridin-1(2H)-one and tetrahydro-1H-xanthen-1-ones derivatives using a single catalytic system, viz $RuH_2CO(PPh_3)_3$. Furthermore, Dr. Gnanaprakasam's research group has also developed a new approach for the end-to-end cyclisation to construct macrocycles through inter/intramolecular dehydrogenative coupling of alcohols and ketones in the presence of Ru-MACHO catalyst. In addition, Dr. Gnanaprakasam's research group discovered the transition-metal-free sequential oxidative fragmentation and rearrangement of peroxyoxindole for the synthesis of 4-methylene-3-substituted quinazolinone derivatives in the presence of varieties of amine and hydroxyl nucleophiles. This reaction was easily achieved by inexpensive benchtop KOH base under ambient condition and synthesised a large number of quinazolinone derivatives in good to excellent yield. Subsequently, his research group have established Indium-catalysed sequential remote C-H functionalisation (C-6 position) and C3-indolylation of peroxyoxindole using indole for the synthesis of terindolinone derivatives. In contrast with Indium (III) Chloride, $FeCl_3 \cdot 6H_2O$ facilitates oxidative cleavage of the peroxyoxindole (Hock cleavage) and further reaction with indole to afford biologically important trisindoline derivatives.

Redox homeostasis

Prof. Harinath Chakrapani's group has developed artificial substrates for an enzyme that is involved in the biosynthesis of hydrogen sulfide. 3-Mercaptopyruvate sulfurtransferase (3-MST) is directly persulfidated by the substrate 3-mercaptopyruvate, and plays a role in sulfur metabolism and trafficking. They investigated the structure-activity relationship by creating a substrate library which was used to tune the rate of the persulfidation step and achieve a large difference in rates. The efficacy and selectivity of artificial substrates was demonstrated. Thus, the enzyme/ artificial substrate system that his lab has developed can be used for in vitro experiments to generate persulfide by the addition of enzymes that are readily available (esterase and 3-MST); for cellular experiments to enhance persulfide, addition of the compound to cells containing 3-MST is sufficient. Finally, the therapeutic relevance of these engineered substrates is demonstrated through mitigating reactive oxygen species levels in cells and protecting animals from inflammation in the brain in an endotoxin-mediated shock model.

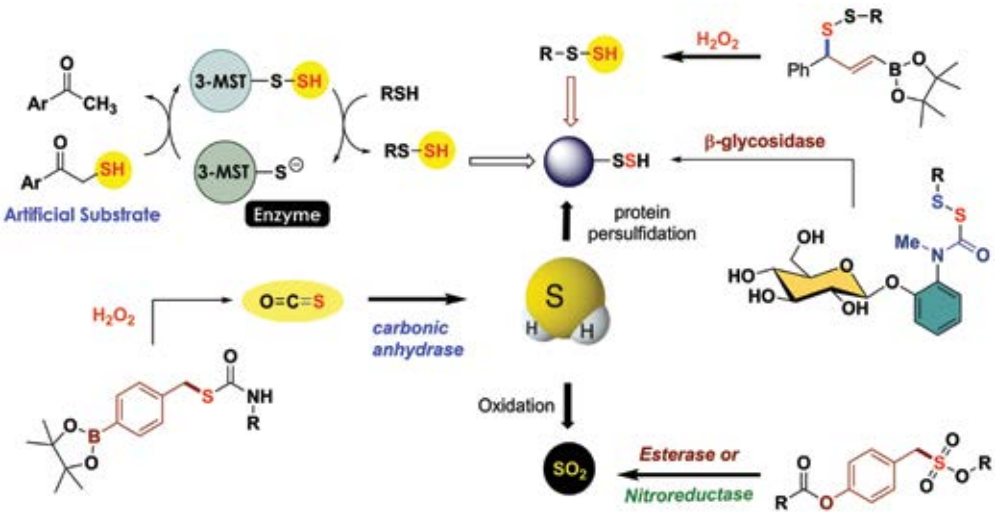


Figure 3:

This enzyme/artificial substrate system can be used for in vitro experiments to generate persulfide by the addition of enzymes that are readily available (Prof. Harinath Chakrapani's Group)

Vitamin biosynthesis

Vitamins are essential biomolecules required by organisms in all domains of life. Vitamins assist enzymes in catalysing metabolic reactions in the cell, ranging from acid-base and oxidation-reduction reactions to radical-based reactions. Dr. Amrita Hazra's laboratory's research programme is built around using vitamin biosynthesis as a tool to study the molecular mechanisms involved in metabolism and nutrient sharing within the bacterial world. To do so, the team uses mechanistic enzymology, analytical chemistry, molecular biology, and microbial genetics. The group works on three main projects in the laboratory:

1. Mechanistic enzymology of the anaerobic biosynthesis of vitamin B12: Vitamin B12 is a tetrapyrrolic corrin cofactor, with a cobalt ion at the center coordinated with an upper and a lower ligand. The anaerobic biosynthesis of the lower ligand of Vitamin B12 involves the bza operon, which contains three unique methyltransferases BzaC, BzaD, and BzaE with unprecedented enzymology. They are currently exploring the mechanisms of these three methyltransferases and related enzymes that assist in lower ligand attachment. https://www.jbc.org/article/S0021-9258(17)50094-0/fulltext

2. Cross-feeding of Vitamin B1 and its biosynthesis intermediates in synthetic microbial communities: Ecosystems are composed of consortia of microbes, many of which are auxotrophic for the synthesis of essential biomolecules. Vitamins are among the repertoire of essential metabolites that commonly get exchanged in the gut and marine microbial communities. The modular nature of vitamin B1 (thiamin) biosynthesis makes it possible for its intermediates or the whole vitamin to be exchanged among members of a microbial community. Dr. Hazra's group has created synthetic microbial co-cultures that rely on the exchange of thiamin and its intermediates to conduct a mechanistic and molecular study of its sharing and synthesis in microbial communities. https://journals.asm.org/doi/abs/10.1128/jb.00503-21

3. Investigating the molecular basis of nucleobase specificity in nucleotide-utilising enzymes: Phosphorylation reactions in biological chemistry typically utilize a nucleotide triphosphate. For example, ATP is a commonly used substrate for kinase enzymes. However, the reaction involves only the use of the triphosphate part of the molecule - the role of the specific nucleobase, adenine in this case, is not apparent. As vitamins such as flavin adenine

dinucleotide and S-adenosyl methionine contain the nucleobase adenine, the group is currently investigating their biosynthesis with a goal of creating their nucleobase homologs for synthetic biology applications. https://chemistry-europe.onlinelibrary.wiley.com/doi/10.1002/cbic.202100211)

Extracellular matrix (ECM) glycopeptides for cell surface markers

Glycosaminoglycans (GAGs) are highly sulfated polysaccharides found on the surface of every mammalian cell. GAGs interact with a plethora of proteins to mediate physiological and pathological processes. The GAGs-protein interactions are governed by four critical and inherent structural aspects: (a) sulfation patterns (O- and N-sulfation), (b) uronic acid composition (L-iduronic acid (IdoA) and D-glucuronic acid), (c) oligosaccharide chain length, and (d) the conformation plasticity of IdoA. Despite rapid progress in the synthesis of structurally defined GAGs, including heparan sulfates (HS), chondroitin sulfate (CS), and keratan sulfate (KS), how the above aspects directly contribute to the biological functions of GAGs remains largely unknown.

Prof. Raghavendra Kikkeri's group reported the synthesis of a new set of HS, CS sialylated-KS, and HS mimics that provide well-defined structures in terms of sulfation patterns, chain length, uronic acid composition and conformation plasticity of IdoA to fine-tuning the recognition and activity of GAGs protein-binding. Microarray, SPR analysis, and STD-NMR studies of HS oligosaccharides with different chemokines, growth factors, selectins, and spike proteins identified several cryptic binding pockets that significantly differ from one other. Notably, I-34 displayed an unprecedented binding specificity to spike protein and the amphiphilic form of this modified the viral infection in *in vitro* model.

Macromolecular engineering

The field of protein nanotechnology is relatively new compared to other nanotechnologies which are based on biological molecules such as DNA, RNA, peptide, carbohydrates and lipids. Computational protein design matured as a robust method for the construction of custom-designed protein nanomaterials of defined size and shape. Although extremely powerful, it is restricted to the standard 20 amino acids that make up the natural proteins. In order to address the limitations of previous methods, Dr. Britto Sandanaraj's group is working on developing chemical technologies for the design of artificial proteins with new functions.

Self-assembling artificial proteins (SAPs) have gained enormous interest in recent years due to their applications in different fields. Synthesis of well-defined monodisperse SAPs is accomplished predominantly through genetic methods. However, the last decade has witnessed the use of a few chemical technologies for this purpose. In particular, micelle-assisted protein labeling technology (MAPLabTech) has made huge progress in this area. The first generation MAPLabTech focused on site-specific labeling of the active-site residue of serine proteases to make SAPs. Further, this methodology was exploited for labeling of N-terminal residue of a globular protein to make functional SAPs.

In one study, Dr. Britto Sandanaraj's group described the synthesis of novel SAPs by developing a chemical method for site-specific labeling of a surface-exposed cysteine residue of globular proteins. In addition, they disclose the synthesis of redox-sensitive SAPs and their systematic self-assembly and disassembly studies using size-exclusion chromatography. These studies further expand the scope of MAPLabTech in different fields such as vaccine design, targeted drug delivery, diagnostic imaging, biomaterials, and tissue engineering.

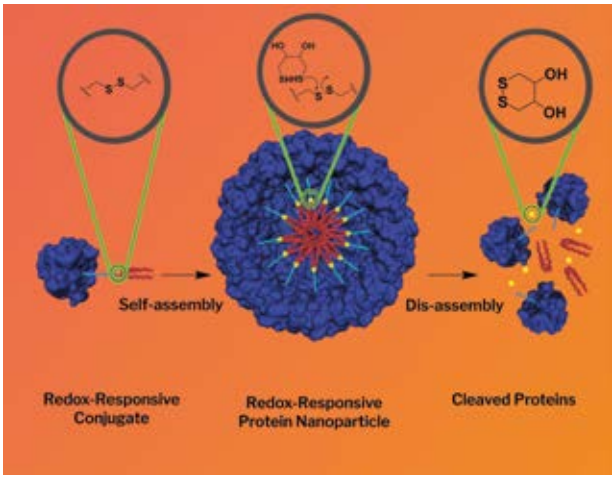


Figure 4:
Synthesis of redox-responsive self-assembling artificial proteins (Dr. Britto Sandanaraj's Group)

Nucleic acid chemistry and biophysics

Prof. Seergazhi G. Srivatsan group is developing biophysical platforms and nucleic acid labelling technologies to understand the structure-function relationship of nucleic acids in cell-free and cellular environments. His group has developed a technology called sgR-CLK, wherein he has repurposed a terminal nucleotide transferase to remodel CRISPR gene editing and targeting system to display small molecules on specific gene targets by click chemistry. This technology offers a simplified solution for site-directed display of small molecule probes, drugs and diagnostic tools on target genes, which can profoundly advance the utility of CRISPR tools in diagnosis and therapeutics. In addition, the group has developed multifunctional nucleoside probes for investigating the structure and ligand-binding properties of oncogenic G-quadruplex and i-motif forming sequences, and DNA polymerase activity in real time and in atomic level by using fluorescence and X-ray crystallography techniques. This small molecule screening platform can greatly facilitate the advancement of G-quadruplex/i-motif based chemotherapeutic strategies. Prof. Srivatsan is also heading a Center of Excellence at IISER Pune, which is part of the InDx program initiated by CCAMP Bangalore on indigenisation of COVID-19 testing kits.

2.2 INORGANIC CHEMISTRY AND MATERIALS SCIENCE

Interfacial materials chemistry

The primary research of Prof. Nirmalya Ballav focuses on interfacial materials chemistry, from fundamentals to applications, upon exploring various solid-solid and solid-liquid interfaces. Research platforms include thin films, coordination polymers, conducting polymers, two-dimensional materials and magnetic semiconductors. Unlike conventional approach, a novel way of electron doping of an electrical insulator with geometrically perfect spin-1/2 Kagome lattice was successfully achieved upon chemically integrating it with the reduced graphene oxide which bestowed a semiconducting property in the material. Also, conversion of an n-type crystalline solid to a p-type crystalline solid was attained upon the chemical integration of a two-dimensional metal-organic framework with reduced graphene oxide. Finally, thin-film to thin-film direct transformation of metal-organic to metal-halide was successfully by exploring chemistry at the solid-gas interface.

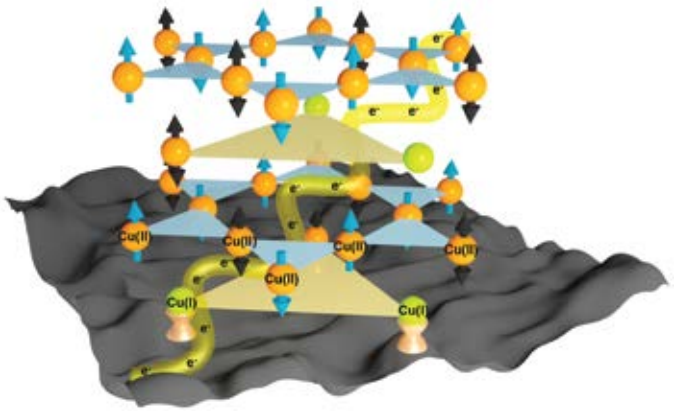


Figure 5:
Schematic of possible electron-doping of spin-1/2 Kagome lattice by functionalised graphene (Prof. Nirmalya Ballav's Group)

Synthetic inorganic chemistry: Materials applications

Small molecules exhibiting ferro- and piezoelectric properties are of recent interest as alternatives for ceramic materials due to their easy synthesis and ability to form flexible devices based on them. Prof. R. Boomi Shankar's group is interested in the design of ferroelectric materials supported by phosphorus and nitrogen-centric molecules and explore them for piezoelectric energy harvesting (nanogenerator) applications. Using heteroleptically substituted ammonium and phosphonium cations and various multi-atomic anions, interesting examples of two component ferroelectrics were synthesised. Particularly, ferroelectric A2MX4, AMX3 and A4(ML6) type hybrid halogenometallate and pseudo-halogenometallate salts were synthesised and studied for their high device performance characteristics in the form of their polymer composites. In addition, the group has also devised several examples of charge-separated, zwitterionic and neutral frameworks that shows not only high ferroelectric polarisation but also very high nanogenerator device characteristics.

Hydrolytic and chemical stability of MOFs

Energy-efficient selective physisorption driven C_2H_2 separation from industrial C2-C1 impurities such as C_2H_4, CO_2 and CH_4 is of great importance in the purification of downstream commodity chemicals. In a recent study, Prof. Sujit K. Ghosh's group addressed this challenge by employing a series of isoreticular cationic metal-organic frameworks. Three square lattice topology MOFs registered higher C_2H_2 uptakes versus the competing C2-C1 gases (C_2H_4, CO_2 and CH_4).

Dynamic column breakthrough experiments revealed the first three-in-one C_2H_2 adsorption selectivity guided separation of C_2H_2 from 1:1 C_2H_2/CO_2, C_2H_2/C_2H_4 and C_2H_2/CH_4 mixtures. Thanks to the abundance of square lattice topology MOFs, this study introduces a crystal engineering blueprint for designing C_2H_2-selective layered metal-organic physisorbents, previously unreported in cationic frameworks (Angew. Chem. Int. Ed. 2021, DOI: 10.1002/anie.202114132.). The group has also recently reported gram-scale synthesis of a previously unreported ultramicroporous MOF, with one dimensional ultramicropores that are lined by purine groups. A basic nitrogen atom of the purine ligand drives high affinity toward C_2H_2 compared to CO_2 and CH_4 with excellent C_2H_2 uptake registered even at a low pressure of ≤10000 ppm. This MOF registers one of the highest separation selectivities among C_2H_2 selective physisorbents that can separate C_2H_2 from CO_2. A new record-high C_2H_2/CH_4 IAST selectivity is also set (Chem. Mater., 2021, 33, 14, 5800-5808).

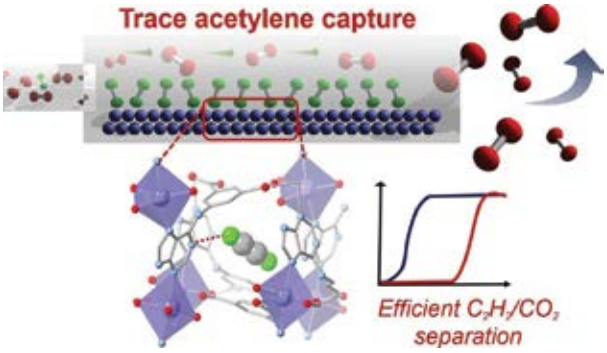


Figure 6:
Efficient capture of trace acetylene by an ultramicroporous metal–organic framework (MOF)
(Prof. Sujit Ghosh's Group)

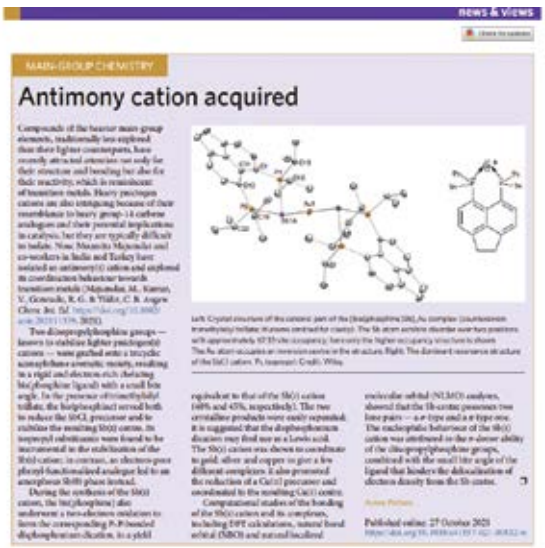
Silylene as a ligand in homogeneous catalysis

Dr. Shabana Khan's group has demonstrated the ability of N-heterocyclic silylenes (NHSis) as the alternative ligands to NHCs. They have prepared silylene [$PhC(NtBu)_2SiN(SiMe_3)_2$] supported Cu(I), Ag(I), and Au(I) arene complexes and utilised them further for catalytic applications e.g. Click Chemistry, A3 coupling, Glycoside synthesis etc. In addition, the group also demonstrated the reactivity of a disilene and silylene towards the main group halides and NOBF4.

Main-group and transition metal compounds for catalysis

The design and syntheses of new classes of ligands is an important objective in catalysis. While most of the electron donor ligands are either neutral or anionic in nature, ligands possessing cationic charges in close proximity to or on the coordinating atom are capable of reducing electron density on the metal center. Such type of transition metal complexes are useful as Lewis-acid catalysts. Earlier Dr. Moumita Majumdar's group established the first example of the low-valent Group 14 Ge(II) dication stabilised within a bis(alpha-iminopyridine) ligand framework, that showed nucleophilic behaviour towards transition metals. In 2021, they have stabilised the fugitive antimony(I) cation using 5,6-bis(diisopropylphosphino)acenaphthene; which is isoelectronic analogue of the neutral carbone. Computational analyses revealed that there are two lone pair of electrons at the Sb(I) cationic site having sigma- and pi-symmetry. The strongly electron-donating and weak accepting nature of the phosphines coupled with the ligand backbone rigidity has enabled accumulation of electron density at the Sb(I) cationic site, thereby exhibiting the first case of nucleophilic behaviour with coinage metals. The group has also prepared an intramolecularly double donor-stabilised stannylene that shows remarkable coordination to the Au(I) cation giving the first example of an ionic homoleptic distannylene-gold(I) complex.

Figure 7:
Work from Dr. Moumita Majumdar's group (Angew. Chem. Int. Ed. 2021, 60, 25522-25529) has been featured in Nature Chemistry by the Editor (Nat. Chem. 2021, 13, 1035)


NEWS & VIEWS

MAIN-GROUP CHEMISTRY

Antimony cation acquired

Codoping in perovskite semiconductors

Over the last 10 years, organic-inorganic hybrid lead halide perovskites have emerged as an interesting optoelectronic material for solar cell, light emitting diodes, photodetectors, LASER, and so on. But an outstanding problem is water/moisture and thermal instability of such material. Over the last year, major research focus in Dr. Angshuman Nag's group was on developing new material design concepts to improve the stability of such hybrid perovskites and their derivatives. The idea was to introduce intermolecular non-covalent interactions within the organic part of the hybrid structure. Two successful outcomes of this idea are: (i) iodine—iodine noncovalent interactions in 2D layered hybrid perovskite $(I\text{-}(CH_2)_n\text{-}NH_3)_2PbI_4$ (n = 2-6) providing enhanced thermodynamic stability of the crystal phase, suppressing temperature dependent phase transition, and (ii) cation-π interactions in 1D hybrid perovskite derivative like (4,4'-TMDP) Pb2Br6 (4,4'-TMDP: 4,4'-trimethylenedipyridinium), yielding water/moisture stability. The long range intermolecular cation-π interactions between the ammonium ion of one 4,4'-TMDP with the aromatic ring of adjacent 4,4'-TMDP becomes significantly stronger than the interaction of water molecules with 4,4'-TMDP.

Another related research direction is the optical doping in Pb-free perovskites. Different Pb-free perovskites like Cs_2SnCl_6 are stable and environmentally benign. But they do not absorb/emit light in the visible and near infrared region. To impart optical functionality, the group dopes such Pb-free perovskites with Sb^{3+} and Bi^{3+} ions that have two s-electrons in their outermost orbital. Employing temperature (5 K to 300 K) dependent photoluminescence measurements, the group obtained insights on optical excitation and emission processes.

Electrochemistry

State-of-the-art battery performance is often limited by the cathode and consequently, expanding the storage metrics often require a heavy cathode. Since charge is stored within the bulk of the electrodes in most batteries, energy/power trade-off is one of their classical challenges and alternative cell chemistries that avoid these drawbacks are highly sought after. Dr. Muhammed Musthafa O.T. developed an ultra-high-capacity primary metal-ion battery comprising an acidic aqueous electrolyte with suspended magnetite particles and a hexacyanometallate based insertion cathode. During discharge the hexacyanometallate is reversibly reduced and its original redox state is restored during intermittent periods by wirelessly charging with magnetite particles. Recovery involves sacrificial surface redox of Fe^{3+}/Fe^{2+} couple in magnetite particles with the formation of water and re-oxidation of hexacyanometallate. Structural flexibility of the magnetite particles with respect to their oxidation states leads to a battery with high cumulative capacity which offers opportunities for fast and remote charging with minimal power losses.

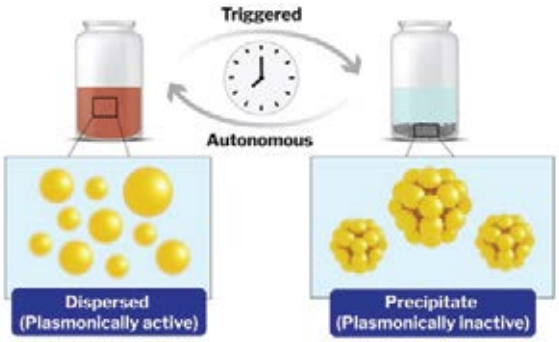
Functional nanomaterials

One of the research areas of Dr. Pramod Pillai's lab is focused on controlling the thermodynamics of nanoparticle self-assembly via the precise control of different interparticle interactions at the nanoscale. In one example, the power of fine-tuned interparticle interactions in creating self-assembled structures was demonstrated, which showed a transient switching between completely precipitated and redispersed stages of nanoparticles (NPs). The pH-dependent temporal changes in the strength of electrostatic interactions were explored to unveil a transient self-assembly response in plasmonic NPs (see Figure). The assembly process was triggered by the electrostatic attraction between positively charged gold NPs (AuNPs) and an aggregating agent, ethylenediaminetetraacetic acid (EDTA). The autonomous changes in the pH and ionic strength of the solution, under the influence of atmospheric CO_2, weaken the aggregating ability of EDTA and initiate the complete disassembly of NP precipitates. The use of a nondestructive mode of autonomous disassembly helped in achieving some of the desirable feats in the field

of transient self-assembly such as easy removal of waste, formation of a transiently stable precipitate state, and negligible dampness in redispersion. The chemical strategy adopted in the present work, to introduce transientness, can act as a generic tool in creating the next generation of complex matter.

Figure 8:

The answer is blowin' in the wind: Components from atmosphere were used to introduce temporal fluctuations in interparticle interactions and choreograph dynamic self-assembly in plasmonic NPs.
(Dr. Pramod Pillai's Group)



MOFs for large scale carbon capture

Prof. Ramanathan Vaidhyanathan's group pursues research in materials for environmental and energy benefits. The group develops Metal-Organic Frameworks for a CO_2-free environment. Their design takes a different approach to develop ultra-microporous MOFs (pore size < 6Å) from readily available ligands and affordable metals. For example, seeded by the Zn-aminotriazolate-oxalate MOF developed by Dr. Vaidhyanathan in 2010, George Shimizu and co-workers (U of Calgary, Canada) have developed a Zn-triazolate-oxalate MOF and BASF has scaled this MOF developed by us to multi-tonnes in 2021. A company has licensed it and demonstrated its true potential as an industrial CO_2 scrubber (Svante, Canada). As another major contribution to porous materials, the group has developed Covalent Organic Frameworks (COFs). The group uses rigorous crystallographic modelling from the powder X-ray diffraction data to solve the COFs structures. They exploit the heteroatom-lined pores of the COF to develop rapid-charging lightweight charge storage electrodes/electrolytes (Haldar et al., Nanoscale Horizons, 2020, 5, 1264), which can find use in battery. More recently, the group demonstrated the synergy between COF and redox electrolyte to realise exceptional enhancement in super capacitance (Kushwaha et al., AENM, 1, 2003626 (2021)). The team is currently planning for a start-up from IISER Pune.

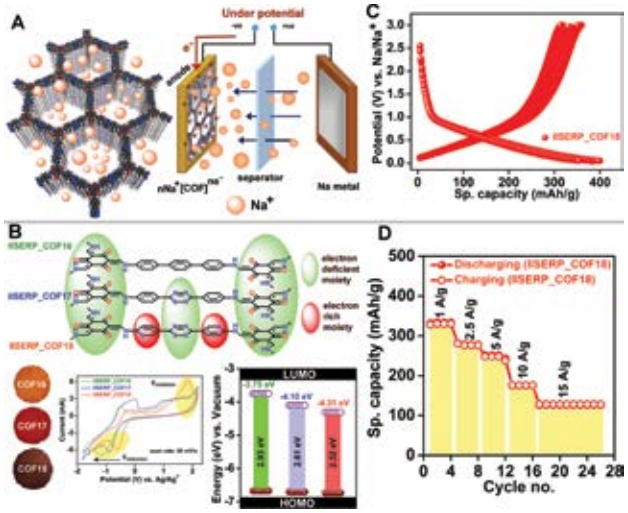


Figure 9:

A pyridyl-tetrazine COF with balanced push-pull electronics sets-up anodic driving force for reversible storage of Na+ ions in a Na-ion battery. Practical specific capacities at stable potential and excellent rate-performance are highlights of this designer COF. (Prof. Ramanathan Vaidhyanathan's Group)

2.3 SPECTROSCOPY, THEORETICAL AND COMPUTATIONAL CHEMISTRY

DNA-Protein recognition, Conformational properties of block polyelectrolytes

The theoretical methods developed in Dr. Srabanti Chaudhury's group has been implemented to develop a simple theoretical method to analyse the reaction dynamics on catalysts with multiple active sites based on a discrete-state stochastic description and obtain a comprehensive description of the dynamics of chemical reactions on such catalysts. The team determined how the dynamics of catalysed chemical reactions depend on the number of active sites, on the number of intermediate chemical transitions, and on the topology of underlying chemical reactions. A novel theoretical model has been developed recently to investigate the microscopic mechanism of cooperative communications within single nanocatalysts. Explicit calculations could quantitatively explain all experimental observations, clarifying the molecular origin of cooperative communications. The group has also developed discrete-state stochastic kinetic model to explain how DNA- target search processes are influenced by bulk crowding where the crowders are mobile. The theoretical results are discussed using physical explanations and they are also tested with extensive Monte Carlo computer simulations.

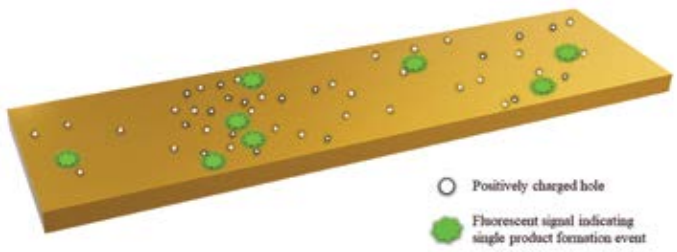


Figure 10:

Schematic of hole migration. Circles represent positively charged holes. Green stars represent fluorescent signal indicating single product formation event (Dr. Srabanti Chaudhury)

Studying weak non-covalent interactions

Prof. Aloke Das's research group uses various gas phase laser spectroscopy techniques in combination with quantum chemistry calculations to probe various types of weak non-covalent interactions such as hydrogen bonding, n→π* interaction etc., which are backbone of biomolecules and materials. Detailed understanding of these weak interactions is the key for designing improved drugs, catalysts, various supramolecular assemblies etc.

Recently, the group explored the interplay between the weak n→π* interaction and strong hydrogen bond by studying a complex of phenyl formate and water (1:1) formed in the gas phase using electronic, vibrational, and rotational spectroscopy combined with quantum chemistry calculations. The nCO→π*Ar interaction between the lone-pair electrons on the oxygen atom of the carbonyl group (CO) and the π* orbitals of the phenyl group was earlier reported in the cis conformer of the phenyl formate monomer. In the present work, they studied the effect of the microhydration on the nCO→π*Ar interaction present in phenyl formate. Two conformers of phenyl formate...H_2O were observed in both microwave and mass-selected UV/IR spectroscopy experiments. One of the conformers (C1) was found to be stabilised by a strong O-H...O=C hydrogen bond accompanied by relatively weaker O-H...π hydrogen bond and nCO→π*Ar interaction. The result demonstrates that the weak nCO→π*Ar interaction present in the cis-phenyl formate monomer does not disappear in the presence of H_2O, which forms a strong hydrogen bond with the same C=O group already involved in the nCO→π*Ar interaction.

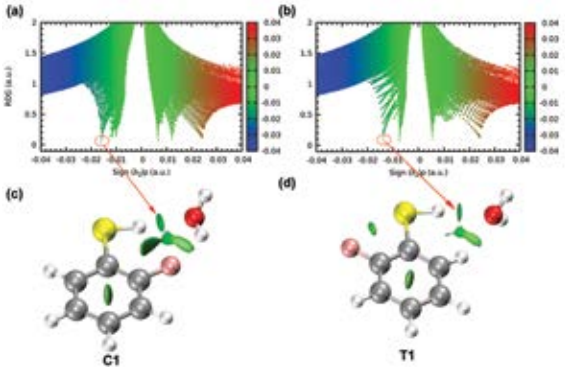


Figure 11:
Non-covalent Interaction (NCI) plot by showing the S-H...O hydrogen bond in 2-fluorothiophenol...H_2O complex. (Prof. Aloke Das's Group)

In another work, Dr. Das's group investigated the physical nature and strength of an unconventional hydrogen bond namely S-H...O interaction by studying model complexes of 2-fluorothiophenol (2-FTP) with H_2O, CH_3OH, C_2H_5OH etc. in the gas phase as well as condensed phase. Although S-H...O hydrogen bond was weak, they found a systematic modulation of the strength of the S-H...O hydrogen bond by changing the hydrogen bond acceptor from H_2O to C_2H_5OH. This work is very interesting and important as most of the sulfur-centered unconventional hydrogen bonds reported in the literature are based on X-H...S type, where the hydrogen bond acceptor atom is a weak electronegative atom i.e. S but the hydrogen bond donor atom (X) is still a strong electronegative atom such as O and N.

Photophysics of biologically important molecules

In recent decade, enhancement in the emission quantum yield and expansion of the emission tunability spectrum have been the key incentive aspects of luminescent copper nanoclusters (SLCuNC), which directs the evolution of future generation light harvesting materials. In this context, Prof. Hazra's group is working on the development of novel methodologies which can broaden emission tunability spectrum and can enhance the quantum yield of the system. The group reported broadband emission tunability in a SLCuNC system, mediated by in-situ ligand replacement. 1,6-hexanedithiol protected blue emissive discrete Cu nanoclusters (CuNC) and red emissive CuNC assemblies have been synthesised in one pot. The blue emissive CuNC was further converted to green-yellow emissive CuNC over time by a ligand replacement process. Steady-state emission results and fluorescence dynamics studies were used to elucidate that the nature of the emission was altered from metal-centered intrinsic to ligand-centered extrinsic emission.

For the last few years, one of the aims of Dr. Partha Hazra's group is to develop novel organic luminogens with aggregation induced emissive (AIE) and mechanochromic behaviour. Now a days, these type of metal free organic luminogens exhibiting aggregation induced emission (AIE) and mechanochromism along with room temperature phosphorescence (RTP) nature have attracted widespread interest. However, luminogens showing AIE and mechanochromic properties are often conventional fluorophores with lifetime in nano-second time scale and designing such type of muti-functional luminogens have often met with limited success. Starting from an ACQphore TPANDI, by simple structural engineering, the group has demonstrated a route to obtain multi-functional organic luminogen like-TPACNPMI with AIE, mechanochromic and as well as RTP properties.

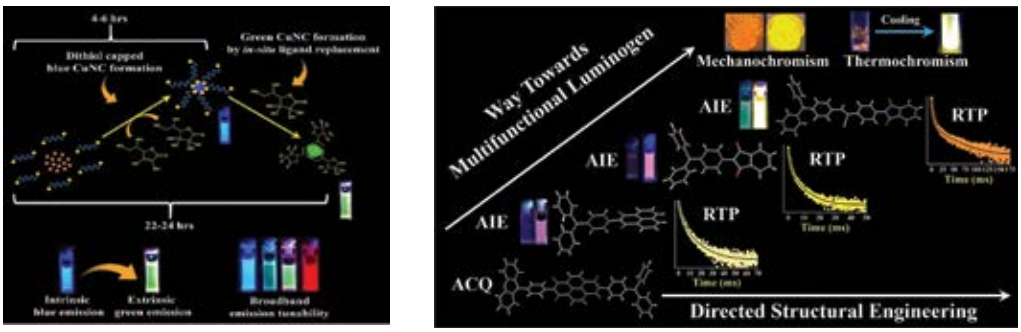


Figure 12:

(Left) Broadband emission tunability of a single Cu nanocluster system by in-situ ligand replacement; (Right) A route to obtain multi-functional luminogen by directed structural engineering (Dr. Partha Hazra's Group)

Understanding properties of materials through simulation methods

Prof. Arun Venkatnathan and his research group have applied classical molecular dynamics (MD) simulations to reveal the role of various ion-ion and ion-solvent interactions and ion dynamics in sodium battery electrolytes. Sodium is very abundant, inexpensive, and is a promising alternative to conventional lithium-ion batteries. The group collaborates with the experimental groups of Professor Michael Zdilla and Professor Stephanie Wunder from Temple University, Philadelphia, U.S.A. Experiments on a soft solid material (e.g., sodium perchlorate in an organic solvent (DMF) have shown a reversible stoichiometric conversion with temperature and thumb pressure which can be a potential stimuli response material as well. To validate experimental findings, Prof. Venkatnathan's group modelled the mechanism of $(DMF)_3$-$NaClO_4$ conversion and stimuli response with changes in temperature and pressure. For example, a snapshot of pressure-induced transformation of the electrolyte from simulations is shown in the accompanying Figure.

The results are highlighted in a paper published by Prabhat Prakash, Shylendran Ardhra, Birane Fall, Michael J. Zdilla, Stephanie L. Wunder, and Arun Venkatnathan, Chemical Science, 12, 5574 (2021).

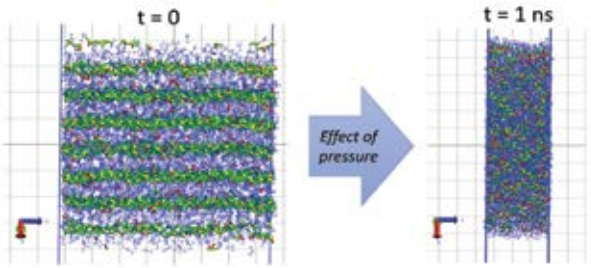
The group applied quantum chemistry calculations and observed several ion conduction pathways pre and post-stoichiometric conversion in the same material. The authors demonstrated the role of the solvent and anions in sodium-ion mobility. This work was highlighted in a paper published by Prabhat Prakash, Ardhra Shylendran, Birane Fall, Michael J. Zdilla, Stephanie L. Wunder, Arun Venkatnathan, J. Phys. Chem. C, 126 (10), 4744, 2022.

Prof. Venkatnathan's group also investigated a diglyme-based liquid sodium-ion electrolyte as an alternative to solid electrolytes. The authors examined the effect of several ionic concentrations and temperatures on ion-ion/solvent interactions and ion dynamics where the results published by Shylendran Ardhra, Prabhat Prakash, Rabin Siva Dev, Arun Venkatnathan, J. Phys. Chem. B, 126(10), 2119, 2022. The effect of concentration on interactions with sodium ions with anions and the occurrence of various types of configurations (solvent separated, contact ion pairs, aggregated ions) are described in this work.

The outcome of these investigations is expected to advance the use of solid electrolytes which can provide safer batteries and also spur the search for alternate solvents to the conventionally used carbonate solvents.

Figure 13:

Pressure induced transformation in the z-direction. Reproduced with permission from Prabhat Prakash, Shylendran Ardhra, Birane Fall, Michael J. Zdilla, Stephanie L. Wunder, and Arun Venkatnathan, Chemical Science, 12, 5574 (2021).
(Prof. Arun Venkatnathan's Group)



3. DATA SCIENCE

3.1 DATA ASSIMILATION, MACHINE LEARNING

Dynamical systems, Data assimilation

Prof. Amit Apte's group works on various nonlinear filtering algorithms for data assimilation in earth sciences. The main focus is on developing algorithms that work with high dimensional, highly nonlinear and chaotic systems such as the atmosphere and the ocean. In a recent work (doi:10.1109/ICC54714.2021.9703185), they explored the distance between filtering distributions starting from different initial conditions as a function of time using Wasserstein metric, thus directly assessing the stability of particle filters and ensemble Kalman filters. In another work (doi:10.1137/21M142616X), the group considered nonlinear filters for diffusion processes when the observation and signal noises are small and of the same order, study probabilities of deviations of true filtering estimates from that obtained by solving the associated variational problem.

Machine learning, Computational biology

Dr. Leelavati Narlikar's lab has been developing new machine learning-based models to answer the long standing question: how is regulatory information encoded in the four-letter alphabet of our genome? Recently, they introduced a novel Bayesian sequence framework (doi:10.1101/gr.274563.120) that models the fact that regulatory regions can be diverse in terms of their mechanism and characterises this diversity in terms of DNA motifs, all of which are learned de novo. In other work (doi:10.1093/bioinformatics/btab274), they presented a new method exoDIVERSITY to learn protein-DNA binding sites from high throughput ChIP-exo experiments. Using no prior motif information, it automatically deduces the numbers of different binding modes from the data, by learning a joint distribution over footprints and motifs.

4. EARTH AND CLIMATE SCIENCE

4.1 EARTH SURFACE PROCESSES, CLIMATE

Himalayan glaciers

A clear understanding of the response of the runoff of glacierised catchments to changing climate over different time scales is important. Dr. Argha Banerjee's group used glacio-hydrological model studies to investigate the climate response of glacier runoff and that of the catchment runoff to temperature and precipitation changes in the Himalaya and elsewhere. The group showed that in general the glacier runoff is relatively insensitive to the interannual variability of precipitation, irrespective of the prevailing climate. This implies that a temperature-sensitive glacier runoff and a precipitation-sensitive off-glacier runoff are going to determine the climate response of the runoff of the glacierised catchments. They also developed a linear-response framework that explains several well-known empirical characteristics of glacier runoff over different time scales.

3D inverse modeling of large-scale MT data

Geoelectrical properties of the subsurface provide valuable constraints for a plausible geological model. Such information is used in various applications, e.g., groundwater mapping, mineral exploration, geodynamics studies, and geomagnetic induced current modeling. Generally, the Magnetotelluric (MT) method is employed for regional-scale studies to estimate the subsurface conductivity. However, the 3D inversion of large-scale MT data such as USArray and AusLAMP is computationally challenging. Dr. Rahul Dehiya developed a radiation boundary-based 3D MT modeling algorithm that shows a one-order faster computation to address this challenge. In this scheme, the boundary conditions are derived using a coarsely discretized finite-difference operator on an arbitrary surface, enclosing the computational domain. These boundary conditions are referred to as radiation boundary conditions. The final computation is done only for the computation domain using the finer discretization. This two-step modeling is not only efficient but also reduces the inversion domain. Consequently, it decreases the number of the unknown in inverse modeling. The initial test of the developed inverse modeling suggests a computational advantage of one order, facilitating finer discretization of the inversion domain, which may be necessary to address the static shift problem.

Organisation of tropical convection

Monsoon low-pressure systems (LPS) are synoptic scale vortices embedded in the monsoon background flow. Monsoon LPS contributes more than 50% of the total monsoon rainfall over India. The LPS can be formed due to local processes (in-situ) or by the northwestward propagating disturbances from the west Pacific (downstream amplification). Such a classification has not been done in the climate models. Since the climate models are important tool for understanding the climate change, it is crucial to classify the LPS genesis in climate models for a process-based understanding of the climate change. Using multi-model analysis, Dr. Suhas Ettammal showed that the in-situ to downstream amplification event ratio closely follow the observations. At the same time, major biases are observed in the temporal distribution of downstream amplification LPS events in climate models.

Stable isotope geology

Dr. Shreyas Managave's group carried out bulk and compound-specific isotopic analysis of soil and grass samples collected from areas along the precipitation gradient of the Western Ghats.

