



भारतीय विज्ञान शिक्षा एवं
अनुसंधान संस्थान पुणे
वार्षिक प्रतिवेदन २०२०-२०२१

INDIAN INSTITUTE OF SCIENCE
EDUCATION AND RESEARCH PUNE
Annual Report 2020–2021



On the Cover

One of the ways bacteria can become resistant to antibiotics is through acquiring foreign DNA. SauUSI enzyme offers a barrier for the entry of foreign DNA and prevents the bacterial pathogen *Staphylococcus aureus* from becoming resistant to the antibiotic vancomycin. On the Cover is the crystal structure of SauUSI determined by Prof. Saikrishnan Kayarat's research group. In this work, the group addresses the problem of antimicrobial resistance by studying what makes SauUSI a potent barrier (Tumuluri et al., *Nucleic Acids Research* 49(4):2161-2178).

Image Credit

Vinayak Sadasivam Tumuluri, Saikrishnan Kayarat

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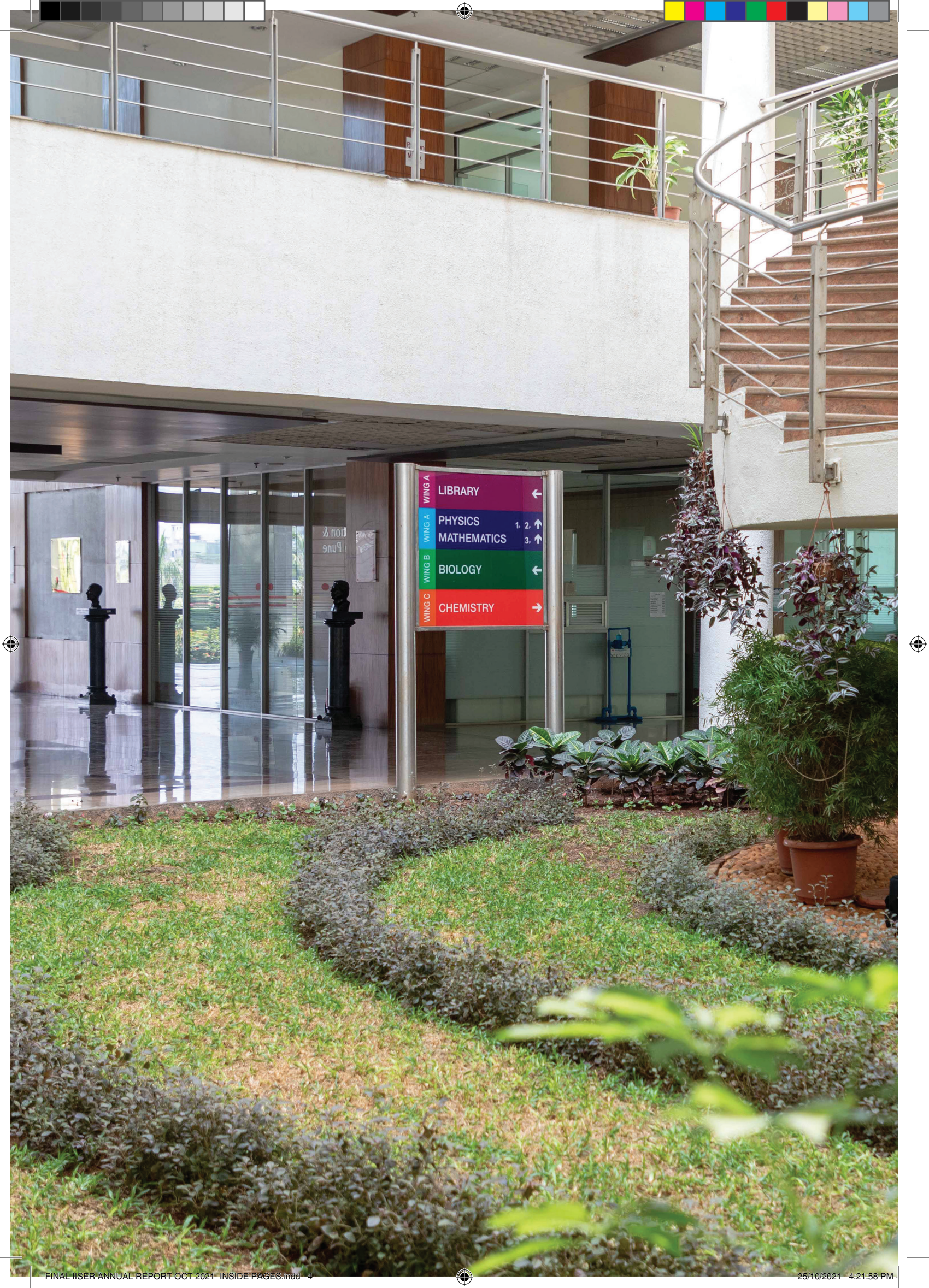




भारतीय विज्ञान शिक्षा एवं अनुसंधान संस्थान पुणे
वार्षिक प्रतिवेदन २०२०-२०२१

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH PUNE
Annual Report 2020–2021





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

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, Earth and Climate Science, Humanities and Social Sciences, Mathematics, and Physics. Researchers at the Institute investigate a wide spectrum of topics in the basic sciences as well as in applied areas of research.

The Institute is ranked 25 in the 2020 India Rankings of the National Institutional Ranking Framework (NIRF) in the overall category; 601-800 in the 2021 Times Higher Education (THE) World University Rankings; and is listed among the top 10 in India for research output by the 2021 Nature Index Tables.

HIGHLIGHTS 2020-21

Numbers are as of March 31, 2021.
Financial data rounded off to the
nearest whole number.

1654
Students

382 PhD,
201 Integrated PhD,
and 1071 BS-MS

13
**New MoU and
Agreements**

10 National
3 International

54

**Online outreach
sessions by
Science Activity
Centre**

55

**New
Extramural
Grants
Garnered**

103

**crores (in ₹)
Extramural
Funds
Received**

489

**Publications
in 2020**

62

**Postdoctoral
Fellows**

Patents

9 filed
10 published
1 granted

109

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

131

**Non-Teaching
Staff Members**

131

Faculty Members
+ 20 faculty fellows,
independent scientists,
and visiting faculty



Foreword



The events of the past year have made it clear that we have to inculcate in ourselves a culture of safety for all we do on our campus. As an institute, we hope to encourage this culture of safety and care, and extend it to all aspects of the way we function. We have all to learn that we are not above the rules and regulations that govern the safety of everyone. We must stop thinking that we, or our work, are too important to have to follow rules. The pandemic is a good example of how even if a few people flout safety rules, it can affect the safety of everyone. The pandemic has taught us that nothing is more important than to keep ourselves and each other safe.

The COVID-19 pandemic is a time when we as an Institute have to stand together and look out for each other. Though we have some measures in place to help us through, such as the vaccine, the threat of the third wave still hangs over us. It is all the more important that we look out for each other as the fight against the pandemic continues. We are a society built on collectivist ideals, and on coming together in times of strife. So we need to not only take care of ourselves, but also take care of those around us - our neighbours and our fellow students and staff. We know that just because we may have been vaccinated, does not mean that we are immune to the disease. We know that we can still be a carrier of the disease. We need to keep that in mind as we work and study.

Safety, consequently, becomes our most important prerogative, as an Institute. Though it is often frustrating, difficult and stressful to keep up with health and safety regulations as measures and policies change, it is essential that we remember that our biggest priority must always be each other. As an institute, we are doing our best to ensure that we all stay safe and healthy, so that we may be able to continue working in a normal and effective manner. Hence, we urge everyone to stay as safe as they can, to respect the rules and regulations, and to adopt COVID-appropriate behaviour at all times. We urge all Institute members to do their best for the Institute, which, in turn, will do its best for the campus community.

The recent fire in the chemistry labs, though a deeply unfortunate accident, has shown us the importance of developing a cautious and thoughtful mindset when it comes to our work and daily lives. We all need to make sure that we carry out our own individual activities, research or otherwise, in a manner that does not affect the safety of others. Though we were lucky this time, largely in part to the students and staff who were on site at the time of the incident and had the courage and presence of mind to move the most dangerous and flammable substances away from the fire, we may very well not be so lucky the next time. The Institute has been prompted to come out with more stringent safety measures, and importantly, to put in place better systems to tackle any future such event as efficiently as possible. We urge everyone to follow, at all times, the institute's safety measures, and to imbibe a culture of safety, so we may all sleep safe, knowing that we have each other's backs.