The results showed a quantitative relationship between the carbon isotopic composition of soil organic matter and rainfall.

Fieldwork to know the effect of climate on soil formation was carried out in Tamhini Ghat and Sinhgad areas. A part of the collection has been analysed for depth-wise variation of the carbon content and the factors controlling it. The results revealed a strong influence of vegetation on the soil carbon content in the region.

A collaborative project has been initiated with Kashmir University. The trees commonly used in dendroclimatological studies are being grown in a controlled environment to assess the factors controlling the isotopic composition of tree rings.

A new project aimed at creating a sulfur iso-scape for the Indian region has been initiated. It involves community out-sourced collection of surface soil samples from various parts of India. About 60 samples from various parts of India have been collected so far.

The experiment aimed at deciphering seasonality in the hydrogen isotopic composition of the leaf wax material was continued. The processes involving the extraction of different leaf wax components were completed. Characterisation of leaf wax molecular proxies such as ACL, CPI, and carbon isotopic composition is completed.

Weather prediction and understanding natural variability

Dr. Neena Joseph Mani studied the modulation of convectively coupled Kelvin waves (CCKWs) by different Madden-Julian oscillation (MJO) states over the Indian, Pacific and Atlantic Ocean domains. Convectively active CCKW events associated with active MJO convection, suppressed MJO convection, and weak MJO states were derived using wavenumber over the three domains and composite analysis indicate that the amplitude and phase speed of CCKW are modulated by the MJO state. CCKW amplitude is stronger (weaker), and it propagates relatively slower (faster) and more (less) eastward when the MJO amplitude is strong (weak). CCKW phase speed is much slower over the Indian Ocean domain, while it propagates relatively faster over the Atlantic Ocean domain. It is hypothesized that the observed difference in CCKW phase speeds is related to the Gross Moist Stability (GMS). The clear linear relationship observed between GMS and CCKW phase speeds over the different domains, during different MJO states and the observed differences in CCKW vertical structures support this hypothesis. It is found that the CCKW exhibits a baroclinic vertical structure over the Indian and Pacific Ocean domains and a barotropic vertical structure over the Atlantic Ocean. Planetary-scale convection associated with the MJO reduces the static stability allowing for baroclinic modes to prevail, which in turn reduces the GMS and the effective equivalent depth, eventually slowing down the CCKW phase propagation.

Sediments in man-made reservoirs of western India preserve records of regional rainfall variability

With the emergence of climate change at an unprecedented scale, there is a pressing need to understand the response of human-environment systems (e.g., watersheds) to climate change stress in climate hotspots. Finding the natural archives that preserve the history of climate change and its effects on the human-environment system is arduous. Sediments from two reservoirs in semi-arid Central Maharashtra, located in western India, provide a record of the evolution of the drainage basins in response to change in rainfall patterns and human intervention, such as dam construction. Since the reservoirs were built by damming the distributaries of the rain-fed Bhima river, the sedimentation patterns are likely influenced by the monsoonal fluctuations.

Dr. Sudipta Sarkar's group adopted an integrated approach to study the evolution of the sediments in the reservoir by combining remote sensing, seismic methods, and sedimentological and geochemical investigations of the shallow cores (~1 m) collected from the reservoirs. Time-series satellite data analysis shows that numerous reservoirs were built following high rainfall during the monsoon seasons of 1988–1989, reflecting the necessity of conservation and harvesting of rainwater. Using the chirp seismic data the transition from a natural fluvial system to a dammed reservoir system was determined. A good match between the Ti/Al peaks and the positive rainfall anomalies, indicating monsoon-induced rainfall likely enhanced catchment erosion and Ti fluxes. Finally, sedimentation rates (0.70+0.11 cm/yr at Matwali and 1.6–2.1 cm/yr at Indirabazar) for both reservoirs were determined. The information would be useful in terms of assessing the impact of climate events on these watersheds and the lives and livelihoods that depend on natural resources in these watersheds.

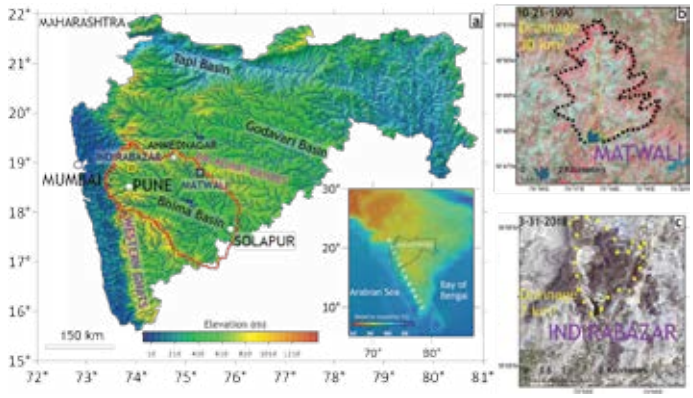


Figure 14:

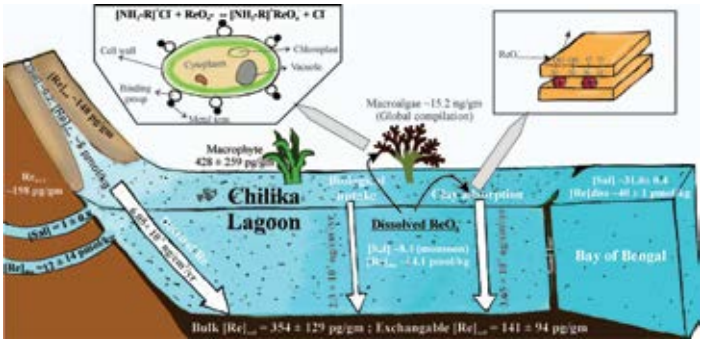
(a) Watershed map of the state of Maharashtra, western India with the Bhima river basin outlined in which the two sites Matwali and Indira Bazar are marked; the inset map is that of relative humidity, which depicts the long-term (01-01-1970 to 08-31-2017) mean humidity using 0.125° x 0.125° ERA-Interim data that is overlain on the shaded relief image derived from the Shuttle Radar Topography Mission digital elevation model. (b) False color composite of a Landsat image (October 21, 1990, near-infrared (red color channel), red (green color channel), and green (blue color channel) of the catchment area of the Matwali site. The yellow dotted lines demarcate the channels that terminate into the Matwali reservoir. (c) Natural color composite of a Planet image (March 31, 2018) showing the catchment of the Indira Bazar site and the reservoir (dark blue). (Dr. Sudipta Sarkar's Group)

Weathering and erosion

The research group of Dr. Gyana Ranjan Tripathy mainly investigates abundance and distribution of trace elements and their isotopes in aquatic systems to quantify surficial weathering processes and its impact on coastal inventory of bio-essential elements. In a recent study, the group has investigated the sources and coastal behavior of rhenium (Re), which serves as a reliable proxy for past oceanic redox state and terrestrial organic carbon cycling. Towards this, spatial distributions of dissolved rhenium concentrations along the salinity gradient of a large tropical lagoon (Chilika lagoon (India)) and their possible source waters have been investigated for three different seasons. Co-variation between water salinity and rhenium concentrations show non-conservative Re behaviour in the lagoon. Water samples from all three seasons show the removal of Re from the high-saline regions of the lagoon. Significant correlations of sedimentary Re with Mg and Al concentrations point to adsorptive rhenium removal onto Mg–Al rich clay (montmorillonite and chlorite) surfaces. Further, huge occurrence of biomass in the lagoon, appreciable Re concentrations in macrophytes and a significant Re-TN (total nitrogen) correlation indicate possible biological uptake of Re by amino acids during cellular membrane formation. Mass balance calculations show about 60% of sedimentary Re are accumulated

through clay adsorption, whereas the remaining 40% is scavenged through biological activities. This authigenic Re removal rate of the Chilika is found to be ~4 times higher than its accumulation onto oxic marine sediments. Outcomes of this study identify this new and significant coastal sink for rhenium and hence, warrant the need to revisit the oceanic Re budget to incorporate these removal pathways.

Figure 15:
Sources and cycling of rhenium (Re) in the Chilika lagoon, India. The figure depicts all possible pathways (e.g. clay adsorption and biological uptake) and rates of Re removal from this coastal system (Dr. Gyana Ranjan Tripathy's Group)

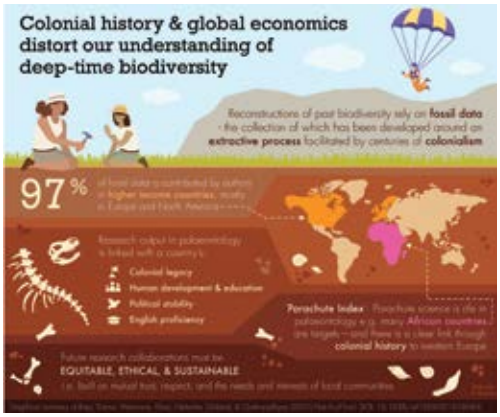


4.2 RESPONSE OF ECOSYSTEMS

Ancient and recent marine ecosystems

Fossils provide an essential record of how life on Earth has evolved. However, the fossil record is incomplete, primarily because the dead remains of an organism rarely survive the vagaries of nature to emerge as a fossil. Apart from the natural biases, the fate of the fossils after their discovery plays a significant role in our ability to use them meaningfully to reconstruct past biodiversity. An international team of seven paleontologists, including IISER Pune faculty member Dr. Devapriya Chattopadhyay, investigated how colonial history and socio-economic factors affect the global distribution of fossil data. Using scientific publication and geographic data from the Paleobiology Database which is a widely used database to investigate past biodiversity patterns, the authors show that 97% of palaeontological data is generated by researchers based in Northern America and Western Europe. The authors also observe that many affluent countries conduct a large amount of research abroad, often without collaboration with local researchers in the countries they are working in. The authors point out that this is a demonstration of 'parachute science,' where lower-income countries are exploited for their fossils, but the higher-income countries retain the knowledge and power. This study proposes a few steps for the paleontological community to adopt for reducing the global disparities in paleontology. They encourage the community to develop more equitable, ethical, and sustainable collaborations based on mutual trust and respect. These findings are recently published in the journal *Nature Ecology and Evolution.*

Figure 16:
This is the graphical summary of a collaborative work from Dr. Devapriya Chattopadhyay's group on the effect of colonialism and economics on the understanding of deep-time biodiversity.
Photo courtesy: Emma Dunne



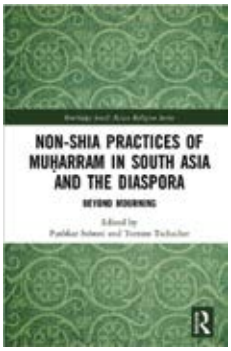
5. HUMANITIES AND SOCIAL SCIENCES

5.1 HISTORY OF SCIENCE, ARCHITECTURE, MATERIAL CULTURE

Material Culture

Dr. Pushkar Sohoni carried out research on the architecture of Maharashtra, about which two volumes are in preparation along with co-editors. He carried out preliminary research on colonial education practices, science education in particular, in preparation for a grant proposal. The research project on colonial market halls in India was completed. A monograph on Shia practices of Muharram in the South Asian diaspora was published. Several research articles, including one co-authored with an IISER Pune student, were produced.

Figure 17:
Monograph on non-Shia practices of Muharram in South Asia and the diaspora (Dr. Pushkar Sohoni)



5.2 DEVELOPMENT STUDIES

Water and environmental change

Dr. Bejoy Thomas and collaborators work on problems in the broad areas of development, environmental sustainability and water resources. He looks at these issues at different scales - local and global - using a variety of approaches including field research, in agrarian and peri-urban settings, and analysis of existing data.

Dr. Thomas began a new collaborative project focusing on Bhima basin looking at the 'nexus' or linkages between food security, water resources and biodiversity conservation. The project will look at the distribution of resources (equity) and find answers to the question of what constitutes fair outcomes in sustainable development. Dr. Thomas also works on the equity and fairness implications of climate action interventions and climate adaptation policies. He was a contributing author to Chapter 18 on 'Climate Resilient Development Pathways', as part of Working Group 2 in IPCC's Sixth Assessment Report, and has been engaging with different stakeholders, academic and practitioner, on these issues.

5.3 HUMANITIES

Political ideas in modern India, Gandhian studies, gender studies

Dr. Chaitra Redkar worked on critical analysis of the rationalist discourse in Modern Maharashtra particularly with reference to Gopal Ganesh Agarkar, Vinayak Damodar Savarkar, B R Ambedkar and Narhar Kurundkar. Dr. Redkar worked on questions such as how does the philosophy of positivism influence their perception; how does science and religion appear in their thinking; and how do these ideas shape their politics.

Another topic Dr. Redkar is working on involves understanding the works of Dhiren Majumdar as part of the ongoing study of Gandhism after Gandhi. Dr. Redkar is also in the process of planning a study of villages in Ahmednagar district to understand the political economy of sugar.

Literary and Language Studies

Dr. Pooja Sancheti works on South Asian Anglophone fiction within the framework of transnationalism, feminist theory, and postcolonialism, with special focus on vulnerability, power relations, and violence. She has had two papers on the subject accepted recently at internationally renowned journals and has presented her research at several international conferences.

Dr. Sancheti is also interested in studying the role of language in science (pedagogy), particularly from applied stylistics and EAP perspectives. She is working in collaboration with a professor at Glasgow University, UK to publish an in-depth report on a 4-part workshop they conducted for Indian science teachers on this area. The aim is to expand the understanding of language at the conceptual level in the discourse of science. She has presented her research on language and science pedagogy (especially college level academic writing) at several conferences, and has had a book chapter accepted on the topic.

In the overlapping field of language and literature, Dr. Sancheti has also been working on literary translations (from English into Hindi).

One of the research topics Dr. Pushkar Sohoni from the Humanities and Social Sciences department works on is the fort of Ahmadnagar and its water systems (Photo source: Dr. Pushkar Sohoni)

6. MATHEMATICS

6.1 ALGEBRA AND NUMBER THEORY

Special values of L-functions associated to automorphic forms

Dr. Baskar Balasubramanyam continued his research work on special values of L-functions and p-adic interpolation of these special values over families and study arithmetic/geometric properties of these objects. He has also worked on estimates of cusp forms over cocompact arithmetic subgroups.

Moduli of curves

In a joint work with Loic Merel (University of Paris), Dr. Debargha Banerjee wrote down the Eisenstein cycles and Manin Drinfeld Properties. In a joint work with (V.G. Narasimha Kumar Cheraku), Dr. Banerjee proved Ribet's conjecture for Eisenstein maximal ideals (https://arxiv.org/abs/2111.07747).

Whitehead group of general orthogonal modules

Along with postdoctoral fellow Dr. Kuntal Chakraborty, Dr. Rabeya Basu studied the relative cases of Quillen–Suslin's local-global principle for the general quadratic (Bak's unitary) groups, and its applications for the (relative) stable and unstable K1-groups. In a separate work, Dr. Basu deduced the graded version of the local-global principle for the general quadratic groups and applied this to study the Bass' nil groups.

Analytic number theory and arithmetic of modular forms

Dr. Kaneenika Sinha's research interests lie in the applications of Fourier analysis to analytic number theory, probabilistic number theory and arithmetic geometry. Dr. Sinha studies the distribution properties of special arithmetic sequences and families with a focus on Fourier coefficients of modular forms, zeta zeroes and traces of Frobenius of curves over finite fields, and eigenvalues of regular graphs. Her primary research programme pertains to asymptotic distribution measures of such sequences, rate of convergence of sequences to their distribution measures, fluctuations in the rate of convergence among families of sequences. Dr. Sinha also studies questions about pair correlation and local spacing statistics among sequences which arise from some of the above families.

Specific topics in this research over the past year are as follows:

1. Central limit type theorems for the fluctuations of Hecke eigenvalues in large families of modular cusp forms about the Sato-Tate distribution measure.

2. An average analogue of a conjecture of Katz and Sarnak, which compares the pair correlation of families of straightened Hecke angles to that of a uniformly distributed, random sequence in the unit interval.

3. Extending the above themes to eigenvalues of families of random, regular graphs. While the linear eigenvalue statistics of these families are similar to those of Hecke eigenvalues of modular cusp forms, their spacing statistics coincide with those in the Gaussian Orthogonal Ensemble.

6.2 ANALYSIS, DIFFERENTIAL EQUATIONS, APPLICABLE MATHEMATICS

Probability theory and control theory

Over the last year, Dr. Anup Biswas worked on a couple of projects involving nonlocal operators. The team also studied ergodic control problems for controlled switching diffusions. For nonlocal operators, they considered mixed local-nonlocal operators and studied maximum principles, Faber-Krahn inequality etc.

Mathematical finance

Regime switching optimal growth model with risk sensitive preferences

By Dr. Anindya Goswami in collaboration with Dr. Nimit Rana (Faculty of Mathematics - Bielefeld University, Germany) and Prof. Tak Kuen Siu (Department of Actuarial Studies and Business Analytics, Macquarie Business School, Macquarie University, Sydney, Australia)

The team considered a risk-sensitive optimization of consumption-utility on an infinite time horizon where the one-period investment gain depends on an underlying economic state whose evolution over time is assumed to be described by a discrete-time, finite-state, Markov chain. They suppose that the production function also depends on a sequence of i.i.d. random shocks. For the sake of generality, the utility and the production functions are allowed to be unbounded from above. Under the Markov regime-switching model, it is shown that the value function of the optimization problem satisfies an optimality equation and that the optimality equation has a unique solution in a particular class of functions. Furthermore, they show that an optimal policy exists in the class of stationary policies. The group also derived the Euler equation of optimal consumption. Furthermore, the existence of a joint stationary distribution of the optimal growth process and the underlying regime process is examined. Finally, they present a numerical solution by considering power utility and some hypothetical values of parameters in a regime-switching extension of the Cobb—Douglas production rate function.

Inference of binary regime models with jump discontinuities

By Dr. Anindya Goswami with Dr. Milan Kumar Das (Institute of Statistical Science, Academia Sinica, Taiwan) and Mr. Sharan Rajani (Carnegie Mellon University)

Identifying the instances of jumps in a discrete-time-series sample of a jump-diffusion model is a challenging task. The team developed a novel statistical technique for jump detection and volatility estimation in a return time series data using a threshold method. The consistency of the volatility estimator has been obtained. Since the team has derived the threshold and the volatility estimator simultaneously by solving an implicit equation, they have obtained unprecedented accuracy across a wide range of parameter values. Using this method, the increments attributed to jumps have been removed from a large collection of historical data of Indian sectorial indices. Subsequently, they have tested the presence of regime-switching dynamics in the volatility coefficient using a new discriminating statistic. The statistic has been shown to be sensitive to the transition kernel of the regime-switching model. Upon testing using Bootstrap method, the team found a clear indication of the presence of multiple regimes of volatility in the data. A link to all Python codes is given in the conclusion. The methodology is suitable for analysing high-frequency data and may be applied for algorithmic trading.

Functional Analysis, Operator Theory

The Nevanlinna Pick interpolation problem and the distinguished varieties

This project advances the understanding of the uniqueness of the solutions of a Nevanlinna Pick interpolation problem in domains such as the Bidisk (or more generally the Polydisks) and the symmetrized bidisk. While the solvability criterion in these domains is understood, the uniqueness of the solution is not as concrete as in the classical case of the open unit disk. In a recent joint

work with Dr. Das and Mr. Kumar (arXiv:2104.12392 [math.FA]), Dr. Haripada Sau has been able to show that under some natural conditions, all the solutions to a given Nevanlinna Pick interpolation problem in the symmetrized bidisk must coincide on a certain algebraic varieties, called the distinguished varieties. This required a thorough understanding of such varieties.

Toral algebraic pairs
In a joint work with Dr. Das, Dr. Haripada Sau studied the pairs of commuting contractions that are annihilated by polynomials with a geometric condition on its zero set, called the toral algebraic pairs. They have characterized toral algebraic pairs of commuting isometries. In particular, a commuting pair of isometries is toral algebraic if and only if so is its minimal unitary extension. This triggered the natural question when a toral algebraic pair of commuting contractions lifts, in the sense of And\^o, to a toral algebraic pair of commuting isometries. While this question remains open, a family including all the commuting contractive matrices is obtained for which the answer is affirmative.

Dr. Sau is also currently involved in two separate projects: one is a polydisk extension of the first project mentioned above, and the other is on Toeplitz operators. More precisely, he is studying those Toeplitz operators that attain their norm. Note that an operator acting on an infinite dimensional vector space does not necessarily attain its norm. Apart from the case of the unit disk, the question when a Toeplitz operator on the Hardy space of the bidisk attains its norm appears to be unknown at this moment.

Probability and combinatorics
Dr. Moumanti Podder works on topics that are amalgamations of probability and combinatorics, often mingled with a healthy dose of game theory and mathematical logic. In the past 1.5 years, she completed two manuscripts, namely "Combinatorial games on multi-type Galton-Watson trees" (solo, accepted for publication in the Indian Journal of Discrete Mathematics, Volume 7, Issue 2, December 2021) and "Combinatorial games on Galton-Watson trees involving several-generation-jump moves" (submitted, pre-print available at https://arxiv.org/abs/2205.02124, with contributions from doctoral student). Another paper titled "Zero-one laws for existential first order sentences of bounded quantifier depth", written jointly with Maksim Zhukovskii, got accepted for publication in the ACM Transactions on Computational Logic.

Currently, Dr. Podder is working on several research projects, two of which focus on the popular topic of probabilistic cellular automata (PCA), the important and often-difficult-to-resolve questions pertaining to their ergodicity, and the connection between these questions and the probabilities that certain related percolation games on lattice graphs culminate in draws. Another ongoing project focuses on a game-theoretic model in which the inhabitants of a certain region are thought of as agents or players and where they investigate the process of spreading of a contagious disease (the players take intelligent decisions regarding to what extent they should stay indoors, or go out and risk exposure to the disease, on the basis of a suitable utility function).

A purely combinatorial problem that Dr. Podder is currently working on involves studying graph nim games on various graphs. Another project that is very close to being completed is concerned with understanding the various moments and limiting distributions (after suitable centering and scaling) of certain linear eigenvalue statistics (defined with respect to suitable test functions) corresponding to the uniformly random d-regular graph on n vertices as n \rightarrow \infty, where d = d(n) is a function of n such that \frac{\log n}{\log d} \rightarrow \infty as n \rightarrow \infty. In a separate ongoing project, they explore tournament-valued stochastic processes that provide rough models for problems in evolutionary biology (in particular, the co-existence of several species of lizards where, between any two species, there is one that "dominates" the

other). A couple of newly commenced projects include studying the fascinating Maker-Breaker percolation games on rooted Galton-Watson trees (and eventually, other random rooted trees) and some complex stochastic processes governing the arrival and subsequent collection (by respective passengers) of checked baggages on airport conveyor belts.

6.3 GEOMETRY AND TOPOLOGY

Toric vector bundles and tensor triangular geometry

Algebraic geometry is the study of geometric objects described by polynomials. Such objects carry a rich structure if they have a lot of symmetry. In a project with Mr. Kartik Roy, Dr. Vivek Mohan Mallick (https://arxiv.org/abs/2112.06444) studied the relationship between a space with certain symmetries associated with rotations and certain geometric objects described by a graded ring. The later type of spaces, known as multihomogeneous spaces, are important as they are generalizations of what is known as projective spaces, and a large class of geometric objects can be realized as a subspace of multihomogeneous spaces.

In another work with Dr. Samarpita Ray, Dr. Mallick reformulated the work of Nakano, Vashaw and Yakimov on non-commutative tensor triangulated categories to a frame-theoretic setting. This is in the lines of the work done by Kock and Pitsch, who developed the link for commutative tensor triangulated categories. Tensor triangulated categories are abstract objects; they unify the essence of various results spanning a wide range of mathematics including Algebraic Geometry, Representation Theory and KK-theory of C*-algebras.

With Dr. Umesh Dubey, Dr. Mallick is working on a version of Vistoli and Vezzosi's result describing the K-theory equivariant tensor triangulated categories in terms of the usual K-theory. Dr. Mallick is also working on two other projects along with student Pavan and collaborator, Jose Ignacio Burgos.

Geometry and topology of complex manifolds and varieties

Prof. Mainak Poddar's research is mainly focused on studying geometric phenomena in which symmetry plays a major role using algebraic, complex analytic and symplectic methods. Recently, he has been involved in a joint project with B.D. Park, R. Harris, and A. Joshi (a BS-MS student at IISER Pune) to address problems in the symplectic geography of four manifolds using abelian branched covers of the complex projective plane, branched along suitable line arrangements. Along with Anoop Singh, Prof. Poddar has recently developed the notions of relative G-connection and relative equivariant structure for a family of holomorphic principal bundles.

Another underlying theme of Prof. Poddar's research is the extension of the understanding of objects or constructions in regular or nonsingular cases to the singular situation. He has been working on a joint project with postdoctoral fellows J. Dasgupta and B. Khan to extend the notion of logarithmic connections to singular toric varieties. Prof. Poddar is also involved in a joint project with S. Ganguli on defining Heegaard Floer invriants for three dimensional orbifolds; and in another project with student D. Pal on extending the notion of generalized complex structure to some singular situations.

6.4 DISCRETE MATHEMATICS

Parameterized algorithms

Dr. Soumen Maity's research primarily focuses on parameterized algorithms and combinatorics. Many computational problems that we want to solve are often NP-hard or worse, but somehow, they need to get solved. Over the years multiple paradigms for coping with NP-hardness have been introduced: for instance, approximation algorithms, average-case analysis, and randomized algorithms were all borne out of a desire to solve hard problems by relaxing the problem or strengthening the model. Within the last 20 years, a new paradigm has been introduced, where one measures the time complexity of an algorithm not just in terms of the input length but also a small side parameter. A priori, the parameter can be anything, but the interesting case is when complex instances of the problem still have relatively small parameter values. The overall goal is to identify interesting parameterizations of hard problems where they can design algorithms running in time polynomial in the input length but possibly exponential (or worse) in the small parameter. Such an algorithm is called "fixed-parameter tractable" and it is the gold standard for parameterized algorithms. Dr. Soumen Maity works on the parametrized complexity of globally and locally minimal defensive alliances, edge deletion to restrict the size of an epidemic, the harmless set problem in social network, upper edge dominating set problem and maximum minimal feedback vertex set problem.

7. PHYSICS

7.1 ATOMIC AND MOLECULAR PHYSICS, OPTICS, AND QUANTUM INFORMATION

Light-matter quantum systems

Dr. Bijay Agarwalla's research is focused on understanding the fundamental aspects of dynamical and steady-state properties of non-equilibrium quantum systems by developing analytical and computational tools, with possible applications to quantum technology. In this year's research, the group worked on understanding the impact of non-equilibrium current fluctuations in the performance of thermal machines. The team provided universal tighter bounds on the fluctuations for different classes of machines. Furthermore, they recently uncovered the existence of a new type of dissipative quantum phase transition for a clean ordered one-dimensional long-range fermionic system in a two-terminal transport setting. They are also exploring low-dimensional quasi-periodic lattice systems and recently proposed a readout scheme using single and multiple qubits that can predict transport signatures (ballistic, subdiffusive, etc) in such systems.

Computational study of correlated quantum systems

Dr. Sreejith G.J.'s research group worked on developing a DMRG algorithm for fractional quantum Hall systems and have been successful in this extremely challenging endeavour. The algorithm provides powerful tools to study strongly interacting electronic systems. In a related direction, the team made progress in understanding the entanglement properties and connections to idealised conformal limit descriptions of strongly interacting FQH states using another highly efficient algorithm. A generalisation of the algorithms to Parton states has also been developed. In another direction, they developed Matrix Product States algorithms and employed them to study the transport properties of strongly interacting quantum chains of the Clock model type.

In addition to theoretical works, in collaboration with FQH research group at Saha Institute, the group studied equilibration properties of edge channels in FQH systems. A review article describing applications of star-shaped clusters of spins in NMR systems was also completed during the year.

Lastly, in collaboration with Prof. Santhanam and Dr. Sachin Jain and undergraduate students, the group explored disease propagation time scales in models defined on graphs representing transportation networks in India.

Plasmon enhanced Raman and fluorescence scattering in Fourier space

Dr. G.V. Pavan Kumar's group works at the interface of nanophotonics and soft-matter physics. Over the past year, they have published research results on topics related to optical forces, optical tweezers, single molecule Raman scattering and momentum-space imaging, some of which are highlighted below.

1. The group showed simultaneous detection of spin and orbital angular momentum of light through scattering from a single nanowire (Diptabrata Paul, Deepak K. Sharma, G.V. Pavan Kumar; Laser and Photonics Reviews, accepted, (2022)). This is one of the fundamental results from the lab which shows for the first time how coherent light scattering can be used to detect the polarization and topological charge carried by an laser beam. This experimental proof has important consequence on understanding the transfer of momentum, and hence the force from an optical beam to matter. Specifically, the optical

forces and torques that arise of such interaction can be of relevance in understanding nanoscale energy transduction at sub-wavelength scale.

2. The group detected single molecule SERS signatures in a specialized nanoscale optical tweezers realized from the thermoplasmonic fields of a gold nanoparticle (Sunny Tiwari, Utkarsh Khandelwal, Vandana Sharma and G.V. Pavan Kumar; Journal of Physical Chemistry Letters (2021) 12, 11910-11918). This is the first time when a single molecule SERS has been observed from a thermoplasmonic tweezer at sub-wavelength scale. This work was highlighted in the newspaper: Indian Express https://indianexpress.com/article/cities/pune/new-technique-can-detect-a-single-molecule-in-nanoparticle-based-optical-tweezers-7716766/

Other topics the group worked on includes advanced aspects of nano-optical forces and their optothermal counterparts. Specific emphasis is on understanding the origin of optical forces and torques from various light-matter interaction studies.

Ultra cold dipolar gases and Rydberg atoms

Dr. Rejish Nath's group along with Prof. T.S. Mahesh's group experimentally observed the new phenomenon of Rydberg biased freezing using an NMR quantum setup, together with the quantum correlations. In a couple of works with Dr. Sebastian Wuester's group at IISER Bhopal, Dr. Rejish Nath studied the properties of a system in which a Rydberg atom is coupled to a Bose-Einstein condensate. The latter constitute a novel setup for the open quantum system, and all the microscopic properties are calculated. Other works include the scattering of bright solitons in dipolar condensates, hyper chaos in a Rydberg dressed atoms in optical lattices and fermi surface deformation of fermions in optical lattices. In soliton-soliton scattering, a soliton dimer collides with a single soliton and lead to the formation of two soliton dimers. In the problem of fermi surface deformation, highly anisotropic Rydberg-Rydberg interactions are found to modify the Fermi surfaces drastically.

7.2 CONDENSED MATTER, STATISTICAL PHYSICS, MATERIALS

2D Materials, magneto-optics, semiconductors

Dr. Ashish Arora joined the institute in November 2021 and plans to set up a magneto-optics laboratory at IISER Pune. The team aims to explore magneto-optical effects in 2D materials (semiconductors and magnets) and their heterostructures on the micron length scales. During the year, in collaboration with Prof. Shouvik Datta, Dr. Arora worked on a project titled “Tailoring quantum oscillations of excitonic Schrodinger Cats for quantum communication”. As part of this, he built a setup in Prof. Datta's lab for performing micro-photoluminescence on a resonant tunnel diode sample having InAs quantum dots. This work has been submitted in two international conferences: 64th Electronic Materials Conference, The Ohio State University, Ohio, U.S.A. (2022) and Low-Dimensional Materials and Devices, SPIE Optics+Photonics, San Diego, California, U.S.A. (2022).

Soft condensed matter

Rigidity dictates spontaneous helix formation of thermoresponsive colloidal chains in poor solvent: The formation of helical motifs typically requires specific directional interactions. Dr. Apratim Chatterji’s group demonstrated that isotropic interparticle attraction can drive self-assembly of colloidal chains into thermo-reversible helices, for chains with a critical level of

backbone rigidity. They simulated a minimal model that captures the spontaneous emergence of the helical conformations of the polymeric chain and provides insight into this shape transition. This work suggests that a purely mechanical instability for semiflexible filaments can drive helix formation, without the need to invoke directional interactions. In this collaborative effort between experiments and theory, experiments were realised in CSIR-NCL and IIT Bombay, whereas the theory and mechanism was developed in IISER Pune. (ACS Nano (2021) 15, 12, 19702-19711).

Elastic Response of polymer-nanoparticle sponges: Microscopic model for large deformations: Sponge made of polymer nano-composites: In one sample created in the lab of K. Guruswamy (IITB), the ~*O*(1 cm) porous sponge comprised of a cross-linked polymer networks of width ~*O*(1 nm). These enmeshed 22 nm silica nano-particles, to form ~*O*(10 μm) walls of width ~*O*(1 μm) that surrounded ~*O*(100 μm) pores. The macroscopic stress response to applied strain depends on the intertwined response of all these different length-scales. Dr. Chatterji's group has come up with a minimalist model which captures the macroscopic stress-strain response as measured in the lab, and elucidated the microscopic mechanisms of the three stage response (Physical Review Materials (2022) 6, 025604).

Optoelectronics

Dr. Shouvik Datta's group is investigating (http://arxiv.org/abs/2107.13518) the experimental control of macroscopically large, quantum coherent state of a two-component Bose-Einstein condensate (BEC) of spatially indirect electron-hole pairs or exciton. Usually, bottom-up approaches are used in quantum computation, where one assembles individual qubits into a quantum superposition state to fabricate N-qubit quantum registers in a step-by-step manner. However, in this work the team explored a top-down approach where they start with macroscopically large, quantum coherent state having millions or more dipolar excitons undergoing Bose-Einstein Condensation to build N-Qubit quantum registers in the temperature range of 10-100 K. Operational temperatures of these excitonic BEC can be raised further with more densely packed, ordered array of QDs in the x-y plane and/or using materials having larger excitonic binding energies. However, fabrications of single crystals of 0D-2D heterostructures using 2D materials (e.g. transition metal di-chalcogenides, oxides, perovskites etc.) having higher excitonic binding energies are still an open challenge for semiconductor optoelectronics. Even now these 0D-2D heterostructures can be scaled up for mass production of miniaturized, portable quantum optoelectronics devices using the existing III-V and/or Nitride based semiconductor fabrication technologies. Therefore, work from Dr. Datta's group can lead to faster and wider adaptation of quantum technologies in terms of miniaturization and portability. A recent paper by the group on dual measurements of temporal and spatial coherence of light in single experimental setup using Modified Michelson Interferometer is here (*Review of Scientific Instruments* (2021) 92, 105109). Further, the group is also exploring optical interferometry based instrumentation techniques to probe momentum space information of light emitting devices as well as excitonic superconductivity in semiconductor heterostructures.

Phase transitions, sorting dynamics

With A. Shah and R. Rajesh (IMSc Chennai), Prof. Deepak Dhar studied phase transitions in a model of hard long rigid rods. The team showed that the entropy per site for long rods of length k, and width 1, in the limit of large k, the leading term in the entropy per site at full packing is (log k)/k^2. They also gave some non-rigorous arguments in support of the conjecture that at high densities, there is a first order transition from the nematic state to a high density disordered phase, and chemical potential per rod at the transition varies as k log k, and also determined the variation of density jump at the transition.

With S. Kulkarni, Prof. Dhar studied the scaling function determining the finite size rounding off of the phase transition in a random regular graph of degree 3 and having N sites. This was determined as a function of N and verified these in simulations.

In a work with S. Saryal, Prof. Dhar studied a model of molecular solids with asymmetric molecules, and hard core intractions, where the centers of mass of the molecules are fixed at lattice sites, but the molecules can take arbitrary orientations, subject to the excluded volume constraint. It was shown that the model undergoes a series of phase transitions as function of density, and for a range of densities, the model reduces to determining the statistics of partial covering of the lattice by non-overlapping dimers.

Computational materials science

Research activity in Dr. Prasenjit Ghosh's group encompasses four broad areas of computational materials science, namely, heterogeneous catalysis, thermoelectrics, nuclear quantum effects (NQE) in H-bonded systems and photovoltaics. Activation of methane, one of the main components in natural gas and one of the primary contributors to global warming, is challenging. In a recent work, Dr. Ghosh's group showed that C-vacancies in non-stoichiometric titanium carbide can reduce the barrier for methane activation by almost one order of magnitude compared to that observed on other surfaces. Their work suggested that tuning the C-vacancy concentration, one can use these cheap transition metal carbides as catalysts for methane activation. Additionally, members of his group have developed a method where they have coupled quantum-mechanics-molecular-mechanics (QMMM) based methods with path integral molecular dynamics simulations (PIMD). This coupling significantly reduces the computational costs to perform PIMD simulations to study NQE and their role in liquid solid interfaces.

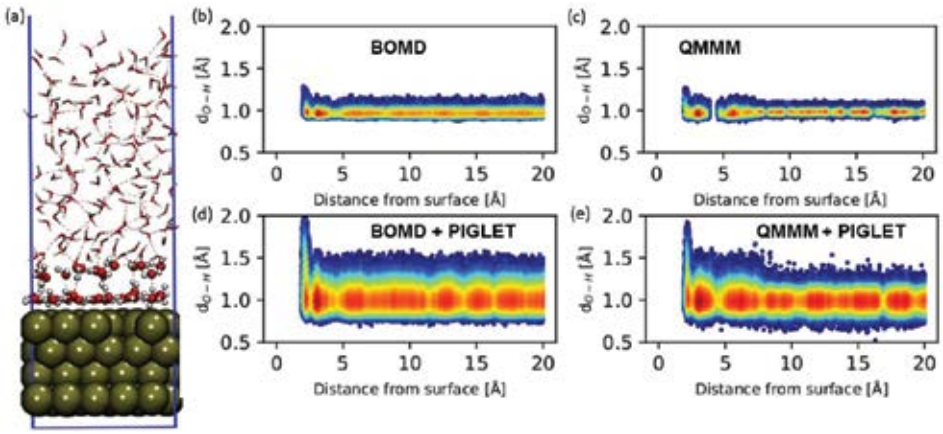


Figure 18: *(a) The Pt/water system used in a computational materials science study. The OH bond lengths as a function of distance from the surface as obtained from the following types of simulations: (b) BOMD; (c) QMMM; (d) BOMD+PIGLET; and (e) QMMM+PIGLET. The increase in the OH bond lengths near the surface in (d) and (e) compared to those in (b) and (c) are due to nuclear quantum effects. The results in (e) are using the implementation of QMMM+PIMD (PIGLET) and they are in agreement with those obtained from fully quantum mechanical BOMD+PIGLET simulations. (Dr. Prasenjit Ghosh's Group)*

These interfaces are very crucial for applications in electrocatalysis and information regarding the interfacial properties are not easily accessible from experiments. In the area of thermoelectrics, their group have shown the crucial role of the electron-optical phonon coupling on the transport properties of layered ionic materials.

Fabrication of nanodevices

Dr. Atikur Rahman's group has combined the CVD synthesised monolayer MoS_2 with p type silicon to form a silicon-MoS_2 p-n junction. The sensitivity of TMDs to their surrounding environment has been utilised to enhance the photoresponse of the heterostructure. By modulating the surrounding environment, they were able to attain a photoresponse enhancement up to 3 orders of magnitude. The insights from the study will help in developing photodetectors based on mixed dimensional Van der Waals heterostructures. The study also will shine light on the development of 2D materials based high-efficiency optoelectronic devices. In order to understand the mobility limiting factors in TMDs, the group observed that coulomb impurities act as a major contributor of carrier scattering. They successfully improved the mobility in monolayer MoS_2 field effect transistors by screening the coulomb impurities by tuning the surrounding dielectric environment, achieving a four order enhancement in mobility.

The group has also shown that by varying the local dielectric environment and doping at the interface the PL of monolayer TMDs can be modulated. This study sheds light on the mechanism of PL modulation by controlling the effect of impurity via dielectric and substrate engineering and provides a recipe for getting desired PL from monolayer TMDs.

7.3 COSMOLOGY, PARTICLE PHYSICS, AND GRAVITY

Gravity and Yang-Mills

Scattering amplitudes in a quantum field theory carry the physical information in the Theory – these are also what we measure in an experiment. Over the past two decades, there have been significant advances in our understanding of how to compute these objects efficiently. Of particular interest is the fact that there is a remarkable simplicity underlying these structures. Most of the simplification has been a consequence of two sacrifices: manifest locality and manifest Lorentz invariance. The light-cone gauge is ideal for the study of scattering amplitudes. Inherently non-local and non-covariant, this gauge focuses exclusively on the physical degrees of freedom in a theory, making the 'physics' in a theory manifest. Spurious degrees of freedom and redundancies do not obscure the symmetries in a theory and the compact spinor helicity variables emerge naturally in this gauge.

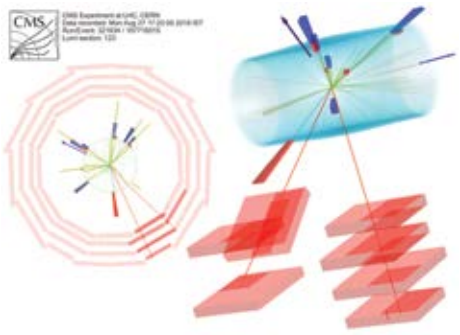
One approach to constructing higher order interaction vertices (or scattering amplitudes) in a theory is to build them up from lower order vertices (amplitudes) by using a multiplicative universal factor, associated with the emission of a soft boson. Over the past year, Dr. Sudarshan Ananth's group has focused on this universal 'soft factor', understanding how it may be extracted from the light-cone action. This factor allows us to construct higher order interaction vertices (amplitudes) from known (lower order) ones. Unlike covariant actions – which are typically written down and checked – light-cone actions, may be derived from first principles. Thus soft factors in this gauge are extremely useful tools in understanding gauge theories and gravity.

Experimental high energy physics

The analysis of Run 2 data collected by the CMS experiment continued this year in Dr. Sourabh Dube's group. A search in multilepton final states for three separate models of beyond standard model phenomena was conducted. The search included final states with up to three hadronically decaying tau leptons. Effective and coherent use of multivariate algorithms resulted in the strongest constraints to date on the Type-III seesaw fermions, and on a doublet model of vector-like tau leptons. The search also had a detailed model-independent component, with events categorized based on several kinematic variables. This led to the first constraints from the LHC on a singlet model of vector-like tau leptons.