There are many who have worked very hard to keep us safe. Our COVID-19 Task Force has done stupendous work in ensuring that our campus has remained relatively disease-free, thereby making it possible for research and other activities to keep going even at the peak of the pandemic this year. Our COVID-19 Testing Centre and COVID-19 Vaccination Centre have played critical roles in keeping us safe. Our Clinic has worked with great dedication to make sure that those infected received good hospital care even when hospital beds were very difficult to come by, when the pandemic was raging this year. There are many also who have helped us recover. In the past month, our engineering staff has done wonders to get most of the chemistry department functional. Our technical staff had to confirm that hundreds of small instruments are in working order. It is only because of the dedication of our engineering and technical staff, and that of our housekeeping staff, students and faculty, that research activities could restart within a month of the fire incident. We can all be justifiably proud that we have stood together as a community.

Finally, no appeal for a culture of safety on campus has much meaning, unless we give prominence to the need to ensure the safety of women. A year ago, *Kalpa* did us all a great service by publishing an article highlighting instances of misogynistic and sexist behaviour on campus. Such behaviour only leads to women feeling unsafe on the campus. It must stop.

We need to remember that our freedom as a campus community does not come without struggle, and without individuals coming together under a single goal. We all need to stay safe, be considerate, be compassionate, and be wise, and we will all come out the other side as better people.

Jayant B. Udgaonkar

Director, IISER Pune

August 24, 2021

Director's Report



I present here the Annual Report of the Institute for the duration April 2020 to March 2021. The year 2020-21 was marked by the COVID-19 pandemic. Advised by the COVID-19 Task Force, the IISER Pune leadership and administration addressed the practical aspects of dealing with the pandemic such as moving to online teaching and managing physical distancing and safety measures on campus. Through the efforts of volunteers from among faculty members, students, and staff from the institute, a COVID-19 testing centre was set up on campus. Some of our researchers initiated COVID-19 research, and others reached out to the community within and around the campus.

We had seven new faculty members join the institute in the past year. They were Raghav Rajan and Nishad Matange (Biology); Arjun Datta (Earth and Climate Science); Pooja Sancheti (Humanities and Social Sciences); and Moumanti Podder, Haripada Sau and Divyang Bhimani (Mathematics). We wish them the best, and we are sure they will do very well, for themselves and meet the expectations of the Institute.

We have 131 faculty members in our six departments. Our student strength is 1654 students, with 1071 BS-MS, 201 Integrated PhD, and 382 PhD students.

The total number of research publications since inception, from 2006 to 2020, is 3334, with 489 publications during 2020 calendar year. Nine patent applications were put in and ten published by our faculty members during the 2020 calendar year. An Indian patent application for hydrophobin mimics by Britto Sandanaraj and team was granted during 2020.

Our faculty members continued to garner extramural funds. In the past year, the Institute managed a total of 192 extramural projects, and our faculty members secured 55 new projects.

Two new initiatives were launched during 2020-21: the Centre for Water Research and the I-Hub Quantum Technology Foundation.

The Centre for Water Research (CWR) was constituted in November 2020. It draws upon expertise from faculty across different departments at the institute including Biology, Earth and Climate Science, and Humanities and Social Sciences. The CWR aims to generate interdisciplinary knowledge about water systems, including their history and heritage, resource management and sustainable use, and to train the next generation of scholars to look at water from an integrated/multi-dimensional lens.

The I-Hub Quantum Technology Foundation has been set up as a Section 8 company at IISER Pune, with support from the Department of Science and Technology. The I-Hub is set up with the aim to develop quantum computers and novel quantum materials for day-to-day applications. Led by members from the Physics department of the institute, this hub will have participation from up to 13 research groups from the institute and will network with over 20 participating institutes from within the country and also several collaborators from foreign universities and institutions.

The quality of research accomplishment at the Institute led to recognition in the form of prestigious awards to faculty members. Anjan Banerjee was elected as Fellow of the Indian Academy of Sciences, Bengaluru, elected as Fellow of the National Academy of Sciences, India, and awarded the Tata Innovation Fellowship 2020-21 by the Department of Biotechnology; Anup Biswas was selected as a Swarnajayanti Fellow by the Department of Science and Technology; Harinath Chakrapani was selected to receive the 2021 CRSI Bronze Medal by the Chemical Research Society of India (CRSI), and won the S. Ramachandran National Bioscience Award for Career Development for 2020-21 from the Department of Biotechnology; Partha Hazra was selected for the Japan Society of Promotion of Science (JSPS) Invitation Fellowship for 2020; M. Jayakannan was selected as a Pioneering Investigator 2021 by *Polymer Chemistry*, an RSC Journal; Siddhesh S. Kamat received the CSIR-CDRI Award for Excellence in Drug Research (Life Science Category) for 2021; Shabana Khan received the DST's 2021 Science and Engineering Research Board (SERB) POWER Fellowship, and received the Humboldt Experienced Researcher Fellowship (2020); Moumita Majumdar was named as ChemComm 2020 Emerging Investigator; Nishad Matange was awarded the Intermediate Fellowship of the DBT/Wellcome Trust India Alliance; Joy Merwin Monteiro was invited to become a Member of the Editorial Board of *Communications Earth and Environment*; Angshuman Nag was selected as a Swarnajayanti Fellow by the Department of Science and Technology; Rejish Nath was selected as a Swarnajayanti Fellow by the Department of Science and Technology; Thomas Pucadyil was elected as Fellow of the Indian Academy of Sciences, Bengaluru, and elected as a Fellow of the Indian National Science Academy; Sunish Kumar Radhakrishnan was awarded a Senior Fellowship of DBT/Wellcome Trust India Alliance; Sudipta Sarkar was elected as a Fellow of Geological Society of London, U.K.; Seema Sharma was elected as Fellow of the Indian Academy of Sciences, Bengaluru; Sreejith G.J. was awarded the Indian National Science Academy's Young Scientist Medal for 2020; and S.G. Srivatsan received the Sun Pharma Research Award in Pharmaceutical Sciences 2020, received the National Prize for Research on Chemistry of Peptides and Nucleic Acids 2020, and was selected for the Chemical Research Society of India (CRSI) Bronze Medal for 2020.

Eight PhD students and 5 Integrated PhD students were selected for the Prime Minister's Research Fellowship (PMRF) during the year. A team of 14 students won a gold medal at the 2020 International Genetically Engineered Machines (iGEM) contest where close to 250 teams participated in the competition internationally. This is the first gold medal from an iGEM competition awarded to a team from IISER Pune. The team also bagged the iGEMer's Prize,

i.e., they were officially voted the best undergraduate team project by all the other teams in the competition.

The Institute signed MoUs with University of Glasgow, U.K. (was renewed for the next 3 years); School of Engineering, Osaka University, Japan; and Johns Hopkins University, U.S.A. to support academic collaboration. A MoU was signed with King's College London to enable building on a partnership forged during the pandemic. A MoU with Max-Planck-Gesellschaft (MPG), Germany with all seven IISERs was renewed to support research collaboration and faculty exchange between the organisations.

IISER Pune signed 15 agreements / MoU's, of which 10 are new and 5 ongoing ones received an extension with extended terms, during 2020-21 with the following industries and academic organisations for collaborative research projects: Bombay Natural History Society; Accurate Gauging & Instruments Pvt. Ltd.; IARI-Pune; ACTREC Mumbai; Shiv Nadar University; C-CAMP Bengaluru; University of East Anglia (U.K.); Venbiotech Pvt. Ltd.; University of Edinburgh; and Rudra Nanotech Pvt. Ltd.

The agreements with Pilkington Technologies Management Limited, England; KPIT Technologies Limited; Dentsply Sirona Implants, Sweden; and Zumator Biologics Inc. received an extended term of partnership. Agreement with Cipla Foundation enabled support to IISER Pune COVID-19 Testing Centre.

Every year, a very large number of school students and teachers would visit the Smt. Indrani Balan Science Activity Centre (SAC) on campus. Owing to the COVID-19 pandemic, as physical visits have been halted during 2020-21, the SAC team moved their activities online. The team initiated a series of online live demo sessions of Science and Math activities for school students and teachers on the IISER Pune Science Activity Centre YouTube channel. The SAC has conducted a total of 54 successful online demo sessions through YouTube Live and via webinars, which connected more than 1 lakh people including students and teachers from different parts of the country.