In addition, in preparation for Run 3 of the LHC, detailed improvements in photon identification using deep neural networks were planned and put in the CMS framework. Work also continued on incorporating the Phase 2 upgrades in the Fast Simulation package of CMS.

Figure 19:
The image shows an event display of a proton-proton collision event detected at the CMS experiment that produced two muons, one electron, one hadronically decayed tau lepton, and four b-jets. This event was analysed as part of the 3L1T channel in the search for nonresonant phenomena in multilepton final states described in arXiv:2202.08676 [hep-ex]. (Dr. Sourabh Dube's Group)



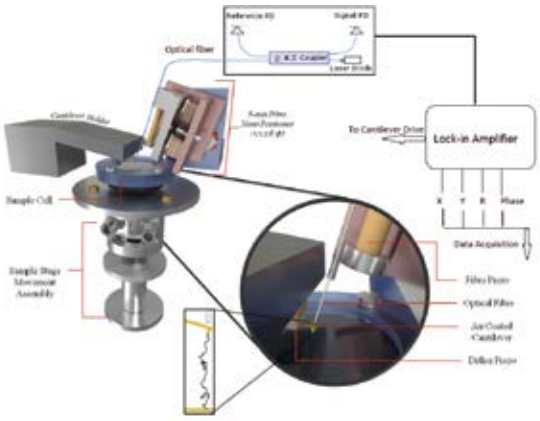
Diffusion in nanoconfinement

Proteins are a type of heteropolymers which play a pivotal role in biological processes responsible for life. In their folded state they are thought to assume a three dimensional shape which determines their function and hence can be viewed as natural nano-machines designed to achieve specific tasks in cellular processes such as recognition, catalysis, regulation and carrying cargo. It has been increasingly realised that the folded state needs to switch between many shapes or conformations in order to react with small ligands or lipids and nucleotides. Proteins need flexibility in shape to perform tasks. Despite much efforts, the flexibility of single protein's folded state characterised by its viscoelastic parameters has not been possible to measure.

In Dr. Shivprasad Patil's laboratory, they have used a special interferometer based Atomic Force Microscope with unprecedented force sensitivity to measure the in-phase elastic and out of phase viscous component of a single folded domain.

They have devised an analysis method to separate out the probe hydrodynamics as well as other effects to accurately measure dissipation provided by the folded domains as well as its stiffness. The work is likely to provide breakthroughs for understanding protein function through dynamics governed by its viscoelastic properties.

Figure 20:
A home-built interferometer based Atomic Force Microscope for measuring folded protein's viscoelastic response (Dr. Shivprasad Patil's Group)



Experimental high energy physics

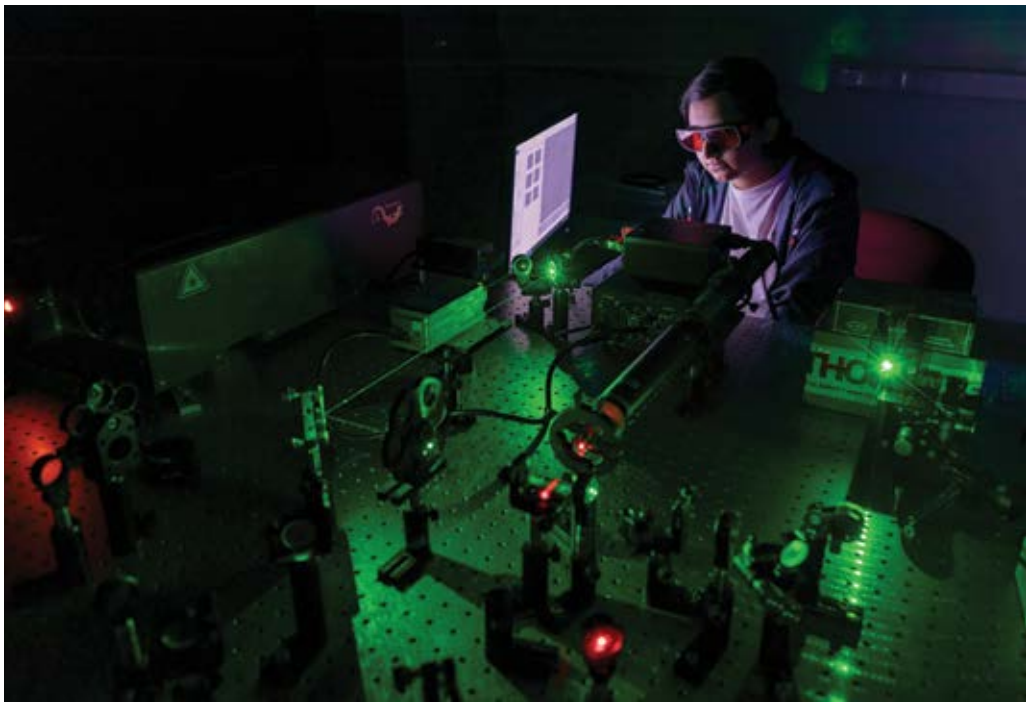
The CMS collaboration is preparing to upgrade the endcap calorimeter detectors in view of High Luminosity LHC operations with a High Granularity Calorimeter system having an unprecedented transverse and longitudinal segmentation. Dr. Seema Sharma's group measured its performance with high energy positron and pion beams with a full scale prototype for the first time, and improving the energy reconstruction using advanced machine learning tools based on graphical neural networks. With full Run2 data, they are working on searches for new physics using multijet and MET final states with photons and stop searches with tau leptons.

Probing new physics

Dr. Arun Thalapillil's research has been focused on understanding the effects of dark matter on the near horizon charactersitics of black holes and in applying machine learning techniques to identify exotic particles in cosmic ray events.

Gravitation and mathematical physics

The black hole black string phase transition in the space of static solutions to Einstein gravity has been well-studied both numerically and analytically. In particular, there has recently been a significant progress in an understanding of the geometry and topology change in the phase transition by using the large dimension limit of general relativity. For the first time, in 2021, Dr. Suneeta Vardarajan and MS student Sreejith Nair considered the black hole black string phase transition in Einstein-Gauss-Bonnet (EGB) gravity, which arises naturally in string theory due to higher curvature corrections to Einstein gravity. They demonstrated that whether there is a phase transition to a black hole depends on the value of the Gauss-Bonnet parameter. For the values of the parameter for which there is a transition, the near-neck geometry is conelike exactly as seen in Einstein gravity, and the geometry away from the cone approaches that of the black hole in EGB gravity.



PUBLICATIONS AND PATENTS

Total Publications during 2006-2021
(Publications in 2021 calendar year)

TOTAL: **3881** *(547)*

699 *(113)*
BIOLOGY

1207 *(123)*
CHEMISTRY

01 *(01)*
DATA SCIENCE

82 *(15)*
EARTH AND CLIMATE SCIENCE

39 *(07)*
HUMANITIES AND SOCIAL SCIENCES

237 *(45)*
MATHEMATICS

1616 *(243)*
PHYSICS

Publications

IISER Pune has published a total of 3881 papers since inception to the end of 2021. During the 2021 calendar year, institute members published 547 research papers, 14 book chapters, 01 book, 04 book reviews, and 02 conference papers.

The list of publications from IISER Pune members in the 2021 calendar year is given in the *Appendix* section of this report.

Patents

Since inception and as of December 31, 2021, IISER Pune has filed 56 patent applications, and had 41 published patents and 10 granted patents.

During the 2021 calendar year, IISER Pune filed 11 patent applications, had 07 patents published, and 05 patents granted.

PATENTS

Below is the list of patents filed / published / granted during 2021 calendar year.

Filed *Published* *Filed and Published* *Granted*

Sr. No.	Inventors	Title	Country and Patent Info
01	Tanpure, Arun Ankush; Sawant, Anupam Ashok; Galande, Sanjeev Anant; Srivatsan, Seergazhi Gopalan	Novel azide-modified UTP analogs for posttranscriptional chemical functionalization and imaging of RNA	**India** Application No.: 1555/MUM/2015 Publication No.: IN356910B Granted No.: IN356910
02	Mullangi, Dinesh; Sorout, Shalini; Ramanathan, Vaidhyanathan	PD loaded amphiphilic covalent organic framework as catalyst for multi-fold heck reactions, aqueous phase C-C couplings and CO oxidation	**India** Application No.: 2692/MUM/2015 Publication No.: IN201502692I3 Granted No.: 381211
03	Ottakam Thotiyl, Muhammed Musthafa; Thimmappa, Ravikumar; Devendrachari, Mruthyunjayachari Chattanahalli; Aralekallu, Shambhulinga	Chemically chargeable photo battery	**India** Application No.: 201621010024 Publication No.: IN201621010024A Granted No.: 368081
04	Halder, Sattwick; Roy, Kingshuk; Nandi, Shyamapada; Vaidhyanathan, Ramanathan	Self-exfoliated triazole-triformyl phloroglucinol based covalent organic nanosheets for high and reversible lithium ion storage	**U.S.A.** Application No.: 16/700,481 Publication No.: 10,981,925B2 Granted No.: 10,981,925
05	Britto, Sandanaraj Selvaraj; Bhandari, Pavankumar Janardhan; Reddy, Mullapudi Mohan	Supramolecular protein assemblies with advanced functions and synthesis thereof	**U.S.A.** Application No.: 16/146,891 Publication No.: US20190134212A1 Granted No.: US 11173212B2
06	Britto, Sandanaraj Selvaraj; Bhandari, Pavankumar Janardhan; Reddy, Mullapudi Mohan	Generation-dependent supramolecular assemblies of protein-dendron conjugates	**U.S.A.** Application No.: 16/771,124 Publication No.: US20210163916A1
07	Haldar, Sattwick; Chakraborty, Debanjan; Vaidhyanathan, Ramanathan	Covalent organic framework as flexible white light emitter	**India** Application No.: 201821028796 Publication No.: IN201821028796A
08	Galande, Sanjeev; Naik, Rutika	Combined expression pattern of SATB family chromatin organizers as improved biomarker tool for cancer prognosis	**U.S.A.** Application No.: 17/266,206 Publication No.: US20210262041A1
09	Galande, Sanjeev; Naik, Rutika	Combined expression pattern of SATB family chromatin organizers as improved biomarker tool for cancer prognosis	**Europe** Application No.: 19847807.5 Publication No.: EP3833779A1
10	Galande, Sanjeev; Naik, Rutika	Combined expression pattern of SATB family chromatin organizers as improved biomarker tool for cancer prognosis	**China** Application No.: 201980066379.7 Publication No.: CN112912517A

Sr. No.	Inventors	Title	Country and Patent Info
11	Galande, Sanjeev; Naik, Rutika	Combined expression pattern of SATB family chromatin organizers as improved biomarker tool for cancer prognosis	**Japan** Application No.: 2021 – 530331
12	Vaidhyanathan, Ramanathan	Covalent organic framework derived lightweight nanomagnets and a chemical method thereof	**India** Application No. 202021004764 Publication No.: IN202021004764A
13	Kushwaha Rinku; Vaidhyanathan, Ramanathan	Method of enhancing the supercapacitance of covalent organic framework via use of redox active additives in electrolyte	**India** Application No.: 202021021759 Publication No.: IN202021021759
14	Abraham, Nixon Mundathukudiyil	Olfactory-action meter for precise quantification of olfactory deficits	**U.S.A.** Application No.: 17/443,527
15	Kikkeri, Raghavendra; Kumar, N. Vijendra; Shanthamurthy, Chethan D.; Jain, Prashant; Raigawali, Rakesh, Vered Padler-Karavani; Leviatan Ben-Arye Shani	Heparan sulfate compounds as chemokine inhibitors	**India** Application No.: 202121003052
16	Britto, Sandanaraj Selvaraj; Bathla, Punita, Abhijit De	Assay for determining target engagement in real time	**India** Application No.: 202121011849
17	Rapol, Umakant D.; Hotha, Srinivas; Nair, Sunil; Patel, Kushal H.; Dutta, Pranab; Maurya, S. Sagar; Biswas, Korak; Das, Pratim Kumar	Chemical oxygen generator	**India** Application No.: 202121020842
18	Datta, Shouvik; Bhunia, Amit; Singh, Mohit Kumar; Mohamed Henini; Maryam Al huwayz	Excitonic Bose-Einstein Condensate (BEC) as qubits using semiconductor nanostructures for quantum technologies	**India** Application No.: 202121025498
19	Sonde, Ramakrishna Ramnath; Bhatia, Divesh; Roy, Shantanu; Pant, Kamal Kishor; Hotha, Srinivas; Rapol, Umakant; Nair, Sunil; Mhatre, Dwijra; Singh, Kuldeep; Parmar, Kaushal; Singh, Shreya; Patel, Kushal; Dutta, Pranab; Maurya, Shivasagar; Biswas, Korak; Das, Pratim Kumar	Hybrid oxygen system using passive and active systems	**India** Application No.: 202111029508
20	Wable, Minal; Furquan, Mohammad; Banerjee, Abhik; Ogale, Satishchandra	Process for graphene-like carbon coating on substrates	**India** Application No.: 202121059467

EXTRAMURAL GRANTS

IISER Pune faculty members have been consistently securing competitive research funds from various government science and technology departments. In the 2021-22 financial year, the institute has received Rs. 34.74 crores of research funds for 157 research projects.

The list of new extramural grants sanctioned during the 2021-22 financial year is given in the Appendix section of this report.

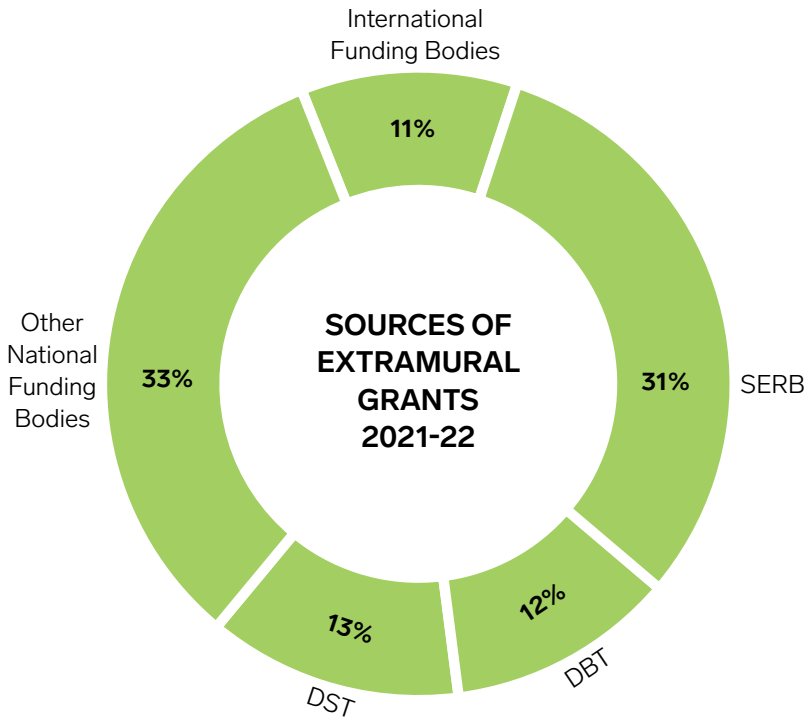
NEW PROJECTS SANCTIONED IN 2021-22

In the 2021-22 financial year, 51 new research projects have been initiated. Some of the projects initiated in the 2021-22 financial year are highlighted here:

- Funds have been received in two new schemes: SERB-SUPRA (Scientific and Useful Profound Research Advancement) Scheme; Team Science Grant from DBT/Wellcome Trust India Alliance
- Chemistry department received its second FIST grant
- Three new DBT/Wellcome Trust India Alliance grants secured by faculty members
- Grant received for COVID-19 genome sequencing from Rockefeller Foundation
- IISER Pune became a member of the INSACOG, a consortium of National Laboratories established by the Ministry of Health and Family Welfare and the Department of Biotechnology

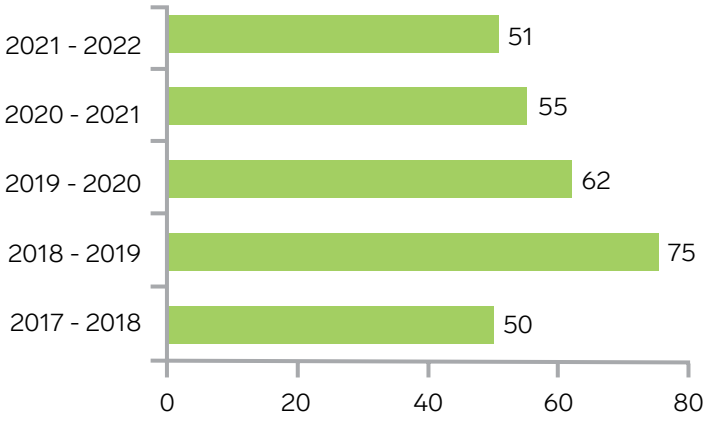
SOURCES OF EXTRAMURAL GRANTS, 2021-22

Majority of the funds received through extramural grants have been from government bodies, with research funds from SERB contributing to 31%, followed by DST (13%), and DBT (12%), of the research funds received (in 106 projects) in 2021-22. Funding from other Indian funding bodies (Wellcome Trust-DBT India Alliance, IFCPAR, MoES, MHRD, INSA, DRDO, DAE, IUCAA, etc) has contributed to 33% of funds for research in sectors such as education, defense, atomic energy, etc (in 39 projects). The international funding bodies (HHMI, IEEE, UEA, IUBS, EMBO, Swansea University, Max Planck, etc) have contributed to 11% of the total research funds (in 12 projects).



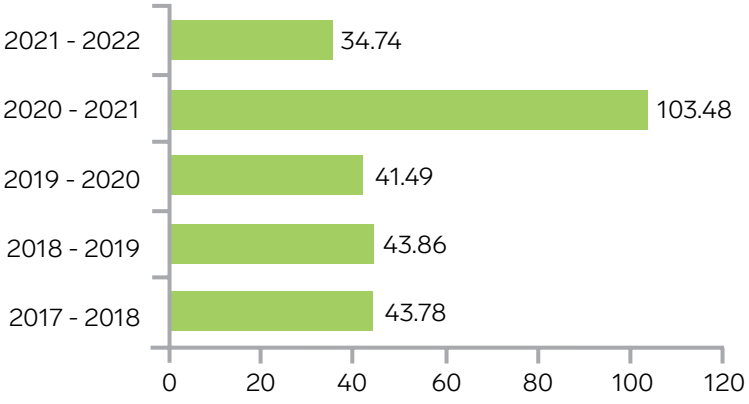
NUMBER OF NEW EXTRAMURAL GRANTS SANCTIONED

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
Associate Professor, Mathematics
Named as Rahul Bajaj Chair Professor (2021-24); Selected for the Department of Science and Technology (DST)'s SwarnaJayanti Fellowship for 2020-21

Dr. Gnanaprakasam Boopathy
Associate Professor, Chemistry
Acharya P. C. Ray Flow Chemistry Technology Award (2021)

Dr. Srabanti Chaudhury
Associate Professor, Chemistry
Received Bronze Medal of the Chemical Research Society of India for 2022

Prof. Sutirth Dey
Professor, Biology
Received SERB-STAR Award for 2021 conferred by Science and Engineering Research Board (SERB)

Dr. Amrita Hazra
Assistant Professor, Chemistry
Nominated as ChemBioTalents 2022 by *ChemBioChem* journal (Wiley-VCH Chemistry Europe)

Prof. R. Boomi Shankar
Professor, Chemistry
Received Bronze Medal of the Chemical Research Society of India for 2022; Received SERB-STAR Award for 2021 conferred by Science and Engineering Research Board (SERB)

Dr. Devapriya Chattopadhyay
Associate Professor, Earth and Climate Science
Received 2021 Ernst Mach Fellowship, Nach Betreuung Stipendium/EZA, Austrian Agency for International Cooperation in Education & Research (OeAD), Austria

Prof. Deepak Dhar
Distinguished Professor Emeritus and NASI-Senior Scientist, Physics
Selected to receive the prestigious Boltzmann Medal for 2022

Prof. Rajesh Gokhale
Professor, Biology
Appointed as the Secretary of the Department of Biotechnology

Prof. Srinivas Hotha
Professor, Chemistry
Named as Fellow of the Royal Society of Chemistry, U.K.

Dr. Siddhesh Kamat
Associate Professor, Biology
Selected for the Department of Science and Technology (DST)'s SwarnaJayanti Fellowship for 2020-21

Dr. Nishad Matange
Assistant Professor, Biology
Selected as a DBT/ Wellcome Trust India Alliance Intermediate Fellow; Received the 2021 eLife Ben Barres Spotlight Award

Prof. Satishchandra Ogale
Honorary Professor Emeritus, Physics
Received the 2021 CNR Rao Prize Lecture Award in Advanced Materials from the Materials Research Society of India

Dr. Sagar Pandit
Assistant Professor, Biology
Elected as Life Fellow of the Royal Entomological Society, U.K.

Prof. Thomas Pucadyil
Professor, Biology
Named as Rahul Bajaj Chair Professor (2021-24)

Prof. Shyam S. Rai
Honorary Professor Emeritus and Raja Ramanna Fellow, Earth and Climate Science
Received the Raja Ramanna Fellowship from the Department of Atomic Energy, Government of India

Dr. Raghav Rajan
Assistant Professor, Biology
Selected as a DBT/Wellcome Trust India Alliance Senior Fellow

Dr. Seema Sharma
Associate Professor, Physics
Elected as Deputy-Spokesperson of India-CMS Collaboration

Prof. Pinaki Talukdar
Professor, Chemistry
Named as Rahul Bajaj Chair Professor (2021-24)

Prof. Ramanathan Vaidhyanathan
Professor, Chemistry
Received Prof. C.N.R. Rao Award for Research in Inorganic and Physical Chemistry (2021); Named a Fellow of the Royal Society of Chemistry, U.K.

MEMBERSHIPS AND AFFILIATIONS

Dr. Nixon Abraham
Assistant Professor, Biology
Invited Member, Royal Society of Medicine (since January 2022)

Dr. Ashish Arora
Assistant Professor, Physics
Academic Editor of a special issue on *2D Semiconductor Nanomaterials and Heterostructures in Nanomaterials*, MDPI, Basel, Switzerland (2022-)

Dr. Anup Biswas
Associate Professor, Mathematics
Associate Editor, *Communications in Optimization Theory*

Dr. Gnanaprakasam Boopathy
Associate Professor, Chemistry
Scientific Advisory Board, Venbiotech Pvt. Ltd.

Dr. Shouvik Datta
Associate Professor, Physics
American Physical Society; Materials Research Society, U.S.A.; Invited to Participate in the working group of IEEE, U.S.A. P7130, Standard for Quantum Technologies Definitions and P7131, Standard for Quantum Computing Performance Metrics & Performance Benchmarking

Dr. Bijay Agarwalla
Assistant Professor, Physics
Faculty Associate, International Centre for Theoretical Sciences (ICTS), Bengaluru (2022-2025)

Dr. Rabeya Basu
Associate Professor, Mathematics
Visiting Faculty, Central Michigan University, U.S.A. (February 2022)

Prof. R. Boomi Shankar
Professor, Chemistry
Life Fellow, Indian Chemical Society

Prof. Aloke Das
Professor, Chemistry
Steering Committee Member, Asian Spectroscopy Conference (2021-2025)

Dr. Rahul Dehiya
Assistant Professor, Earth and Climate Science
Member, American Geophysical Union

Dr. Sreejith G.J.
Associate Professor, Physics
Regular Member, Indian Physics Association

Dr. Aurnab Ghose
Associate Professor, Biology
Re-elected as member of the IBRO (International Brain Research Organisation) Asian Pacific Regional Committee (APRC) (January 2022 to December 2024)

Dr. Prasenjit Ghosh
Associate Professor, Physics
Life Member, Chemical Research Society of India

Dr. Amrita Hazra
Assistant Professor, Chemistry
Selected as Visiting Professor, ENS Lyon (2022-2023)

Dr. Siddhesh Kamat
Associate Professor, Biology
Member, Society of Biological Chemists (India); Member, Chemical Research Society of India

Dr. G.V. Pavan Kumar
Associate Professor, Physics
Member (Biophotonics Committee), Optical Society of America; Member, American Physical Society; Board of Studies, Physics Department, Central University of Karnataka

Dr. Soumen Maity
Associate Professor, Mathematics
Member, Expert Committee for Mathematical Research Impact-Centric Support Scheme (MATRICS), SERB-DST

Dr. Moumita Majumdar
Associate Professor, Chemistry
Early Career Advisory Board Member, *ChemistryOpen*, Wiley-VCH (2022-); International Advisory Board Member, *Chemistry-An Asian Journal* Wiley-VCH (2022-)

Dr. Angshuman Nag
Associate Professor, Chemistry
Editorial Advisory Board Member, *ChemistrySelect*

Mridula Nambiar
Assistant Professor, Biology
Early Career Researcher Reviewer, *eLife* and *Genetics*

Dr. Rejish Nath
Associate Professor, Physics
Review Editor, *Frontiers in Physics*

Dr. Atikur Rahman
Associate Professor, Physics
Member, Materials Research Society (MRS)

Dr. Girish Ratnaparkhi
Associate Professor, Biology
Board Member, Indian Drosophila Board

Dr. Sudipta Sarkar
Assistant Professor, Earth and Climate Science
Member, American Geophysical Union

Dr. Seema Sharma
Associate Professor, Physics
Member, Indian Physics Association

Dr. Kaneenika Sinha
Associate Professor, Mathematics
Editorial Board Member, *Resonance*

Dr. Pushkar Sohoni
Associate Professor, Humanities and Social Sciences
Life Member, Bharat Itihas Samshodhak Mandal, Pune (2021-)

Prof. Ramanathan Vaidhyanathan
Professor, Chemistry
Associate Editor, *Chemistry of Materials* (ACS) (2022); Editorial Board Member, *ACS Materials Letters* and *Nature Scientific Reports* (2021)

Dr. Suneeta Vardarajan
Associate Professor, Physics
Member, Scientific Council of the Indian Association of General Relativity and Gravitation (IAGRG)

Shown above are new memberships and affiliations obtained during 2021-22. Many other faculty members have ongoing editorial board memberships and other academic recognitions through which they contribute to the scientific community and the education sector. 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 2021-2022 is given in the Appendix section of this report.

Academic Programmes

PhD PROGRAMME

PhD student numbers across departments as on March 31, 2022

TOTAL: 434

127
BIOLOGY

166
CHEMISTRY

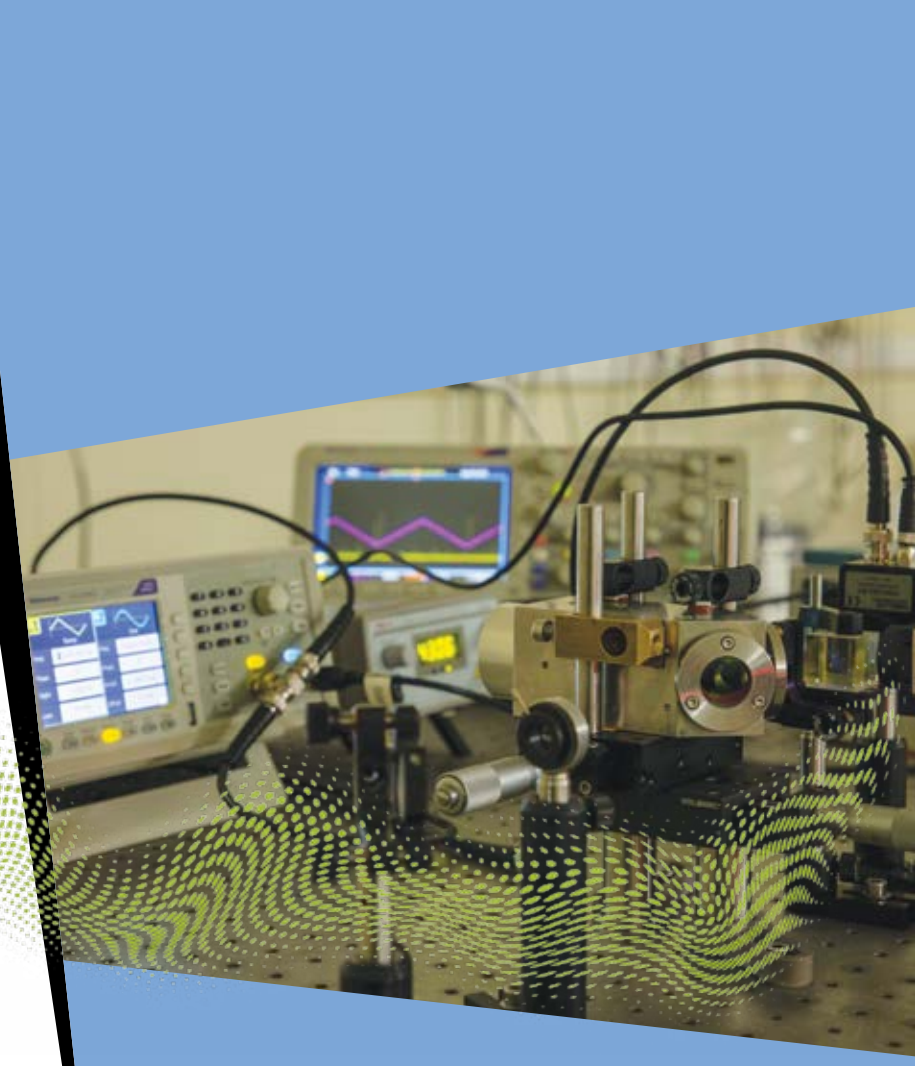
01
DATA SCIENCE

30
EARTH AND CLIMATE SCIENCE

13
HUMANITIES AND SOCIAL SCIENCES

30
MATHEMATICS

67
PHYSICS



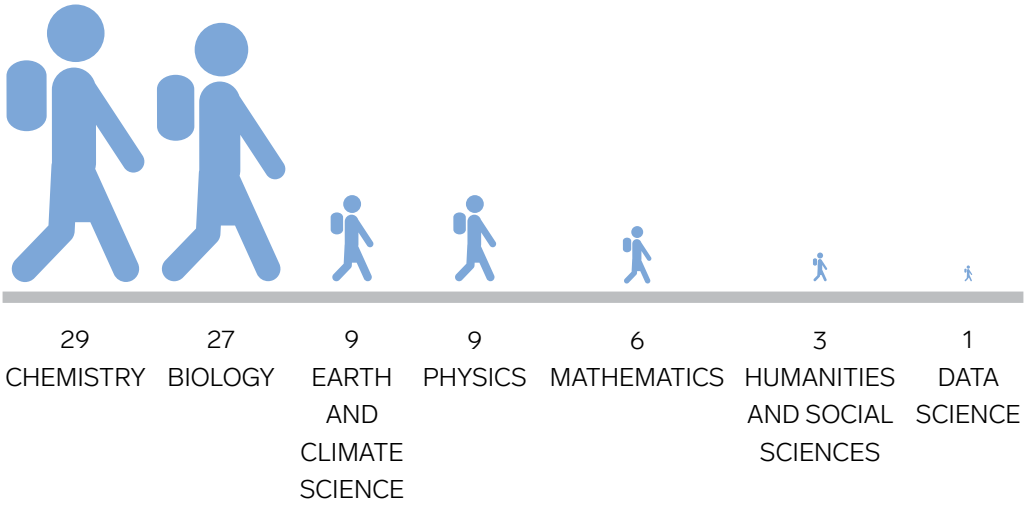
PhD students are the main driving force in the research programmes at the Institute. The PhD programme has a year-long coursework before the research work begins. Admission to PhD programmes at the Institute is through national-level tests followed by interviews conducted separately for each department.

During the August 2021 and January 2022 admission sessions, 84 (Men 46, Women 38) PhD students were admitted to the PhD programme: 27 (Men 13, Women 14) in Biology; 29 (Men 17, Women 12) in Chemistry; 01 (Women 01) in Data Science; 09 (Men 03, Women 06) in Earth and Climate Science; 03 (Men 02, Women 01) in Humanities and Social Sciences; 06 (Men 04, Women 02) in Mathematics; and 09 (Men 07, Women 02) in Physics.

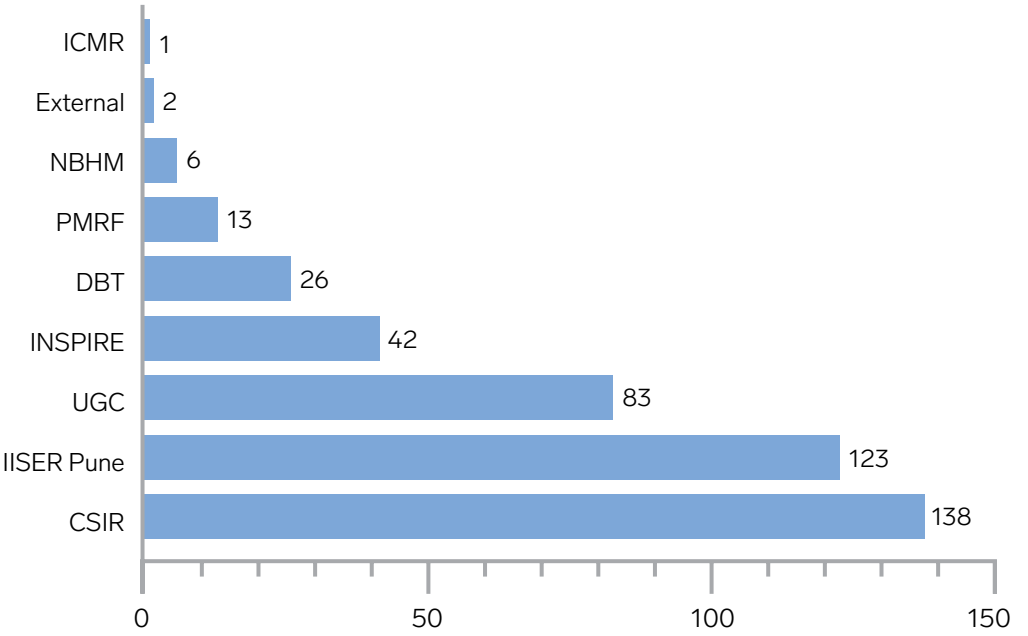
The strength of PhD students at the Institute as of March 31, 2022 is 434 (Men 256, Women 178). Here is a break-up of the numbers across departments: 127 (Men 56, Women 71) in Biology; 166 (Men 105, Women 61) in Chemistry; 01 (Women 01) in Data Science, 30 (Men 18, Women 12) in Earth and Climate Science; 13 (Men 04, Women 09) in Humanities and Social Sciences; 30 (Men 23, Women 07) in Mathematics; and 67 (Men 50, Women 17) in Physics.

PhD STUDENT ENROLLMENT DURING AUGUST 2021 AND JANUARY 2022 SESSIONS

The subject-wise distribution of the 84 PhD students admitted during the year is as follows:



SOURCES OF FELLOWSHIPS FOR PhD STUDENTS



Category-wise Numbers of PhD Students (as on March 31, 2022)

Gender	GE	OBC	SC	ST	PD	EWS	Total
Men	169	52	19	03	04	09	256
Women	135	30	07	02	01	03	178
Total	**304**	**82**	**26**	**05**	**05**	**12**	**434**

During the 2021-22 period, PhD student Arnav Saha (Biology) was selected to receive the Prime Minister's Research Fellowship (PMRF).

Thirteen PhD students received one or more travel grants for participating in international conferences and for carrying out collaborative research work. The funding agencies that the students secured travel awards from include Fulbright India, UK-India Education and Research Initiative (UKIERI), British Ecological Society, Infosys Foundation, SERB, European Association of Geochemistry, King Abdullah University of Science and Technology (KAUST), American Society of Plant Biologists (ASPB), Council of Scientific & Industrial Research (CSIR).

Valedictory Ceremonies:
Considering the pandemic situation, to celebrate the graduation of students, two valedictory ceremonies were held during the year in lieu of a convocation: on August 13, 2021 where 30 students were conferred PhD degree, and on February 04, 2022, where 15 students were conferred PhD degree.

The following 31 students have successfully completed their requirements for the award of PhD degree (completed thesis defense between April 01, 2021 and March 31, 2022). Of these, 23 students have received their degrees during the one of the two valedictory ceremonies held during the year, on August 13, 2021 and on February 04, 2022.

Sr. No.	Student	Department	Advisor	Thesis Title
01	**Mohd Danish** 20163435	ECS	Gyana Ranjan Tripathy	Biogeochemical cycling of trace elements in a tropical coastal lagoon system (Chilika, India)
02	**Khot Maithilee Sanjay** 20133254	Biology	Kundan Sengupta	Role of nuclear structure-function relationships in epithelial to mesenchymal transitions
03	**Pradhan Saurabh Jagdish** 20173518	Biology	Sanjeev Galande	Elucidating the role of chromatin organization during cell fate specification and vertebrate organogenesis
04	**Rijubrata Kundu** 20163480	Mathematics	Anupam Kumar Singh	Powers in finite groups of lie type
05	**Manu Gautam** 20153407	Chemistry	Muhammad Mustafa O.T.	Carbon derived electrodes and electrolytes for electrochemical energy systems
06	**Rahul Maity** 20153366	Chemistry	Ramanathan Vaidhyanathan	Crafting pore architecture of water-stable microporous MOFs for selective CO_2 capture

Sr. No.	Student	Department	Advisor	Thesis Title
07	**Buwa Natasha Nandkishore** 20133255	Biology	Nagaraj Balasubramanian	Caveolin1 Tyr14 phosphorylation: Regulation and role in adhesion-dependent cellular responsiveness of normal and cancer cells
08	**Bhattacharjee Anindya Subir** 20153391	Biology	Nixon Abraham	Stimulus and post-stimulus olfactory representations in health and disease
09	**Zahid Manzoor Bhat** 20163432	Chemistry	Muhammad Mustafa O.T.	Design and development of unconventional pH differential fuel cells
10	**Virender Kumar Sharma** 20153389	Biology	Mayurika Lahiri	Post-translational regulation of Apoptosis inhibitor 5 (Api5) during cell cycle progression and DNA damage-induced apoptosis
11	**Deshmukh Neeraj Ravindra** 20153409	Mathematics	Amit Hogadi	Motives of algebraic stacks
12	**Mehendale Neelay** 20163441	Biology	Siddhesh S. Kamat	Understanding oxidized phosphatidylserine and sphingolipid metabolism in macrophages
13	**Shatruhan Singh Rajput** 20143354	Physics	Shivprasad Patil	Viscoelasticity of single biopolymers using atomic force microscopy
14	**Manawa Makarand Diwekar-Joshi** 20123173	Biology	Sanjeev Galande	Comparison of the insulin-glucose relationship in the steady state and perturbed state
15	**Souparna Chakrabarty** 20123179	Biology	Deepak Barua	Phenology of woody species in a seasonally dry tropical forest: Relationship between phenology parameters, and variation between functional groups and habitats with contrasting abiotic conditions
16	**Shaikh Minhaj Shamshoddin** 20173501	Chemistry	Siddhesh S. Kamat	Synthesis of MAG and Lyso-PS lipids with varying lipid tails
17	**Yashwant Kumar** 20133270	Chemistry	Amrita B. Hazra	Molecular determinants of stability and nucleobase specificity in flavin biosynthesis enzymes
18	**Toraskar Suraj Uttamrao** 20153377	Chemistry	Raghavendra Kikkeri	Carbohydrate functionalized gold nanoparticles encode bacterial targeting and immunomodulation
19	**Jyoti Yadav** 20153408	Chemistry	Shivprasad Patil	Nanomechanics of biomaterials using atomic force microscope
20	**Srilatha Arra** 20133236	Chemistry	Mukul Kabir	Optical properties and photocatalytic activity of 2D materials
21	**Debashree Roy** 20173498	Chemistry	Nirmalya Ballav	Seed-mediated growth of anisotropic Au nanostructures: Mechanistic insights and application possibilities

Sr. No.	Student	Department	Advisor	Thesis Title
22	**Abhishek Kanyal** 20153385	Biology	Krishanpal Karmodiya	PfHDAC1 is a regulator of cell cycle in *Plasmodium falciparum* and drives the artemisinin resistance associated transcriptome
23	**Soumen Khan** 20153387	Biology	L.S. Shashidhara	Comparative analysis of target selection by the Hox protein ultrabithorax in *D. melanogaster* and *A. mellifera*
24	**Bodas Devika Sudhir** 20133252	Biology	Aurnab Ghose	Neuromodulatory mechanisms underlying the regulation of feeding drive in zebrafish
25	**Souptik Chakraborty** 20163477	Mathematics	Mousomi Bhakta	Multiplicity results for fractional elliptic equations and system of equations
26	**Vivek Kumar** 20153398	ECS	Shyam S. Rai	Seismic imaging of crust beneath the western Tibet-Pamir and western Himalaya using ambient noise and earthquake waveform data
27	**Tariq Ahmad Sheikh** 20173505	Chemistry	Angshuman Nag	Designing low-dimensional hybrid lead halide perovskites for excitonic photophysics, chiroptics and water-stability
28	**Basudev Pattanayak** 20163483	Mathematics	Manish Mishra	On the depth and genericity of representations of a p-adic group
29	**Gautam Sharma** 20153418	Physics	Prasenjit Ghosh	First principles investigation of thermoelectrics materials
30	**Abhijith K.** 20163438	Biology	Mayurika Lahiri	Understanding the role of apoptosis inhibitor 5(Api5) in breast cancer
31	**Sudipa Mondal** 20163481	Mathematics	Chandrasheel Bhagwat	On the cuspidal cohomology of GL_4

INTEGRATED PhD PROGRAMME

Integrated PhD student numbers across departments as on March 31, 2022

TOTAL: 189

71
BIOLOGY

48
CHEMISTRY

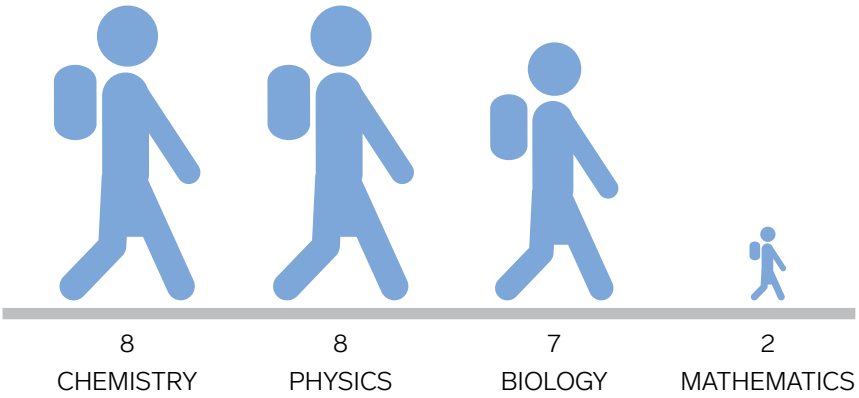
20
MATHEMATICS

50
PHYSICS

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 the departments of 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.

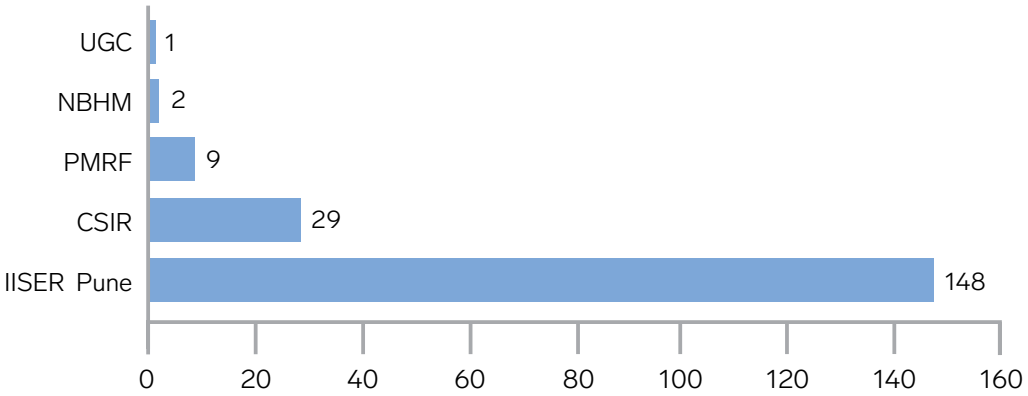
During the August 2021 session, 25 (Men 14, Women 11) students took admission to post-BSc Integrated PhD programme: 07 (Men 03, Women 04) in Biology; 08 (Men 04, Women 04) in Chemistry; 02 (Men 02) in Mathematics; and 08 (Men 05, Women 03) in Physics.

INTEGRATED PhD STUDENT ENROLLMENT DURING AUGUST 2021 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, 2022 is 189 (Men 121, Women 68). Here is the break-up of the numbers across departments: 71 (Men 28, Women 43) students in Biology; 48 (Men 35, Women 13) in Chemistry; 20 (Men 17, Women 03) in Mathematics; and 50 (Men 41, Women 09) in Physics.

Category-wise Numbers of Integrated PhD Students (as on March 31, 2022)

Gender	GE	OBC	SC	ST	Total
Men	106	12	03	00	121
Women	67	01	00	00	68
Total	**173**	**13**	**03**	**00**	**189**

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

Academic Years 2018-2020:
Sarkar Meghadeepa Manojit (Biology); Sajid Saikia (Chemistry); Jaiswal Shubham Shravin (Mathematics); and Saurabh Pant (Physics)

Academic Years 2019-2021:
Radhika Malaviya (Biology); Ankita Chandra (Chemistry); and Farmanullah (Physics)

Prizes for Academic Excellence are given to the students who have secured the highest CGPA at the end of second year. Prizes for the previous two years were given together during the Foundation Day held on April 09, 2022.

During the 2021-22 period, three Integrated PhD students were selected to receive Prime Minister's Research Fellowship (PMRF): Sonali Gupta (Biology); Sagnik Chatterjee (Physics); and Arindam Pal (Chemistry)

Three Integrated PhD students received travel grants for participating in international conferences and for carrying out collaborative research work from Infosys Foundation and from host organisations.

Valedictory Ceremonies: Considering the pandemic situation, to celebrate the graduation of students, two valedictory ceremonies were held during the year in lieu of a convocation. During the ceremony held on August 13, 2021, 19 Integrated PhD students were awarded dual Master's and PhD degrees and 05 students graduated with MS degree. During the ceremony held on February 04, 2022, 16 Integrated PhD students were awarded dual Master's and PhD degrees and 03 students graduated with MS degree.

The following 28 students have successfully completed their requirements for the award of Integrated PhD degree (completed thesis defense between April 01, 2021 and March 31, 2022). Of these, 23 students have received their degrees during the one of the two valedictory ceremonies held during the year, on August 13, 2021 and on February 04, 2022.

Sr. No.	Student	Department	Advisor	Thesis Title
01	**Konoya Das** 20142011	Chemistry	Partha Hazra	Unravelling the anomalous nature of the aqueous nanochannels in lyotropic liquid crystals
02	**Shubham Singh** 20152014	Biology	Siddhesh Kamat	Mapping the neuroanatomy of deregulated lipid metabolism and signalling pathways in PHARC syndrome
03	**Punita Bathla** 20142003	Biology	Britto S. Sandanaraj	Development of activity-based reporter gene technology (AbRGT) and its applications
04	**Shalini Pandey** 20142016	Chemistry	Nirmalya Ballav (Supervisor), and Sudipta Basu (Co-Supervisor)	Targeting endoplasmic reticulum stress as a therapeutic strategy in cancer
05	**Bhatkar Sayali Atul Vaishali** 20142025	Physics	Nabamita Banerjee (Supervisor), and Sachin Jain (Co-Supervisor)	Asymptotic conservation laws for loop level soft photon theorems

Sr. No.	Student	Department	Advisor	Thesis Title
06	**Soham Pal** 20142023	Physics	T.S. Mahesh	NMR investigation of quantum thermodynamics and quantum correlations
07	**Ron Sunny** 20132020	Biology	Deepak Barua	Hydraulic traits of seasonally dry tropical forests
08	**Dhriti Nagar** 20132002	Biology	Aurnab Ghose	Formin-2b (Fmn2b) in the development of neural circuits in zebrafish
09	**Dhanya S. Menon** 20122040	Physics	Suneeta Vardarajan	AdS instability & nonlinear perturbations in confined geometries
10	**Mangaonkar Jay Sandip Supriya** 20132019	Physics	Umakant D. Rapol	Bose-Einstein condensate based atom-optics δ-Kicked rotor for precision measurements
11	**Chougale Yashwant Kerba Ashwini** 20142031	Physics	Rejish Nath	Atomic chains with Rydberg excitations: Bose-hubbard parameters to correlation dynamics
12	**Maduskar Aditi Ajit Aarati** 20122022	Biology	Aurnab Ghose	Mechanisms underlying peptidergic modulation of feeding and feeding-associated behaviours
13	**Gungi Akhila** 20132004	Biology	Sanjeev Galande	Role of histone lysine methyltransferases and demethylases in axis patterning and regeneration of hydra
14	**Arnab Sen** 20142019	Physics	Bhas Bapat, IISER Pune and Vandana Sharma, IIT Hyderabad	Dissociation dynamics of molecules subject to intense ultrashort laser pulses
15	**Ankita Niranjan** 20142034	Physics	Rejish Nath	Quantum state control of two interacting Rydberg atoms
16	**Swati Sharma** 20132007	Biology	Richa Rikhy	Functional characterization of BAR domain proteins in actomyosin network organization during *Drosophila* embryogenesis
17	**Amarendranath Soory** 20132001	Biology	Girish Ratnaparkhi	SUMOylation regulates the function of *Drosophila* Jun and helps maintain gut immune homeostasis
18	**Arunabha Sen** 20142007	Chemistry	Sujit K. Ghosh	Advanced functional porous materials for sensing and sequestration of toxic pollutants
19	**Arindam Bhattacharjee** 20152035	Physics	Nabamita Banerjee and Sachin Jain	Asymptotic symmetries and dual theories of (2+1) dimensional (super)gravity theories
20	**Mehak Malhotra** 20132011	Chemistry	Manickam Jayakannan	Linear and star block copolymer nano-architectures for drug delivery
21	**Anindita Adak** 20112007	Chemistry	H.N. Gopi	Exploration of naturally occurring g-amino acids in the design of foldamers and biologically active peptidomimetics

Sr. No.	Student	Department	Advisor	Thesis Title
22	**Sneha Banerjee** 20122027	Chemistry	Pankaj Mandal	Low-frequency dynamics in complex liquid systems
23	**Sunny Tiwari** 20152042	Physics	G.V. Pavan Kumar	Molecular plasmonics: Directional optical antennas and single molecule SERS
24	**Rayan Chakraborty** 20152025	Chemistry	Angshuman Nag and Prasenjit Ghosh	Dielectric confinement, structure, and luminescence of 2D layered hybrid lead halide perovskites
25	**Swati Deswal** 20152030	Chemistry	R. Boomi Shankar	Synthesis of organic-inorganic hybrid ferroelectric materials and their utility in mechanical energy harvesting applications
26	**Abhijit Gupta** 20152021	Chemistry	Arnab Mukherjee	Design and application of scalable machine learning algorithms in molecular recognition, structure prediction and drug discovery
27	**Debaprasanna Kar** 20152032	Mathematics	Diganta Borah	Boundary behavior of the Carathéodory and Kobayashi-Eisenman volume elements and the Kobayashi–Fuks metric
28	**Divya Rao** 20132003	Biology	Raghav Rajan	Progression of variable repeats of introductory notes to the stable zebra finch song

BS-MS PROGRAMME

Fifth year projects carried out by the outgoing batch of BS-MS students during 2021-22

TOTAL: 239

60
BIOLOGY

52
CHEMISTRY

15
EARTH AND CLIMATE SCIENCE

06
HUMANITIES AND SOCIAL SCIENCES

12
INTER-DISCIPLINARY

18
MATHEMATICS

76
PHYSICS

The 5-year BS-MS programme gives students a well-rounded exposure to all areas of science by combining undergraduate level teaching with research. The first two years of the programme involve basic training in science imparted by faculty members across all research departments, namely, Biology, Chemistry, Data Science, Earth and Climate Science, Humanities and Social Sciences, Mathematics, and Physics. 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.

FIFTH-YEAR PROJECTS AS PER HOST ORGANISATION

154
IISER PUNE

58
NATIONAL

27
INTERNATIONAL

The academic year 2021-22 saw 273 students (188 boys and 85 girls) taking admission to the BS-MS programme. Of these, 228 were admitted through the state and central boards' stream, via the IISER Aptitude Test; 30 through the IIT-JEE stream; and 15 through the KVPY stream.

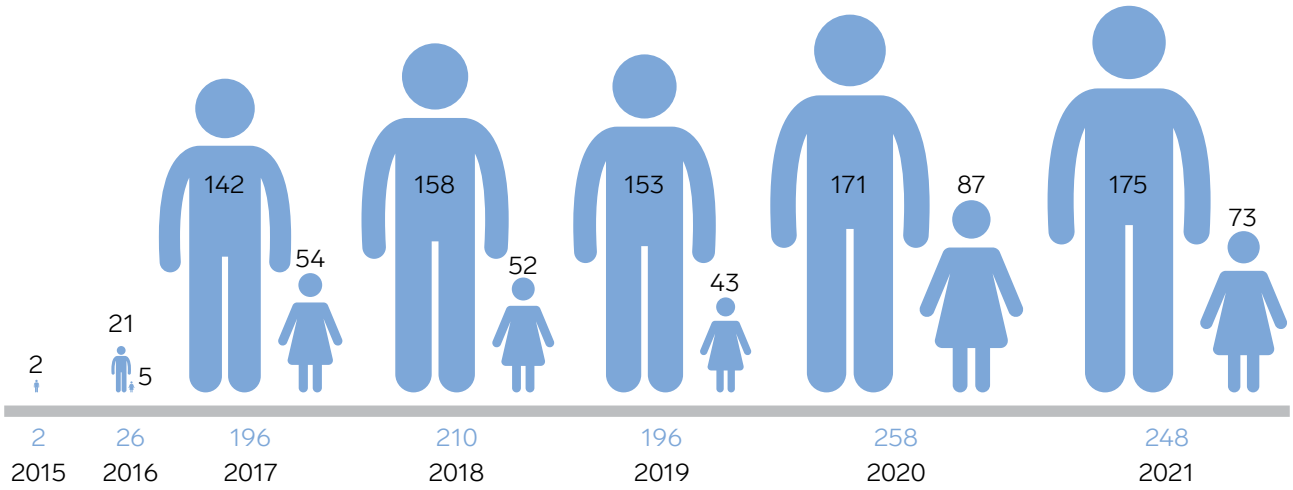
Category-wise Distribution of Students Enrolled in 2021

Gender	EWS	GE	KM	OBC	PD	SC	ST	Total
Boys	25	85	0	41	6	23	8	**188**
Girls	5	31	0	27	2	11	9	**85**
Total	**30**	**116**	**0**	**68**	**8**	**34**	**17**	**273**

Overall Category-wise Distribution of Existing BS-MS Students (as of March 31, 2022)

Gender	EWS	GE	KM	OBC	PD	SC	ST	Total
Boys	46	406	5	200	17	106	42	**822**
Girls	8	121	3	98	6	53	25	**314**
Total	**54**	**527**	**8**	**298**	**23**	**159**	**67**	**1136**

TOTAL BS-MS STUDENT STRENGTH DURING 2021-22



Subsequent to admission, 25 students discontinued from the programme, as they got admission in other courses, making the final number of students enrolled in 2021 to 248. In addition, from the previous batches, 18 students opted to discontinue the programme.

From the 2021 batch, 48 students were found eligible for receiving DST-INSPIRE scholarship and 47 students qualified for KVPY scholarship.

The total number of BS-MS students receiving DST-INSPIRE and KVPY scholarships is as follows:
DST-INSPIRE=263, KVPY=267

Details of the fifth-year projects carried out by the outgoing batch of BS-MS students during 2021-22

Sr. No.	Student	Supervisor	Project Title
	BIOLOGY		
01	**Sidharth Adithyan P.B.** 20141071	Nixon M. Abraham, IISER Pune	Nose driven anemotaxis in mice
02	**Akber Hussain M.** 20151037	Sunish Radhakrishnan, IISER Pune	Dissecting the role of an uncharacterised cell-cycle regulated protein during developmental regulation in *Caulobacter*
03	**Rajaditya Das** 20151042	Meghna Krishnadas, CSIR-CCMB, Hyderabad	The role of intraspecific variation in driving species distributions and habitat associations of tree seedlings in a fragmented tropical forest landscape
04	**Bandaru Peddiraju** 20151098	Deepak Barua, IISER Pune	Effect of different heat stress durations on the PS-II heat tolerance of tropical tree species and its relation with temperature response of carbon uptake
05	**Rishabh Singhal** 20161001	Nixon M. Abraham, IISER Pune	Effect of environmental enrichment on mouse nasal turbinate development
06	**Pawar Sahil Vinod** 20161006	Sagar Pandit, IISER Pune	Host plant microRNA mediated regulation of insect gene expression
07	**Avi Adlakha** 20161032	Thomas Kuner, Heidelberg University, Germany	Periglomerular cell function in odour discrimination probed in AMPA-type glutamate receptor-interacting protein CKAMP44 knockout mice
08	**Dilsha Farheen P.M.** 20161055	Krishanpal Karmodiya, IISER Pune	Investigating the putative phosphorylation of PfHDAC1 and its effect on gene expression
09	**Gurmail** 20161098	Thomas Pucadyil, IISER Pune	Understanding the function of Vps1 in membrane remodelling
10	**Sanak Mukherjee** 20161116	Collins Assisi, IISER Pune	A neural network-based community detection algorithm
11	**Paranjape Sujay Manoj** 20161122	Sagar Pandit, IISER Pune	Herbivory induced aggregation of tortoise beetles on morning glory plants
12	**Shintre Sharvani Shrinivas** 20161137	Varadharajan Sundaramurthy, TIFR-NCBS, Bengaluru	Understanding the connection between recycling endosomes and autophagy and interpreting its role in *Mycobacterium tuberculosis* survival
13	**Chitvan Chandolia** 20161138	Raghav Rajan, IISER Pune	Function of introductory notes preceding the male zebra finch song in male-female interaction
14	**Joshi Omkar Prasanna** 20161151	Nagaraj Balasubramanian, IISER Pune	Adhesion dependent regulation of mitochondrial membrane potential
15	**Borkar Janhavi Milind** 20161172	Vinothkumar Kutti Ragunath, TIFR-NCBS, Bengaluru	Towards a mechanism for hydrolysis of dimethylformamide by the enzyme dimethylformamidase
16	**Sudiksha Mishra** 20161178	Sanjeev Galande, IISER Pune	Functional characterization of Specificity protein (Sp1) in zebrafish (*Danio rerio*)

Sr. No.	Student	Supervisor	Project Title
17	**Sneha Sarkar** 20161195	Mridula Nambiar, IISER Pune	Deleterious role of centromeric crossovers in chromosomal segregation during meiosis
18	**Deepshikha Sen** 20161199	Nixon M. Abraham, IISER Pune	Neural mechanisms underlying olfactory dysfunctions in a COVID-19 mouse model
19	**Debiprasad Panda** 20161202	Nagaraj Balasubramanian, IISER Pune	Identifying the regulators of adhesion-independent Golgi organization in lung cancer cells
20	**Shashank Pritam** 20171013	M.S. Madhusudhan, IISER Pune	Prediction of polyproline type II helix receptors
21	**Abhinav Masih** 20171033	Saikrishnan Kayarat, IISER Pune	Engineering a lytic bacteriophage with a DNA shredder
22	**Supratim Das** 20171038	Xinghua Mindy Shi, Temple University, U.S.A.	Biomedical data enhancement using deep learning
23	**Deshpande Kshitij Ganesh** 20171042	Sudha Rajamani, IISER Pune	Interactions of mononucleotides with prebiotically pertinent protocellular membranes
24	**Lakshmi Sriram** 20171047	Saikrishnan Kayarat, IISER Pune	Characterizing the effects and applications of methylation dependent restriction endonucleases on genomic DNA
25	**Aiswarya Ajith B.** 20171049	Gayathri Pananghat, IISER Pune	Biochemical characterization of *Myxococcus xanthus* MreB and structural analysis of actin filaments with interacting proteins
26	**Guneet Singh Tarang** 20171057	Jeetender Chugh, IISER Pune	Mutational perturbation to the intrinsic adaptability of a dsRBD: Implications to RNA shape-dependent targeting
27	**Tarun Yadav** 20171058	Jared Rutter, University of Utah School of Medicine, U.S.A.	An analysis of the genomic landscape of PTEN and ATAD1 in T-cell acute lymphoblastic leukemia
28	**Ananya Dodamani** 20171060	Mridula Nambiar, IISER Pune	Analysis of multiple cohesin complexes in fission yeast during cell division
29	**Nikhil Phaniraj** 20171065	Judith M. Burkart, University of Zürich, Switzerland	Machine learning approaches for tracking changes in marmoset vocalizations and social behaviors
30	**Tathagata Bhattacharya** 20171071	Mayurika Lahiri, IISER Pune	Functional association between golgi and microtubule reorganisation in cancer
31	**Angha Ajay Bhangale** 20171073	Suhita Nadkarni, IISER Pune	The role of neurogranin in synaptic plasticity
32	**Shivam Sachin Chitnis** 20171075	Vivek Jayaraman, HHMI, Janelia Research Campus	Fruit fly navigation in the presence of visual compass cues
33	**Prerana Bose** 20171076	Kundan Sengupta, IISER Pune	Investigation copy number variations in colorectal cancer
34	**S. Pavithirah** 20171080	Collins Assisi, IISER Pune	Excitatory-inhibitory balance in recurrent networks
35	**Rose Mary Roshan** 20171081	Mayurika Lahiri, IISER Pune	Functional relevance of the interaction between Api5 and TopBP1

Sr. No.	Student	Supervisor	Project Title
36	**Meenakshi P.V.** 20171087	Gayathri Pananghat, IISER Pune	Characterization of bacterial chemosensory protein, FrzE, in *Myxococcus xanthus*
37	**Vimal Das E.S.** 20171091	Mridula Nambiar, IISER Pune	Role of DDK Kinase Hsk1-Dfp1 in cohesin loading at centromeres in *Schizosaccharomyces pombe*
38	**B. Niranjan** 20171092	Aurnab Ghose, IISER Pune	Modulation of innate fear by CART neuropeptide
39	**Pratyush M.R.** 20171093	Deepa Agashe, NCBS, Bengaluru	Effects of mutation rate and bias on bacterial mutator dynamics
40	**Samarendra Pani** 20171095	Tobias Marschall, Heinrich Heince University, Dusseldorf, Germany	Pangenome-based genome inference using long read sequencing data
41	**Shefali Dharmakirti Sonarkar** 20171098	Gayathri Pananghat, IISER Pune	Characterization of chemotaxis proteins FrzA and FrzB in *Mxyococcus xanthus*
42	**Rashmita N.** 20171101	Sunish Radhakrishnan, IISER Pune	Elucidating the function of GufA during growth and development of *Caulobacter crescentus*
43	**Shawn David** 20171102	Dasaradhi Palakodeti, InSTEM, Bengaluru	Role of ribonucleoproteins in stem cell function of planarians
44	**Madabhushi Abhinava Jagan** 20171114	Anand Krishnan, IISER Bhopal	The evolution and function of avian vocal sequences
45	**Satavisha De** 20171116	Sutirth Dey, IISER Pune	Studying the scaling of cell division and mutation accumulation with body size using an individual-based model of organismal development
46	**Gaikwad Vibhor Vijay** 20171121	Amrita B. Hazra, IISER Pune	Probing the biological chemistry of exchange and sharing of thiamin and its biosynthesis intermediates within an *Escherichia coli* synthetic cocultures
47	**Pranav S.R.** 20171127	Guy Tanentzapf, University of British Columbia, Vancouver, Canada	Sexual dimorphism in the *Drosophila* hematopoietic organ - the lymph gland
48	**Sayantan Datta** 20171131	Sutirth Dey, IISER Pune	The Eco Evo dynamics of asexual microbial populations with fluctuating population dynamics
49	**Varsha Jaisimha** 20171135	Gagandeep Kang, Christian Medical College, Vellore	Characterising nasal microbiome profiles on the basis of influenza exposure and vaccination among healthy adult volunteers in South India
50	**Vaibhav Chhaya** 20171136	Anand Krishnan, IISER Bhopal	Form and function in the bills of cavity-excavating barbets
51	**K. Sai Vignaish** 20171145	Kundan Sengupta, IISER Pune	Response of nuclear lamins upon induction of therapy-induced senescence in cancer cells

Sr. No.	Student	Supervisor	Project Title
52	**Shubhankar Gajanan Londhe** 20171154	Annalisa Marsico, Institute of Computational Biology, Neuherberg, Germany	Quantifying secondary-structure binding preferences of RNA-binding proteins via interrogation of deep neural networks
53	**Kelkar Vidyadheesh Jagdish** 20171158	Girish Ratnaparkhi, IISER Pune	Age-dependent deterioration in motor functions, circadian rhythm and sleep in *Drosophila* model of Amyotrophic Lateral Sclerosis 8
54	**Umbarkar Prajakta Keshao** 20171161	Gayathri Pananghat, IISER Pune	Building a three-dimensional model of the actomyosin ring formed during cytokinesis
55	**Mahajan Utkarsh Anil** 20171163	Sunish Radhakrishnan, IISER Pune	Dissecting the mechanism regulating the activity of a conserved σ54-dependent transcriptional activator in bacteria
56	**Lisas Kumar Sewatkar** 20171166	Aurnab Ghose, IISER Pune	Cytoskeletal and signalling mechanisms of axon collateral branching
57	**Samudra Prasanna Girish** 20171186	Nixon M. Abraham, IISER Pune	Molecular mimicries of glycosaminoglycans unravelling the mechanisms of uptake and plasticity in neuronal cell types
58	**Patil Harshal Rajendra** 20171198	Kartik Shanker, IISc Bengaluru	Distribution and diversity of reef associated organisms in the Andaman Islands
59	**Shivangi Patel** 20171213	Pascal Fries, Ernst Strüngmann Institute, Frankfurt, Germany	Attentional Scanning in Macaque Area V4
60	**Nikita Gupta** 20171218	Jayant B. Udgaonkar, IISER Pune	Residue specific structural properties of liquid-liquid phase separated Tau

CHEMISTRY

01	**Kota Siddhartha** 20151018	D. Annapurna Padmavathi, Osmania University, Hyderabad	H atom tunneling in radical reactions
02	**Lokhande Rishikesh Aniruddha** 20151191	Shabana Khan, IISER Pune	NHC based transition metal catalyst for water oxidation
03	**Manish Kumar** 20161012	Hosahudya N. Gopi, IISER Pune	Site-selective modification of peptides and proteins
04	**Manjima B.S.** 20161017	Harinath Chakrapani, IISER Pune	Designing an enzyme-triggered persulfidating agent
05	**Writam Sinha Roy Choudhuri** 20161020	Boopathy Gnanaprakasam, IISER Pune	Studies towards the synthesis of anti-cancer agent IIIM-290
06	**Saurav Raj** 20161022	Akimitsu Narita, Okinawa, Japan	Synthesis of a novel functionalized Dibenzo[hi,st]ovalene (DBOV) and study of its optical properties

Sr. No.	Student	Supervisor	Project Title
07	**Wanjari Paras Raju** 20161029	Pinaki Talukdar, IISER Pune	Photo-responsive hydrazone-based synthetic ion transporter with tuneable ionophoric activity
08	**P. Balakrishna** 20161041	Moumita Majumdar, IISER Pune	Preparation of Germanium(IV) mono-cation and di-cation as sigma acceptor ligand towards transition metals
09	**Nithun Raj V.** 20161042	Hosahudya N. Gopi, IISER Pune	Base-mediated molecular rearrangement in alpha-beta unsaturated gamma amino acids
10	**Arkajit Guha** 20161054	Ruma Banerjee, University of Michigan, Ann Arbor, U.S.A.	Hydrogen Sulfide (H_2S)-induced reverse electron transfer
11	**Ninawe Pranay Pravin** 20161060	Nirmalya Ballav, IISER Pune	Integration of a 2D Metal-Organic Framework with functionalized graphene
12	**Roshni Rani Khamari** 20161069	S.G. Srivatsan, IISER Pune	Synthesis of glycine-containing nucleotide analog for developing a novel chemo-enzymatic DNA labeling method
13	**Akash A.** 20161076	M. Jayakannan, IISER Pune	L-Dopa based enzyme-responsive poly(ester-urethane)s for drug delivery applications
14	**Bhatta Chandra Shekar** 20161081	M. Jayakannan, IISER Pune	Star-block biodegradable polymers for drug delivery
15	**Ishan Jaiswal** 20161106	Christina Roth, University of Bayreuth, Germany	Si-C nanocomposites as an anode material for Li-ion batteries
16	**Rohit B. Raj** 20161111	Pramod Pillai, IISER Pune	Plasmonic photocatalysis with anisotropic nanoparticles
17	**Vishnupriya G. Kumar** 20161113	Muhammad Mustafa O.T., IISER Pune	Isomerism governed molecular electrocatalysis
18	**Rahul Verma** 20161119	Shabana Khan, IISER Pune	aNHC stabilized first row metal complexes and their catalytic application
19	**Meenu Meena** 20161126	Partha Hazra, IISER Pune	Design, synthesis, and optical properties of novel aggregation induced emissive organic luminogen
20	**Mekan Deep Gurvindersingh** 20161132	Ramanathan Vaidhyanathan, IISER Pune	Development of COF derived nanosheet composite for electrocatalysis
21	**Rishav Kumar** 20161144	Wolfgang Schumann, Ruhr University, Bochum, Germany	Investigation of novel Cu-based catalysts for selective CO_2 reduction on gas diffusion electrodes
22	**Hitesh Kumar Panwar** 20161153	Shabana Khan, IISER Pune	PN3P ligand and its transition metal complexes
23	**Ankit Kumar Yadav** 20161155	Ramanathan Vaidhyanathan, IISER Pune	Bimetallic (Mn/Co) oxide nanoparticles supported over a covalent organic framework for oxygen evolution reaction

Sr. No.	Student	Supervisor	Project Title
24	**Kumbhar Vaibhav Umakant** 20161159	Corina Andronescu, University Duisburg-Essen, Germany	CO_2 electroreduction on Mn-N-C and Ni-N-C electrocatalyst embedded in gas diffusion electrodes
25	**Piyush Kumar** 20161169	Corina Andronescu, University Duisburg-Essen, Germany	Selective glycerol electrooxidation over non noble metal based electrocatalysts
26	**Manjul Yadav** 20161174	Arnab Mukherjee, IISER Pune	Calculation of vapor-liquid phase diagram of the binary mixture of methanol and benzene using Gibbs ensemble Monte Carlo
27	**Jishnu C.V.** 20161192	Harinath Chakrapani, IISER Pune	Design and synthesis of esterase activated nitroxyl (HNO) donors
28	**Chandana Chandran** 20161193	Ramanathan Vaidhyanathan, IISER Pune	Electrodeposition of Cu nanoparticles on Covalent Organic Framework and its role as heterogeneous catalyst for Ullmann reaction
29	**Gupte Vruta Sunil** 20161204	Amrita B. Hazra, IISER Pune	Bioengineering SAM synthetase for the production of SAM nucleobase analogs
30	**P. Riya** 20171002	Amrita B. Hazra, IISER Pune	A study on the genomic and functional context of CobT - a phosphoribosyltransferase involved in Vitamin B12 biosynthesis
31	**Reshma Reji** 20171004	Ramanathan Vaidhyanathan, IISER Pune	COF supported zirconium oxyhydroxide nanoparticles as heterogeneous catalyst for knoevenagel condensation and nerve agent simulant detoxification
32	**Sarathchandran J.** 20171006	Arnab Mukherjee, IISER Pune	Single water entropy: Implementation and analysis on supercooled water
33	**Simantini Paul** 20171017	Eluvathingal D. Jemmis, IISc Bengaluru	Exploration of bilayer-boron clusters using Density Functional Theory
34	**Devanandan K.** 20171026	Hosahudya N. Gopi, IISER Pune	Synthesis of 5,5 di-substituted gamma-lactams through a base mediated molecular rearrangement
35	**Ahammed Suhail Odungat** 20171029	Muhammad Mustafa O.T., ISER Pune	A secondary electrochemical neutralization cell
36	**Arshad T.** 20171030	Shabana Khan, IISER Pune	Synthesis of N-heterocyclic olefin capped copper nanoparticles
37	**Remya K.R.** 20171031	Raghavendra Kikkeri, IISER Pune	Synthesis of sulfated tri-iduronic acid analogs to target cancer
38	**Prashant Kumar** 20171039	Sridhar Rajaram, JNCASR, Bengaluru	Synthesis of 6-Bromoindurubin derivatives for use in the preparation of lead molecules to treat Parkinson's Disease
39	**Albert Jacob** 20171054	Bharat Kale, Centre for Materials for Electronic Technology, Pune	Enhancing the performance of $SnWO_4$ nanomaterials as Li-ion battery anodes

Sr. No.	Student	Supervisor	Project Title
40	**Keerthana M.** 20171106	M. Jayakannan, IISER Pune	Polycaprolactone based clickable nano-assemblies for antimicrobial activity
41	**Bodhayan Biswas** 20171115	Srinivas Hotha, IISER Pune	Total synthesis of Tridecasaccharide N-glycan present in HIV gp41
42	**Ankur Prakash** 20171133	Malay Patra, TIFR Mumbai	Synthesis and characterization of platinum-sugar conjugate for targeted delivery to cancer cells
43	**Gujare Aditi Ashok** 20171138	M. Jayakannan, IISER Pune	L-amino acid and sugar-based biodegradable poly(ester-urethane) for drug delivery applications
44	**Satyam Saurabh** 20171141	Satishchandra Ogale, IISER Pune	De novo synthesis of a covalent organic framework featuring high iodine uptake for Li-ion battery: A new route for transforming hazardous into treasure
45	**Anil Kumar** 20171146	Partha Hazra, IISER Pune	Design, synthesis and optical properties of two novel triphenylamine donor based D-A-A* type luminogens
46	**Muhammed Jibin P.** 20171156	Pramod Pillai, IISER Pune	Plasmonically driven organic transformation: A tool to study the effect of nanoparticle size on thermoplasmonic heat generation
47	**Devesh Maurya** 20171170	M. Jayakannan, IISER Pune	Fluorophore-tagged poly-L-lysine block copolymers for biomedical applications
48	**Kshitij V. Banzal** 20171174	Pinaki Talukdar, IISER Pune	Photoactivation of synthetic ion transporter to improve the specificity to kill the cancer cells
49	**Mohit Chatwani** 20171202	Corina Andronescu, University of Duisburg-Essen, Germany	Alcohol oxidation over Co-Ni based electrocatalysts
50	**Rakshit Rajput** 20171203	Srinivas Hotha, IISER Pune	Synthesis of O-1 antigen fragment of *Klebsiella pneumoniae* using gold-catalysed glycosylations
51	**Kinjal Mondal** 20171210	Srabanti Chaudhury, IISER Pune	Theoretical investigation of the role of protein-DNA search in quorum sensing cells
52	**Dheeraj Tembhurne** 20171216	Arnab Mukherjee, IISER Pune	Study the behaviour of entropy of water at supercooled state

EARTH AND CLIMATE SCIENCE

01	**Sanjay Golla** 20161031	Kirpa Ram, Institute of Environment and Sustainable Development (IESD), BHU	Long-term variabilities of aerosol optical properties over Kanpur city
02	**Shreeyesh Biswal** 20161036	Utsav Mannu, IISER Pune	Studying subduction using a 2D coupled thermomechanical petrological model
03	**Utpal Singh** 20161049	Sudipta Sarkar, IISER Pune	Evolution of submarine channel system and mass transport deposits in the Taranaki Basin, offshore New Zealand

Sr. No.	Student	Supervisor	Project Title
04	**Vishal Ranjith** 20161133	Neena Joseph Mani, IISER Pune	Assessment of BIOME4 PNV Maps of India and their sensitivity to climate
05	**Vedanth Prasanna Kumar** 20161184	Devapriya Chattopadhyay, IISER Pune	Molluscan predator-prey interaction and its relationship to the physiographic variables: A case study from the Andaman Islands, India
06	**Reshma Thampy** 20161188	Manoj M.G., Cochin University of Science and Technology, Kochi	Study on characteristic features of active-break cycle of ISMR over Kerala as observed with wind profiler radar (ST Radar)
07	**Rahul Tak** 20171052	Utsav Mannu, IISER Pune	Comparative analysis of catalog based magnitude of completeness estimation methods
08	**Vivek Kumar** 20171123	Rahul Dehiya, IISER Pune	Near-surface geophysical characterization of Baner hill region, Pune, India
09	**Kardile Vaishnavi Vitthal** 20171124	Gyana Ranjan Tripathy, IISER Pune	Sediment geochemistry of the Krishna river system: Implications to weathering pattern and elemental mobility
10	**Bhadrasree R. Jeevan** 20171159	Argha Banerjee, IISER Pune	Glacier response in Chandra Valley over decadal to millennial time scale
11	**Aditya Singh Bagri** 20171176	Sabin Thazhe Purayil, IITM Pune	The impact of rising global temperatures on regional monsoons
12	**Sourajit Sahoo** 20171177	Kuljeet Kaur Marhas, Physical Research Laboratory (PRL), Ahmedabad	Isotopic variations of Carbon and Nitrogen in graphite, crystallized under semi-equilibrated conditions in IAB iron meteorites
13	**Mayur Raj Singh** 20171194	Manju Mohan, Centre for Atmospheric Sciences, IIT Delhi	Assessment of diurnal temperature range and urban heat island effect over megacity Delhi
14	**Vishnupriya S.** 20171212	Suhas Ettammal, IISER Pune	Role of extratropical stratospheric air in the genesis of downstream monsoon low pressure systems
15	**Mulkalwar Ishwari Mahendra** 20171220	Suhas Ettammal, IISER Pune	Amplitude modulation of the Quasi-Biennial Oscillation (QBO) by the convectively coupled equatorial waves

HUMANITIES AND SOCIAL SCIENCES

01	**Chavan Akash Balasaheb** 20161152	Chaitra Redkar, IISER Pune	Caste and occupation: Systematic literature review of the studies on Charmakars and Mehtars
02	**Viraj Daniel Dsouza** 20171036	Shalini Sharma, IISER Pune	Can environmental justice guide sustainable development? Case of Pune and Sabarmati Riverfront Development Projects, India
03	**Gowri Niranjana** 20171059	Chaitra Redkar, IISER Pune	Problematising sexual assault against dalit women: An analysis of media reports in the Hathras rape case

Sr. No.	Student	Supervisor	Project Title
04	**Chirag Gupta** 20171151	Bejoy Thomas, IISER Pune	Measuring water poverty: A cross-country study using Water Poverty Index
05	**Shrineel Saraf** 20171179	Anil Zankar, IISER Pune	Symbiosis of arts and science through science fiction
06	**Kaustubh Mishra** 20171206	Bejoy Thomas, IISER Pune	Multidimensional poverty in India

INTER-DISCIPLINARY

01	**Namit Abhishek** 20161023	Bipin Kumar, IITM, Pune	Application of convolutional recurrent neural network in precipitation forecasting
02	**Mithil Kotak** 20161166	Chaitanya Athale, IISER Pune	A minimal computational model of collective dynein activity on microtubules in ciliary beating
03	**Malavika Biju** 20171027	Joy Merwin Monteiro, IISER Pune	Computational topology and Rossby wave packets
04	**Wanjari Rishabh Umesh** 20171056	Aniruddha Pant, AlgoAnalytics, Pune	Study of self-supervised learning for images and videos with specific applications to CCTV data
05	**Rohit Sahasrabuddhe** 20171094	Shai Pilosof, Ben-Gurion University of the Negev, Israel	The social-ecological complexity in managing a renewable resource: Modelling the effect of persistently sustainable harvesters
06	**Shraddha Sunil Pathak** 20171110	Ankur A. Kulkarni, IIT Bombay	Information design for epidemic containment
07	**Kaabaadee Rijyuta Nayan** 20171143	Milind Sohoni, IIT Bombay	Modelling the reallocation of groundwater in the context of its usage in agriculture
08	**Ajay** 20171155	Aniruddha Pant, Algoanalytics, Pune	Graph neural networks for multivariate time series forecasting
09	**Rahmathulla M.P.** 20171164	Aniruddha Pant, AlgoAnalytics, Pune	Text analytics to assist financial research & analysis
10	**Atey Kaustubh Vilasrao** 20171172	Bipin Kumar, IITM Pune	Deep learning for super-resolution of meteorological data
11	**Rishabh Dev** 20171196	Rajib Chattopadhyay, IITM, Pune	Development of AI/ML Based early warning system for vector-borne diseases outbreaks using meteorological and health parameters
12	**Govind Gandhi M.** 20171207	Camille Roth, Centre Marc Bloch, Berlin, Germany	Symbolic regression of dynamic network models

Sr. No.	Student	Supervisor	Project Title
	MATHEMATICS		
01	**Vaikunt P. Mallya** 20151189	Soumen Maity, IISER Pune	Parameterized algorithms on graph problems
02	**Patil Jatin Suresh** 20161058	Rabeya Basu, IISER Pune	Relation between algebra and topology
03	**Goutham Dev C.R.** 20161064	Rabeya Basu, IISER Pune	On K-theory of Leavitt path algebras
04	**Akash Gupta** 20161130	Tirthankar Bhattacharyya, IISc Bengaluru	Functional analysis and operator theory
05	**Wankhede Hitesh Vilas** 20161167	M. Rajesh Kannan, IIT Kharagpur	Spectral Graph Theory
06	**Tirumala Venkata Chakradhar** 20171007	Anisa Chorwadwala, IISER Pune	Spectral geometry of the Laplace-Beltrami Operator
07	**Yashi Jain** 20171019	Steven Spallone, IISER Pune	How many irreducibles are prime?
08	**Lokamruth K.R.** 20171034	Tarun Rambha, IISc Bengaluru	Epidemic modelling at a community level using contact networks
09	**Aditya Khanna** 20171035	Steven Spallone, IISER Pune	Counting cores and bar cores: From modular forms to McKay numbers
10	**Shweta K. Singh** 20171053	Amit Chattopadhyay, IIIT, Bengaluru	Topological clustering on Riemannian manifold
11	**Dipankar Maity** 20171064	Amit Hogadi, IISER Pune	Infinity categories
12	**Shruthi Ravindra Bharadwaj** 20171082	Ricardo Cao and Juan M. Vilar, University of A Coruña, Spain	Default status prediction in credit data using mixture cure models
13	**Megha Dinesh Bhat** 20171086	Tejas Kalelkar, IISER Pune	Hyperbolic Knot Theory and geometric triangulations
14	**Arijit Paul** 20171089	Mainak Poddar, IISER Pune	A study of Heegaard Floer homologies
15	**Chrisil Ouseph** 20171137	Vivek Mohan Mallick, IISER Pune	Algebraic topology and obstruction theory
16	**Joshi Amey Abhay** 20171147	Doug Park, University of Waterloo, Canada	Abelian branched covers and symplectic geography problem
17	**Bihan Chatterjee** 20171149	Anindya Goswami, IISER Pune	Path-dependent options in semi-Markov regime switching models
18	**Abhishek Koparde** 20171169	Arvind Nair, TIFR, Mumbai	Etale cohomology and rationality of L-series of varieties