During the year, the Science Media Centre (SMC) on campus conducted five science communication training workshops online, three of which were supported by National Council for Science & Technology Communication (NCSTC), one by IUCAA Pune, and one by Vigyan Prasara. Connecting with the citizens of Pune and beyond during the COVID-19 pandemic, the SMC broadcasted four episodes in English and three in Marathi in a series called, "10 Questions to 10 PuneKars".

Three of the films produced by the Science Media Centre went on to win awards. "The Trials and Triumphs of G N Ramachandran" received the Best of Festival Award in the 6th International Science Film Festival of India (ISFFI); "Sir Fred Hoyle; The Man Ahead of Time" received the Poonam Chaurasia Memorial Award in the 10th National Science Film Festival of India (NSFF); and "Superhydrophobic and germicidal nano-coating for PPE" won third prize in the *Science Through My Eyes Film Competition 2020* by INSA-SERB under the category of Working Professionals.

This year saw generous support from our partners and benefactors towards COVID-19 related activities, and towards research and student development. Support from ICICI Lombard General Insurance Ltd., Cipla Foundation, Integrated Decisions and Systems India Pvt. (IDeas), and CAF Target Funds enabled the procurement of equipment, consumables, and safety gear for use at the COVID-19 Testing Centre.

Persistent Foundation supported a study of sero-surveillance of COVID-19 in Pune city, a project which was implemented by IISER Pune faculty members in collaboration with Savitribai Phule Pune University (SPPU). Xytel India Ltd. supported the procurement of equipment required for research activities on infectious diseases.

Dr. Sara Ahmed provided a generous endowment for the newly established Centre for Water Research (CWR) at IISER Pune. Precision Wires Ltd and Coriolis Technologies Pvt. Ltd. have extended support to research activities on campus.

Infosys Foundation, Siemens Ltd., Xytel India Ltd., IDEaS, Trimurti Fabricators Private Limited and Twenty-Twenty Interior Design Software India (P) Ltd. supported tuition fee waivers, PhD fellowships, scholarships, research, and Best Thesis awards for students. Considering the constraints posed by the pandemic, Innoplexus Ltd. has topped up their grant amount towards travel awards for students and will make the awards available upon resumption of travel. Scivic Engineering Ltd. has offered support to some of the students for their extended PhD duration due to the lockdown during the year.

Eppendorf India Ltd. and Praj Industries continued their support for outreach activities, and the Science Activity Centre and the Community Service Group formed during the pandemic have both received support through crowdsourcing from within the institute community and members of the public.

Finally, it is my pleasure to acknowledge the counsel and support of the members of the Board of Governors. They provided sensible advice for the proper running of the Institute. Shri Sudhir Mehta took over as the new Chairperson of the Board of Governors, and the Institute has benefited much from his wisdom.



Jayant B. Udgaonkar
Director, IISER Pune

Governance

BOARD OF GOVERNORS

Chairperson (from 07/09/2020)

Shri. Sudhir Uttamlal Mehta

Chairperson, Torrent Private Limited

Acting Chairperson (up to 06/09/2020)

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Director, IISER Pune

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Director, Indian Institute of Science, Bengaluru

The Chief Secretary

Government of Maharashtra, Mantralaya, Mumbai

The Secretary

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Independent Management Consultant, Healthcare and Biotechnology, New Delhi

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Additional Secretary (TE), Ministry of Education, New Delhi

Ms. Darshana M. Dabral

Joint Secretary & Financial Advisor, Ministry of Education, New Delhi

Prof. Bhas Bapat

Professor and Dean (Academics), IISER Pune

Prof. Sanjeev Galande

Professor and Dean (Research and Development), IISER Pune

Secretary

Col. G. Raja Sekhar (Retd.)

Registrar, IISER Pune

FINANCE COMMITTEE

Chairperson (from 07/09/2020)

Shri. Sudhir Uttamlal Mehta

Chairperson, Torrent Private Limited

Acting Chairperson (up to 06/09/2020)

Dr. Shekhar C. Mande

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

Members

Prof. Jayant B. Udgaonkar (Ex-officio)	<i>Director, IISER Pune</i>
Ms. Darshana M. Dabral	<i>Joint Secretary & Financial Advisor, Ministry of Education, New Delhi</i>
Dr. C.P. Mohan Kumar	<i>Registrar, IISER Tirupati</i>
Dr. R. Premkumar	<i>Registrar, Indian Institute of Technology Bombay, Mumbai</i>
Prof. Sanjeev Galande (Special Invitee)	<i>Dean (Research and Development), IISER Pune</i>

Secretary (Ex-officio)

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

List is as of March 31, 2021; changes during the year not shown here

Chairperson

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

Prof. Sanjeev Galande	<i>Dean (Research and Development)</i>
Prof. Bhas Bapat	<i>Dean (Academics)</i>
Prof. Harinath Chakrapani	<i>Dean (International Relations and Outreach)</i>
Prof. Sunil Mukhi	<i>Dean (Faculty)</i>
Dr. Shivprasad Patil	<i>Dean (Student Activities)</i>
Dr. Srabanti Chaudhury	<i>Associate Dean (Doctoral Studies)</i>
Dr. Chandrasheel Bhagwat	<i>Associate Dean (Doctoral Studies)</i>
Dr. Anirban Hazra	<i>Associate Dean (Graduate Studies)</i>
Dr. Arijit Bhattacharyay	<i>Associate Dean (Graduate Studies)</i>
Dr. Sourabh Dube	<i>Associate Dean (International Relations and Outreach)</i>
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Prof. Tarun Sauradeep Ghosh	<i>Chair, Physics</i>
Prof. Mainak Poddar	<i>Chair, Mathematics</i>
Prof. Thomas Pucadyil	<i>Chair, Biology</i>
Dr. Pushkar Sohoni	<i>Chair, Humanities and Social Sciences</i>
Dr. Devapriya Chattopadhyay	<i>Chair, Earth and Climate Science</i>
Prof. M.S. Santhanam	<i>Professor</i>
Prof. Sudarshan Ananth	<i>Professor</i>
Prof. A. Raghuram	<i>Professor</i>
Prof. R. Boomi Shankar	<i>Professor</i>
Prof. V.G. Anand	<i>Professor</i>
Prof. Sujit Kumar Ghosh	<i>Professor</i>
Dr. Umeshreddy Kacherki	<i>Librarian</i>
Prof. Srinivas Hotha	<i>Professor</i>
Prof. Aloke Das	<i>Professor</i>
Prof. Pinaki Talukdar	<i>Professor</i>
Prof. Saikrishnan Kayarat	<i>Professor</i>
Prof. T.S. Mahesh	<i>Professor</i>
Prof. L.S. Shashidhara	<i>Professor</i>
Prof. Sutirth Dey	<i>Professor</i>
Prof. Anjan Banerjee	<i>Professor</i>
Prof. S.G. Srivatsan	<i>Professor</i>
Prof. M. Jayakannan	<i>Professor</i>

Prof. Ramakrishna G. Bhat	<i>Professor</i>
Prof. Rama Mishra	<i>Professor</i>
Prof. Prasad Subramanian	<i>Professor</i>

Members (External)

Prof. Guruswamy Kumaraswamy	<i>Professor, IIT Bombay, Mumbai</i>
Prof. Sonal Kulkarni-Joshi	<i>Professor, Linguistics, Deccan College, Pune</i>
Prof. Dilip Dhavale	<i>Professor, Chemistry, Savitribai Phule Pune University, Pune</i>

Secretary

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

Chair

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

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

Secretary

Col. G. Raja Sekhar (Retd.)	<i>Registrar, IISER Pune</i>
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IISER Pune's Efforts Against COVID-19

In March 2020, when the COVID-19 pandemic broke out, IISER Pune began to implement steps to prevent the spread of the infection. Various committees and individuals such as from the Institutional Committee on Administration, Medical Committee, and Deans for Academics, Student Activities, Faculty, and Research & Development worked to prepare guidelines on different activities of the institute. Among the early measures was to suspend all classes and allow students residing in hostels to return to their homes before travel restrictions came into place. This was shortly followed by a lockdown across India owing to increasing cases of COVID-19 infection, the epidemiology and pathology of which were not yet well understood by the medical community and public health officials at that time.