Sr. No.	Student	Supervisor	Project Title
	PHYSICS		
01	**Avik Mukherjee** 20141118	Arun Kumar Pati, HRI, Allahabad	Noise and entropic uncertainty relations in quantum systems
02	**Anmol Kumar Sahu** 20151093	Tejinder Pal Singh, TIFR Mumbai	Do we really require a curved description of spacetime to explain Gravity?
03	**Kumar Gourav** 20161011	Vijayakumar Chikkadi, IISER Pune	Active microrheology of Newtonian and non-Newtonian fluids using dual trap tweezer
04	**Hirve Shriya Shrikant** 20161024	Tarun Souradeep, IISER Pune	Search for a new measure to quantify violation of statistical isotropy in the CMB
05	**Anoop Raj** 20161046	Kedar Damle, TIFR Mumbai	Dimer model and worm algorithm
06	**P.B.S. Murthykrishnan** 20161062	Sunil Nair, IISER Pune	Compensated ferrimagnets for spintronic applications
07	**Thejas C.S.** 20161065	Umakant D. Rapol, IISER Pune	Frequency stabilization of 1064 nm narrow linewidth laser
08	**Aadarsh Kumar** 20161077	Shivprasad Patil, IISER Pune	Cantilever dynamics using small amplitude AFM
09	**Hassan Yazdani** 20161080	Shankar Kumar Selvaraja, IISc, Bengaluru	Liquid crystal integrated photonic circuit for on-chip tunable optical filter
10	**M. Gopika** 20161082	Pramod Pullarkat, Raman Research Institute, Bengaluru	Devising techniques to probe the mechanical response of axons
11	**Ashish Ranjan** 20161085	Vinod M. Menon, City College of New York, U.S.A.	Single molecule strong coupling in plasmonic nanocavities
12	**Mankar Geet Rajio** 20161089	Subhabrata Majumdar, TIFR, Mumbai	Cosmology with quasars
13	**Sreejith A. Nair** 20161091	Suneeta Vardarajan, IISER Pune	Black hole black string phase transitions
14	**Seemant Mishra** 20161094	Urna Basu, S.N. Bose National Centre for Basic Sciences, Kolkata	Effect of stochastic resetting on interacting particle systems
15	**Devadharsini S.** 20161095	Deepak Vaid, NIT-K Surathkal	The spinorial formulations of scattering amplitudes and loop quantum gravity
16	**Himanshu A. Bhisikar** 20161099	Kanak Saha, IUCAA, Pune	A study of clumps and star formation in NGC 4571
17	**Mansi Budamagunta** 20161103	M.S. Santhanam, IISER Pune	Dynamical processes on transportation networks: Effects on infectious disease spreading

Sr. No.	Student	Supervisor	Project Title
18	**Divyansh Vardhan** 20161107	Arijit Bhattacharyay, IISER Pune	Pattern formation in planar DC semiconductor gas discharges
19	**Appu S.** 20161110	Surjeet Singh, IISER Pune	Exploring properties of Heusler alloys hosting magnetic skyrmions
20	**Wridhdhisom Karar** 20161125	Martin Weides, University of Glasgow, Scotland	Improved single shot quantum measurement using superconducting circuits
21	**Ajgaonkar Durgesh Raman** 20161139	Urna Basu, S. N. Bose National Centre for Basic Sciences, Kolkata	Dynamics of non-interacting 1D inertial run and tumble particles
22	**Muskan Shinde** 20161140	Olivier Absil, University of Liège, Belgium	Optimization of METIS high contrast imaging modes
23	**Moirangthem Bicky Singh** 20161149	Sunil Nair, IISER Pune	Resonant ultrasound spectroscopy of some oxide systems
24	**Sounak Sinha** 20161168	Diptimoy Ghosh, IISER Pune	Entanglement in quantum field theory and quantum gravity
25	**Shah Aagam Parag** 20161175	Deepak Dhar, IISER Pune	Phase transitions in hard rods on a lattice
26	**Rohan Maniar** 20171001	Mukul Kabir, IISER Pune	Electronic and magnetic properties of quantum materials using SCAN functional
27	**Sahana N.** 20171008	Tuhin Roy, TIFR, Mumbai	From construction to application - a study in Effective Field Theories
28	**Rahul Kumar** 20171012	Seema Sharma, IISER Pune	Calibration of CMS HGCAL Silicon sensors and particle energy reconstruction
29	**Sabarenath J.P.** 20171014	Sunil Mukhi, IISER Pune	Black holes, classical entropy and one-loop corrections
30	**Chetan Pandey** 20171015	Sudarshan Ananth, IISER Pune	Yang Mills theories, quadratic forms and Nicolai maps
31	**Praniti Singh** 20171016	Diptimoy Ghosh, IISER Pune	Primordial black holes as a dark matter candidate
32	**Amit Yadav** 20171018	Sunil Nair, IISER Pune	Study of multiglass state in some pyrochlore oxides
33	**Ritwick Kumar Ghosh** 20171021	Sunil Mukhi, IISER Pune	Path integral approach to quantum gravity
34	**Santhosh M.** 20171022	Sreejith G.J., IISER Pune	Free parafermionic spin chains
35	**Ashwath Narayanan Madhusudan** 20171023	Rejish Nath, IISER Pune	Fidelity susceptibility approach to study metastable phase separated states in the extended Bose-Hubbard ladder

Sr. No.	Student	Supervisor	Project Title
36	**Yogeshraj Nambisan** 20171025	Rajeev Bhalerao, IISER Pune	A parametric study of relativistic hydrodynamics out of equilibrium
37	**Amlan Nanda** 20171028	Nils Andersson, University of Southampton, U.K.	A mode-sum approach to tidal deformation of slowly rotating stars
38	**Abhishek Kumar Gupta** 20171037	Vijayakumar Chikkadi, IISER Pune	Deformation of colloidal glasses
39	**Gopidi Harshan Reddy** 20171040	Prasenjit Ghosh, IISER Pune	First principles study of Skutterudite/Nb interface at high temperatures for thermoelectric applications
40	**Aditya Milind Kolhatkar** 20171041	Sreejith G.J., IISER Pune	DMRG for the quantum hall effect and application in an exact model
41	**Akash Trivedi** 20171044	Abhishek Dhar, ICTS, Bengaluru	Investing the validity of quantum master equations
42	**Bhadane Anurag Nitinrao** 20171046	Umakant D. Rapol, IISER Pune	Optical phase locked loop for atom interferometry
43	**Soubhadra Maiti** 20171050	Ujjwal Sen, Harish-Chandra Research Institute, Allahabad	Glassy noise in quantum phase estimation algorithm
44	**Fernandes Johann Milton** 20171066	Arijit Bhattacharyay, IISER Pune	Cosmological fit of the LTB model with the JLA supernova dataset
45	**Aakash R.** 20171072	C.M. Chandrashekar, Institute of Mathematical Sciences, Chennai	High-dimensional quantum walks for field theory simulations
46	**Nandhini R.** 20171077	Anil Prabhakar, IIT Madras	Improving quantum gates using pulse programming
47	**Aniket Ashok Zodage** 20171079	Rosalind Allen, University of Edinburgh, U.K.	Mutant number statistics for spatially structured microbial populations
48	**Advait Ashirwad Thatte** 20171085	Gautam Menon, Ashoka University, Sonipat	Studying phase separation in the nucleus
49	**Mayank Pathak** 20171097	Parthasarathi Majumdar, Indian Association for the Cultivation of Science (IACS), Kolkata	Aspects of acoustic geometry in inviscid and slightly viscous fluids
50	**Thangjam Kelvin** 20171103	Sunil Nair, IISER Pune	Synthesis and characterisation of La doped PZT ceramics for potential electrocaloric cooling applications
51	**Bibhut Chandan Sahoo** 20171104	Sachin Jain, IISER Pune	Momentum space bootstrap of conformal correlation functions
52	**Nagananda K.K.** 20171109	Sumilan Banerjee, IISc Bengaluru	Green's function based real-space renormalisation group for disordered systems
53	**Sreekuttan L.S.** 20171120	Urbasi Sinha, Raman Research Institute, Bengaluru	Application of machine learning in quantum state estimation

Sr. No.	Student	Supervisor	Project Title
54	**Nishant Baruah** 20171122	Vijayakumar Chikkadi, IISER Pune	Nonequilibrium self-assembly of colloidal particles in active liquids
55	**Ghugal Shreeja Gajanan** 20171125	Masamune Oguri, University of Tokyo, Japan	Two-component modeling of galaxy-scale strong lensing
56	**Sougata Chowdhury** 20171132	Arnab Kundu, Saha Institute of Nuclear Physics, Kolkata	Quantum error correction and holography
57	**Zade Aashna Anil** 20171134	Sachin Jain, IISER Pune	CFT correlators from slightly broken higher spin symmetry
58	**Gautam Jagadish Hegde** 20171139	Rejish Nath, IISER Pune	Soliton dynamics in spinor and dipolar Bose-Einstein condensates
59	**Sheikh Parvez Mandal** 20171148	Ujjwal Sen, Harish-Chandra Research Institute, Allahabad	Quantum search in a non-Markovian environment
60	**Hitesh Kumar** 20171150	Aparna Deshpande, IISER Pune	Understanding layer-by-layer anisotropy in Transition Metal Dichalcogenides (TMDs) with scanning probe microscopy
61	**Shrivastava Prachi Dhanendra** 20171153	M.S. Santhanam, IISER Pune	Extreme events and higher order networks
62	**Swarnavo Basu** 20171157	Mathias S. Scheurer, University of Innsbruck, Austria	Unsupervised classification of topological insulators
63	**Amartya Harsh Singh** 20171165	Diptimoy Ghosh, IISER Pune	EFTs, positivity, and the swampland
64	**Prabhav Jain** 20171168	Sachin Jain, IISER Pune	Bosonization in Higher Dimensions
65	**Avinash Verma** 20171173	Nishita Dattatray Desai, TIFR, Mumbai	Using simplified likelihood in reinterpretation of physics beyond the Standard Model
66	**Pranay Naredi** 20171175	M.S. Santhanam, IISER Pune	Discrete-time quantum walks with lazy and chaotic coins
67	**Ashutosh Rana** 20171178	Satishchandra Ogale, IISER Pune	Effect of imidazole on kinetics of zinc metal electrodeposition in aqueous solution
68	**Yuvraj Chaudhry** 20171180	Shouvik Datta, IISER Pune	Exploring excitonic superfluidity
69	**Somesh Kurahatti** 20171182	Apratim Chatterji, IISER Pune	Microscopic model to investigate stress-strain response for polymer nanocomposites containing rod-like partic
70	**Patil Rushikesh Anil** 20171187	Kedar Damle, TIFR, Mumbai	Exact calculations of non-local quantities in a loop model
71	**Achintya Mitra** 20171189	Arijit Bhattacharyay, IISER Pune	A study of Hawking radiation analogues in BEC

Sr. No.	Student	Supervisor	Project Title
72	**Parmar Dhruvanshu Maheshbhai** 20171191	Seema Sharma, IISER Pune	Search for effective field theory parameters for H→ZZ*→4l using normalizing flow models
73	**Sugat Kokiloo** 20171192	Shankaranarayanan S., IIT Bombay	Entanglement and black hole physics
74	**Jamunkar Abhishek Ravindra** 20171214	G. Raghavan, DIAT, Pune	Bell state measurements in quantum information theory and quantum foundations
75	**Manish Kumar Gupta** 20171215	Sivasurender Chandran, IIT Kanpur	Understanding the external stimuli induced control over bacterial motility and biofilm formation
76	**Sayan Debnath** 20171222	Ashna Bajpai, IISER Pune	Exploring linear and nonlinear AC- susceptibilities in a single crystal of alpha-Fe_2O_3 around the morin transition,using a home built AC-susceptometer

ACADEMIC ACHIEVEMENTS OF BS-MS STUDENTS

Institute Prizes related to academic excellence (CNR Rao Education Foundation Prize and Prizes for Academic Excellence) are given every year to BS-MS and Integrated PhD 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.

Year 2020-2021
Saransh Rakesh Agrawal (Batch 2020, Semester 1)
Shah Neev Vinay (Batch 2019, Semester 2)
Shivang Yadav (Batch 2019, Semester 2)

Year 2021-2022
Srirang Nabar (Batch 2020, Semester 2)

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.

Year 2020-2021
Ankan Nath (Batch 2019, Semester 3)
Ravish Mehta (Batch 2019, Semester 3)
Madheshvaran S. (Batch 2018, Semester 4)
Patil Rushikesh Anil (Batch 2017, Semester 5 & 6)
Viraj Meruliya (Batch 2016, Semester 7 & 8)

Year 2021-2022
Rik Sarkar (Batch 2020, Semester 3)
Kshitij Verma (Batch 2019, Semester 4)
Mihir Neve (Batch 2018, Semester 5 & 6)
Pratyush M.R. (Batch 2017, Semester 7 & 8)

Valedictory Ceremonies:

Considering the pandemic situation, to celebrate the graduation of students, two valedictory ceremonies were held during the year in lieu of a convocation: on August 13, 2021 and on February 04, 2022.

During the Valedictory Ceremony held on August 13, 2021, 82 students graduated with BS-MS dual degrees, and 07 students received BS degree. Twenty-one students passed with distinction.

During the Valedictory Ceremony held on February 04, 2022, in lieu of Convocation of the Institute, 77 students graduated with BS-MS dual degrees, and 03 students received BS degree. Viraj Meruliya who secured a CGPA of 9.8 was awarded the Institute Gold Medal. Five students passed with Distinction (CGPA>9.0).

Students who passed with Distinction (CGPA>9.0) during the year:

Patel Vishrut Yogesh
Suman Satish Kulkarni
Sahiti Chebolu
Avinash Roy
Utkarsh Khandelwal
Gopal Chandra Santra
Kasturi Lele
Siddhant Sharma
Pranay Nayak
Koustav Halder
Shambhavi S.
Adarsh Srinivasan
Amruta Swaminathan
Aleena M.J.
Viraj Meruliya
Jitesh Seth
Kabir Vinay Dabholkar
Rakshitha T.
Dayal Singh
Bagal Viraj Bhagwan
Joshi Purva Chandrashekhar
Avi Adlakha
Arkajit Guha
Akash Gupta
Vishal Ranjith
Joshi Omkar Prasanna

LIST OF COURSES

August 2021 Semester 1

BS-MS Course Code	BS-MS Credits	Course Title	Semester	Coordinator/Instructor
BI1113	3	Introductory Biology - I	1	Nagaraj Balasubramanian, Girish Ratnaparkhi
TD1113	3	Introduction to Computing	1	Pranay Goel, Collins Assisi, Suhita Nadkarni
CH1113	3	Principles of Organic Chemistry	1	Ramakrishna G. Bhat, Srinivas Hotha
EC1213	3	Evolution of Earth and Life	1	Gyana Ranjan Tripathy, Devapriya Chattopadhyay
TD1123	3	Academic Communication Skills	1	Pooja Sancheti
MT1113	3	Calculus - I	1	Mousomi Bhakta, Diganta Borah
PH1113	3	Introductory Mechanics	1	Diptimoy Ghosh, Mukul Kabir
PH1123	3	Physics Lab - I	1	Aparna Deshpande, Bhas Bapat, Seema Sharma, Atikur Rehman

August 2021 Semester 3

BS-MS Course Code	BS-MS Credits	Course Title	Semester	Coordinator/Instructor
BI2113	3	Ecology and Evolution	3	Sutirth Dey
BI2123	3	Introduction to Biological Systems (E)	3	Aurnab Ghose, Collins Assisi
CH2113	3	Principles of Inorganic Chemistry	3	R. Boomi Shankar, R. Vaidhyanathan
CH2223	3	Principles of Organic Chemistry II (E)	3	Harinath Chakrapani
EC2113	3	Introduction to Climate Science	3	Neena Joseph Mani
EC2123	3	Landscapes and their Evolution	3	Argha Banerjee
MT2113	3	Introduction to Probability	3	Vivek Mohan Mallick, Anup Biswas
MT2123	3	Advanced Linear Algebra (E)	3	Anisa Chorwadwala
PH2113	3	Introductory Quantum Physics	3	Sourabh Dube, Satishchandra Ogale
PH2123	3	Mathematical Methods for Physics (E)	3	Bijay Kumar Agarwalla, Sunil Mukhi

August 2021 Semester

Note: Semesters 5 and 7 refer to BS-MS semesters; 11 and 13 refer to iPhD semesters 1 and 3 respectively; and 21 refers to PhD semester 1

BS-MS / iPhD Course Code	BS-MS / iPhD Credits	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/Instructor
BI3124	4	**BI6114**	4	Advanced Molecular Biology	5,11,21	Gayathri Pananghat, Mayurika Lahiri
BI3134	4	**BI6124**	4	Bioinformatics	5,7,11,13,21	M.S. Madhusudhan
BI3144	4	**BI6134**	4	Cellular Biophysics - I	5,7,11,13,21	Chaitanya Athale
BI3154	4	**BI6144**	4	Neurobiology - I	5,7,11,13,21	Nixon M. Abraham, Suhita Nadkarni
BI3164	4	**BI6154**	4	Plant Biology - I	5,7,11,13,21	Anjan Banerjee, Kalika Prasad
BI4113	3	**BI6163**	3	Animal Physiology - II	7,13,21	Nishad Matange, N. Subhedar
BI4123	3	**BI6173**	3	Advanced Immunology	7,13,21	Satyajit Rath, Vineeta Bal
BI3174	4	**BI6184**	4	Advanced Biochemistry - I	5,7,11,13,21	Siddhesh Kamat, Sudha Rajamani
BI3184	4	**BI6194**	4	Ecology - I	5,7,11,13,21	Deepak Barua
BI3194	4	**BI6314**	4	Developmental Biology	5,7,11,13,21	Girish Ratnaparkhi, Richa Rikhy
BI4133	3	**BI6323**	3	Epigenetics	7,13,21	Krishanpal Karmodiya, Kundan Sengupta
BI3323	3	**BI6333**	3	Structural Biology	5,7,11,13,21	Saikrishnan Kayarat, Gayathri Pananghat
BIO491	3			Literature Review	7	Raghav Rajan
BI3313	3			Lab Training/ Theory Project	5	Sagar Pandit
BIO401	3			Lab Training/ Theory Project	7	Sagar Pandit
BI5713	3			Lab Training	13	Deepak Barua
BI5723	3			Lab Training	13	Deepak Barua
BI5513	3			Lab Training	11	Deepak Barua
BI5733	3			Lab Training	13	Deepak Barua
BI5114	4	**BI6344**	4	Biostatistics	11,13,21	Ramana Athreya
		BI6352	2	Cell Signalling in Prokaryotes	13,21	Sunish Radhakrishnan
CH3114	4	**CH6114**	4	Physical Organic Chemistry	5,7,11,13,21	Hosahudya N. Gopi
CH3124	4	**CH6124**	4	Main Group Chemistry	5,7,11,13,21	Moumita Majumdar
CH3134	4	**CH6134**	4	Symmetry and Group Theory	5,7,11,13,21	Jeetender Chugh
CH3143	3	**CH6144**	4	Self-Assembly in Chemistry	5,7,11,13,21	S. Sandanaraj Britto
CH3154	4	**CH6154**	4	Chemical Equilibrium and Kinetics	5,7,11,13,21	Arnab Mukherjee
CHM411	4	**CH6164**	4	Organic Synthesis - II	7,13,21	Boopathy Gnanaprakasam
CHM413	4	**CH6174**	4	Bioinorganic Chemistry	7,13,21	V.G. Anand
CHM421	4	**CH6184**	4	Polymer Chemistry	7,13,21	M. Jayakannan

BS-MS / iPhD Course Code	BS-MS / iPhD Credits	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/Instructor
CHM422	4	**CH6194**	4	Statistical Thermodynamics	7,13,21	Anirban Hazra, Srabanti Chaudhury
CHM430	3			Advanced Physical Chemistry Laboratory	7,13	Pramod Pillai, Pankaj Mandal, Muhammed Musthafa
CHM431	3	**CH6314**	4	Chemical Biology	7,13,21	Amrita Hazra
CHM432	3	**CH6324**	4	Solid State Chemistry	7,13,21	Partha Hazra
CHM445	3	**CH6334**	4	Electrochemistry	7,13,21	Nirmalya Ballav
CHM446	4	**CH6344**	4	Fundamentals of Solution-State NMR Spectroscopy: Principles and Applications	7,13,21	Jeetender Chugh
CH3313	3			Lab Training/ Theory Project - I	5	Angshuman Nag
CHM401	3			Lab Training/ Theory Project - II	7	Angshuman Nag
CH5712	2			Lab Training	13	Jeetender Chugh
CH5722	2			Lab Training	13	Jeetender Chugh
		CH6352	2	Reaction Mechanism	13,21	Hosahudya N. Gopi, Ramakrishna G. Bhat, Boopathy Gnanaprakasam
EC3114	4	**EC6114**	4	Numerical Computation	5,21	Suhas Ettammal
EC3124	4	**EC6124**	4	Physics of the Atmosphere	5,7,21	Neena Joseph Mani
EC4114	4	**EC6134**	4	Atmosphere and Ocean Dynamics	7,21	Suhas Ettammal
EC3134	4	**EC6144**	4	Applied Mathematical Methods	5,21	Joy Merwin Monteiro
EC3144	4	**EC6154**	4	Introduction to Geophysics	5,7,21	Arjun Datta, Shyam S. Rai
EC3154	4	**EC6164**	4	Sedimentology and Stratigraphy	5,21	Sudipta Sarkar
EC3164	4	**EC6174**	4	Earth and Planetary Materials	5,7,21	Shreyas Managave
ECS411	4	**EC6184**	4	Exploration Seismology	7,21	Rahul Dehiya
ECS453	4	**EC6194**	4	Tropical Meteorology	7,21	Suhas Ettammal, Sibin T.P. (IITM Pune)
ECS457	3	**EC6314**	4	Sequence Stratigraphy	7,21	Alok Dave
EC3174	4	**EC6324**	4	Structural Geology and Tectonics	5,7,21	Shreyas Managave, Durga Mohanty (SPPU Pune)
EC3183	3	**EC6334**	4	Parameter Estimation and Inverse Theory	5,7,21	Rahul Dehiya
ECS460	4	**EC6344**	4	Igneous and Metamorphic Petrology	7,21	Shreyas Managave, Raymond Duraiswamy (SPPU Pune)
EC3194	4	**EC6354**	4	Paleobiology	5,7,21	Devapriya Chattopadhyay
EC4123	3	**EC6364**	4	Sedimentology and Paleobiology Lab	7,21	Alok Dave
EC3323	3	**EC6374**	4	Hydrology	5,7,21	Argha Banerjee, Sanjeev Jha (IISER Bhopal)

BS-MS / iPhD Course Code	BS-MS / iPhD Credits	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/Instructor
		EC6382	2	Fundamentals of Climate Science	21	Neena Joseph Mani
		EC6392	2	Fundamentals of Geology	21	Devapriya Chattopadhyay, Gyana Ranjan Tripathy
		EC6512	2	Fundamentals of Geophysics	21	Arjun Datta
		EC6522	2	Classic papers in Earth and Climate Science	21	Argha Banerjee
EC3313	3			Lab Training/ Theory Project	5	Shreyas Managave
ECS401	3			Lab Training/ Theory Project	7	Shreyas Managave
		HS6114	4	PhD Reading Course	21	Pooja Sancheti
HS3114	4	**HS6124**	4	Disasters and Society	5,7,13,21	Shalini Sharma
HS3123	3	**HS6134**	4	Evolution of Cinema	5,7,13,21	Anil Zankar
HS3133	3	**HS6144**	4	History of Mathematics in India	5,7,13,21	Venketeswara Pai R.
HS3144	4	**HS6154**	4	Select Key Political Concepts	5,7,13,21	Chaitra Redkar
HS3153	3	**HS6164**	4	Economics and Public Policy	5,7,13,21	Bejoy K. Thomas
HS3164	4	**HS6174**	4	Contemporary Stories from the Subcontinent	5,7,13,21	Pooja Sancheti
HS3313	3			Lab Training/ Theory Project	5	Pushkar Sohoni
HSS401	3			Lab Training/ Theory Project	7	Pushkar Sohoni
MT3114	4			Rings and Modules	5,7,11	Baskar Balasubramanyam
MT3124	4			Real Analysis II	5,7,11	Ayan Mahalanobis
MT3134	4			Point Set Topology	5,7,11	Rabeya Basu
MT3144	4			Ordinary Differential Equations	5,7,11,13	Steven Spallone
MT3154	4			Graph Theory	5,7,11	Krishna Kaipa
MT3164	4			Numerical Analysis	5,7,11	Anindya Goswami
MT3174	4			Fields and Galois theory	5,7,11,13	Anupam Kumar Singh
MTH412	4			Algebraic Topology	7,11,13	Tejas Kalelkar
MTH413	4	**MT6114**	4	Algorithms	7,11,13,21	Soumen Maity
MTH415	4	**MT6124**	4	Probability	7,11,13,21	Moumanti Podder
MTH421	4			Measure Theory and Integration	7,11,13	Divyang Bhimani
MT3184	4			Markov Chains and Queueing models	5,11,13	Anindya Goswami, Pallavi Manohar
MTH449	4			Probabilistic Number Theory	7,11,13	Kaneenika Sinha
MTH450	4			Representation Theory of Finite Groups	7,11,13	Chandrasheel Bhagwat
MT3313	3			Lab Training/Theory Project	5	Baskar Balasubramanyam
MTH401	3			Lab Training/Theory Project	7	Baskar Balasubramanyam
MT5513	3			Semester Project	11	Kaneenika Sinha
MT5723	3			Semester Project	13	Kaneenika Sinha

BS-MS / iPhD Course Code	BS-MS / iPhD Credits	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/Instructor
MT5730	14			Research Project	13	Kaneenika Sinha
	4	**MT6134**	4	Algebra - I	13,21	Supriya Pisolkar
	4	**MT6144**	4	Analysis - I	13,21	Haripada Sau
	4	**MT6154**	4	Topology - I	13,21	Debargha Banerjee
PH3114	4	**PH6114**	4	Electrodynamics	5,7,11,21	Sreejith G.J.
PH3124	4			Quantum Mechanics - I	5,7,11	Arijit Bhattacharyay
PH3134	4			Optics	5,11	G.V. Pavan Kumar
PH3144	4	**PH6134**	4	Electronics I	5,7,11,13,21	Sunil Nair
PH3153	3	**PH6144**	4	Methods of Experimental Physics	5,7,11,13,21	Shivprasad Patil
PH3163	3			Mathematical Methods II (3)	5,7,11,13	Suneeta Vardarajan
PH5113	3			Adv. Classical Mechanics	7,11,13	Arun M. Thalapillil
PHY411	4	**PH6154**	4	Condensed Matter Physics - I	7,13,21	Surjeet Singh
PHY412	4	**PH6164**	4	Statistical Mechanics - II	7,13,21	Deepak Dhar
PHY421	4	**PH6174**	4	Advanced Optics	7,13,21	Shouvik Datta
PHY453	3	**PH6184**	4	Computational Physics	7,13,21	Prasenjit Ghosh, Apratim Chatterji
PHY461	3	**PH6194**	4	Quantum Field Theory	7,13,21	Sachin Jain
PHY465	3	**PH6314**	4	Physics of Soft Matter	7,13,21	Vijayakumar Chikkadi, Apratim Chatterji
PH3313	3			Lab Training / Theory Project	5	Prasad Subramanian
PHY401	3			Lab Training / Theory Project	7	Prasad Subramanian
PH5513	3			Lab Training / Theory Project	11	Prasad Subramanian
PH5713	3			Lab Training / Theory Project	13	Prasad Subramanian
		PH6322	2	Conformal Field Theory	21,13	Sunil Mukhi
		PH6332	2	Standard Model	21,13	Diptimoy Ghosh
		PH6342	2	Quantum Measurements	21,13	T.S. Mahesh
DS3313	3			Lab Training / Theory Project	5	Leelavati Narlikar
DS4313	3			Lab Training / Theory Project	7	Leelavati Narlikar

January 2022 Semester 2

BS-MS Course Code	BS-MS Credits	Course Title	Semester	Coordinator/Instructor
BI1213	3	Introduction to Biomolecules	2	M.S. Madhusudhan, Girish Ratnaparkhi, Nagaraj Balasubramanian, Aurnab Ghose
CH1213	3	Principles of Physical Chemistry	2	Anirban Hazra, Angshuman Nag
CH1223	3	General Chemistry Practicals - I	2	Pramod Pillai, Anirban Hazra, Ramanathan Vaidhyanathan, R. Boomi Shankar, V.G. Anand, Britto S. Sandanaraj, Boopathy Gnanaprakasam
EC2233	3	The Solid Earth	2	Arjun Datta
HS1213	3	History of Science	2	Pushkar Sohoni
MT1213	3	Calculus - II	2	Manish Mishra, Diganta Borah
MT1223	3	Linear Algebra	2	Baskar Balasubramanyam, Rabeya Basu
PH1213	3	Electricity and Magnetism	2	Arka Banerjee, Susmita Adhikari

January 2022 Semester 4

BS-MS Course Code	BS-MS Credits	Course Title	Semester	Coordinator/Instructor
BI2213	3	Cell Biology	4	Richa Rikhy, Thomas Pucadyil
BI2223	3	Physiology	4	Nishad Matange, Satyajit Rath, Nishikant Subhedar
BI2233	3	Genetics	4	Mridula Nambiar, Kalika Prasad
CH2213	3	Analytical Chemistry (E)	4	M. Jayakannan
CH2233	3	Fundamentals of Molecular Spectroscopy	4	Pankaj Mandal
CH2243	3	General Chemistry Practicals - II	4	Shabana Khan, Sujit Kumar Ghosh, S.G. Srivatsan, Harinath Chakrapani, Pramod Pillai, Arun Venkatnathan
TD2213	3	Thermodynamics	4	Srabanti Chaudhury, Muhammad Mustafa O.T.
EC2213	3	Principles of Planetary Climate	4	Joy Merwin Monteiro
EC2233	3	The Solid Earth	4	Arjun Datta
EC2243	3	Atmosphere and Ocean Chemistry (E)	4	Gyana Ranjan Tripathy
MT2213	3	Group Theory (E)	4	Ayan Mahalanobis
MT2223	3	Real Analysis - I	4	Praphulla Koushik
MT2233	3	Discrete Structures	4	Moumanti Podder
PH2213	3	Classical Mechanics (E)	4	Arijit Bhattacharyay, Sreejith G.J.
PH2223	3	Thermal & Statistical Physics	4	Vijayakumar Chikkadi, Sachin Jain
TD2223	3	Data Analysis	4	Amit Apte, Leelavati Narlikar

January 2022 Semester

Note: Semesters 6 and 8 refer to BS-MS semesters; 12 and 14 refer to iPhD semesters 2 and 4 respectively; and 22 refers to PhD semester 2

BS-MS/ iPhD Course Code	BS-MS/ iPhD Credits	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/ Instructor
BI3214	4	**BI6214**	4	Animal Physiology - I	6,8,12,14,22	Aurnab Ghose, Nishikant Subhedar
BI3224	4	**BI6224**	4	Introductory Immunology	6,8,12,14,22	Satyajit Rath, Vineeta Bal
BI3234	4	**BI6234**	4	Animal Behaviour	6,8,12,14,22	Raghav Rajan
BI3244	4	**BI6244**	4	From Planets to Cells	6,8,12,14,22	Sudha Rajamani
BI3254	4	**BI6254**	4	Microbiology	6,8,12,14,22	Sunish Radhakrishnan, Gayathri Pananghat
BI3264	4	**BI6264**	4	Mathematical & Computational Biology	6,8,12,14,22	Collins Assisi, Suhita Nadkarni
BI3274	4	**BI6274**	4	Chemical Ecology	6,8,12,14,22	Sagar Pandit
BI3284	4	**BI6284**	4	Advanced Biochemistry - II	6,8,12,14,22	Thomas Pucadyil, Amrita B. Hazra
BI3294	4	**BI6294**	4	Ecology - II	6,8,12,14,22	Deepak Barua
BI3413	3	**BI6413**	3	Physical Biochemistry	6,8,12,14,22	Jayant B. Udgaonkar
BI3423	3	**BI6423**	3	Data Science	6,8,12,14,22	Pranay Goel
BI3433	3	**BI6433**	3	Evolution	6,8,12,14,22	Sutirth Dey
BI3444	4	**BI6444**	4	Genome Biology & Epigenetics	6,8,12,14,22	Krishanpal Karmodiya, Kundan Sengupta
BIO463	4	**BI6454**	4	Biology and Disease	8,12,14,22	Mayurika Lahiri, Siddhesh Kamat
BI5214	4	**BI6464**	4	Literature Review	14,22	Saikrishnan Kayarat
BI3613	3			Semester Project	6	Chaitanya Athale
BIO402	3			Lab/Theory Project	8	Chaitanya Athale
BI5223	3			Lab Training	12	Deepak Barua
PRB201	10			Research Project	14	Deepak Barua
SRB201	5			Research Seminar	14	Deepak Barua
	2	**BI6472**	2	Design Principles of Nervous Systems	14,22	Aurnab Ghose
CH3214	4	**CH6214**	4	Quantum Chemistry	6,8,12,22	Arun Venkatnathan
CH3224	4	**CH6224**	4	Organic Synthesis - I	6,8,12,22	Boopathy Gnanaprakasam
CH3234	4	**CH6234**	4	Transition Metal Chemistry	6,8,12,22	Sujit Kumar Ghosh
CHM420	4	**CH6244**	4	Structural Methods and Analysis	8,14,22	Pinaki Talukdar, Seergazhi Srivatsan
CHM410	4	**CH6254**	4	Advanced Molecular Spectroscopy	8,14,22	Aloke Das
CHM423	4	**CH6264**	4	Medicinal Chemistry	8,14,22	Raghavendra Kikkeri

BS-MS/ iPhD Course Code	BS-MS/ iPhD Credits	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/ Instructor
CHM433	3	**CH6274**	4	Photochemistry and Photophysics	8,12,14,22	Pramod Pillai
CH4224	4	**CH6284**	4	Advanced Material Science	8,12,14,22	Ramanathan Vaidhyanathan, R. Boomi Shankar
CHM442	3	**CH6294**	4	Organometallic Chemistry	8,12,14,22	Ramakrishna G. Bhat
CH3613	3			Semester Project	6	Raghavendra Kikkeri
CHM402	3			Lab Training/Theory Project	8	Raghavendra Kikkeri
CH5212	2			Lab Training	12	Jeetender Chugh
PRC201	5			Research Project	14	Jeetender Chugh
SRC202	2			Research Seminar	14	Jeetender Chugh
CHM428	4	**CH6414**	4	Chemistry for Alternative Energy	8,12,14,22	Angshuman Nag, Muhammad Mustafa O.T.
CH4214	4	**CH6424**	4	Organotransition Metal Catalysis	8,12,14,22	Shabana Khan
CH3243	3			Advanced Organic Chemistry Laboratory	6,8,12	Raghavendra Kikkeri
CH3253	3			Advanced Inorganic Chemistry Laboratory	6,8,12	Nirmalya Ballav, V.G. Anand
	2	**CH6432**	2	Introduction to Machine Learning in Chemistry	14,22	Arnab Mukherjee
	2	**CH6442**	2	Advanced Asymmetric Synthesis and Catalysis	14,22	Boopathy Gnanaprakasam, Ramakrishna G. Bhat, Srinivas Hotha
EC3214	4	**EC6214**	4	Geo and Cosmochemistry	6,8,22	Shreyas Managave
EC3224	4	**EC6224**	4	Geophysical Fluid Dynamics	6,8,22	Suhas Ettammal
EC3234	4			Physics of Geological Processes	6,8	Arjun Datta, Guest Faculty Prof. R.G. Sastry (Visiting Professor IIT Bhubaneswar)
EC3243	3			Analytical Geochemistry Lab	6,8	Gyana Ranjan Tripathy
EC3253	3			Introduction to Field Techniques	6,8	Sudipta Sarkar, Shreyas Managave
EC3264	4	**EC6234**	4	Physical Oceanography	6,8,22	Joy Merwin Monteiro
EC3274	4	**EC6244**	4	Geoelectromagnetic Exploration	6,8,22	Rahul Dehiya
EC4213	3	**EC6293**	4	Exploration Seismology Lab	8,22	Sudipta Sarkar, Rahul Dehiya

BS-MS/ iPhD Course Code	BS-MS/ iPhD Credits	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/ Instructor
ECS456	3	**EC6253**	3	Glacial Dynamics	6,8,22	Argha Banerjee
EC4224	4			Climate Modelling	8	Neena Joseph Mani, Guest Faculty Dr. Vinu K. Valsala, IITM Pune
EC4234	4			Science of Climate Change	8	Joy Merwin Monteiro, Proposed as NKN course by Vinoj V., IIT Bhubaneswar
EC3284	4	**EC6264**	4	Satellite Data Analysis & Image Processing	6,8,22	Sudipta Sarkar
EC3293	3	**EC6273**	3	Isotope Geochemistry	6,8,22	Gyana Ranjan Tripathy
ECS442	3	**EC6283**	3	Geological Field Training	8,22	Devapriya Chattopadhyay
EC3613	3			Semester Project	6	Shreyas Managave
ECS402	3			Lab Training/Theory Project	8	Shreyas Managave
HS3213	3	**HS6213**	3	Introduction to Paninian Grammar	6,8,14,22	Venketeswara R. Pai
HS3223	3	**HS6223**	4	Development Studies: Concepts, Applications and Perspectives	6,8,14,22	Bejoy Thomas
HS3234	4	**HS6234**	4	Science as Narrative in Literature and Cinema	6,8,14,22	Anil Zankar
HS3613	3			Semester Project	6	Pushkar Sohoni
HSS402	3			Lab Training/Theory Project	8	Pushkar Sohoni
HS3244	4	**HS6244**	4	Political Thought in India: A Study of Select Texts	6,8,14,22	Chaitra Redkar
HS3253	3	**HS6253**	3	Introduction to Political Ecology: Selected Approaches	6,8,14,22	Shalini Sharma
		HS6264	4	Research Methods, Fieldwork, and Ethics	22	Shalini Sharma, Anil Zankar, Bejoy Thomas, Chaitra Redkar, Pooja Sancheti, Pushkar Sohoni, Venketeswara R. Pai, Sara Ahmed
HS3264	4	**HS6274**	4	Introduction to the History of Architecture in India	6,8,14,22	Pushkar Sohoni
HS3274	4	**HS6284**	4	Introduction to Archaeological Science	6,8,14,22	Pushkar Sohoni, Behrouz Bazgir
MT3214	4			Complex Analysis	6,8,12	Kaneenika Sinha
MT3224	4			Algebraic Number Theory	6,8,12,14	Supriya Pisolkar

BS-MS/ iPhD Course Code	BS-MS/ iPhD Credits	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/ Instructor
MT3234	4			Measure Theory and Integration	6	Anup Biswas
MT3244	4			Calculus on Manifolds	6,8,12	Vivek Mohan Mallick
MT3254	4			Coding Theory	6,8,12,14	Krishna Kaipa
MT3264	4	**MT6214**	4	Algorithms	6,8,22	Soumen Maity
MTH411	4			Functional Analysis	8,12,14	Chandrasheel Bhagwat
MTH422	4			Differential Geometry	8,12,14	Mainak Poddar
MTH426	4	**MT6224**	4	Stochastic Processes	8,12,14,22	Anindya Goswami
MTH423	4			Commutative Algebra	8,12	Amit Hogadi
MTH424	4			Partial Differential Equations	8,12,14	Mousomi Bhakta
MT5214	4	**MT6234**	4	Algebra - II	14,22	Chandrasheel Bhagwat
MT5224	4	**MT6244**	4	Analysis - II	14,22	Haripada Sau
MT5234	4	**MT6254**	4	Topology - II	14,22	Steven Spallone
		MT6264	4	Algebra - I	22	Anupam Kumar Singh
		MT6274	4	Analysis - I	22	Divyang Bhimani
		MT6284	4	Topology - I	22	Tejas Kalelkar
		MT6294	4	Probability	22	Moumanti Podder
MT3613	3			Semester Project	6	Baskar Balasubramanyam
MTH402	3			Theory Project	8	Baskar Balasubramanyam
MT5614	4			Semester Project	12	Kaneenika Sinha
MSP502	4			Theory Project	14	Kaneenika Sinha
		MT6414	4	Theory Project	22	Anisa Chorwadwala
PH2233	3			Physics Lab - II	4,6	Sunil Nair, Satishchandra Ogale, Ashna Bajpai, Ashish Arora
PH3214	4	**PH6214**	4	Quantum Mechanics - II	6,8,12,22	Rejish Nath
PH3224	4			Condensed Matter - I	6,8,12	Prasenjit Ghosh
PH3234	4			Statistical Mechanics - I	6,8,12	Bijay Kumar Agarwalla
PH3244	4			Physics Lab - IV	6,8,12,14	Shivprasad Patil
PH3253	3	**PH6224**	4	Group Theory in Physics	6,8,12,14,22	Arun M. Thalapillil
PH3264	4	**PH6234**	4	Computational Physics	6,8,12,14,22	Apratim Chatterji
PH3273	3	**PH6244**	4	Electronics & Instrumentation	6,8,12,14,22	Umakant D. Rapol
PH3613	3			BS-MS Semester Project	6	Shouvik Datta
PH5613	3			iPhD Semester Project	12	Shouvik Datta
PHY420	4	**PH6254**	4	Atomic and Molecular Physics	8,14,22	T.S. Mahesh

BS-MS/ iPhD Course Code	BS-MS/ iPhD Credits	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/ Instructor
PHY422	4	**PH6264**	4	Nuclear and Particle Physics	8,14,22	Sourabh Dube, Diptimoy Ghosh
PHY434	3			Physics Lab - VII	8,14	G.V. Pavan Kumar
PHY463	3	**PH6284**	4	Adv Condensed Matter Physics	8,14,22	Surjeet Singh, Sreejith G.J.
PHY557	3	**PH6294**	4	Quantum Field Theory - II	8,14,22	Sunil Mukhi
PHY441	3	**PH6414**	4	Quantum Information	8,14,22	M.S. Santhanam
PHY342	3	**PH6424**	4	Non-linear Dynamics	8,14,22	Deepak Dhar
PHY464	3	**PH6434**	4	Astrophysical Processes	8,14,22	Prasad Subramanian
PHY402	3			BS-MS Semester Project	8	Shouvik Datta
LRP201	3			iPhD Semester Project	14	Shouvik Datta
PH4213	3	**PH6444**	4	Cosmology	8,14,22	Tarun Souradeep
		PH6212	2	Black holes	14,22	Suneeta Vardarajan
		PH6222	2	Electrodynamics - II	14,22	Rajeev Bhalerao
DS3613	3			Semester Project	6	Leelavati Narlikar
DS4613	3			Semester Project	8	Leelavati Narlikar

News, Events, and Initiatives

CONFERENCES, SYMPOSIA, AND WORKSHOPS

Conferences and workshops organised by IISER Pune researchers bring together the scientific community from within and outside India. After the disruptions caused by the pandemic during 2020-21, scientific events saw a revival during 2021-22, albeit in the online mode.