During the months that followed, faculty members and the academics office managed an urgent transition to online teaching with support from our IT team members, while also coming up with ways to reach out to students with limited or no internet access. Led by the COVID-19 Task Force, the IISER Pune leadership and administration addressed the practical aspects such as repopulating the campus in phases and formulating standard operating procedures for campus activities. The campus clinic and medical personnel, staff from the administration, housekeeping, security, and various other institute staff and faculty members contributed to this effort to ensure physical distancing and safety measures on campus.

Now, a year and more later, armed with new knowledge about COVID-19 infection and with vaccines against the virus, the pandemic seems to have eased but with the possibility of its appearance in waves. The campus is functioning with caution and with physical distancing and masking measures in place.

In May 2020, a COVID-19 testing centre was set up on campus. This was run by volunteers from among faculty members, students, and staff from the institute. Some of our researchers initiated COVID-19 research and a few others reached out to the community within and around the campus. Some of these activities carried out during 2020-21 are described below.



COVID-19 Testing Centre

Expanding the testing capacity was a critical element in the management of the COVID-19 pandemic, especially right after the pandemic began during March 2020. As a research institution, IISER Pune had the infrastructure and technical know-how required for conducting tests. The institute's Action Committee on COVID-19 initiated setting up of a COVID-19 testing centre on the campus.

With the help of volunteers from within the IISER Pune community including students, staff and faculty members, the Centre commenced testing activities on May 21, 2020. Throat and nasal swab samples arriving from government hospitals were tested for the presence of the virus causing COVID-19 using an ICMR approved kit. The Centre ran its activities till June 19, 2021, when the requirement subsided. During this time, the volunteers at the Centre had tested over ~53,000 swab samples.



Research at IISER Pune on COVID-19 and SARS-CoV-2

The COVID-19 situation prompted our researchers apply their expertise to learn about the virus and address the challenges posed in the management of the disease. These research activities were on the following topics:

- Ventilator
- Diagnostics
- Vaccines and Drug Candidates
- Understanding the spread of the pandemic
- Molecular studies of SARS-CoV-2

Here is a list of research projects initiated by IISER Pune members to understand and manage the COVID-19 pandemic.

- Design and fabrication of low-cost ventilators (Dr. Umakant Rapol, Dr. Sunil Nair and team)
- Making superhydrophobic and germicidal nano-coating for personal protection equipment (PPE) (Dr. Atikur Rahman)
- Generating oxygen through chemical means (Prof. Srinivas Hotha, Dr. Umakant Rapol, Dr. Sunil Nair in association with IIT Delhi)
- Assessing if early detection of olfactory dysfunctions (loss of the sense of smell) can be used as a screening method for COVID-19 patients (Dr. Nixon Abraham and team, with collaborators from BJ Government Medical College and Sassoon General Hospitals, Pune).

At the beginning of this work in April 2020, the team had circulated a questionnaire with a test for sense of smell that anyone can do using simple substances from around them. Following this, the team went on to develop a non-invasive method to study loss of smell in COVID-19 patients. Their observations are reported in a paper in the journal *e-Clinical Medicine* (28:100575).

- Making an ultra-sensitive nano-biosensor platform for field effect transistor-based point-of-care detection (Dr. Atikur Rahman)
- Developing a carbon nanotube (CNT)-based surveillance diagnostic tool for detecting the SARS-CoV-2 virus (Dr. Ashna Bajpai, Dr. Sunil Nair, with collaborators from Stellargene)
- Synthesis of oligonucleotide probes for COVID-19 detection (Prof. S.G. Srivatsan and team; Center for Excellence in Indigenisation of Diagnostics (InDx) project funded by C-CAMP, Bengaluru)
- Developing a rapid and low-cost diagnostic test for COVID-19 using synthetic biology: This work was initiated under the Shastri COVID-19 Pandemic Response Grant (SCPRG) by Dr. Chaitanya Athale's group in collaboration with Dr. Keith Pardee from University of Toronto, Canada. The team's results demonstrated their ability to encode RNA viral sequences in laboratory settings. The team is working on testing for specificity and sensitivity. Additionally, the team received preliminary results for in-house substitution of cell free extracts (CFE) that form the basis of this kind of paper-based diagnostics.
- Identifying potential lead candidates against SARS-CoV-2 (Dr. Britto Sandanaraj and team)
- New and repurpose existing drugs to inhibit spike protein/ACE2 interaction (Dr. Arnab Mukherjee and team, with collaborators from IGIB, New Delhi): Some of this work has been published in May 2021: *Chemistry-An Asian Journal* (16:1634-1642).
- Targeting SARS-CoV-2 Nsp13 helicase for structure-based inhibitor design (Dr. Saikrishnan Kayarat, Dr. M.S. Madhusudhan and team with collaborators from NCL, Pune and IISER Thiruvananthapuram)
- Exploring the use of amphiphilic heparan sulfate mimetics as antivirals for COVID-19 (Dr. Raghavendra Kikkeri, with collaborators from the University of Queensland): Here is a publication on this work from May 2021: *iScience* 24 (5):102479.
- Assessing the spread of COVID-19 in Pune city through epidemiological and serological survey along with the evaluation of immune responses to SARS-CoV-2 infection (Dr. Aurnab Ghose and team, with SP Pune Univ., THSTI, Faridabad, CMC, Vellore and Pune Municipal Corporation, with support from Persistent Foundation).
- An infectious diseases hazard map for India with predictive capabilities: This map has been produced based on transportation networks and mobility patterns with predictive capabilities. The map gives hazard values for about 450 cities and towns in India with a population of more than 1 lakh. An online resource for this hazard map has been made available in June 2021 (Prof. M.S. Santhanam, Dr. G.J. Sreejith, Dr. Sachin Jain and team)
- Generating knockout mice for ACE2 receptor as a model for studying COVID-19 pathogenesis: The team generated ACE knockout models and established the line for ACE2 knockout. Currently, animals are in active breeding and available for the use of researchers across the country. (Prof. Sanjeev Galande and team)

- Assessing the emergence of SARS-CoV-2 variants and their contribution to viral transmission, virulence, clinical outcomes, re-infections and breakthrough infections (Dr. Krishanpal Karmodiya, Prof. Sanjeev Galande, Dr. Aurnab Ghose, Prof. L.S. Shashidhara, (Ashoka University and IISER Pune), and Dr. Joy Monteiro from IISER Pune along with National Chemical Laboratory Pune and with support from Persistent Foundation, Pune Knowledge Cluster and Pune Municipal Corporation).

COVID-19 Data Curation and Analysis for Pune City

COVID-19 testing, patient and contact tracing data collected by the Pune Municipal Corporation was curated and analysed by IISER Pune researchers to provide decision support to the local administration in the matters of geographical spread and differences in the public health response of different wards in PMC. This information was also used in forecasting sub-city level requirements of critical care infrastructure and deaths. (Dr. Joy Merwin Monteiro and team from IISER Pune, Prof. L.S. Shashidhara (Ashoka University and IISER Pune), Dr. Sarika Bhattacharya and Dr. Anu Raghunathan (CSIR-NCL, Pune), Pune Knowledge Cluster, Dr. Bhalchandra Pujari (SP Pune University, Pune) and Dr. Vidya Mave and team (Johns Hopkins branch in Pune)

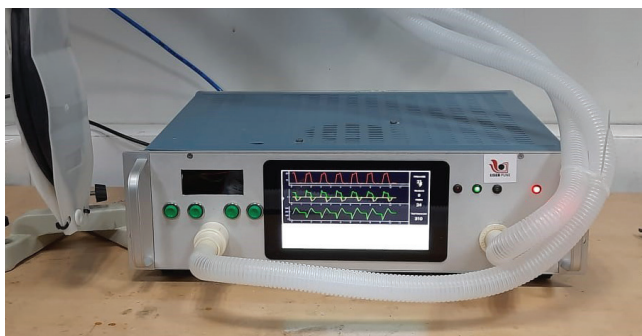
Public Engagement and Community Service Efforts by IISER Pune Members

Several institute members contributed in their individual capacity to help debunk myths surrounding the disease and aid the public understanding of the science behind the functioning of the virus and on ways to target the virus, while also urging the public to follow government advisories on physical distancing and lockdown measures.

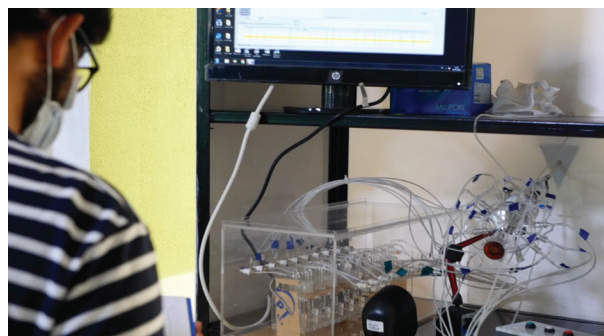
Members from the MANAV team on campus were involved in creating a tool that can curate COVID-19 related published information from Twitter and rate content and make it easily accessible to a general readership.

A Community Service Group (CSG) comprising IISER community members and staff ensured dissemination of accurate information about the pandemic and safety measures, in localities around the Institute and among families associated with the Institute. The CSG crowd-sourced the acquisition of masks, soaps, sanitizers, and hygiene kits for IISER Pune staff workers, and these were distributed to staff and their families and visitors to the campus. Given the urgency of the situation, the CSG focused on construction workers and their families, about eighty of them, that were stranded on campus. A fundraising appeal was sent to the IISER community including faculty, staff and students. These funds were used to provide two rounds of dry ration, some fresh produce, clothes, toys, and books during the first lockdown. Some of the other contributions made by the CSG included primary health care and medical advice.

During the lockdown, Smt. Indrani Balan Science Activity Centre at IISER Pune began a weekend live science and math demo series to engage with students and educators through the online medium.



Laboratory prototype of ICU ventilator



Equipment used for testing for the sense of smell in asymptomatic COVID-19 patients



Research Activities and Achievements



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RESEARCH REPORT

Publications in 2020
TOTAL: 489



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BIOLOGY



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CHEMISTRY



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EARTH AND
CLIMATE SCIENCE



02

HUMANITIES AND
SOCIAL SCIENCES



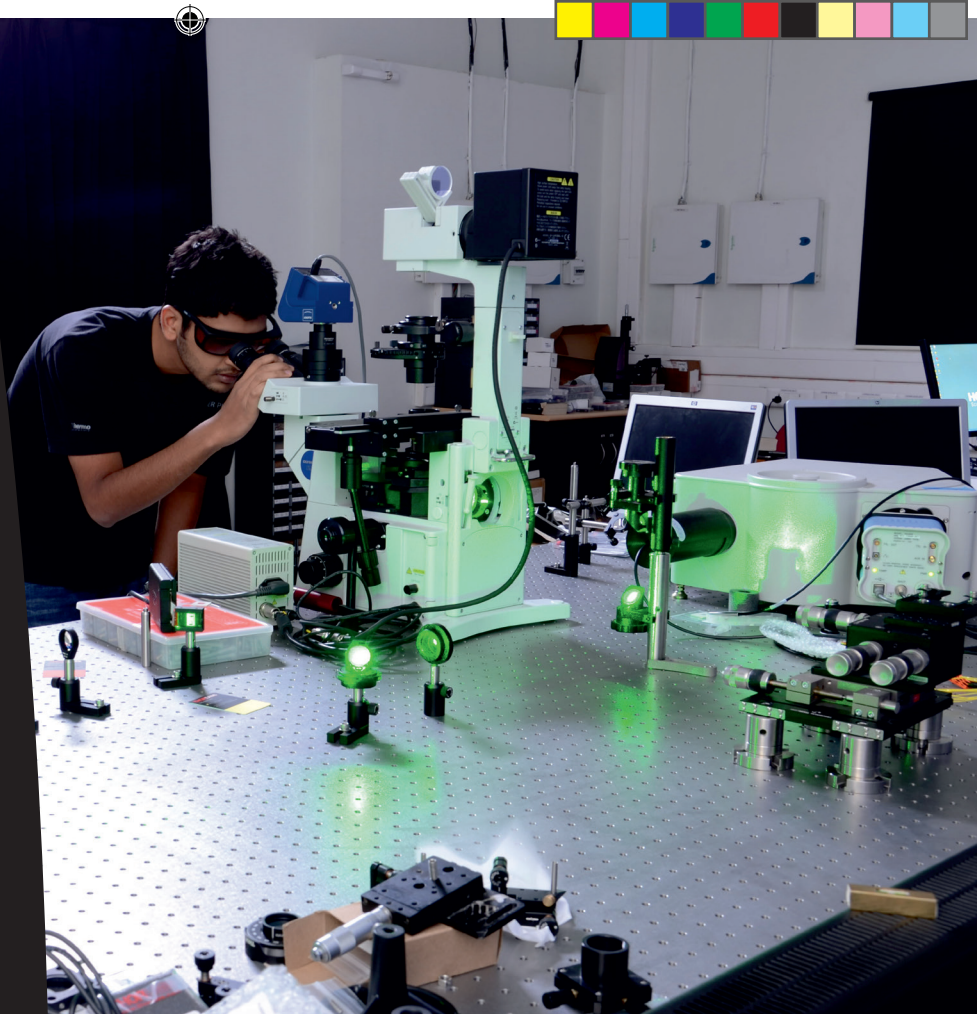
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MATHEMATICS



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PHYSICS



Research at IISER Pune aims to reach a fundamental understanding of how the physical world works. Responding to the challenges posed by the COVID-19 pandemic since March 2020, some of our faculty members are applying their expertise to understand SARS-CoV-2 virus and to manage the pandemic.

The year 2020-21 saw two new research initiatives from the institute: the Centre for Water Research (CWR) and the I-Hub Quantum Technology Foundation (I-Hub). The CWR aims to generate interdisciplinary knowledge about water systems, including their history and heritage, resource management and sustainable use. I-Hub has been set up as a Section 8 company at IISER Pune, with support from the Department of Science and Technology. The I-Hub aims to develop quantum computers and novel quantum materials for day-to-day applications.

IISER Pune has performed consistently in terms of obtaining research publications from work carried out at the Institute, in the number of patent applications filed during the year, and in the extramural funding garnered. 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

Biological mechanisms of lipid signaling pathways

The advent of genome sequencing technology has resulted in an explosion of available protein sequences. Concomitant with the rising number of sequences, the propagation of annotation errors or lack of annotation, have become more prominent throughout databases that rely heavily on high-throughput computational predictions of protein function without much experimental support. Understanding the genetic basis for rare hereditary human disorders has also greatly benefited from tremendous advances in DNA sequencing technologies. Human genome mapping projects and sequencing have, to date, facilitated determination of the genetic basis for over 4,000 inherited diseases, with additional pathogenic mutations still being discovered. However, it is also becoming apparent that as a greater number of disease-causing mutations are being mapped, many of the affected genes encode unannotated proteins. Thus, assigning biochemical and cellular functions to such proteins is critical to achieve a deeper mechanistic understanding of these pathological disorders and for identifying potential therapeutic interventions for them. While there are several established high throughput platforms to study DNA (genomics), RNA (transcriptomics) and proteins (proteomics), there is a large disconnect thereafter in terms of biochemical technologies available that relate protein activities (in particular, enzyme activities) to their endogenous substrates and products (see Figure).

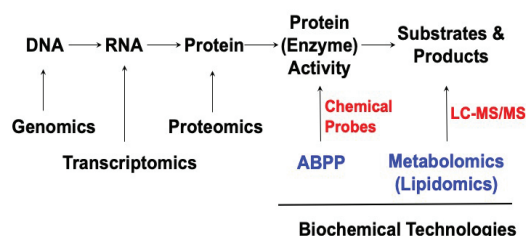
The long term goal of Dr. Siddhesh Kamat's group is to build on emerging biochemical platforms to enable us to identify and understand as-of-yet uncharacterized lipid signalling pathways in vivo, annotate their metabolic enzymes and cognate receptors that regulate their biology and provide new physiological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

Figure 1:

Overview of candidate global profiling methods.

Standard genomics, transcriptomics and proteomics measure DNA, RNA and Protein abundance, respectively. In contrast, the emerging biochemical technologies, ABPP and metabolomics measure key functional aspects of enzymes, i.e. their activity and endogenous substrate/products, respectively.