In addition to the conferences and workshops listed below, research departments organised webinars by researchers within and outside IISER Pune.

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

SCIENTIFIC EVENTS

"nanoGe" International Conference (online): Semiconductor Nanocrystals I: Basic Science (synthesis, spectroscopy, electronic structure, device and application)
March 07-09, 2021
Organisers Angshuman Nag (IISER Pune); Emmanuel Lhuillier (CNRS-Sorbonne université, Paris); and Sandrine Ithurria (ESPCI, Paris)

Phase Separated Systems in the Nucleus (PSINU2021)
April 06-09, 2021
Organisers Jomon Joseph (NCCS Pune); Krishnaveni Mishra (University of Hyderabad); Gautam Menon (Ashoka University); Shovamayee Maharana (MPI, Dresden); Dimple Notani (NCBS, Bengaluru); Rashna Bhandari (CDFD, Hyderabad); Mayurika Lahiri (IISER Pune); Krishanpal Karmodiya (IISER Pune); Saikrishnan Kayarat (IISER Pune); and Sudha Rajamani (IISER Pune)
Co-organiser Krishanpal Karmodiya (IISER Pune)
Conveners Kundan Sengupta (IISER Pune); B.J. Rao (IISER Tirupati); S.C. Lakhotia (Banaras Hindu University, Varanasi); and Sanjeev Galande (IISER Pune)

Symposium on Number Theory, organised in honour of Prof. M.V. Subbarao on his birth centenary
July 12-16, 2021
Organisers M. Vidyasagar (IIT Hyderabad); Kaneenika Sinha (IISER Pune); and Baskar Balasubramanyam (IISER Pune)

Symposium on Recent Advances in Aquatic Geochemistry
August 07, 2021
Organiser Gyana Ranjan Tripathy, IISER Pune

Workshop on Geodynamic Modelling (Under the KARYASHALA Scheme - A SERB initiative)
October 04-08, 2021 (online)
Organisers Sudipta Sarkar, IISER Pune and Utsav Mannu, IISER Pune

Virtual workshop on Trace elements in Aqueous systems
October 29-30, 2021
Organiser Gyana Ranjan Tripathy, IISER Pune

L-functions and Iwasawa theory, CEFIPRA conference
November 15-19, 2021
Co-organiser Baskar Balasubramanyam, IISER Pune

Hunting SUSY @ HL-LHC (ONLINE), ICTS, Bengaluru
November 22-26, 2021
Organisers Satyaki Bhattacharya (SINP, India), Rohini Godbole (IISc, India), Kajari Majumdar (TIFR, India), Prolay Mal (NISER Bhubaneswar, India), Seema Sharma (IISER Pune, India), Ritesh K. Singh (IISER Kolkata, India) and Sanjay Kumar Swain (NISER Bhubaneswar, India)

Eighth Annual Homi Bhabha Memorial Public Lecture
December 03, 2021
Speaker: Alessandra Buonanno, Max Planck Institute for Gravitational Physics (Albert Einstein Institute) Germany
Title: What gravitational waves tell us about the Universe
Organiser Physics Department, IISER Pune

58th Annual Convention of Chemists (ACC), Indian Chemical Society (ICS), Young Scientist Conclave 2021
December 23, 2021 (Online)
Organisers D.B. Ramachary, Madhurima Jana, Shabana Khan

ChemSymphoria 2021: Chemistry In-house symposium
December 27-29, 2021
Organiser Chemistry Department, Chemphilic Club

ISEB3: International Conference on Insect Systematics and Evolutionary Biology
February 16-18, 2022
Organisers Sutirth Dey, IISER Pune, jointly with Punjabi University Patiala

CAPACITY BUILDING

National Girl Child Day Celebration
January 24, 2022 (online)
Organiser Women in Science Committee, IISER Pune

International Women's Day Celebration
March 08, 2022 (online)
Organiser Women in Science Committee, IISER Pune

Online Workshop on Scientific Project Management
January 10-14, 2022
Organisers Vandana Gambhir and Vasundhara Laad from IISER Pune in partnership with the Department of Science and Technology (DST)

NEWS AND EVENTS

INAUGURATION OF THE ATAL INCUBATION CENTRE ON IISER PUNE CAMPUS

April 09, 2021

The online inauguration and formal virtual launch of IISER Pune's technology business incubator, Atal Incubation Centre - IISER Pune SEED Foundation (AIC-SEED) was held in April 2021.

Dr. R.A. Mashelkar, FRS, National Research Professor, and eminent scientist, inaugurated AIC-SEED in an online event as the Chief Guest. Shri Ramanan Ramanathan, Mission Director, Atal Innovation Mission, NITI Aayog, graced the occasion as the Guest of Honour, and Dr. Abhay Jere, Chief Innovation Officer, Ministry of Education, participated as the Distinguished Guest in this virtual event.

Founder Directors of the AIC-SEED Prof. Sanjeev Galande and Prof. S. Sivaram and IISER Pune Director Prof. Jayant Udgaonkar were present at the event along with team members of the AIC-SEED.

COVID-19 VACCINATION DRIVE

With approval from the Pune Municipal Corporation, IISER Pune begun a functional COVID-19 Vaccination Centre (CVC) on IISER Pune campus from May 12, 2021. Several rounds of vaccinations with Covishield vaccine were conducted based on the availability and supply from PMC. A total of 4405 individuals were vaccinated during these drives. The vaccine was provided free of cost and many IISER Pune community members benefited from this drive.

COVID-19 GENOME SEQUENCING EFFORTS AT IISER PUNE

COVID-19 genome sequencing initiative at IISER Pune has sequenced over 10,000 genomes as of mid-February 2022. The sequences have been submitted to public databases like GISAID and the India-centric INSACOG-IGIB portal.

The COVID-19 genome sequencing work at IISER Pune is being carried out through two channels of collaboration: as a member of INSACOG and as a member of a consortium led by CSIR-CCMB. IISER Pune, the Pune Knowledge Cluster and NCL Pune represent Pune city in the consortium. The bulk of the clinical samples and all the environmental surveillance samples from Pune city are sequenced at IISER Pune.

This work is carried out at IISER Pune campus in an independent COVID-19 Genome Sequencing initiative at the National Facility for Gene Function in Health and Disease (NFGFHD) building on campus. Here, dedicated and well-equipped facilities for RNA handling, cDNA and library

preparation, and next-generation sequencing enable the sequencing effort and data is uploaded to Government-approved online portals. The facility is run by a dedicated team of 8 members.

Faculty members in the Biology department Dr. Krishanpal Karmodiya and Dr. Aurnab Ghose and faculty member in the Earth and Climate Science department Dr. Joy Merwin Monteiro are coordinating this initiative.

The SARS-CoV-2 genome sequencing effort at IISER Pune is supported by the Rockefeller Foundation, the Villoo Poonawalla Foundation (VPF) and the Jankidevi Bajaj Gram Vikas Sanstha (JBGVS).

NEW RESEARCH DEPARTMENTS AT IISER PUNE

A new Department of Data Science has been included at the institute during 2021. This makes it the seventh department at IISER Pune. The department envisions a synthesis of the three foundations of data science: (i) statistics and probability, (ii) applied mathematics, and (iii) computer science; and builds on the existing core strengths of IISER Pune in basic sciences and humanities. Two faculty members, Prof. Amit Apte and Dr. Leelavati Narlikar, have joined the department during the year.

Plans for a new Department of Science Education (DSE) have been initiated during 2021. In September 2021, the Board of Governors has approved the establishment of this department. This is an initiative by the institute as part of NEP 2020. Faculty members at this new department are envisaged to carry out research on teaching methodologies and pedagogy, and on how concepts in science are best taught and learnt. The DSE is currently being developed by a Coordination Committee comprising of faculty members of IISER Pune along with an Advisory Board comprising of external experts.

VALEDICTORY CEREMONY

August 13, 2021; February 04, 2022

Considering the pandemic situation, to celebrate the graduation of students, two valedictory ceremonies were held during the year in lieu of a convocation.

Valedictory ceremony held on August 13, 2021

A total of 82 BS-MS students, 19 Integrated PhD students, and 30 PhD students graduated. Further, 7 students graduated with a BS degree and 5 students from the Integrated PhD programme graduated with an MS degree. Twenty-one BS-MS students received their degrees with Distinction (CGPA >9.0). Four graduating PhD students were presented with the Xytel Best PhD Thesis Awards: Abhishek Mishra (Biology); Nasrina Parvin (Chemistry); Sayali Bhatkar and Avirup De (Physics).

Valedictory ceremony held on February 04, 2022

A total of 77 BS-MS students, 16 Integrated PhD students, and 15 PhD students graduated. Further, 3 students graduated with a BS degree and 3 students from the Integrated PhD programme graduated with an MS degree. Five BS-MS students received their degrees with Distinction (CGPA >9.0). Three students received Xytel Best MS thesis awards (Rakshitha T. (Physics); Shambhavi S. (Mathematics), Snigdha Samantaray (Earth and Climate Science)); and PhD student Deshmukh Neeraj Ravindra (Mathematics) was presented with the Xytel Best PhD Thesis Award. BS-MS student Viraj Meruliya received the Best Outgoing BS-MS student award for 2021.

MIMAMSA 2021

August 28-29, 2021

Mimamsa is a nation-wide inter-college science competition organised by IISER Pune students annually. Amidst the pandemic, Mimamsa 2021 was revamped by deploying digital platform. It was held in 3 rounds- Prelims held on 18th April, Qualifiers on 27th June and Mains on 28-29th August 2021. Mimamsa 2021, which is the 13th edition of the competition since its inception, saw participation of 2600 students from 650 teams spanning 90 colleges across India. It may be recalled that Praj had joined hands with IISER Pune in Nov 2019 to scale up Mimamsa by lending technical and financial assistance.

IISc Bengaluru team emerged as winner of Mimamsa 2021, taking home a prize money of Rs. 50,000. Amongst the finalists, IIT Delhi was declared as runner up where as IIT Madras and IIT Mumbai finished with 3rd and 4th position respectively.

ONLINE HINDI FORTNIGHT CELEBRATIONS

September 13-27, 2021

During the online Hindi Fortnight, several competitions were organised for the institute members. These included Hindi essay writing (Topic: *Best out of waste – creating useful items out of waste materials in the surroundings*), poetry writing, and story writing. Winners of the competitions were given prizes and certificates.

MoU WITH MAHARASHTRA STATE FACULTY DEVELOPMENT ACADEMY TO TRAIN TEACHERS AT UNDERGRADUATE LEVEL

October 20, 2021

The Maharashtra State Faculty Development Academy (MSFDA), Mumbai and IISER Pune, signed a Memorandum of Understanding to implement capacity-building workshops for faculty members of universities and affiliated colleges under the Department of Higher and Technical Education, Government of Maharashtra. The MoU was signed on October 20, 2021 in the presence Shri. Uday Samant, Minister for Higher and Technical Education and Shri. Vikas Rastogi, Principal Secretary. As part of the current endeavour, IISER Pune will collaborate with the MSFDA to organise online as well as intensive in-person workshops on modern inquiry-based teaching skills, research-based pedagogies, and core philosophies of science and mathematics education.

(Left) At the signing of MoU with Maharashtra State Faculty Development Academy to train teachers at undergraduate level; (Right) At the signing of MoU with the Balan Group

MoU WITH THE BALAN GROUP

October 28, 2021

The Balan Group and IISER Pune have signed a Memorandum of Understanding towards building a dedicated space for science outreach on the institute campus. The Balan Group's financial contribution will help expand the Smt. Indrani Balan Science Activity Centre that was earlier set up with their support. With a new demo lab, auditorium, a library and reading room as well as a media centre, the planned Centre is anticipated to become the hub of IISER Pune's outreach activities.

GOLD MEDAL AT iGEM-2021 TO IISER PUNE TEAM

November 14, 2021

A team of 12 students won a gold medal at the 2021 iGEM (international Genetically Engineered Machines) synthetic biology competition. The results were announced in iGEM's Annual Jamboree event held during November 04-14, 2021. The students worked to develop a sustainable model for synthesising chemical compounds using a co-culture of two bacterial strains, thereby avoiding methods that involve carbon emitting petrochemicals or resource-intensive plant biomass.

The team of students included Ashwin Uday; Misaal Bedi; Sanjana Vasanth; Ashli Jain; Namasivayam Gomathi Sankar; Likhith Chandragiri; Vidisha Hate; Arsh Shaikh; Soorya Narayan; Akash Dutta; Arya Narnapatti; and Jason Joby.

SPORTS EVENTS DURING 2021-22

IISER Pune members participated in the Inter-IISER virtual games and sports fest titled "Tenacity" initiated by IISER Berhampur and IISER Kolkata held online during April 01-04, 2021. The fest comprised three main events - Chess, Cubing and Gaming. There were 10 participating institutes including all 7 IISERs, NISER, IISc and CEBS.

IISER Pune organised Inter-IISER Chess hunt – 2021 online on May 09, 2021 across IISERs. A “Run of Unity” was organised on October 31, 2021 as part of celebrating Rashtriya Ekta Divas. It was a 5K run, and the route was set inside IISER Pune campus. One of the important sport events organised every year in spring semester, IISER Premier League (IPL), saw active participation from students, staff and faculty members. The competition was held during November 06 to December 19, 2021.

NATIONAL SCIENCE DAY 2022

February 28, 2022

IISER Pune celebrated the 2022 National Science Day by conducting various public events. Due to the COVID-19 pandemic, all programmes were held be online all-day long on the IISER Pune Science Activity Centre’s YouTube channel and Facebook and Twitter pages.

Talks on these topics were held by invitees and by the outreach team members: C.V. Raman: A brief History, The James Webb Space Telescope, Rocks full of life?, Tackling Plastic Pollution!, Reconstructing past climate using tree Rings, Data Science: Making sense of uncertainty, Reading the blueprint of life: DNA Sequencing, Colours in Mathematics, (Mil)lets do it!, Quick Primer on Particle Physics with an experimentalist, along with live demonstration of science and math activities, science quiz and virtual demonstration of science and math models curated by the school children and teachers.

INTERNATIONAL WOMEN'S DAY 2022

March 08, 2022

Organised by the Women in Science Committee of the institute, the 2022 International Women's Day event included talks and panel discussion on the topic of 'Break the bias'. Speakers included Dr. Anita Joshi (Medical Officer, IISER Pune), Prof. Sudarshan Ananth, (Physics Department, IISER Pune), Dr. Reshma Chirayil Chandrasekharan (Assistant Professor, IIM Bangalore and alumni IISER Pune), and Shalaka Patil (Senior Research Fellow, Biology Department, IISER Pune). The programme was moderated by Gowri Niranjana, BS-MS student, IISER Pune.

THEME-BASED EVENTS, EVENTS BY STUDENT TEAMS

The Institute celebrated these events during the year: 7th International Day of Yoga (June 21, 2021); Independence Day (August 15, 2021); Swachhta Pakhwada (September 01-15, 2021); Vigilance Awareness Week (October 26 to November 01, 2021); Republic Day (January 26, 2022); and Matribhasha Diwas (February 21, 2022). These events were coordinated by the Administration section of the Institute with support from student club members and other institute members.

In early September this year, the Sports Club and Sports Committee at IISER Pune initiated the "Step-up Step-in Challenge" where they called out to the institute members to walk, and, as a group, complete within two weeks a collective distance of 3500 kilometers, which corresponds to the approximate length of our country from south to north. The team conducted this challenge during September 05-18, 2021 as part of the Fit India Freedom Run 2.0 programme initiated by the Government of India to celebrate the birth anniversary of Mahatma Gandhi.

The Yogen Club organised several events during the year such as Pranayam workshop, mindfulness session, and live yoga sessions. The club released the 2021 edition of *Yogen Magazine* in August 2021.

The Math department of the institute, along with the Math Club organised the 2022 Math Day virtual celebrations during March 19-20, 2022. The activities included Rubik's cube competition and a special talk by Prof. Amit Apte on 'Cricket, climate, neural networks AI, ML, and mathematics'.

The Science Club organised two sets of series of talks by scientists during February 19-28, 2022 on the occasion of National Science Day: one series was on the theme of chaos and the other about life of a scientist. The Science Club also released the 2022 edition of *Helicase* magazine with interviews of notable scientists like Dr. Bruce Alberts, Ms. Elbakyan, and Dr. Mihir Metkar along with contributions from faculty members Prof. Sudipta Sarkar, Prof. M.S. Santhanam, and Dr. K.P. Mohanan.

INTERNATIONAL RELATIONS

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

MEMORANDA OF UNDERSTANDING (MOU) AND AGREEMENTS SIGNED DURING 2021-22

A total of 28 collaborations, 26 ongoing and 2 new, were pursued during 2021-22.

Partner Organisation/s	Purpose
15 June 2021 MoU with Temple University, Philadelphia, U.S.A.	For academic and research cooperation; MoU renewed for 5 years considering strong research collaboration in the area of Chemistry and the Dual Masters and Doctoral Degree (DMDD) programme
23 Sept 2021 MoU with Durham University, U.K.	Towards developing a virtual Centre for Teaching Excellence and Pedagogy (vCTEP) in collaboration with multiple international partners and to launch a Certificate Programme in Science Education
22 Dec 2021 MoU with Institut de physique du globe de Paris (IPGP), France	Towards enabling IISER Pune BS-MS students to enroll for a one-year International Master in Solid Earth concurrently with their 5th year of BS-MS programme at IISER Pune; MoU renewed for the next four years

ACTIVITIES UNDER EXISTING MoUs

STEM education workshops with the University of Glasgow

A joint workshop series aimed at developing a course on STEM Education by the School of Education, University of Glasgow, and IISER Pune was initiated on February 03, 2022. The workshops are a part of the Going Global Exploratory Grant by the British Council awarded to Dr. Gabriella Rodolico (Department of Education, UoG) and Dr. Aparna Deshpande (Department of Physics, Faculty-in-Charge, Science Activity Centre, IISER Pune) to develop the "STEM Challenge Project" into a full course for pre-service teachers. As part of the "STEM Challenge Project", pilot workshops are being attended by 21 pre-service teachers each from India and Scotland. Based on the results of these workshops, a course for training teachers will be co-developed by the University of Glasgow's School of Education and IISER Pune.

ENS-IISER Meeting on pedagogy and online teaching practices

The ENS IISER cooperation network, with the support of the French Embassy in India, hosted its first French-Indian virtual workshop during May 10-11, 2021. This workshop focused on the exchange of practices in education and pedagogical approaches, as well as the adaptation to online teaching in the COVID pandemic context.

PARTNERSHIPS AND ENDOWMENTS

The Institute has been fortunate to receive support from corporates and individuals alike for various activities on campus. We wish to further our partnerships and hope to receive such support in the coming years too.

PARTNERSHIPS WITH INDUSTRIES AND ACADEMIC ORGANISATIONS

IISER Pune signed 22 agreements / MoU during FY 2021-22 with industries and academic organisations.

Of these, 15 were new partnerships, initiated with the following organisations for collaborative research projects: Cipla Ltd.; International Business Machines (IBM) Corporation; Innovassynth Technologies Ltd.; B.J. Govt. Medical College; Tata Memorial Hospital (TMH), Mumbai; Central Drug Research Institute (CDRI); Rockefeller Foundation (RF); Total Energies Marketing Services (TMS), France; Interactive Research School for Health Affair (IRSHA) Pune, a constituent of Bharati Vidyapeeth Deemed University; Pune Knowledge Cluster (PKC); Bosch Ltd.; Cambridge Enterprise Ltd. (CEL); University of Nottingham (UoN); Ramot at Tel Aviv University Ltd. (TAU); and MMV Medicine for Malaria Venture.

The agreements with Pilkington Technologies Management Ltd., England; KPIT Technologies Ltd.; Zumator Biologics Inc.; and University of East Anglia (U.K.) received an extended term of partnership.

ENDOWMENTS

Many of our activities during the year were implemented through corporate partnerships aimed at supporting the ecosystem in tackling the pandemic situation.

1. SUPPORT FOR RESEARCH ACTIVITIES

1.1 Systemic genomic surveillance of SARS-Cov 2 in Pune city

Villoo Poonawalla Foundation and Jankidevi Bajaj Gram Vikas Sanstha supported the study involving genome surveillance of the SARS-CoV-2 virus. The study was on vaccine breakthrough infections and reinfections in a randomised manner (without correlating with the SARS-CoV-2 antibodies). The study paved the way for the better control and management of the spread of SARS-CoV-2 in the Pune city and the Maharashtra state.

2. INFRASTRUCTURE SUPPORT

2.1 Tree plantations to increase the diversity of native species and develop the RET garden (Rare, Endangered, and Threatened species) on the IISER Pune campus

Brose India Automotive Systems Pvt. Ltd. is supporting IISER Pune's efforts to increase tree cover on the campus with an emphasis on boosting native tree diversity and develop Rare, Endangered, and Threatened (RET) plantation areas with increased numbers of rare and endangered species, and addition of walkways and informational signage to encourage

visitors and educate the community about the importance of local endemic and rare species. Thus, by improving the vegetation on the campus, the two organisations intend to strengthen the flora and fauna of the Pune region.

3. SUPPORT FOR STUDENT WELFARE ACTIVITIES

3.1 IISER Pune -IDeaS Ltd. Scholarship for meritorious students

The scholarship is awarded to exceptional students in their 2nd year of BS-MS course, Integrated PhD and PhD programmes. Since 2018, this scholarship is provided through the annual donation by Integrated Decisions and Systems (India) Private Limited (IDeaS), an information technology company in Cyber City, Pune.

During the August semester of AY 2021-2022, 09 students pursuing their BS-MS course, 04 students pursuing Integrated PhD, and 08 students pursuing PhD have been awarded this scholarship. During the January semester, the scholarship is extended to 05 BS-MS students 03 Integrated PhD students, and 02 PhD students.

3.2 Financial assistance to students belonging to the Economically Weaker Section

Through generous support from Integrated Decisions and Systems (India) Private Limited (IDeaS), Innoplexus Consulting Services Pvt. Ltd., Alta Laboratories Ltd., Twenty Twenty Interior Design Software (I) Pvt. Ltd., Xytel India Pvt. Ltd., and Trimurti Fabricators Pvt. Ltd., financial assistance is extended to 133 students belonging to the economically weaker section.

3.3 Infosys Foundation Endowment Fund

In 2016 Infosys Foundation provided an endowment to IISER Pune for student development activities. Every year this endowment supports tuition fee waivers to meritorious and economically underprivileged students pursuing their BS-MS programme as well as travel expenses to PhD and Integrated PhD students to present their research work at national and international conferences.

During the reporting period of 2021-22, the tuition-fee waiver is extended to 48 BS-MS students and 04 Integrated PhD students whereas the travel grant is availed by 07 PhD and Integrated PhD students.

3.4 IISER Pune - Xytel Ltd. Best Thesis Award

In the year 2018, Xytel India Pvt. Ltd. provided one-time financial support under its Corporate Social Responsibility (CSR) Programme for instituting Best MS and PhD Thesis Award in all disciplines at IISER Pune.

In the reporting period, 08 of our exceptional students, were recognised for their innovative research in various disciplines by the Thesis Evaluation Committees and were declared the winners of the IISER Pune - Xytel Ltd Best Thesis Award 2021. As the course completion durations were extended for students due to the COVID-19 Pandemic lockdown, the valedictory ceremony was held twice during the AY 2021-2022. Four students received their awards during the Valedictory Ceremony held on August 13, 2021 whereas four students received them at the ceremony held on February 04, 2022.

4. SUPPORT FOR STUDENT-CENTRIC RESEARCH ACTIVITIES

4.1 Support for microscope-based Physics undergraduate experiments

Precision Wires Pvt. Ltd. extended support to the Physics undergraduate laboratory for introducing a new set of microscope-based advanced experiments which are highly beneficial for students. Through the Optical Microscope procured with the support of the partner agency, the students will be able to study the phenomenon of Brownian motion, build an optical tweezer, and study material properties such as crystal defects, surface topology, particle sizes, solid-liquid interface, the interface of immiscible liquids, emulsions, etc. Thus, an optical microscope supports a wide range of undergraduate physics experiments. More than 100 undergraduate students will be benefited from this equipment every year thus contributing to the quality technical education of these budding scientists.

5. SUPPORT FOR OUTREACH ACTIVITIES

5.1 IISER Pune - Praj Industries Ltd Mimamsa 2021 and Mimamsa 2022

Mimamsa is a national-level annual science challenge at the undergraduate level organised by the students of IISER Pune. The partnership with Praj Industries, since the 2020 edition, has helped to scale up Mimamsa and it is now one of the nation's premier science competitions.

The 2021 edition of Mimamsa was held entirely online, between April 2021 to August 2021. Over 2600 students participated all across India, with IISc Bengaluru, IIT Delhi, IIT Madras, and IIT Bombay making it to the Mains (finals). The team from IISc Bengaluru triumphed and were the champions of the 2021 edition.

The Mimamsa 2022 edition was conducted in February 2022 (Prelims) and April 2022 (Mains). Over 1200 teams from all across India registered and over 4250 students, in teams of 4, finally participated in the preliminary round conducted online using Mimamsa's online portal. This was the largest Mimamsa event in its unbroken 14-year-old history in terms of participants.

The Mains of the 2022 edition was conducted in person, with the 16 finalists from the final 4 teams traveling to IISER Pune, along with select exemplary campus coordinators, visiting the campus. The finalists were IIT Madras, IISc Bengaluru, IISER Kolkata, and IIT Roorkee. During the Mains event, a Mimamsa Science Fest was organised, which consisted of talks and exhibitions for high school students, college students, teachers, and science enthusiasts. The team from IIT Madras went on to win the competition and were the champions of the 2022 edition.

5.2 Molecular Biology Training Programme for School and Undergraduate Students

IISER Pune, in partnership with Eppendorf continued the 'Molecular Biology for Everyone' series of paid workshops for school, undergraduate (Bachelors), and post-graduate (Masters) students in the year 2021-2022.

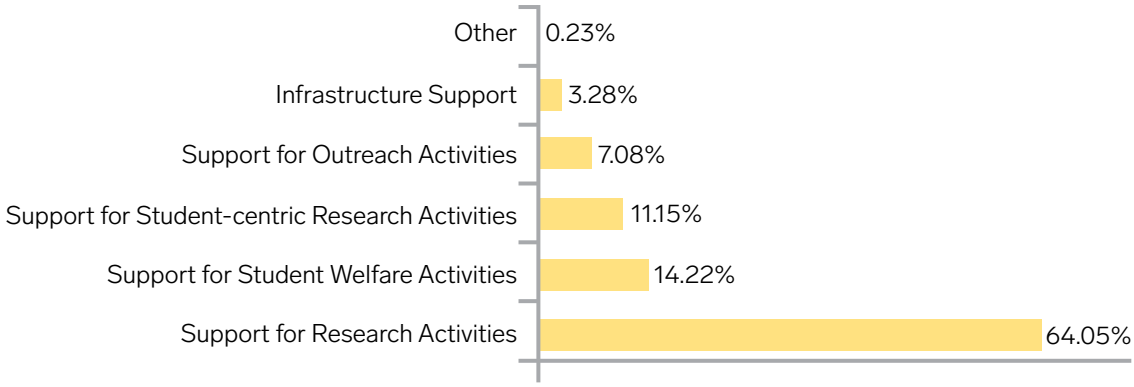
During the reporting period, majority of the participants were college students because most students had not received any hands-on experience in their colleges due to the pandemic and online classes. Registrations for the second session of 'Molecular Biology for Beginners' (MBB) workshops began in September 2021. In October 2021, after the State government allowed educational institutes to resume classes, paid one-day workshops were scheduled. A total of 23 MBB workshops were conducted between October 17, 2021 and March 06, 2022. These include workshops that had to be re-scheduled due to the second wave of the pandemic (March 2021). The workshops were conducted from 9.00 am to 5.00 pm, on

weekends and school holidays. All COVID-19 rules and regulations were duly followed by the participants and the instructor, which included wearing masks, hand sanitisation, monitoring temperature, and oxygen saturation, wearing disposable gloves, maintaining a working distance of 6 feet, and sanitisation of the lab after every workshop.

A total of 112 applications were received from school students in classes 9th-12th as well as BSc and MSc students. Registrations were completed by 91 students on a first-come-first-served basis. The batch size was reduced to 02-05 students and one instructor. They were taught how to isolate genomic DNA from *E.coli* bacteria, use the isolated DNA to perform a Polymerase Chain Reaction (PCR), observe the PCR results using agarose gel electrophoresis (AGE), check the quality of the genomic DNA isolated using AGE and draw conclusions using basic bioinformatics tools like BLAST. Participant feedback was taken after every workshop in the form of a questionnaire and converted into points on a scale from 1 to 5. The overall ratings the workshop received were 4.84 out of 5.

SUMMARY OF PURPOSES OF ENDOWMENTS RECEIVED DURING FY 2021-2022

Data is shown as percentage of the total funds received



OUTREACH ACTIVITIES

IISER Pune believes that the benefits of high-quality science education and infrastructure should not be restricted to members of the institute. As an attempt to spread the excitement of science and to make the expertise and facilities at IISER Pune available to the science and education community, IISER engages in several outreach activities. These encompass social outreach in the local community, capacity building for teachers, making and popularising simple science toys, and effectively communicating scientific research through various media.

SMT. INDRANI BALAN SCIENCE ACTIVITY CENTRE (SAC)

Experiential learning is considered to be a very effective way of learning and understanding science and mathematics. To encourage its incorporation into classroom practice, the Smt Indrani Balan Science Activity Centre was established as a part of the Centre of Excellence in Science and Mathematics Education in August 2017. The Science Activity Centre (SAC) is engaged in developing low-cost interactive science toys that can be used to teach science in a participative and hands-on way. The objective is to strengthen the teaching and learning of science and mathematics through these simple toys and hands-on activities, which students can build and experiment with. The SAC also generates educational resource material for students and teachers, aimed at improving conceptual understanding of topics from the curriculum.
Web link: https://www.iiserpune.ac.in/engage/outreach-and-training/science-activity-centre

Sunday Live Lecture and Demonstration Series
Sundays: April 2021 to March 2022
During the COVID-19 pandemic, the SAC started a Sunday live lecture and demonstration series. This was a fortnightly live session series on SAC's YouTube channel. The focus was exploring concepts from the syllabus for classes V to XII by students and teachers. Demos of science and math activities were carried out using readily available materials at home during lockdown, like plastic bottles, glasses, tubes, balloons, straws, candles, matchsticks, and other household items from the kitchen. This series received tremendous response from the audience, with the active participation of students and teachers. More than 500 viewers watch the demonstrations live on regular basis. The total number of views has surpassed 2,22,300 for last year.
Webinars playlist:
https://youtube.com/playlist?list=PLNsl4FmzN-wka0IRUQsWfOm27IcRqYKMg

Wednesday Live Demonstration Series

Wednesdays: April 2021 to May 2022

This was a weekly live session series that also took place during the COVID-19 pandemic. Every Wednesday, we held online science and mathematics sessions in which we explored various topics through hands-on activities. This series was received very well by students, who stated that it provided them with virtually hands-on and laboratory experience. They could explore science and math activities during the pandemic, which they had missed out due to online mode of education in their schools. Over 2500 students have benefited from this series.

Celebration of 2021 Teacher's Day

September 05, 2022

Teacher's Day (September 05) is a special day for all the education community to appreciate teachers' work and celebrate and honour them for their special contributions to the teaching and learning process. We celebrated Teacher's Day by organising a special talk by the well-known science communicator and Padma Shri awardee, Mr. Arvind Gupta. He shared stories of the great books in education and also his thoughts on science education. He demonstrated various simple activities to understand the basic concepts of science and mathematics, and he encouraged teachers to think about how they could design their own low-cost tinkering laboratory. Over 13,000 teachers and students viewed this session.

Web link: https://youtu.be/5QoObgwAv2M

Celebration of 2021 Children's Day

November 14, 2021

Children's Day is celebrated across India to raise awareness about the rights, education, and welfare of children. It is celebrated on November 14 every year, the birth day of the first prime minister of India. On the occasion of this day, we organised an online demonstration of science and math activities by well-known science communicator and toy maker Dr. Vidula Mhaiskar. She encouraged students to think about how we can observe different things in nature. She also explained how children can design various toys using readily available materials to understand basic concepts in science and mathematics. Over 13,700 children and teachers viewed this online session so far.

Web link: https://youtu.be/tDIMB_p-Iu0

Celebration of 2022 National Science Day

February 20, 2022

This is the major public event celebrated all over the country every year on February 28 with great enthusiasm. This year, due to COVID-19 pandemic related restrictions, this event was conducted in online mode on SAC's YouTube channel. We had planned various talks, like, C.V. Raman: A brief History, The James Webb Space Telescope, Rocks full of life?, Tackling Plastic Pollution!, Reconstructing past climate using tree Rings, Data Science: Making sense of uncertainty, Reading the blueprint of life: DNA Sequencing, Colours in Mathematics, (Mil)lets do it!, Quick Primer on Particle Physics with an experimentalist, along with live demonstration of science and math activities, science quiz and virtual demonstration of science and math models curated by the school children and teachers. Over 27,000 viewers have been benefitted from various events so far over the last month.

Web link: https://youtube.com/playlist?list=PLNsl4FmzN-wmDhqZ2Lfj0HvOeiDlSK8ez

Toycathon

Toycathon-2021 is conceived to challenge India's innovative minds to conceptualise novel toys and games based on Bharatiya civilisation. It was a joint initiative by the Ministry of Education, the WCD (Women and Child Development) Ministry, the Ministry of Micro, Small and Medium Enterprises, the Textile Ministry, the Ministry of Information and Broadcasting, and the All India

Council for Technical Education. Two projects, named Solar Viewer and Science Playbook, from our Science Activity Centre have been selected under the theme Environment and out-of-box, creative and logical thinking in the Grand Finale of Toycathon 2022.
Web link to reference: https://toycathon.mic.gov.in/

In-person Workshops
As the COVID-19 pandemic in India seems to be receding, restrictions have been lifted in past few months. After the long pandemic break, we have started in-person workshops at the SAC. In these workshops, we invite a group of 50–60 students and teachers and conduct half-day workshops with them. During the workshops, we demonstrate hands-on activities and give them a chance to design and build their own activities. We also invite faculty from IISER Pune to interact with students. A tour of the IISER Pune campus is also conducted with participants so they can explore the educational environment in the IISER campus.

Other Activities
As part of the teacher training project "STEP for STEM", supported by Tata Technologies, 50 teachers were selected for level 2 workshops. We have conducted a total of 10 workshops for teachers, encouraging them to use activity-based teaching tools and develop resources with the SAC. Under this project, teachers have developed 101 text lesson plans, and these text lesson plans have been converted into video lesson plans. Now we have 101 bilingual text and video lesson plans available on our website, and these are widely used by the teachers. So far, over 80,000 people have viewed these video lesson plans. Some teachers are using these resources in their classroom teaching.
Web link (Video lesson plans):
https://youtube.com/playlist?list=PLNsI4FmzN-wlyGvWeWDlI8fJHyI3-m1j8

Web link (Text lesson Plans):
https://drive.google.com/drive/folders/17TXUXLk0lUYzatSKJnfLsK2djVcHSYDe

SCIENCE MEDIA CENTRE

The Science Media Centre at IISER Pune is actively involved in the activities of Science communication with the aim of sharing science through innovative strategies. In the year 2021-22, SMC has worked in four different areas; namely, production of higher education content for online self learning platforms like National Programme on technology enhanced Learning (NPTEL), presenting research projects going on in the labs at IISER Pune in an innovative and unique way, documentation of the institutional events and outreach activities and production of public lecture series.

SMC has acted as a service provider for the faculty members at IISER Pune and also for the institutes and individuals for communicating their research and to present their work to a wider audience. A few of these projects were

- Production of a video on the first ever 2D IR spectrometer to be set up in India at CSIR-NCL in Pune
- Production of TEDx talk by Professor Kaneenika Sinha from IISER Pune
- Research coverage of Prof. R. Boomi Shankar's laboratory at IISER Pune
- The MS Aries series by Aditya Khanna in which some of the BS-MS students at IISER Pune explain their masters thesis
- Production of the 8th Homi Bhabha Memorial Lecture on December 03, 2021 by Prof. Alessandra Buonanno from Max Planck Institute for Gravitational Physics
- Creating cover arts and graphics for international journals and many more.

In the last one year SMC has covered around 60 events, visits, seminars, symposiums at IISER Pune such as the visit by Secretary of DBT and AYUSH (March 16, 2022), National Science Day 2022 online event (live-streamed on February 28, 2022); valedictory function for BS-MS students graduating in 2021-22 (February 04, 2022), 74th Independence Day (Aug 15, 2021), etc.

The SMC has also produced 5 lecture series including the series in Physics by Professor Deepak Dhar, series on the Physics of Ultracold gases, Water talks: a 10 videos series focusing on reconstructing the Duties of Water in India; on Probabilistic Number Theory; on real analysis; and on Science education.

The team recorded 2 NPTEL online courses: Introductory Organic Chemistry by Prof. Harinath Chakrapani and Dr. Neeraja Dashaputre; and Cellular Biophysics by Dr. Chaitanya A Athale.

The SMC organised interviews of eminent scientists Dr. R. A. Mashelkar (in association with S&T Digital) and Prof. Deepak Dhar from IISER Pune who received the Boltzmann Medal 2022 in Physics.

The SMC has supported IISER Pune's academic activities by recording classroom lectures and courses for students who were studying online during the pandemic.

The team also undertook the project of screening 9 short films on 'Eminent scientists of India' on the occasion of International Science Day on November 10, 2021 in collaboration with the Films Division of India.

YouTube Channel link:
https://www.youtube.com/IISERPuneSMC

iRISE

The Inspiring India in Research Innovation and STEM Education (iRISE) is a three-year collaborative programme between the Department of Science & Technology (DST), IISER Pune, British Council, Royal Society of Chemistry, Tata Trusts, and Tata Technologies.

The programme started in October 2021 with fours strands: Teachers Development Strand, Early Career Researcher, Thought Leadership Forum and CxO Forum. Under the Teachers' Development strand of the iRISE, so far IISER Pune has collaborated with the Central Board

for Secondary Education (CBSE), Delhi, State Council for Education, Research and Training (SCERT), Maharashtra, and Bihar Education Project Council, Bihar to train secondary school teachers in inquiry and activity-based learning for STEM subjects.

MS-DEED

The Maharashtra State Development of Educators and Enhancement in Delivery (MS-DEED) Programme is a close collaboration between IISER Pune and the Maharashtra State Faculty Development Academy (MSFDA) - Centre for Multi-disciplinary Curriculum & Pedagogy under the Department of Higher and Technical Education, Government of Maharashtra.

The programme aims to engage in developing the professional capacity of teachers aligned with NEP 2020 through training faculty members of universities and colleges. Our focus is on integrating classrooms and labs with scientific teaching, active-inquiry-based learning and 'low threshold high ceiling' approaches with emphasis on teaching strategies by and for teachers.

IISER Pune started the MS-DEED programme in December 2021 and has conducted several online and in-person workshops. Several of the IISER faculty community members have been contributing to the programme as trainers. Since its inception, 1000+ science and mathematics teachers of 275+ higher education institutions have been reached through these workshops across all districts of Maharashtra State.

SOCIAL OUTREACH

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

Disha is a student run social outreach organisation at IISER Pune. It is a platform for IISER Pune students to work towards the goal of socioeconomic equity. *Disha* works for making education accessible for children from underprivileged and marginalised communities from nearby localities.

Prutha, a green initiative by IISER Pune students, works to create awareness about issues related to the environment and to promote a clean campus. The group is involved in organising nature walks, clothes donation drives, and activities around management of waste. This year the team ran a used-notebook-and-paper collection drive and organised a photo collection drive of the biodiversity on campus.

Support Structure

SUPPORT STRUCTURE AND FACILITIES

ISER Pune has set up institutional policies and procedures to facilitate smooth functioning of the institute and to coordinate activities on the campus.

Matters related to general administration, finance, human resource management, IT requirements, procurement of equipment and consumables, civil, electrical and other engineering infrastructure are all handled by qualified staff members in consultation with institutional committees. The institutional committees are comprised of teaching and non-teaching staff members with a dual purpose: to oversee all support systems and to develop and implement plans to support the future needs of the institute.

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

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

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

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

The campus is connected through a dedicated internet leased line of 1 Gbps National Knowledge Network and a 300 Mbps line for uninterrupted internet access. The institute has a centrally managed indoor and outdoor dual band campus wide Wi-Fi access network along with IT security perimeter protection. The **Information Technology (IT)** section manages setting up, upgradation and operations of these facilities along with hosting critical infrastructure services such as email, website, DNS, Eduroam, iisERP, computer laboratories, virtual reality laboratory, dining management system, facial recognition based attendance system, and recruitment as well as admissions software. The team also manages institute machines, local area network, voice over internet phones (VoIP), audio-video equipment during on campus events, supports the IT related operations of campus facilities such as the auditorium, convention centre, classrooms, seminar halls, lecture halls and e-classrooms. Being a year of the pandemic, online classes, VPN based "work from home" services, online exams, online recruitment exams were facilitated successfully.