(Dr. Siddhesh Kamat's Group)



Mechanisms of nucleotide-dependent restriction enzymes

Dr. Saikrishnan Kayarat's laboratory is working on understanding the mechanism of NTP-dependent restriction-modification enzymes. The group determined the crystal structure and the mechanism of SauUSI, an ATP-dependent restriction enzyme, which is a potent barrier to horizontal gene transfer and antibiotic resistance acquisition in *Staphylococcus aureus*. The study unraveled a hitherto unknown mode of DNA cleavage that results in multiple breaks of the double-stranded DNA between two target sites of the enzyme. The group also demonstrated the significance of ATP-dependent DNA translocation by Type ISP restriction-modification enzymes in activation of the nuclease.

The group has also initiated biochemical and structural studies of the proteins involved in the replication and transcription of the SARS-CoV2 genome. The aim of the study is to understand the mechanism of action of these enzymes, and also to discover therapeutics against them.

Cell motility and bacterial cytoskeleton

Dr. Gayathri Pananghat's research is on understanding 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 a novel polarity determining protein in *Myxococcus xanthus*, RomX. Studies are underway to characterize its interaction with other partners in the polarity-determining pathway such as RomR, MglA and MglB.
- Structures of FtsZ from the cell wall less organism *Spiroplasma* have helped us observe an intermediate conformation which provides the structural basis of kinetic polarity of FtsZ filaments and why it is opposite to that of microtubules, along with supporting biochemical and mutational data.
- Structure determination and membrane-binding characterization of the cytoskeletal proteins of *Spiroplasma* and their visualization using cryotomography is in progress.

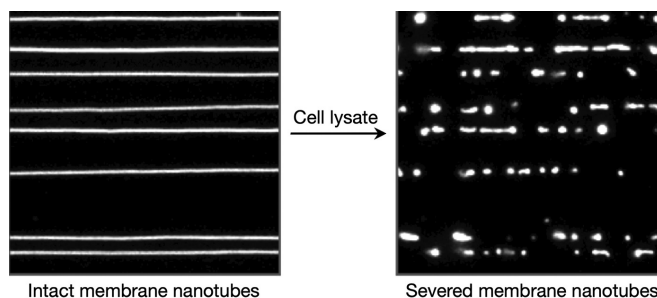
Understanding protein machines that catalyse membrane fission

Membrane fission of organelles requires the enclosing lipid bilayer to be brought to close proximity, which from theory represents a distance of separation of ~ 5 nanometers. Since organelles are of much larger dimensions, fission necessitates topological transformation of organelles into a highly curved tube-like intermediate. Using arrayed membrane nanotubes that mimic such curved intermediates, Dr. Thomas Pucadyil's group screens tissue lysates for fission activity and identify the sets of proteins that contribute to such activity (see Figure). The group then purifies and reconstitutes the functions of such proteins to better understand how they work. The hits that emerge from the screen are tested for cellular function by making knock-out models and analysing morphological changes to various membrane compartments.

Figure 2:

The image shows severing of an array of membrane nanotubes in presence of cell lysate.

(Dr. Thomas Pucadyil's Group)



1.2 CELL AND DEVELOPMENTAL BIOLOGY

DNA damage and maintenance of genome integrity

Dr. Mayurika Lahiri's group has been investigating the process by which genome instability or lipid mediators in the micro-environment can lead to cellular transformation of breast epithelial cells using three-dimensional breast acini as a model system. Recent studies have shown chronic PAF (a lipid mediator) induction to lead to breast epithelial cell transformation. Other projects involve studies on deregulation of Api5, (anti-apoptotic protein) or TopBP1, (key checkpoint regulator) lead to cellular transformation in the breast acini. The group is working on finding out the molecular mechanism of such transformation. In order to understand whether any of these proteins can be used as bio-markers for the Indian population, Dr. Lahiri's laboratory collaborates with Prashanti Cancer Care Mission (PCCM), Pune to use patient blocks to study the expression level of the proteins in the Indian population. The other research projects include investigating the post-translational modifications of Api5, and changes in microtubule dynamics following DNA damage.

Molecular principles underlying animal development and disease

Dr. Girish Ratnaparkhi's laboratory uses the fruit fly to understand the workings of the nervous system, the host-defense system as well as their cross-talk. In the immune system the post-translational protein modifier, SUMO, regulates the immune response (Hegde *et al.*, 2020), this being the focus of interest. Using SUMO conjugation resistant variants of immune proteins, generated by CRISPR Cas9 genome editing, the group found that SUMO conjugation/de-conjugation works to fine tune the kinetics of immune signaling. In the nervous system, their goal is to understand cellular/organismal mechanisms that lead to the initiation and progression of Amyotrophic Lateral Sclerosis (ALS), a human neurodegenerative disorder. An underlying common mechanism for ALS has yet to be elucidated, and the group's approach is to understand the relationships between different ALS-familial loci, which they believe will lead us to a comprehensive understanding of mechanisms of disease. To that end, the group has discovered the ALS1 and ALS8 are connected via the ROS signaling, while ALS8 and ALS14 are interacting via an adapter, Caspar, a negative regulator of inflammation.

Regulatory processes that govern growth and development in bacteria

Dr. Sunish Kumar Radhakrishnan's group is interested in understanding the fundamental regulatory processes that govern growth and development in bacteria. Most bacteria utilise the propeller-type nanomachine, flagellum as the primary organelle for locomotion in liquids and semi-solid surfaces. The flagellar-assisted motility helps the newly-formed bacterial progeny to swim out in search of new nutrient-rich niches such as host cells. In addition to motility, at the time of invasion of host cells by pathogenic bacteria, flagella also play a crucial role in adhesion of bacterial cells to host cell surfaces. During development, to ensure the inheritance of flagella by the newly formed offspring, bacterial cells couple the flagellar assembly process to the cell division process. However, the precise mechanism, and the molecules, that couple flagellation to cell division has remained unknown. Through a combination of genetic, biochemical and imaging-based approaches, the group has identified the underlying mechanism that couples flagellar development to cell division in bacteria. As this regulatory process impinges on two important events during bacterial development, the molecules operating in this process can be exploited as drug targets while designing drugs to combat pathogenic bacteria (Ref: Siwach *et al.* (2021) *Developmental Cell* 56:657-670).

1.3 CHROMOSOME BIOLOGY AND EPIGENETIC REGULATION

Epigenetics and transcriptional regulation in *Plasmodium falciparum*

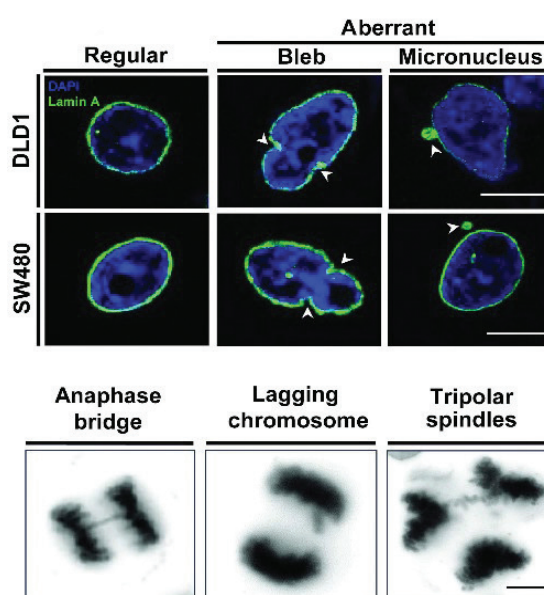
Plasmodium falciparum infects millions and kills thousands of people annually the world over. With the emergence of artemisinin and/or multidrug resistant strains of the pathogen it has become even more challenging to control and eliminate the disease. Multiomics studies of the parasite have started to provide a glimpse into the confounding genetics and mechanisms of artemisinin resistance. In order to explore the prevalence, geographical distribution and co-existing patterns of genetic markers associated with/enabling artemisinin resistance, the group used genomic SNP datasets from 2517 isolates from 15 countries from the MalariaGEN Network. Dr. Krishanpal Karmodiya's group has identified a number of mutations which are co-selected in artemisinin-resistant parasites. They have also explored the multiple, publicly available transcriptomics datasets to identify genes from key biological pathways whose consistent deregulation may be contributing to the biology of resistant parasites. This study highlights the genetic and gene expression features of resistant parasites to propel further exploratory studies in the community to tackle artemisinin resistance.

Chromosome biology

Research in the Dr. Kundan Sengupta's group is focussed on studying the molecular mechanisms of nuclear organization and function on nuclear lamins in cancer cells and in cellular models of differentiation. The group overexpressed the transcription factor (Twist1) in colorectal cancer cells, which showed striking phenotypic and molecular signatures characteristic of Epithelial to Mesenchymal Transitions (EMT). Remarkably, these studies revealed an increase in chromosomal losses and gains, nuclear aberrations such as nuclear blebs, micronuclei. They also detected a significant decrease in the levels of all three lamin sub-types, underscoring their contribution in the maintenance of the mechanical and functional integrity of the nucleus. Furthermore, EMT induction was accompanied by aberrant chromosome segregation involving multipolar spindles, lagging chromosomes and anaphase bridges. Remarkably, Twist1 overexpression showed a significant increase in DNA damage, further underscoring a novel role of Twist1 in inducing genome instability, which enhances heterogeneity in the epithelial/mesenchymal (E/M) hybrid sub-population – a major contributor of cancer progression.

Figure 3:

Twist1 overexpression enhances nuclear and mitotic aberrations in colorectal cancer cells: (Top panel) Representative images of nuclei acquired using a confocal microscope showing nuclear aberrations upon Twist1 overexpression in colorectal cancer cells. Nuclei are stained with Lamin A that lines the border of the nucleus, revealing nuclear blebs and micronuclei, scale bar ~10 μ m; (Bottom panel) Representative images of mitotic aberrations showing anaphase bridges, lagging chromosomes, and tripolar spindles, scale bar ~10 μ m (Dr. Kundan Sengupta's Group)



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. Following up on previous work that showed that dry tropical forest trees are precariously close to their upper limits, they have quantified thermotolerance in trees from more mesic climates with greater water availability and are examining the relationship between tolerance to temperature and drought. Finally, in addition to approaches examining the underlying mechanisms for temperature and drought, the group is scaling up to community level responses to determine how future climates will affect ecosystem dynamics and function.

Population dynamics

Dr. Sutirth Dey's group investigated the effects of sex-biased dispersal (SBD) using *Drosophila melanogaster* populations with varying dispersal propensities. In the presence of high-dispersive mates, the dispersal of both male and female individuals was significantly increased. However, the magnitude of this increase was much larger in males than in females, indicating that the former shows greater mate-finding dispersal (Mishra et al, *Journal of Animal Ecology*, 2020).

The group also conducted experimental evolution with *Escherichia coli* populations of two different sizes in two nutritionally limited environments, and studied fitness trade-offs. They found that although larger populations adapted more to their selection conditions, the *E. coli* also became more maladapted to other environments, ultimately paying heavier costs of adaptation (Chavhan et al, *Evolution* 2020).

The group evolved *Escherichia coli* populations under two different conditions of UV exposures followed by whole-genome whole-population sequencing. Their results suggest that selection pressures at different physiological stages can lead to differences in the genomic signatures of adaptation, which need not necessarily translate into observable phenotypic differences (Selveshwari et al, *Journal of Evolutionary Biology*, 2021).

Evolution of appendage forms, functional genomics

By comparative genomic analyses and experimental validation, Prof. L.S. Shashidhara's group has shown that a single base-pair difference in the regulatory sequences of target genes of a transcription factor could lead to major phenotypic diversity. They have discovered that the Hox protein Ubx, which is involved in wing development in the model organism *Drosophila* (fruitfly), binds preferentially to a TAAAT core sequence in *Drosophila* genome as against a TAAT core sequence in *Apis* genome. Ubx shows higher affinity to bind to TAAAT motif than TAAT motifs resulting in differential expression of corresponding target genes in *Drosophila*. This suggests an intriguing evolutionary mechanism to explain a Hox protein such as Ubx can bring huge diversity in wing number and morphology during insect evolution with minimal molecular changes.

1.5 NEUROBIOLOGY AND COMPUTATIONAL BIOLOGY

Olfactory information processing and decision-making

Dr. Nixon Abraham's group studies the neural basis of olfaction in health and disease. Along with investigating the neural circuit mechanisms using rodent models, they also study olfactory perception and decision-making in normal healthy human subjects and patients with olfactory deficits using the olfactory-action meter the group developed in the lab. The group combines state-of-the-art methods in molecular biology, automated behavioral training, and *in vivo* imaging with optogenetic neural control to study information encoding in mouse models.

In one of the projects, they investigated the olfactory deficits of COVID-19 patients. The ongoing pandemic threatens the global community, because a large fraction of infected people are asymptomatic, yet effectively transmit SARS-CoV-2. Finding and isolating these silent carriers is a crucial step in confining the spread of the disease. Loss of sense of smell (anosmia) has been self-reported by COVID-19 patients from different countries, consistent with expression of the molecular factors mediating SARS-CoV-2 uptake into human olfactory epithelial supporting cells. To quantitatively assess the olfactory functions of asymptomatic COVID-19 patients, the



group designed an olfactory-action meter that determines a detectability index at different odor concentrations and an olfactory matching accuracy score. The test can be performed in less than 20 minutes and identifies 82% of asymptomatic SARS-CoV-2 carriers, despite the fact that subjectively, only a few of the patients noticed a compromised ability to smell (Bhattacharjee et al., 2020).

Neural mechanisms underlying movement initiation in songbirds

A central role of the brain is to respond to stimuli with the appropriate movement. The same movement can be produced in response to an external stimulus or can be triggered by internal stimuli. For e.g., you can reach out for a bar of chocolate because someone gave it to you or because you are hungry. Dr. Raghav Rajan's laboratory uses the zebra finch, a songbird, as the model system to understand how the brain initiates movements. The song sequence of the adult male zebra finch consists of a stereotyped sequence of sounds interleaved by silent gaps and is about 0.5 to 1 second in duration. This song sequence begins with a variable number of short syllables called introductory notes. In the last year, they have shown that these introductory notes (just like song) are also learned from a tutor. The group has also been examining neural activity in motor areas of the zebra finch brain, during the production of introductory notes, to understand how birds switch from repeating introductory notes to initiating the song.

2. CHEMISTRY

2.1 ORGANIC AND CHEMICAL BIOLOGY

Peroxide synthesis using metal catalyst

Continuous-Flow chemistry is a fascinating and emerging technology in continuous production for both short and multistep synthesis due to its several advantages over a batch process. In this direction, Dr. Gnanaprakasam's research group is focusing on new synthetic methods integrated with continuous-flow for the chemistry of peroxidation, rearrangement reactions and strained-ring synthesis toward the biologically important molecules. Recently, highly efficient, selective and direct C-H peroxidation of 9-substituted fluorenes has been achieved by his research group using TBHP in the presence of Mn-catalyst under batch/continuous-flow mode. Toward sustainable drug synthesis, Dr. Gnanaprakasam's research group developed a highly efficient and environmentally benign metal-free alkylation of 1,3-dicarbonyl compounds using secondary alcohols. Moreover, this application was extended for the continuous Fischer-Indole synthesis and Mannich reaction for the synthesis of the Ondansetron drug in gram-scale application. Furthermore, Dr. Gnanaprakasam's research group developed an efficient and new approach for the synthesis of spirooxindole 2*H*-azirines via intramolecular oxidative cyclization of 3-(amino(phenyl)methylene)-indolin-2-one derivatives under batch/continuous flow (Scheme 3, Figure).



Scheme 3.