During the year, the IT section successfully steered the operations of the National Supercomputing Funded PARAM Brahma supercomputing facility at the Institute on a 24x7 basis with 99.99% uptime, which is oversubscribed at any point in time, and upgraded the existing computing power from 797 Teraflops to 1.7 Petaflops with GPU's including the software ecosystem thereof. This has helped many researchers of the institute as well as other institutes to successfully carry out their compute-intensive research in the areas of High Performance computing, Artificial Intelligence, Deep Learning, Machine Learning, and Big Data from a location of their choice. The facility was securely available for authorised users on a continual basis, in spite of major cyber security attacks world over, especially on supercomputing facilities. Additionally, the IT team provides support for the high performance computing clusters and parallel file system based storage hosted in multiple data centers aggregating 450 TF and 1 PB for various scientific and research applications in the areas of computational biology, particle physics, astrophysics, computation chemistry, materials modelling, molecular dynamics, nanoparticles, cryptography, seismology, climate science, etc.

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.

Srinivasa Ramanujan Library is an integral part of academic and research work on campus. It supports the teaching, learning, and research programmes of the institute with over 28000 print books, 4000 e-journals, and over 6000 e-books. Library facilitates access to electronic, print, and multimedia resources and provides essential online information and research support services. Several online resources and 819 print books have been added to the library collection during 2021-22. A large part of the journals and online resources' subscription is through e-ShodhSindhu – a national consortium for higher education e-resources formed by the Ministry of Education (MoE), Govt. of India, and 'IISER Library Consortium'. Library services are completely automated with all required software tools and the circulation kiosk is integrated with RFID technology and a biometric user authentication system.

The library provides various research support services such as Faculty Research Profiles, Assistance to Open Access Publishing, Bibliometrics and Scientometrics, Plagiarism Checking Service, Off-Campus Access to e-Resources, Current Awareness Service, Document Delivery Service, Inter Library Loan, Author Workshops, Orientation, Training, and Digital Literacy Programmes. The library also provides access to various research tools such as Web of Science, Scifinder Scholar, MathScinet, Derwent Innovation, Grammarly, Turnitin, Cambridge Structural Database, and ChemDraw.

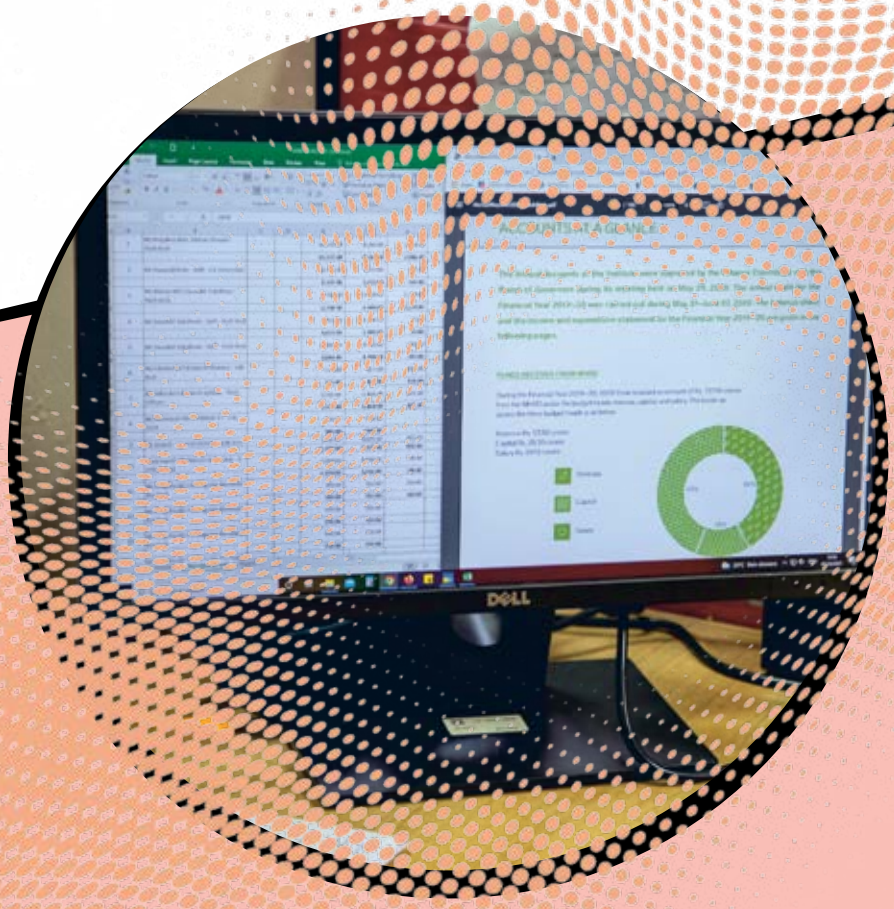
Digital Repository (DR) has been set up to preserve and provide instant access to the scholarly output of IISER Pune faculty, students, staff, and others associated with the institute. It serves as

a platform for the IISER Pune community to share their research work with the wider community. Metadata of the records available in the repository are also integrated with the National Digital Library of India. The Library has been actively engaged in designing and delivering need-based information services. During the COVID-19 pandemic, library continued to stay connected with the user community and support their academics by providing off-campus access to e-resources through 'Remote Access Portal'.

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.

The infrastructure and facilities on the campus cater to 136 regular faculty members; 21 visiting and emeritus faculty and project scientists; 133 non-teaching staff members; 57 postdoctoral fellows; 1759 students (434 PhD, 189 Integrated PhD, and 1136 BS-MS); and 135 research and management staff recruited through extramural projects. The numbers are as of March 31, 2022.

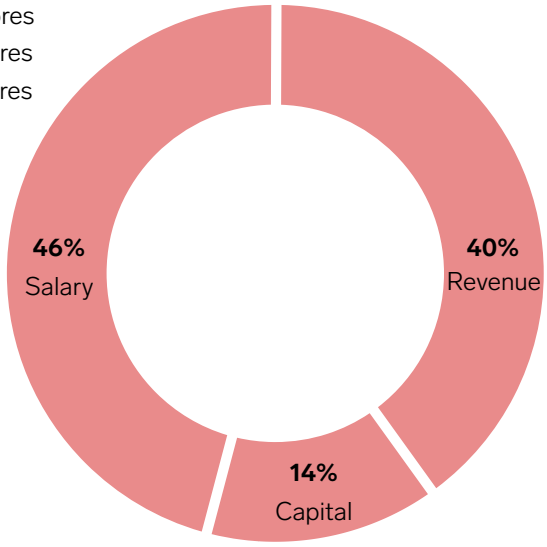
Accounts at a Glance



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 June 03, 2022. The annual audit for the Financial Year 2021-22 was carried out during June 16-July 01, 2022. The balance sheet and the income and expenditure statement for the Financial Year 2021-22 are given in the following pages.

Revenue ₹ 49.99 crores
Capital ₹ 17.75 crores
Salary ₹ 57.25 crores



FUNDS RECEIVED FROM THE MINISTRY OF EDUCATION

During the Financial Year 2021-22, IISER Pune received an amount of ₹ 124.99 crores from the Ministry of Education under the budget heads revenue, capital, and salary. The break-up across the three budget heads is as given above.

CORPUS

The cumulative corpus fund as on March 31, 2022 from the Internal Revenue generated is ₹ 86.59 crores. The Institute generated an amount of ₹ 14.75 crores during the Financial Year 2021-22 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 2021-22, a total of ₹ 34.74 crores have been received by the Institute via extramural grants. New grants initiated during the Financial Year 2021-22 are listed in the *Appendix* section of this report.

ENDOWMENTS

Some of the activities at IISER Pune are supported through endowments from corporate organisations. During the financial year 2021-22, ₹ 3.14 crores was received via endowments. Details are given in the *Partnerships and Endowments* chapter of this report.

BALANCE SHEET

as on March 31, 2022

Amount in ₹

Sources of Funds	Schedule	Current Year 2021-22	Previous Year 2020-21
Corpus/Capital Fund	1	691,55,68,605	678,21,94,867
Designated/Earmarked/Endowment Funds	2	37,94,34,902	36,72,08,888
Current Liabilities and Provisions	3	87,70,68,151	103,58,81,215
Secured Loans - HEFA Loan	3 D	5,96,44,670	-
Total		**823,17,16,328**	**818,52,84,970**

Application of Funds	Schedule	Current Year 2021-22	Previous Year 2020-21
Fixed Assets	4		
Tangible Assets		597,43,35,187	597,51,38,227
Intangible Assets		6,03,54,748	5,52,76,519
Capital Works-In-Progress		1,49,03,882	1,29,31,858
Investments From Earmarked / Endowment Funds	5		
Long Term		-	-
Short Term		15,85,08,129	16,03,15,103
Investments - Others	6	166,26,40,059	172,60,76,078
Current Assets	7	21,96,64,587	3,87,22,685
Loans, Advances & Deposits	8	14,13,09,732	21,68,24,496
Total		**823,17,16,328**	**818,52,84,970**
		(0)	**-**
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 17, 2022

INCOME AND EXPENDITURE STATEMENT

For the year ended March 31, 2022

Amount in ₹

Particulars	Schedule	Current Year 2021-22	Previous Year 2020-21
INCOME			
Academic Receipts	9	8,36,71,320	6,00,58,697
Grants/Subsidies	10	115,62,55,823	94,12,05,186
Income from Investments	11	-	-
Interest Earned	12	-	-
Other Income	13	5,43,02,970	2,68,48,221
Prior Period Income	14	10,85,851	9,92,948
Total (A)		**129,53,15,964**	**102,91,05,052**
EXPENDITURE			
Staff Payments & Benefits *(Establishment Expenses)*	15	56,14,10,159	47,50,95,632
Academic Expenses	16	14,21,02,657	14,88,44,334
Administrative and General Expenses	17	23,72,13,221	23,40,83,367
Transportation Expenses	18	50,88,103	47,84,633
Repairs & Maintenance	19	10,97,20,874	7,05,82,319
Finance Costs	20	13,42,782	60,560
Depreciation	4	34,62,77,325	35,60,89,134
Other Expenses	21	8,96,62,509	10,75,567
Prior Period Expenses	22	11,95,129	76,71,721
Total (B)		**149,40,12,759**	**129,82,87,267**
Balance being excess of Income over Expenditure (A-B)		**(19,86,96,795)**	**(26,91,82,215)**
Transfer to Capital Fund (Depreciation)		34,62,77,325	35,60,89,134
Over Utilization of Grant in Aid for Revenue Exps (Schedule 3C) Under Utilization of Grant in Aid for Revenue Exps (Schedule 3C)			
Balance being surplus/deficit carried to Institute Corpus Fund		**14,75,80,530**	**8,69,06,919**
Significant Accounting Policies	23		
Contingent Liabilities and Notes to Accounts	24		

For and on behalf of IISER Pune

sd/-	**sd/-**	**sd/-**
CA. Vasundhara Laad	**Col. G. Raja Sekhar (Retd.)**	**Prof. Jayant B. Udgaonkar**
Jt. Registrar (F & A)	Registrar	Director

Place: Pune | **Date:** May 17, 2022

Appendix

PUBLICATIONS IN 2021

The list has been generated from the information shared by institute members with our campus Library and, additionally, includes papers sourced from the Web of Science database with authors having IISER Pune as their primary affiliation.

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

BIOLOGY

01. PARDASANI, MEENAKSHI; MARATHE, SHRUTI D.; PURNAPATRE, MAITREYEE MANDAR; DALVI, URVASHI; **ABRAHAM, NIXON M.**, 2021, Multimodal learning of pheromone locations. FASEB Journal, 35(9), e21836. DOI: 10.1096/fj.202100167R

02. NERU, ARUN; **ASSISI, COLLINS**, 2021, Theta oscillations gate the transmission of reliable sequences in the medial entorhinal cortex. eNeuro, 8(3). DOI: 10.1523/ENEURO.0059-20.2021

03. CHAPHALKAR, ANUSHREE R.; JAWALE, YASH K.; KHATRI, DHRUV; **ATHALE, CHAITANYA A.**, 2021, Quantifying intracellular particle flows by DIC object tracking. Biophysical Journal, 120(3), 393-401. DOI: 10.1016/j.bpj.2020.12.013

04. JAIN, KUNALIKA; KHETAN, NEHA; YADAV, SHIVANI A.; Palani, Saravanan; **ATHALE, CHAITANYA A.**, 2021, Collective dynein transport of the nucleus by pulling on astral MTs during Saccharomyces cerevisiae mitosis. Yeast, 38(6), 352-366. DOI: 10.1002/yea.3552

05. JAIN, KUNALIKA; YADAV, SHIVANI A.; **ATHALE, CHAITANYA A**., 2021, Number dependence of microtubule collective transport by kinesin and dynein. Journal of the Indian Institute of Science, 101, 19-30. DOI: 10.1007/s41745-020-00212-2

06. KHETAN, NEHA; Pruliere, Gerard; Hebras, Celine; Chenevert, Janet; **ATHALE, CHAITANYA A.**, 2021, Self-organized optimal packing of kinesin-5-driven microtubule asters scales with cell size. Journal of Cell Science, 134(10). DOI: 10.1242/jcs.257543

07. MUNGEE, MANSI; **ATHREYA, RAMANA,** 2021, Intraspecific trait variability and community assembly in hawkmoths (Lepidoptera: Sphingidae) across an elevational gradient in the eastern Himalayas, India. Ecology and Evolution, 11(6), 2471-2487. DOI: 10.1002/ece3.7054

08. MUNGEE, MANSI; Pandit, Rohan; **ATHREYA, RAMANA,** 2021, Taxonomic scale dependency of Bergmann's patterns: a cross-scale comparison of hawkmoths and birds along a tropical elevational gradient. Journal of Tropical Ecology, 37(6), 302-312. DOI: 10.1017/S0266467421000432

09. ROKADE, SUSHAMA; UPADHYA, MANOJ; Bhat, Dattatray S.; **SUBHEDAR, NISHIKANT K.**; Yajnik, Chittaranjan S.; **GHOSE, AURNAB; RATH, SATYAJIT; BAL, VINEETA,** 2021, Transient systemic inflammation in adult male mice results in underweight progeny. American Journal of Reproductive Immunology, 86(1), e13401. DOI: 10.1111/aji.13401

10. BUWA, NATASHA; KANNAN, NIVEDHIKA; KANADE, SHAUNAK; **BALASUBRAMANIAN, NAGARAJ**, 2021, Adhesion-dependent caveolin-1 tyrosine-14 phosphorylation is regulated by FAK in response to changing matrix stiffness. FEBS Letters, 595(4), 532-547. DOI: 10.1002/1873-3468.14025

11. INCHANALKAR, SIDDHI; **BALASUBRAMANIAN, NAGARAJ,** 2021, Adhesion-growth factor crosstalk regulates AURKB activation and ERK signalling in re-adherent fibroblasts. Journal of Biosciences, Article No 46. DOI: 10.1007/s12038-021-00164-4

12. KASHERWAL, VISHAKHA; Bhatavadekar, Neel B.; **BALASUBRAMANIAN, NAGARAJ**, 2021, Evaluating mouse fibroblast interaction with implant surfaces in a 3D microenvironment. International Journal of Oral & Maxillofacial Implants, 36(6), 1121-1128. DOI: 10.11607/jomi.9183

13. KONDHARE, KIRTIKUMAR R.; KUMAR, AMIT; PATIL, NIKITA S.; MALANKAR, NILAM N.; SAHA, KISHAN; **BANERJEE, ANJAN K.**, 2021, Development of aerial and belowground tubers in potato is governed by photoperiod and epigenetic mechanism. Plant Physiology, 187(3), 1071-1086. DOI: 10.1093/plphys/kiab409

14. Kondhare, Kirtikumar R.; PATIL, NIKITA S.; **BANERJEE, ANJAN K.**, 2021, A historical overview of long-distance signalling in plants. Journal of Experimental Botany, 72(12), 4218-4236. DOI: 10.1093/jxb/erab048

15. KUMAR, AMIT; KONDHARE, KIRTIKUMAR R.; MALANKAR, NILAM N.; **BANERJEE, ANJAN K**., 2021, The Polycomb group methyltransferase StE(z)2 and deposition of H3K27me3 and H3K4me3 regulate the expression of tuberization genes in potato. Journal of Experimental Botany, 72(2), 426-444. DOI: 10.1093/jxb/eraa468

16. MOHANASUNDARAM, BOOMINATHAN; BHIDE, AMEY J.; PALIT, SHIRSA; CHATURVEDI,GARGI; Lingwan, Maneesh; Masakapalli, Shyam Kumar; **BANERJEE, ANJAN K.**, 2021, The unique bryophyte-specific repeat-containing protein SHORT-LEAF regulates gametophore development in moss. Plant Physiology, 187(1), 203-217. DOI: 10.1093/plphys/kiab261

17. BANG, ALOK; Courchamp, Franck, 2021, Industrial rearing of edible insects could be a major source of new biological invasions. Ecology Letters, 24(3), 393-397. DOI: 10.1111/ele.13646

18. Jia, Tony Z.; BAPAT, NIRAJA, V.; VERMA, AJAY; Mamajanov, Irena; Cleaves, H. James, II; Chandru, Kuhan, 2021, Incorporation of basic α-hydroxy acid residues into primitive polyester microdroplets for RNA segregation. Biomacromolecules, 22(4), 1484-1493. DOI: 10.1021/acs.biomac.0c01697

19. GANGULY, S.; **BARUA, DEEPAK**, 2021, Inter-morph pollen flow and reproductive success in a self-compatible species with stigma-height dimorphism: the influence of herkogamy and reciprocity. Plant Biology, 23(6), 939-946. DOI: 10.1111/plb.13308

20. GANGULY, SHATARUPA; SHREENIDHI, P.M.; **BARUA, DEEPAK**, 2021, Increased variation in sex organ positions can increase reciprocity and pollination success in heterostylous plant populations. Plant Species Biology, 36(3), 463-475. DOI: 10.1111/1442-1984.12327

21. Rahim, Sumayya Abdul; Kodandaramaiah, Ullasa; KULKARNI, ABOLI; **BARUA, DEEPAK**, 2021, Striking between-population floral divergences in a habitat specialized plant. PLOS One, 16(6), e0253038. DOI: 10.1371/journal.pone.0253038

22. BARVE, APURVA; Galande, Alisha A.; Ghaskadbi, Saroj S.; Ghaskadbi, Surendra, 2021, DNA repair repertoire of the enigmatic Hydra. Frontiers in Genetics, 12, 670695. DOI: 10.3389/fgene.2021.670695

23. Gaine, Tanushree; CHAKRABARTY, SOUPARNA et al., 2021, Differentiating wild and apiary honey by elemental profiling: a case study from mangroves of Indian Sundarban. Biological Trace Element Research. DOI: 10.1007/s12011-021-03043-z

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BOOKS

01. Non-Shia Practices of Muharram in South Asia and the Diaspora. **SOHONI, PUSHKAR**; Tschacher, Torsten (Eds). 2021, Routledge, ISBN 9780367819040

BOOK CHAPTERS

01. KANITKAR, TEJASHREE RAJARAM; SEN, NEELADRI; NAIR, SANJANA; SONI, NEELESH; AMRITKAR, KAUSTUBH; YAMTIRTHA, YOGENDRA; **MADHUSUDHAN, M. S.** 2021. In Methods for molecular modelling of protein complexes. In: Owens, R.J. (Eds) Structural Proteomics. Methods in Molecular Biology, Vol 2305. Humana, New York, NY. DOI: 10.1007/978-1-0716-1406-8_3

02. Deokar, Megha D.; Kulkarni, Amruta; Garnaik, Baijayantimala; Lele, Ashish K.; **SIVARAM, SWAMINATHAN.** 2021. Aliphatic polyesters with novel molecular architectures via ring-opening polymerization: Synthesis, properties, and applications, pp 163-208. In Lubnin, A. and Erdodi, G. (Eds), Macromolecular Engineering: Design, Synthesis and Application of Polymers. Elsevier, ISBN 9780128219980. DOI: 10.1016/B978-0-12-821998-0.00010-7

03. PANWARIA, PRAKASH; **DAS, ALOKE.** 2021. Exploring non-covalent interactions by jet-cooled electronic and vibrational spectroscopy: Modern techniques of spectroscopy, pp 57-86. In Singh, D.K., Pradhan, M., Materny, A. (Eds.) Progress in Optical Science and Photonics book series (POSP, volume 13). DOI: 10.1007/978-981-33-6084-6_3

04. Sengupta, Soumyadipta; Lyulin, Alexey V.; Kritikos, Georgios; Karatasos, Konstantinos; **VENKATNATHAN, ARUN**; PANT, RAKESH; Komarov, Pavel V. 2021. Multiscale modeling examples: New polyelectrolyte nanocomposite membranes for perspective fuel cells and flow batteries, pp 133-177. In In: Ginzburg, V.V., Hall, L.M. (Eds), Theory and Modeling of Polymer Nanocomposites. Springer Series in Materials Science, vol 310. Springer, Cham. DOI: 10.1007/978-3-030-60443-1_6

05. Mathew, John; **SOHONI, PUSHKAR**. 2021. Teaching and research in colonial Bombay. In History of Universities: Volume XXXIV/1: A Global History of Research Education: Disciplines, Institutions, and Nations, 1840-1950. Oxford Scholarship Online. DOI:10.1093/oso/9780192844774.003.0013

06. **SOHONI, PUSHKAR**. 2021. Architecture of South Asia. In Oxford Bibliographies in Architecture, Planning and Preservation. DOI: 10.1093/obo/9780190922467-0052

07. **SOHONI, PUSHKAR**. 2021. Colonial and modern architecture in India. In Oxford Bibliographies in Architecture, Planning and Preservation. DOI: 10.1093/obo/9780190922467-0051

08. **SOHONI, PUSHKAR**. 2021. Nizam Shahis, art and architecture, pp 140-145. In: Encyclopaedia of Islam, THREE, Edited by: Fleet, K., Krämer, G., Matringe, D., Nawas, J. and Rowson, E. (Eds) DOI: 10.1163/1573-3912_ei3_COM_40173

09. **SOHONI, PUSHKAR**. 2021. Visual language of piety and power: Ta'ziahs and temples in the Western Deccan, pp 41-52. In SOHONI, P. and Tschacher, T. (Eds) Non-Shia Practices of Muharram in South Asia and the Diaspora: Beyond Mourning. Routledge.

10. GAIKWAD, AJINKYA; **MAITY, SOUMEN**. 2021. On structural parameterizations of the offensive alliance problem: Combinatorial optimization and applications, pp 579-586. In Lecture Notes in Computer Science book series (LNCS, volume 13135). DOI: 10.1007/978-3-030-92681-6_45

11. GAIKWAD, AJINKYA; **MAITY, SOUMEN**; TRIPATHI, SHUVAM KANT. 2021. The balanced satisfactory partition problem. SOFSEM 2021: Theory and practice of Computer Science, pp 322-336. In Lecture Notes in Computer Science book series (LNCS) Vol. 12607. DOI: 10.1007/978-3-030-67731-2_23

12. GAIKWAD, AJINKYA; **MAITY, SOUMEN**; TRIPATHI, SHUVAM KANT. 2021. Parameterized complexity of defensive and offensive alliances in graphs. Distributed computing and internet technology, pp 175-187. In Lecture Notes in Computer Science book series (LNCS, volume 12582). DOI: 10.1007/978-3-030-65621-8_11

13. GAIKWAD, AJINKYA; **MAITY, SOUMEN**; TRIPATHI, SHUVAM KANT. 2021. Parameterized complexity of locally minimal defensive alliances. Algorithms and Discrete Applied Mathematics, pp 135-148. In Lecture Notes in Computer Science book series (LNCS) Vol. 12601. DOI: 10.1007/978-3-030-67899-9_11

14. SRINIVASAN, ADARSH; Narayanaswamy, N. S. 2021. The connected domination number of grids. Algorithms and Discrete Applied Mathematics, pp 247-258. In Lecture Notes in Computer Science book series (LNCS, volume 12601). DOI: 10.1007/978-3-030-67899-9_19

BOOK REVIEWS

01. **SUBHEDAR, NISHIKANT.** 2021. Annual Review of Neuroscience. Current Science, 120(4), 724-725. www.currentscience.ac.in/Volumes/120/04/0724.pdf

02. **HAZRA, ANIRBAN; MUKHERJEE, ARNAB**, 2021, Entropy for smart kids and their curious parents. Current Science, 121(1), 161-162. www.currentscience.ac.in/Volumes/121/01/0161.pdf

03. **CHATTOPADHYAY, DEVAPRIYA**, 2021, Actualistic Taphonomy in South America. Ameghiniana, 58(1), 72-73. DOI: 10.5710/1851-8044-58.1.72

04. **THOMAS, BEJOY K.**, 2021, The spirit of green: The economics of collisions and contagions in a crowded world. Current Science, 121(10), 1361-1362. www.currentscience.ac.in/Volumes/121/10/1361.pdf

CONFERENCE PAPERS

01. HARSHITH, B. S.; Samanta, G.K., 2021, Controlled generation of self-images of a microlens array and the second harmonic Talbot Effect, ICOL-2019: Proceedings of the International Conference on Optics and Electro-Optics, Dehradun, India, 85-88. DOI: 10.1007/978-981-15-9259-1_19

02. Paul, Ria; K, Murali; CHETIA, SUMANA; Varma, Hari M., 2021, A simple algorithm for Diffuse Optical Tomography (DOT) without matrix inversion. In European Conferences on Biomedical Optics 2021 (ECBO), OSA Technical Digest (Optica Publishing Group, 2021), paper EM1A.21

INVITED LECTURES

At conferences/workshops and at colleges/universities/institutes/outreach (most events were online due to COVID-19 pandemic)

Nixon Abraham
Neural circuits to behaviour: Dissecting causality using optogenetics, SNCI National Workshop on Advanced Research Techniques for Cellular and Molecular Systems in Neuroscience, December 12, 2021 • *Smelling the force: Mechanosensation through rodent nose*, Synapse 2021, Jointly organised by IISER-Tirupati and IISER-Thiruvananthapuram, December 04, 2021 • *Neurocognitive deficits in long COVID*, National Seminar on Recent Trends and Advancements in Regenerative Medicine & The Role of Omics and Biomarkers in Health, Kerala, 2021, April 23, 2021

Bijay Agarwalla
At the "4th Quantum Condensed Matter Conference" (QMat-2021), a national conference organised by Tata Institute of Fundamental Research (TIFR), December 08-11, 2021 (Online)

Sudarshan Ananth
Faculty development program - REVA University - May 21, 2021

Amit Apte
Simple models of tropical dynamics, Research School - Mathematics of Climate Science, Kigali Rwanda (online), July 07, 2021 • *Some dynamical aspects of the Indian summer monsoon*, Workshop on Prediction and Variability of Air-Sea Interactions: the South Asian Monsoon, ICERM Brown University U.S.A. (online), August 24, 2021 • *Stability of filters for deterministic dynamics*, Dynamic Days Europe 2021, Nice France (online), August 25, 2021 • *Stability of filters for deterministic dynamics,* 4th BRICS Mathematics Conference, IISER TVM India, December 08, 2021 • *Data assimilation: A computational perspective*, HPC Symposium, IIT Madras India (online), January 08, 2022 • *Data science: Making sense of uncertainty*, Science Day 2022, IISER Pune India (online), February 28, 2022 • *An introduction to data assimilation*, Workshop on Stochastic Models, IIT Bombay Mumbai India, March 02, 2022 • *Cricket, climate, neural networks, AI, ML, mathematics*, International Day of Mathematics 2022, IISER Pune India, March 19, 2022

Ashish Arora
Invited talks in conferences: *Exotic states of charged excitons in 2D semiconductors*, National Conference on Quantum Condensed Matter (QMAT-2021), TIFR Mumbai, December 08-11, 2021 • *Excited and dark states of charged excitons in layered 2D semiconductors*, Third Indian Materials Conclave and 32nd Annual General Meeting of MRSI, IIT Madras, December 23, 2021 • *Excited and dark states of charged excitons in 2D semiconductors*, The XXIst International Workshop on Physics of Semiconductor Devices, IIT Delhi, December 14-17, 2021
Invited talks in institutions: *Optical investigations of dark and bright three-particle states in 2D semiconductors* IISER Mohali, Punjab, March 23, 2022; Tata Institute of Fundamental Research, Mumbai, 2021 • *Importance of magnetic fields in semiconductor physics explorations* RTMN University, Nagpur, 2022

Chaitanya Athale
Platform talk at Annual Meeting of the Biophysical Society of U.S.A., San Francisco, U.S.A., February 21, 2022 • At University of California San Francisco, U.S.A., February 18, 2022

Nagaraj Balasubramanian
At the Department of Biotechnology, University of Pune (SPPU), March 2021 • At ASCB sponsored Biologically Speaking Series, August 08, 2021 • At Popular Science Lecture series hosted by Indian Women Scientists Association, March 2021

Nirmalya Ballav
Reduction of graphene oxide: intermediates and product, First Annual Meeting of Energy and Environment Unit: Chem@Nano '21, INST Mohali, September 10-11, 2021 (Webinar) • *Reduction of graphene oxide: product and by-product*, 15th International Conference on Materials Chemistry (MC15), Royal Society of Chemistry (RSC), U.K., July 12-15, 2021 (Webinar) • At DBT Star College Scheme Sponsored Invited Lecture, Jhargram Raj College, West Bengal, June 21, 2021 (Webinar)

Debargha Banerjee
Modularity theorem, IACS, Kolkata • *Variance of epsilon factors for modular forms with arbitrary nebentypus* Online conference on some topics in number theory, SRM University, AP, July 2021 • *The Eisenstein cycles and Manin-Drinfeld properties*, CEFIPRA Conference, Indo-French Centre for the Promotion of Advanced Research (IFCPAR/CEFIPRA), November 16, 2021

Deepak Barua
Leaf phenology in seasonally dry tropical forest trees: Relationships with plant functional traits, Kerala Forest Research Institute (KFRI), Peechi, Kerala, December 06, 2021

Rabeya Basu
Commutative algebra seminar, Purdue University, U.S.A., February 09, 2022 • Colloquium, Central Michigan University, U.S.A., February 22, 2022 • Math In-House Symposium of IISER Bhopal, March 2022

Mousomi Bhakta
Lane-Emden equations with Hardy potential and measure data, IISc-IISER Pune 20-20 Math symposium, September, 2021 • *Fractional elliptic system with critical nonlinearity*: Online Seminar Series on Differential Equations, IIT Jodhpur, July 2021; Webinar series, University de Concepcion, Chile, July 2021; Webinar series Function Spaces/ Nonlinear Analysis and PDE'S, (organised by University of Monastir, Tunisia and IIT Delhi), June 2021 • *Symmetry via maximum principle*, First International Women Webinar on Mathematics, Government College Women University Faisalabad, Pakistan, March 2021

Anup Biswas
Generalized eigenvalue problems, Thiagarajar College of Engineering, Madurai, December 22, 2021 • *Recent developments on risk-sensitive controls*, Asia-Pacific Seminar in Probability and Mathematical Statistics XI, September 15, 2021 • *Maximum principles, Liouville property and principal eigentheory of infinity Laplacians*, University of Monastir, Tunisia, May 25, 2021

R. Boomi Shankar
Organic and organic-inorganic hybrid ferroelectric materials for piezoelectric energy harvesting applications, Materials Challenges in Alternative and Renewable Energy / 4th Annual Energy Harvesting Society Meeting (MCARE-EHS 2021 Virtual), Organised by the American Ceramic Society, July 19-22, 2021 • *Metal-organic and hybrid ferroelectrics for mechanical energy harvesting applications* 71st Conference of Japan Society of Coordination Chemistry (virtual), September 16-19, 2021 • *Molecular ferroelectrics for piezoelectric energy harvesting applications*: RSC-IISER Desktop Seminar with CrystEngComm, IISER Kolkata, September 22, 2021; National Seminar on Crystallography (48), IIT Roorkee, November 25-27, 2021; Chemical Research Society of India, 28th National Symposium in Chemistry (CRSI NSC-28), Department of Chemistry, IIT Guwahati, March 25-27, 2022 • *Metal-organic and hybrid ferroelectrics for piezoelectric energy harvesting applications* Chemical Society, IISER Thiruvananthapuram (CSIT), September 29, 2021 • *Neutral polyhedral Pd(II) cages supported by tris(imido)phosphate trianions*, Main Group Molecules to Materials, NISER Bhubaneswar, December 13-15, 2021 • *Hybrid organic-inorganic ferroelectrics for piezoelectric energy harvesting applications*, 58th Annual Convention of Chemists (ACC 2021) & International Conference on Recent Trends in Chemical Sciences (RTCS-

2021), IIT Guwahati, December 22-23, 2021; Recent Advancements in Chemical, Environment & Energy Engineering (RACEEE2022), Sri Sivasubramaniya Nadar College of Engineering, Chennai, February 24-25, 2022

Gnanaprakasam Boopathy

Catalysis to drug synthesis using continuous flow application, 2nd Flow chemistry symposium, NIPER-Kolkata, December 08-10, 2021 • *Sustainable organic transformations using continuous flow mode*, 27th international conference of International Academy of Physical Sciences on Sustainable chemistry for Future Technologies, Institute of Chemical Technology, Mumbai, September 26-28, 2021 • *Sustainable chemical synthesis using acceptor less dehydrogenation strategy*, International conference on "Advances in Green Chemistry and Sustainable Technology", Syngenta Biosciences Private Limited, Goa, September 29-30, 2021 • *Heterocyclic peroxides: beyond oxidation chemistry*, National conference on Advanced Functional Molecules and Materials (NCAFMM-2021), Karunya Deemed University, Coimbatore, March 12-13, 2021

Harinath Chakrapani

At Advances in Synthetic Organic Chemistry and Their Applications in Modern Medicinal Chemistry (ASOCAMMC21), National Institute of Technology Calicut, Kozhikode, August 26, 2021 (Webinar) • At Chemical Research Society of India (CRSI) Meeting, Kolkata, September 26-30, 2021 • At Kaleidoscope: A Discussion Meeting in Chemistry, Nashik, October 08-10, 2021 • *Artificial substrates for enzymes as a therapeutic paradigm*, XXI National Organic Symposium Trust-Organic Chemistry Conference, Chennai, November 25-28, 2021

Devapriya Chattopadhyay

Live, dead and the very dead: *Tracing evolution in deep time using sea-shells*, International Women's Day, National Centre for Cell Science, Pune, March 08, 2022 • *Paleontological research in India: The colonial past shapes the present and dictates the future*, Diversity Dynamics and Crisis in Paleontology (DDCP) speaker series, Friedrich-Alexander University, GeoZentrum Nordbayern, Erlangen, Germany, November 23, 2021 (Online) • *Faunal response to changing seaways: A global perspective*, International Fossil Day, The Paleontological Society of India, Student Chapter - North Zone, October 13, 2021 (Online) • *Oligo-Miocene bivalve community ecology of Kutch (western India) in response to regional changes in climate and tectonics*, Topical session T91: Community Ecology and the Fossil Record: Diversity, Ecological Structure, and Paleoenvironmental Responses I, Geological Society of America Annual Meeting, U.S.A., October 13, 2021 (Online) • *Paleontological research in the Indian subcontinent: at the crossroads of history and progress*, Inaugural session of seminar series on Decolonizing Palaeontology, at Department of Paleobiology, Smithsonian National Museum, U.S.A., July 16, 2021 (Online)

Aloke Das

Sequence dependent folding motifs of small peptides, Organic Chemistry Departmental Seminar Series, IISc Bangalore, November 26, 2021 • *Sequence dependent folding motifs of small peptides in the gas phase,* 11th Asian Photochemistry Conference, Yonsei University, Seoul, Korea, November 03, 2021; ISRAPS Discussion Meeting on Gas Phase Kinetics and Dynamics, BARC Mumbai, April 10, 2021

Shouvik Datta

Tailoring quantum oscillations of excitonic Schrodinger's Cats as qubits, Quantum Materials (QMAT 2021), TIFR, Mumbai, December 11, 2021 (Online); Recent trends in Condensed Matter Physics-2022 (RTCMP2022), IACS Kolkata, February 25, 2022 (Online)

Sutirth Dey

Size matters: Population size and adaptation in bacteria, Séminaires d'Ecologie et d'Evolution de Montpellier (SEEM), Webinar in the SEEM series, April 16, 2021 • *Variation: A central concept in Biology*, 6 Day's Short Term Training Programme (STTP), Maulana Abul Kalam Azad University of Technology, West Bengal, June 07, 2021 • *A tale of two factors: Mutation rates, and population size*, 6 Day's Short Term Training Programme (STTP), Maulana Abul Kalam Azad University of Technology, West Bengal, June 07, 2021 • *Effects of population size and environmental fluctuations on microbial adaptation*, Joint Annual meeting of the American Society of Naturalists, the Society for the Study of Evolution, and the Society of Systematic Biologists (Virtual Evolution 2021: June 21-25, 2021), June 24, 2021 • *How dispersal evolves and why we should care*, International Symposium on Advances in comparative endocrinology and behavioral ecology (July 01-03, 2021), SPPU, Pune, July 02, 2021 • *Extended evolutionary synthesis*, SPPU, Pune, November 26, 2021 • *How dispersal evolves and why we should care*, Seminar Series, Discipline of Biological Engineering, IIT Gandhinagar, December 13, 2021 • *Critically reading a scientific article*, Refresher Course in Biology, Punjabi University, Patiala, November 22, 2021 • *What cost dispersal evolution? Lessons from the humble fruitfly*, Recent Trends in Biology seminar series (March 11-12, 2022), SPPU, Pune, March 12, 2022

Deepak Dhar

Modelling proportionate growth, P. D. Patel Institute of Applied Sciences, Charotar University of Science and Technology, Changa, Gujarat, April 22, 2021 • *The complexity of glasses and spin-glasses*, Center for Excellence in Theoretical and Computational Sciences, University of Mumbai, October 27, 2021 (Webinar); Society for Promotion of Science and Technology in India, Chandigarh, November 07, 2021 (Webinar); Institute Lecture Series webinar, Indian Institute of Technology, Roorkee, November 10, 2021; Science Club talk, IISER Pune, November 21, 2021; Physics colloquium, Birla Institute of Science and Technology, Pilani, March 04, 2022

Sreejith G.V

An exactly solvable model of interacting electrons in a magnetic field, Emergent Phenomena in Quantum Hall Systems, Princeton University, U.S.A., May 20, 2021 (online); ICTS Bangalore, June 16, 2021 (online); APS March Meeting 2022 Chicago, March 14, 2022 • *Energy transport in chiral clock model*, Young Investigators Meet QCMT 2020, November 2021 (online); Statphys-Kolkata XI, March 25, 2022 (online) • *Single quasiparticle localisation in FQH states* Saha Institute of Nuclear Physics, Kolkata, December 22, 2021 (online)

Aurnab Ghose

Formin' neural circuits with Fmn2, The cytoskeleton of neurons and glia, Webinar Series, Virtual Meeting, July 29, 2021 • *In search of mechanisms underlying neurodevelopmental disorders*, IBRO Associate School, Chandigarh, Virtual Meeting, August 26, 2021 • *Opposing activities of neuropeptides mediate the feeding drive*, Brainwave – Connections to Cognition, Amity University, Kolkata, Virtual Meeting, September 10, 2021 • *Fmn2 mediates growth cone haptotaxis by regulating cell-ECM interactions and cytoskeleton remodelling*, 16th Meeting of the Asia-Pacific Society for Neurochemistry, Singapore, Virtual Meeting, December 14, 2021 • *Circuit architecture and activity modulation in generating behaviour,* Brain Matters, NISER, Bhubaneswar, Virtual Meeting, February 19, 2022 • *Through a formin lens, darkly: Insights into the neuronal cytoskeleton*, Cell biology lecture series, NCCS, Pune, March 14, 2022 • *A cytoskeletal view of neurodevelopment,* Molecular basis of neurodevelopmental disorders--a contemporary view, BGSB University, Kashmir, Virtual Meeting, March 23, 2022

Sujit K. Ghosh

At Department of Chemistry, St. Xavier's College (Autonomous), Mumbai, December 17, 2021 • At Department of Chemistry, Ramananda College, Bishnupur (W.B.), November 12, 2021 (Webinar) • At 2021 Nankai International Mini-Symposium on MOF Materials, Nankai University, China, August 11, 2021 (Webinar)

Prasenjit Ghosh

Multiple proton transfers in molecular crystals: Role of nuclear quantum effects, Theoretical Chemistry Symposium 2021, IISER Kolkata, December 11-14, 2021; Silver Jubilee Conference TSU@25, JNCASR, Bengaluru, October 28-29, 2021 • *CH4 activation and C-C coupling on Ti2C(100) surface in presence of intrinsic C-vacancies: Is excess good?*, DAE-Symposium on Current Trends in Theoretical Chemistry 2021, BARC, Mumbai, September 23-25, 2021 • *Modelling solid liquid interfaces using quantum mechanics molecular mechanics*, Advanced Molecular Dynamics Simulations: A SAARC Regional Summer School 2021, Kathmandu University, Nepal, July 05-16, 2021

Anindya Goswami

Introduction to Financial Mathematics: Exploring the machine learning approach for option pricing problems in stock market, IIIT Naya Raipur, August 22, 2021

Amrita Hazra
Vitamins as tools in synthetic biology, Kaleidoscope 2021: A Discussion Meeting in Chemistry, Nasik, October 2021 • *Investigating the molecular determinants of lower ligand diversity in the biosynthesis of Vitamin B12 and other cobamide cofactors*, Bio/Organic seminar series, University of Utah, U.S.A., April 2021 • *A microbial community approach to the synthesis of vitamin B1*, International Conference on Biotechnology for Sustainable Agriculture, Health and Environment, Location, Jaipur, April 2021

Partha Hazra
Optical properties and applications of novel stimuli-responsive organic smart materials, TIFR Mumbai, June 07, 2021 (online); Saturday Lecture Series on Light as Reagent and Product jointly organised by University of Miami (U.S.A.), University of South Carolina (U.S.A.), and NCL Pune (India), INST Mohali (India), January 29, 2022 (webinar)

Siddhesh Kamat
Mapping sphingolipid pathways during phagocytosis, 10th International Singapore Lipid Symposium (ISLS), National University of Singapore, Singapore, March 08, 2022 • Mumbai Chapter Webinar, Society of Biological Chemists of India, BARC Mumbai, February 2022 • *Metabolism to drug discovery : Where Chemistry and Biology unite* Annual Meeting, Society of Biological Chemists of India, Amity University, Haryana, December 16-19, 2021 • OMICS 2021, Proteomics Society of India Annual Meeting, CCMB Hyderabad, November 2021 • Contemporary Webinar Series, Regional Centre for Biotechnology (RCB), Faridabad, NCR, September 2021 • Annual Talks, Department of Biological Sciences, TIFR Mumbai, September 2021 • CDRI Award Ceremony, CDRI, Lucknow, Uttar Pradesh, September 2021 • Young Investigator's Meeting, EMBO, Heidelberg, Germany, June 2021

Krishanpal Karmodiya
Exceptionally high sequence-level variation in the transcriptome of Plasmodium falciparum, International Scientific Meeting and Workshop: International Workshop on- Discovery of Vaccines and Drugs for Infectious Diseases (virtual meeting), ICGEB, New Delhi, December 06-09, 2021

Shabana Khan
Silylene as a ligand in homogeneous catalysis Chemistry Meet (Manali), March 20-22, 2022 • *N-Heterocyclic silylenes: Versatile ligands in homogeneous catalysis*, ISOS-2021, France, July 05-07, 2021 • *Access to CAAC stabilized stable gold nanoparticles*, MMM-II, NISER Bhubaneswar, December 13-15, 2021

Raghavendra Kikkeri
Asian carbohydrate chemistry and glycobiology webinar, September 24, 2021 • *Deciphering structure-function relationships of heparan sulfate using synthetic glycans*, ICarE webinar, IISER Pune, February 28, 2022

Soumen Maity
The harmless set problem, 16th International Conference and Workshops on Algorithms and Computation (WALCOM 2022), Universitas Jember, Indonesia, March 25, 2022 • *The harmless set problem in social network* In-house Mathematics Symposium 2022, IISER Pune, March 16, 2022 • *Parameterized intractability of defensive alliance problem*, The 8th Annual International Conference on Algorithms and Discrete Applied Mathematics, CALDAM 2022, Pondicherry University, Puducherry, February 10, 2022 • *On structural parameterizations of the offensive alliance problem*, The 15th Annual International Conference on Combinatorial Optimization and Applications-COCOA 2021, Tianjin, China, December 18, 2021 • *Maximum minimal defensive alliance in graph*, IISc-IISER Pune Twenty-20 Symposium, Pune, September 17, 2021

Moumita Majumdar
Designing ligand molecules to battery anode materials using the main-group handle, Departmental Seminar, IISER Tirupati, February 11, 2022 (online) • *Concept behind ligand design to battery anode materials using the main-group handle*, (Chemistry) Meet in Manali, Manali, March 19-22, 2022

Shreyas Managave
Natural climate variability and global warming, Short-Term Course on Climate Change, organised by the UGC-HRDC-Pondicherry University, September 02, 2021 • *Reconstructing past climate using tree-rings* Science Day Event, IISER Pune, February 28, 2022

Angshuman Nag
Nanoscale optoelectronic properties of perovskite semiconductors, Chemistry Seminar, IIT Gandhinagar, April 09, 2021 (virtual) • *Optical properties of layered hybrid perovskites, Nano @ Bulk*, International NanoGe Conference on Nanocrystals, València, Spain, June 28-July 02, 2021 (virtual); European Materials Research Society (E-MRS) 2021 Fall meeting, September 20-23, 2021 (virtual); RSC-IIT Desktop Seminar with JMC-A, IIT Guwahati, October 27-28, 2021 (virtual) • *Nanoscale interface @ bulk hybrid perovskite*, International conference on Interdisciplinary Topics in Advanced Materials (ITAM), IISc and JNCASR, Bengaluru, July 27-30, 2021 (virtual) • *Layered hybrid perovskites: "Plenty of Room" at the interface*, Energy and Environment Unit (EEU) Seminar Series, Institute of Nano Science and Technology (INST) Mohali, August 05, 2021 (virtual); Physics Seminar, IIT Jammu, September 07, 2021 (virtual); National Webinar on "Emerging Low Dimensional Materials," Jain University, Bangalore, September 27-30, 2021 (virtual) • *Pb-free metal halide perovskite*, Luminescent Nanomaterials for Photonic and Biophotonic Applications, Institute of Nano Science and Technology (INST) Mohali, September 17-23, 2021 (virtual); International Conference on Emerging Frontiers in Chemical Sciences (EFCS), Farook College, Kozhikode, October 29-31, 2021 (virtual); 32nd Annual General Meeting of MRSI and the 3rd Indian Materials Conclave, IIT Madras, December 20-23, 2021 (virtual) • *Optoelectronics properties of perovskite semiconductors*, Nanosense (Under UGC STRIDE Scheme) hosted jointly by Fergusson College Pune and Bajaj College of Science Wardha, November 16, 2021 (virtual) • *"Plenty of Room" at the interface of layered hybrid perovskite single crystals*, 9th National Conference on Materials Science and Technology–2021, Indian Institute of Space Science and Technology Thiruvananthapuram, December 29-31, 2021 (virtual) • *Doping s- and f- electrons in Pb-free metal halide perovskites*, nanoGe Spring Meeting, Conference on Colloidal Metal Halide Perovskite Nanocrystals: From Synthesis to Applications symposium, València, Spain, March 09-11, 2022 (virtual)

Mridula Nambiar
Centromeric repression of recombination during meiosis - the how and the why Meeting - BC Centenary: A Celebration of Excellence in Research and Teaching (1921-2021), IISc, Bangalore, December 10-12, 2021 (Online)

Rejish Nath
At Conference on Condensed matter physics, Physical Research Laboratory (PRL), Ahmedabad, Gujarat, August 18, 2021 • At Sacred Heart College, Thevara, Kochi, Kerala, December 10, 2021 • At a webinar of quantum simulations and computations with cold atoms, January 28, 2022 • At IIT Mandi, March 17, 2022

Muhammed Musthafa O.T.
PCCP Desktop Seminar organised by Royal Society of Chemistry and IISER Thiruvananthapuram, May 04-05, 2021

Gayathri Pananghat
FrzCD, a bacterial chemosensory protein that binds DNA, 46.5th Myxobacteria conference, October 23-27, 2021 • *Structural basis for kinetic polarity of the bacterial tubulin FtsZ*, 48th National Seminar on Crystallography, IIT, Roorkee, November 25-27, 2021 • *Shape determination in a helical cell-wall less bacterium*, 2nd Annual Symposium on Single Particle CryoEM and Cellular Tomography, organised by CEM3DIP Society of India, December 18, 2021 (Online lecture) • *Cytoskeletal filaments that sculpt a helical bacterial cell*, BioWaves 2022, a one-day workshop organised by St. Xavier's College, Mumbai, March 12, 2022 (Online lecture)

Shivprasad Patil
Dynamic heterogeneity using fluorescence correlation spectroscopy FCS 2021, Online conference, November 29, 2021

Pramod Pillai
Photochemistry and photophysics with surface engineered quantum dots, nanoGe: NCFun21. Fundamental Processes in Nanocrystals and 2D Materials, October 21-22, 2021; Workshop in Chemistry for PG Students & Teachers, Organised by Calicut Chemistry Collective, Kerala, Online

Conference, November 19, 2021 • *Multicolour luminescent patterning via photoregulation of electron and energy transfer processes in quantum dots,* 11th Asian Photochemistry Conference (APC 2021), November 01-04, 2021 • *Surface ligand directed light harvesting with nanomaterials,* National Conference on Recent Trends in Materials Science (NCMST 2021), Organised by INST Trivandrum, December 29-31, 2021

Mainak Poddar

Bubbling and Gromov compactness I and II, Geometry-Topology seminars (online), IISER Mohali, April 28-May 12, 2021 • *What is differential geometry?* "What is ..." talk series of Maths Club, IISER Pune, November 18, 2021 • *Hamiltonian dynamics and Floer homology* International Conference on Recent Trends in Mathematics (online), Hansraj College, DU, December 24, 2021

Moumanti Podder

Combinatorial games on multi-type Galton-Watson trees, IISc-IISER Pune Twenty-20 Joint Symposium, September 07, 2021 • *A combinatorial game on rooted Galton-Watson trees*, Weekly online seminar on graphs, matrices, and applications, IIT Kharagpur, December 03, 2021 • *A fun glimpse into the world of probabilistic methods*, Math Day, March 13, 2021

Kalika Prasad

Precision of recreation in plants, Annual talk series by Centre for BioSystems Science and Engineering, IISc, Bangalore, November 15, 2021

Sunish Radhakrishnan

Bacterial cell cycle control: Coordinating an organelle biogenesis with cell division Dept. of Biology, Indiana University, Bloomington, IN, U.S.A., February 22, 2022

Atikur Rahman

Synthesis, properties and applications of 2D materials, Nanosense (UGC_ STRIDE), Fergusson College (Autonomous), Pune, November 12, 2021 • *Fabrication and optoelectronic properties of mixeddimensional van der Waals heterostructures*, Low dimensional Materials: Growth, optical and electronic properties (LDMAT - 2021), Organised by UM-DAE Centre for Excellence in Basic Sciences, Mumbai & Materials Research Society of India – Mumbai Chapter, June 03, 2021

Girish Ratnaparkhi

SUMOylation of dorsal attenuates Toll-NFkappaB signalling Indian Drosophila Research Conference, December 13-17, 2021 • *SUMOylation of Jun fine-tunes the Drosophila gut immune response* Society of Biological Chemistry (India) Annual Talks, December 17-20, 2021

Chaitra Redkar

Lecture: *Changing idea of rights*, 3-day National Conference on Indian Democracy Since Independence, organised by T C College, Baramati, February 18, 2021 • **Lecture:** *Concerns and challenges of curriculum design*, 3-day RUSA-sponsored Online National FDP on Curriculum Design Strategies to Enhance Employability and Soft Skills, organised by Patkar Varde College, Mumbai, February 05, 2021 • **Panel discussion:** *Political participation of women: Impact and the way forward*, organised by Gender Impact Studies Center (GISC), Impact and Policy Research Institute (IMPRI), New Delhi, June 10, 2021 • **Talk:** *Savarkar's idea of nationalism*, in a week-long symposium on Indian Political Thought organised by T. K. Tope College, Mumbai, July 29, 2021 • **Talk:** *Tagore's idea of nationalism,* in a week-long symposium on Indian Political Thought organised by T. K. Tope College, Mumbai, July 30, 2021 • **Talk:** *Indian idea of social unity*, ILS Law College, Pune, September 04, 2021 • **Talk:** *Contemporary relevance of Mahatma Gandhi,* Baburao Gholap College organised by Dept. of Continuing Education, SPPU, Pune, October 02, 2021 • **Talk:** *Revisiting the debates between Gandhi and Ambedkar* Sathye College, Mumbai, October 08, 2021 • **Talk:** *Idea of Freedom in the Constitution of India*, Symposium on Constitutional Values organised by the Phule-Ambedkar Chair, University of Mumbai, Mumbai, December 03, 2021 • Conducted 2 sessions on *Philosophy of social science research and research paradigms*, ICSSR sposored Research Methodology Workshop organised by Dept. of Geography, SNDT Women's University, Pune, March 08-09, 2022 • Key note address to the Online Seven Days Inter-Disciplinary Academic Discourse on the Seven Decades of Independence: Ideas & Reflections organised by Departments of Political Science of the RTM Nagpur University, March 25, 2022 • **Talk:** *In search of space for dialogue between Gandhi and Ambedkar*, Rajyashastra Vichar Manch, SRTM University, Nanded, April 13, 2022

Britto Sandanaraj

Micelle-Assisted Protein Labeling (MAPLab) method – A promising platform technology for the custom design of monodisperse stimuli-responsive protein-based supramolecular assemblies, Pacifichem – December 2021

Haripada Sau

From von Neumann Inequality to Crouzeix Conjecture, Math Day Event, IISER Pune, March 20, 2022

S. G. Srivatsan

Chemo-enzymatic technology to visualize RNA and display functional small molecules on gene targets, 58th Annual Convention of Chemists (ACC) of the Indian Chemical Society (ICS), IISER Kolkata, December 22-24, 2021 (Online) • *Probing mood (structure) swings of therapeutic nucleic acid motifs*, Award Lecture, JNCASR Bangalore, November 26, 2021; Online Department Seminar, Ohio State University, U.S.A., October 07, 2021 • *Clickable nucleotide toolbox for displaying small molecules on gene targets* Mini-Symposium on Nucleic Acids, IISER Tirupati, May 25, 2021 (online)

Seema Sharma

SUSY searches at the CMS Experiment, 6th Colombian Meeting on High Energy Physics, Colombia, December 01, 2021 • *Standard Model-III - SM & BSM Physics - an experimental perspective*, BCVSPIN-2021 School: Probing the Mysteries of the Universe, January 12, 2022 • *The CMS experiment – a missing momentum microscope!*, Indian Physics Association Colloquium, Hosted by University of Rajasthan, Jaipur, March 05, 2022

Kaneenika Sinha

Explicit constructions of unbalanced Ramanujan bigraphs, Conference on analytic and combinatorial number theory (to honour Professor R. Balasubramanian on his 70th birthday), Institute of Mathematical Sciences, Chennai, March 26, 2021 • *Central limit theorems in number theory and graph theory*, Conference on modular forms (to honour Professor B Ramakrishnan on his 60th birthday), Institute of Mathematical Sciences, Chennai, September 18, 2021 • *Prime numbers and the growth of ideas*, TEDx talk, NIT Rourkela, January 08, 2022 • *How primes keep secrets,* Science Week organised by the Indian Academy of Sciences, Bengaluru, February 28, 2022

Pushkar Sohoni

Chair, panel on temple architecture at 'An Interdisciplinary Two Days National Conference of Indian Sculpture & Architecture Research Council on 'Ancient Indian Rock Paintings, Caves, Stupa, Temples and Iconography' at Gopinath Munde College, Mandangad, Ratnagiri, March 13, 2022 (online) • *Gunpowder and evolution of forts in the Deccan*, World Heritage Week 2021, Archaeological Survey of India Mumbai Circle, November 23, 2021 (online) • *Architecture as a history of the Medieval Deccan,* Maulana Azad National Urdu University (MANUU) under the Pandit Madan Mohan Malaviya National Mission for Teachers and Teaching, Ministry of Human Resources Development, October 07, 2021 (online) • *Circulation through regimes*: *Yadava-period temples in the Deccan* 19th International Conference on Maharashtra: Circulation, University of Oxford, U.K., September 01, 2021 (online) • Moderator for a panel discussion with architects Bijoy Ramachandran, Pedro Aibeo, and Peter Scriver at the conference 'Blurred Boundaries: In Search of an Identity' hosted by Brick College of Architecture, Pune, September 24, 2021 • *Learning from History: the translation of material, construction, and style* School of Architecture, Chinese University of Hong Kong, for Prof. David Dernie's studio, September 15, 2021 (online) • *Digital approaches to temple environments,* Conference on Temple Cultures & Premodern Worlds across South Asia and the Indian Ocean, organised by Kunsthistorisches Institut in Florenz - Max Planck Institut, Yale Macmillan Center, and the South Asian Studies Council, Yale University, September 15, 2021 (online) • *Yadava temples: Before and after*, Conference on Temple Cultures & Premodern Worlds across South Asia and the Indian Ocean, organised by Kunsthistorisches Institut in Florenz - Max Planck Institut, Yale Macmillan Center, and the South Asian Studies Council, Yale University, September 01, 2021 (online). https://vimeo.com/showcase/9122441/video/660965291 • *Scientific research in colonial India: The Bombay Presidency*, on the panel Science and Empire in the Age

of Global History, at the 26th International Congress of History of Science and Technology, Prague, July 26, 2021 (online) • Panel keynote talk on *Ports: Liminal Spaces – The Case of Chaul* for the panel The Arabian Sea and Western Indian Ocean: Labor, Caste, and Community, at the conference Interwoven: Sonic and Visual Histories of Indian Ocean Worlds, organised by The University of Chicago, May 18, 2021 (online) • *The historic city of Ahmadnagar and its environs*, Ramesh Phirodia College of Architecture, Ahmadnagar, May 18, 2021 • *Domes on a Medieval Temple at Anwa: Continuities in Construction Methods Across Deccani Political Formations* on the panel Political Transformations through Architectural Interventions in Islamic South Asia, at the Historians of Islamic Art Association 2021 Biennial Symposium, University of Michigan, April 16, 2021 (online) • *Changing paradigms of defense*, Seminar of Offense and Defense: Weapons and Forts of India at Sophia College, Mumbai, April 05, 2021 (online)
Narrator for the documentary *The Trials and Triumphs of G.R. Ramachandran,* produced by the Science Media Centre, IISER Pune. https://www.youtube.com/watch?v=bhfLr6uaSao

Bejoy Thomas
Addressing the 'social' questions at different scales, panelist at Workshop on Balancing Net Zero, Gokhale Institute of Politics and Economics, Pune, March 11, 2022 • *Working in a crisis discipline: Perspectives on environment and development,* The Biology Society, February 26, 2022 (online) • *Water education as a problem driven, normative enterprise*, Wednesdays for Water panel on Water Education in Higher Studies, weekly online series, December 01, 2021 • *Rethinking water management in urbanising river basins*, Water Seekers Fellowship 2021 Inception Workshop, October 18, 2021 (online) • *From growth to degrowth: The normative challenge in development*, Seminar at Humanities and Social Sciences department, IIT Tirupati, June 18, 2021 (online) • *Adapting or chasing water? Understanding farmer responses to water stress*, Seminar at Department of Earth and Climate Science, IISER Pune, March 25, 2021 (online)

Gyana Ranjan Tripathy
Erosional changes in the Himalaya during last glacial-interglacial cycle, Frontiers in Geosciences Research conference, Physical Research Laboratory, Ahmedabad, September 27, 2021 (online) • *Re-Os geochronology of organic-rich sedimentary rocks,* Jadavpur University, Kolkata, July 16, 2021 • Invited talk on *Research opportunities in Aquatic Geochemistry* in the weekend webinar series of INYAS, India, on July 03, 2021

Ramanathan Vaidhyanathan
Covalent organic frameworks-modular polymers for energy science, National Prizes for Research in Inorganic and Physical Chemistry Award Lectures, School of Advanced Materials (SAMat) Jawaharlal Nehru Centre for Advanced Scientific Research & C.N.R. Rao Education Foundation, July 02, 2021; IISER Tirupati, July 22, 2021; SAMAT, JNCASR in recognition of the CNR Rao Award, July 02, 2021 • *Covalent Organic Framework (COF) for energy storage*, online Indo-Norwegian Conference FARAON-2022, hosted by University of Oslo and Madurai Kamaraj University, TN, February 02, 2022 • *Exploring COFs for lightweight and fast charging storage*, International Winter School – 2021 on Frontiers in Materials Science – A Hybrid Event, JNCASR, Bengaluru, December 08, 2021

Arun Venkatnathan
Unraveling thermal stability, structure, and ion transport in soft solid battery electrolytes via computer simulations, Theoretical Chemistry Symposium, IISER Kolkata, December 13, 2021 (Online)

ACADEMIC EVENTS ORGANISED

Ashish Arora
Science outreach activities: Actively organizing many science outreach events in collaboration with Smt. Indrani Balan Science Activity Centre, IISER Pune • Administrator of the YouTube channel called "India's Science Theatre" dedicated to science outreach. Highlighted here are a few events either organised or contributed to:

- Title: Mysteries of the Universe: Science Quiz Competition, Description: Streamed live on the YouTube channel of IISER Pune Science Activity Centre on National Science Day, Language: Hindi + English, February 28, 2022
  Engagement: Number of live participants- about 300, Total accumulated views- >26000, Likes- >1000
  Link: https://www.youtube.com/watch?v=_7u4K84DXsw

- Title: Science Quiz Live, Description: I am the administrator of the YouTube channel: India's Science Theatre. I regularly organize online (live) quiz competitions (about once every month). We have a live participation of about 100 people in every episode. A total of 9 episodes have been telecasted so far, Language: Hindi + English
  Link: youtube.com/playlist?list=PLdPvetNaB5SevYfvOYRQu5AL4xLwheuzO

- Title: Rubaru: James Webb Space Telescope, Description: Streamed live on facebook, on the facebook page titled CosmoSing-H, administered by Sh. Harjit Singh (ISRO, Thiruvanathpuram), Language: Punjabi, January 29, 2022
  Engagement: Total views- >7500, Likes- 243
  Link: https://www.facebook.com/cosmosingh20/videos/264376085835928

- Title: Mysterious magnets, Description: A live demonstration show on the YouTube channel of IISER Pune Science Activity Centre, Language: Hindi+English, January 09, 2022
  Engagement: Number of live participants- about 500. Total views- >8600, likes- 514
  Link: https://www.youtube.com/watch?v=0P6dakLUDF8

- Title: Rubaru: Mysteries of magnets, Description: Streamed live on facebook, on the facebook page titled CosmoSing-H, administered by Sh. Harjit Singh (ISRO, Thiruvananthapuram), Language: Punjabi, October 23, 2021
  Engagement: Total views- >1100, Likes- 33
  Link: https://www.facebook.com/cosmosingh20/videos/590321809083580

Chaitanya Athale
Organiser, Biophysics and Synthetic Biology Online Seminar Series • Session Chair of Microtubules and Motors, Biophysical Society of U.S.A., San Francisco, U.S.A., February 21, 2022

Baskar Balasubramanyam
Co-organiser, Symposium on Number Theory, Organised in honour of Prof. M.V. Subbarao on his birth centenary, IISER Pune, July 12-16, 2021 • Co-organiser, L-functions and Iwasawa theory, CEFIPRA conference, November 15-19, 2021

Nirmalya Ballav
ChemSymphoria, December 27-29, 2021

Debargha Banerjee
The Seventh Mumbai-Pune Number Theory Seminar, Department of Mathematics, IIT Bombay, April 09-10, 2021 http://www.math.iitb.ac.in/~ravir/mpnts2021page.html

Deepak Barua
Co-organiser, Plant Ecophysiology Research Workshop, Kerala Forest Research Institute, Peechi Kerala, December 05-08, 2021; https://www.kfri.res.in/noticeboard.asp?ID=1668

Sutirth Dey
Organiser, ISEB3: International Conference on Insect Systematics and Evolutionary Biology, jointly with Punjabi University Patiala, February 16-18, 2022

Anindya Goswami
IISER Pune StatFin Webinar 2022-1.1, March 04, 2022 • IISER Pune StatFin Webinar 2021-2.2, December 10, 2021 • IISER Pune StatFin Webinar 2021-2.1, August 27, 2021

Amrita Hazra
Co-organiser, ENS-IISER meeting on pedagogy and online teaching practices, May 2021

Krishanpal Karmodiya
Co-organiser, Phase Separated Systems in the Nucleus (PSINU2021), IISER Pune, April 06-09, 2021

Shabana Khan
58th Annual Convention of Chemists (ACC), Indian Chemical Society (ICS) , Young Scientist Conclave 2021, Professor D.B. Ramachary, Dr. Madhurima Jana, Dr. Shabana Khan, December 23, 2021 (Online)

G.V. Pavan Kumar
Single-molecule SERS, QMAT, TIFR Mumbai, December 20, 2021 (online) • Thermoplasmonic Trapping, FCS, IISER Thiruvananthapuram, December 10, 2021 (online) • Thermoplasmonic Trapping, IEEE, Delhi Chapter, December 03, 2021 (online) • Nanowire based plasmonic trapping, Compflu 2021, IIT Bombay, November 10, 2021 (online) • Single-molecule SERS, University of Gothenburg, Sweden, October 10, 2021 (online) • Nanowire based plasmonic trapping, Annual Symposium OSI, IIT Delhi, September 15, 2021 (online) • Thermoplasmonic Trapping, Cond Mat Conference, Goa University, September 03, 2021 (online) • Single-molecule SERS fluctuations, LDMAT-2021, SN Bose, Kolkata, August 10, 2021 (online) • Soft Matter Photonics, Physics Department, IISER Tirupati, August 06, 2021 (online) • Optothermal tweezers, OSA Chapter, NISER Bhubaneswar, June 05, 2021 (online) • Optothermal tweezers, TIFR OSA Chapter, TIFR Mumbai, May 20, 2021 (online) • Thermoplasmonics, Physics Department, IIT Jammu, May 15, 2021 (online) • National Science Day Lecture, IISER Pune, February 28, 2022

Moumita Majumdar
Activities organised as part of the Women in Science Committee: Orientation Programme for BS-MS students, December, 2021 (online) • National Girl Child Day Celebration, January 24, 2022 (online) • International Women's Day Celebration, March 08, 2022 (online) • Mentoring Programme, Monthly event (online)

Angshuman Nag
Co-organiser (with Emmanuel Lhuillier (CNRS-Sorbonne université, Paris) and Sandrine Ithurria (ESPCI, Paris)), Virtual “nanoGe” international conference: Semiconductor Nanocrystals I: Basic Science (synthesis, spectroscopy, electronic structure, device and application, March 07-09, 2021

Sudipta Sarkar
Co-oraniser (with Dr. Utsav Mannu), Workshop on Geodynamic Modelling (Under the KARYASHALA Scheme - A SERB initiative), October 04-08, 2021 (online)

Seema Sharma
Organiser, Hunting SUSY @ HL-LHC (ONLINE), ICTS, Bengaluru, November 22-26, 2021
https://www.icts.res.in/discussion-meeting/SUSYatHL-LHC2021

Kaneenika Sinha
Organiser, Symposium on Number Theory, In honour of Prof. M.V. Subbarao on his birth centenary, IISER Pune, July 12-16, 2021

Bejoy Thomas
Organiser, Water Talks, a series of online talks and panels on various dimensions of water, as part of the Centre for Water Research (CWR)'s activities:
Managing groundwater in India through participatory science and community action by Himanshu Kulkarni, ACWADAM, Pune, March 19, 2021 • Do not waste water! Water saving: what does it mean and how to measure and do it? (And: to whom does the saved water go?) by Prof. Margreet Zwarteveen, Water Governance, UN-IHE Delft Institute for Water Education and the University of Amsterdam, April 21, 2021 • Ecological dimensions of India's water security by Jagdish Krishnaswamy, Senior Fellow, ATREE, Bengaluru, May 26, 2021 • Reconstructing the Duties of Water in India: On the Prospects for Value Pluralism by Prof. James Wescoat, the Aga Khan Professor Emeritus of Landscape Architecture and Geography, MIT, Boston, August 25, 2021 • Unlearning Museums: Talking with Water, Panelists: Amy Sharrocks (artist, Museum of Water), Sara Ahmed (founder, Living Waters Museum) moderated by Philippe Pypaert (UNESCO), September 22, 2021 • Water: Memories, Migration, Mapping, Panelists: Gauri Raje (storyteller, India/Scotland), Minket Lepcha (storyteller, India), moderated by Sara Ahmed (IISER Pune), October 20, 2021 • Re-imagining Rivers, Panelists: Parineeta Dandekar (Associate Coordinator, SANDRP), Shailaja Deshpande (Founder and Director, Jeevitnadi - Living River Foundation) moderated by Bejoy Thomas (IISER Pune), November 17, 2021

Gyana Ranjan Tripathy
Virtual workshop on Trace elements in Aqueous systems, IISER Pune (Financially supported by IISER Pune and Capacity building grant, Geochemical Society, U.S.A., October 29-30, 2021 • Symposium on Recent Advances in Aquatic Geochemistry, IISER Pune, August 07, 2021

NEW EXTRAMURAL GRANTS GARNERED

Amount in ₹

Sr. No.	Name of the Project and Project Leader	Project Code	Funding Agency	Period From-To	Total Funds Sanctioned	Funds Received During the Year
01	Transcription- translation uncoupling in bacteria: Dissecting the fundamental principles of a phenomenon unknown in bacteria. PI: Dr. Sunish Radhakrishnan	GAP/SERB/BIO-21-543	SERB	03.04.2021 02.04.2024	83,83,580	20,11,830
02	Superfluid spin transport in quantum antiferromagnets. PI: Dr. Sunil Nair	GAP/SERB/PHY-21-544	SERB	05.04.2021 04.04.2024	2,39,05,590	23,57,140
03	The Living Waters Museum project. PI: Dr. Sara Ahmed	GAP/BC-21-545	Self-Funded	06.04.2021 Till funds received	Not Applicable	14,30,000
04	Nuclear quantum effects on structural properties and dynamics at metal water interfaces: Coupling QMMM and path integral molecular dynamics. PI: Dr. Prasenjit Ghosh	GAP/DST/PHY-21-547	DST	08.04.2021 07.04.2023	1,64,47,744	80,47,744
05	Indigenous Li-ion battery development for solar inverters, solar ev charges, and small electric vehicles. PI: Prof. Nirmalya Ballav Co-PI: Prof. Satish Ogale	GAP/DST/CHE-21-548	DST	15.06.2021 14.06.2024	2,14,29,520	1,43,50,000
06	AOARD 21IOA022 - Integrating organic quantum dots into covalent organic frameworks to make lightweight, flexible, conducting polymers. PI: Prof. Ramanathan Vaidhyanathan	GAP/AOARD/CHE-21-549	Asian Office of Aerospace R & D (AOARD)	06.04.2021 05.04.2023	49,64,896	40,91,680

Amount in ₹

Sr. No.	Name of the Project and Project Leader	Project Code	Funding Agency	Period From-To	Total Funds Sanctioned	Funds Received During the Year
07	Mechanism based inhibitors of 3-mercapatopyruvate sulfur transferase. PI: Prof. Harinath Chakrapani	GAP/DBT/CHE-21-550	DBT-NBA	01.07.2021 30.06.2024	17,00,000	7,00,000
08	Investigating the role of Trithorax group (TrxG) proteins in potato tuber development. PI: Prof. Anjan Banerjee	GAP/DBT/BIO-21-551	DBT	17.08.2021 16.08.2024	27,00,000	9,00,000
09	Publication of *Physics Education* Journal. PI: Dr. Sourabh Dube	GAP/DAE/PHY-21-552	DAE-BRNS	24.06.2021 23.06.2024	3,30,000	3,30,000
10	INSPIRE Faculty Award PI: Dr. Haripada Sau	GAP/DST-INSPIRE-21-553	DST-INSPIRE	01.04.2021 12.02.2024	35,00,000	9,29,353
11	Role and regulation of stress-induced autophagy in proteostasis mechanisms underlying artemisinin resistance PI: Dr. Krishanpal Karmodiya	GAP/DBT/BIO-21-554	DBT	19.08.2021 18.08.2024	39,80,390	18,42,890
12	Wellcome Trust / DBT India Alliance - Senior (Basic) Fellowship PI: Dr. Sunish Kumar Radhakrishnan	GAP/Wellcome Trust/BIO-21-555	Wellcome Trust - DBT India Alliance - Other	01.09.2021 31.08.2026	4,49,84,904	1,01,94,595
13	Raja Ramanna Fellowship PI: Prof. Shyam Sundar Rai	GAP/DAE/ECS-21-556	DAE - Other	20.04.2021 15.03.2024	21,06,280	13,50,000
14	AOARD 21IOA051 - Investigating magnetoelectric multiglasses using nonlinear dielectric & magnetic susceptibilities. PI: Dr. Sunil Nair	GAP/AOARD/PHY-21-557	Asian Office of Aerospace R & D (AOARD)	06.08.2021 05.08.2024	18,47,500	18,47,500
15	Engineering a site-specific synthetic chromatin remodeler for genome editing and gene expression. PI: Prof. Saikrishnan Kayarat	GAP/SERB/BIO-21-558	SERB	30.09.2021 29.09.2024	55,37,410	24,89,570
16	COVID-19: the second wave and beyond. Enhanced viral surveillance by viral genome sequencing to better track SARS-CoV-2 today and monitor future threats tomorrow. PI: Dr. Aurnab Ghose; Co-PI: Dr. Krishanpal Karmodiya & Prof. L.S. Shashidhara	GAP/RF/BIO-21-559	CCMB-Rockefeller Foundation	18.08.2021 31.05.2024	1,19,40,000	1,19,40,000
17	Wellcome Trust / DBT India Alliance PI: Dr. Nishad Matange	GAP/Wellcome-Trust/BIO-21-560	Wellcome Trust - DBT India Alliance – Other	01.09.2021 31.08.2026	2,75,61,924	62,27,629
18	Dissection of signalling mechanisms that couple flagella biogenesis to cytokinesis in bacteria. PI: Dr. Sunish Kumar Radhakrishnan	GAP/DBT/BIO-21-561	DBT	14.02.2022 13.02.2025	98,96,782	38,87,991
19	Using machine learning to identify and interpret disease-relevant non-protein-coding sequence variation. PI: Dr. Leelavati Narlikar	GAP/DBT/MATHS-DSC/21-562	DBT	11.03.2019 transfer from NCL Pune 10.03.2022	58,22,900	20,74,300

Amount in ₹

Sr. No.	Name of the Project and Project Leader	Project Code	Funding Agency	Period From-To	Total Funds Sanctioned	Funds Received During the Year
20	Size matters: Predicting personalized risk of SGA. PI: Dr. Leelavati Narlikar	GAP/BIRAC/MATHS-DSC-21-563	BIRAC	25.10.2021 24.04.2023	9,90,000	2,97,000
21	Transforming higher educational landscape, through the continuous professional development of teachers in Higher Education Institutes (HEIs) of Maharashtra. PI: Prof. Harinath Chakrapani & Dr. Sourabh Dube	GAP/MSFDA/BIO-21-564	MSFDA	29.12.2021 28.03.2025 (duration 41 months)	55,05,000	35,54,650
22	Stability and dynamics of microbial communities: A simulation study. PI: Prof. Sutirth Dey	GAP/SERB/BIO-21-565	SERB	27.12.2021 26.12.2024	38,40,000	12,80,000
23	Molecular ferroelectrics for energy and electronic applications. PI: Prof. R. Boomi Shankar	GAP/SERB/CHE-21-566	SERB	27.12.2021 26.12.2024	38,50,000	12,90,000
24	Highly conjugated covalent organic framework capped bimetallic nanoclusters as synergetic oxysorber- sorbents with optimal thermodynamics and kinetics for O_2/N_2 separation. PI: Prof. Ramanathan Vaidhyanathan	GAP/SERB/CHE-21-567	SERB	30.12.2021 29.12.2024	68,31,000	56,17,000
25	Generation of prebiotic amphiphile diversity and its role in the sustenance, growth, and division of protocellular compartments. PI: Dr. Sudha Rajamani	GAP/DBT/BIO-21-568	SERB	14.01.2022 13.01.2024	52,99,888	17,79,900
26	Wellcome Trust / DBT India Alliance - Dr. Raghav Rajan. PI: Dr. Raghav Rajan	GAP/Wellcome Trust/ BIO-21-569	Wellcome Trust - DBT India Alliance - Other	01.01.2022 31.12.2026	4,49,68,000	1,10,14,850
27	Genomic surveillance for SARS-CoV-2 in India: Indian SARS-CoV-2 genomics Consortium (INSACOG). PI: Dr. Krishanpal Karmodiya Co-PI: Prof. Sanjeev Galande & Dr. Aurnab Ghose	GAP/DBT-INSACOG/ BIO-21-570	DBT - INSACOG	12.01.2022 30.06.2022	81,20,400	28,80,400
28	Tracing Archean oceanic conditions using chemistry of banded iron formations. PI: Dr. Gyana Ranjan Tripathy	GAP/SERB/ECS-21-571	SERB	25.01.2022 24.01.2025	24,68,000	13,50,000
29	Understanding respiratory and neural correlates of introductory note progression to song in the adult male zebra finch. PI: Dr. Raghav Rajan & Dr. Aurnab Ghose	GAP/SERB/BIO-21-572	SERB	25.01.2022 24.01.2025	64,27,578	26,61,158
30	CRISPR-Cas9 based genome editing use to generate a *Drosophila* model of familial amyotrophic lateral sclerosis. PI: Dr. Girish Ratnaparkhi	GAP/ICMR/BIO-21-573	ICMR	01.10.2021 30.09.2024	25,06,118	25,06,118

Amount in ₹

Sr. No.	Name of the Project and Project Leader	Project Code	Funding Agency	Period From-To	Total Funds Sanctioned	Funds Received During the Year
31	Radical strategies for C-C, C-B bond formation using organoboron and organosilicon reagents. PI: Dr. Moumita Majumdar	GAP/CSIR/CHE-21-574	CSIR	10.02.2022 09.02.2025	11,00,000	4,00,000
32	Swarnajayanti Fellowship: Mapping oxidative stress pathways in mammalian systems using an integrated chemical proteomics and metabolomics approach. PI: Dr. Siddhesh Kamat	GAP/SERB/BIO-21-575	SERB-SJF	09.02.2022 08.02.2027	4,98,95,600	3,79,79,120
33	Swarnajayanti Fellowship: Nonlinear elliptic equations with Hardy potential. PI: Dr. Mousomi Bhakta	GAP/SERB/MATHS-21-576	SERB-SJF	09.02.2022 08.02.2027	77,40,200	18,83,240
34	Exploring novel endogenous promoters and signal peptides of moss to drive target expression in physcomitrella patens under photo-bioreactor conditions. PI: Prof. Anjan Banerjee	GAP/CSIR/BIO-21-577	CSIR	10.02.2022 09.02.2025	36,92,000	14,75,333
35	How inflammation predisposes to tumor retention by altering epithelial mechanics. PI: Dr. Raghav Rajan	GAP/UQ/BIO-21-578	The University of Queensland	01.12.2021 31.12.2022	10,59,600	10,59,600
36	Assessment of bone age using artificial intelligence in children and adolescents across different ethnicities. PI: Dr. Pranay Goel Co-PI: Dr. Leelavati Narlikar	GAP/DBT/BIO-21-579	DBT	31.01.2022 30.01.2025	27,43,360	14,49,680
37	Study of the Narasimhan-Simha type metrics on domains in C^n. PI: Dr. Diganta Borah	GAP/SERB/MAT-21-580	SERB	21.02.2022 20.02.2025	6,60,000	2,20,000
38	To decipher the role of MLL complex in the regulation of Rho family of GTPases. PI: Prof. Sanjeev Galande	GAP/DBT/BIO-21-581	DBT	08.02.2022 07.02.2025	33,43,840	11,81,280
39	Study of the squeezing function and the volume elements on domains in C^n. PI: Dr. Diganta Borah	GAP/SERB/MAT-21-582	SERB	25.02.2022 24.02.2025	29,11,749	10,69,892
40	Observational study on long-term immunogenicity of COVID-19 vaccines in vaccine-naïve seronegative and seropositive participants. PI: Dr. Aurnab Ghose	GAP/IUCAA/BIO-21-583	IUCAA	28.02.2022 27.02.2025	16,23,000	16,23,000
41	A microtubule centric approach to tacking Chemotherapy-Induced Peripheral Neuropathy - Wellcome Trust / DBT India Alliance. PI: Dr. Aurnab Ghose	GAP/Wellcome Trust/BIO-21-584	Wellcome Trust - DBT India Alliance - Other	01.10.2021 30.09.2026	3,32,89,518	1,08,75,986
42	Teachers Associateship for Research Excellence (TARE) to Yogesh Ramchandra Kulkarni, Gharda Institute of Technology, Ratnagiri. PI: Dr. Gyana Ranjan Tripathy	GAP/SERB/ECS-21-585	SERB	09.12.2021 08.12.2024	10,05,000	3,35,000

Amount in ₹

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43	INSPIRE Faculty Award PI: Dr. Divyang Bhimani	GAP/DST-INSPIRE/ MATH-21-586	DST-INSPIRE	03.03.2022 28.02.2023	35,00,000	12,72,579
44	Combinatorial games on random rooted trees and random graphs. PI: Dr. Moumanti Podder	GAP/SERB/MAT-21-587	SERB	07.03.2022 06.03.2025	1,52,515	1,03,271
45	Synthesis and characterization of “defective” half-Heusler alloys for thermoelectric applications. PI: Dr. Surjeet Singh	GAP/SERB/PHY-21-588	SERB	14.03.2022 13.03.2025	59,90,669	50,67,563
46	Phase behavior and rheology of active colloidal rotor. PI: Dr. Apratim Chatterji & Dr. VijayaKumar Chikkadi	GAP/SERB/PHY-21-589	SERB	14.03.2022 13.03.2025	68,92,787	49,13,010
47	Tuning optoelectronic properties of 2Dmaterials through dielectric engineering for device applications. PI: Dr. Atikur Rahman	GAP/SERB/PHY-21-590	SERB	14.03.2022 13.03.2025	69,41,000	59,20,500
48	Exploring the multi-level (phasiRNA, StSP6A and photoperiod) regulation of StGA2oxl, a key tuberization gene in potato. PI: Prof. Anjan Banerjee	GAP/SERB/BIO-21-591	SERB	14.03.2022 13.03.2025	56,85,108	25,41,830
49	Synthesis of new hybrid bidentate SiNP ligands and their application in homogeneous catalysis. PI: Dr. Shabana Khan	GAP/SERB/CHE-21-592	SERB	22.03.2022 21.03.2025	59,09,640	26,43,100
50	The structural and functional annotations of biological networks with special emphasis on *Mycobacterium tuberculosis* - BIC at IISER Pune. PI: Dr. M.S. Madhusudhan (Coordinator & PI), Dr. Chaitanya Athale, Prof. Saikrishnan Kayarat, Co-PI: Dr. Pranay Goel, Prof. Sanjeev Galande	GAP/DBT/BIO-21-593	DBT	11.03.2022 10.03.2027	1,37,19,082	46,33,870
51	From the metropole to the colonies: A comparative study of the centre-periphery networks of science and higher education in India and Taiwan. PI: Dr. Pushkar Sohoni	GAP/ICSSR/HSS-21-594	Others - ICSSR	01.04.2022 31.03.2024	8,60,000	3,50,000

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