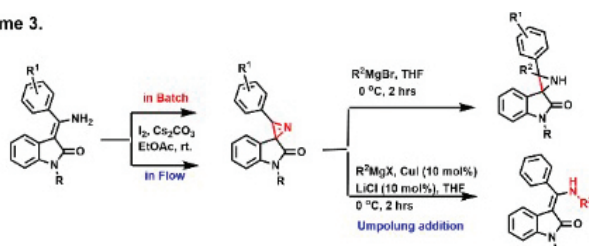


Figure 4:

Continuous-Flow Technology for synthesis of spirooxindole 2H-azirines (Dr. Gnanaprakasam's Group)

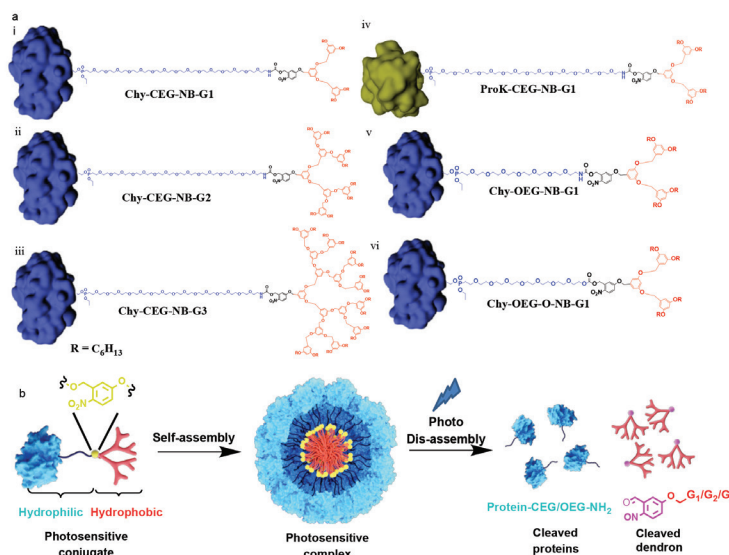
Extracellular matrix (ECM) glycopeptides for cell surface markers

The heparan sulfate (HS) is a major component of cell physiology and pathological process. However, the massive and complex structure of HS hampers the study of structure-function relation in cellular functions. Thus, a long-term goal of HS scientists is to obtain structurally well-defined HS mimics for profound understanding of the cellular regulation, signaling, and functions. Dr. Raghavendra Kikkeri's group reported the rational design and synthesis of N-unsubstituted (NU) and N-acetylated (NA) heparin sulfate tetrasaccharides and its mimics that selectively inhibit heparin sulfate binding chemokines and growth factors. HS analogs were produced by divergent synthesis, where fully protected HS tetrasaccharide precursor was subjected to selective deprotection and regioselectively O-sulfated, and O-phosphorylated to obtain 13 novel HS tetrasaccharides. The exhaustive microarray and SPR analysis revealed that homeostatic and inflammatory chemokines displayed several cryptic binding pockets for HS mimics. Notably, I-21 (IdoA disaccharides with monosulfation) and HT-2,6S-NAc (GlcNHAc(6-O-SO₃[−])-IdoA(2-O-SO₃[−])) turned out to be a potential ligand to target VEGF growth factor and anti-angiogenesis activity. Similarly, 1-45 (highly sulfated-IdoA tetrasaccharide), rare HT-3,6S-NH and HT-2,6S-NH showed selective binding to CCL2 and CCL5 chemokines and modulated cancer metastasis and invasion. These results indicated that HS mimics offer a simple solution to generate selective and efficient activated HSBPs and pave the way to a wide range of new therapeutic application in cancer biology, viral infection, immunology etc.

Macromolecular engineering

The rational design of a multi-responsive protein-based supramolecular system that can predictably respond to more than one stimulus remains an essential but highly challenging goal in biomolecular engineering. In this work, Dr. Britto Sandanaraj's group reported a novel chemical method for the construction of multi-responsive supramolecular nanoassemblies using custom-designed facially amphiphilic monodisperse protein-dendron bioconjugates. The macromolecular synthons contain a globular hydrophilic protein domain site-specifically conjugated to photo-responsive hydrophobic benzyl-ether dendron of different generations using oligoethylene glycol linkers of defined length. The size of the protein nanoassemblies can be systematically tuned by choosing an appropriate dendron or linker of defined length. Exposure of protein nanoassemblies to light results in partial disassembly of complex rather than complete disassembly. The newly formed protein nanoparticle no longer responds to light but could be disassembled into constitutive monomers at the acidic condition or further treatment with a small molecule. More interestingly, the distribution ratio of assembled versus disassembled states of protein nanoassemblies after photochemical reaction does not depend on the dendron generation or nature of linker functionality or the identity of the protein, but heavily influenced by choice of linker length. Altogether, this work discloses a new chemical method for the rational design of a monodisperse multi-responsive protein-based supramolecular system with exquisite control over the disassembly process.

Figure 5:
Rational design of a
monodisperse multi-
responsive protein-based
supramolecular system
(Dr. Britto Sandanaraj's
Group)



Nucleic acid chemistry and biophysics

Prof. Seergazhi G. Srivatsan group is developing biophysical platforms and nucleic acid labeling 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, he has developed multifunctional nucleoside probes for investigating the structure and drug-binding properties of oncogenic G-quadruplex forming sequences 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 based chemotherapeutic strategies. Dr. Srivatsan is also heading a Center of Excellence at IISER Pune, which is part of the InDx program initiated by C-CAMP Bengaluru on indigenization of COVID-19 testing kits.

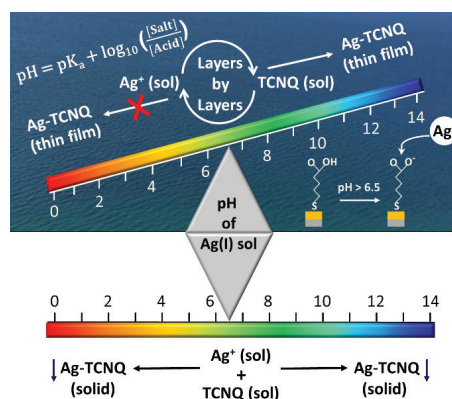
2.2 INORGANIC AND MATERIALS SCIENCE

Interfacial materials chemistry

The primary research of Dr. 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. Metal-Organic Thin-Films with tunable electronic and magnetic properties are promising for variety of technological applications. However, experimental challenges are many: i) simple growth, ii) controllable thickness, iii) structural integrity, iv) film homogeneity, v) desirable electrical conductivity, vi) stability of the thin-films at ambient conditions, specifically against moisture and heat, vii) tuning electrical conductivity of thin-films by physical and chemical stimuli, viii) patterning feasibility by employing standard lithographic techniques, etc. Dr. Ballav's research has shown the paths to overcome those challenges by simple yet elegant design principles of interfacial materials chemistry.

Figure 6:

Thin films in interfacial materials chemistry
(Dr. Nirmalya Ballav's Group)

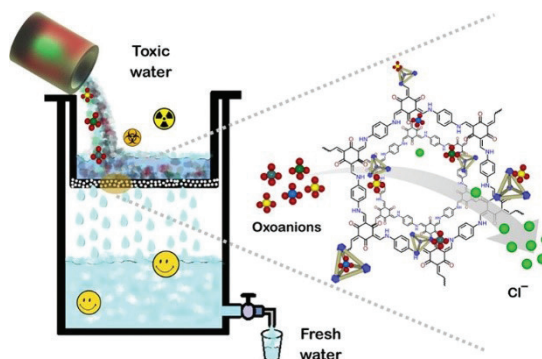


Hydrolytic and chemical stability of MOFs

Water pollution has attracted worldwide significant attention ever since the finding of its harmful effects on the whole ecosystem, including human health. Although several materials are known for selective removal of specific contaminants, designing a single material that can adsorb a variety of water contaminants is still a very challenging task due to a lack of proper design strategies. Prof. Sujit K. Ghosh's group has rationally designed a new class of anion exchangeable hybrid material where the nanosized cationic metal–organic polyhedra (MOP) are embedded inside a porous covalent organic framework (COF) with specific binding sites for toxic oxoanions. The resulting hybrid material exhibits very fast and selective sequestration of high as well as trace amount of a wide range of toxic oxoanions (HAsO_4^{2-} , SeO_4^{2-} , CrO_4^{2-} , ReO_4^- , and MnO_4^-) from the mixture of excessive (~1000-fold) other interfering anions to well below the permissible drinking water limit (Figure). Moreover, the hybrid cationic nanotrap material can reduce the As(V) level from a highly contaminated groundwater sample to below the WHO permitted level (Ref. *ACS Cent. Sci.* 2020, 6, 1534–1541).

Figure 7:

Toxic oxo-anion capture by a hybrid material
(Prof. Sujit K. Ghosh's Group)



Silylene as a ligand in homogeneous catalysis

The advent of N-heterocyclic silylenes (NHSis) and their ability to activate small molecules led to envisage that they could be the alternative ligands to NHCs. However, the area of transition metal silylene complexes had been held back for many years especially because of the very low yield of silylenes. Since the high yield isolation of Si(II) compounds by dehydrohalogenation protocol, there is a significant paradigm shift in the chemistry of transition metal silylene complexes. Dr. Shabana Khan's group is exploring silylene $[\text{PhC}(\text{NtBu})_2\text{SiN}(\text{SiMe}_3)_2]$ as a ligand to prepare Cu(I), Ag(I), and Au(I) complexes which are being utilized further for catalytic applications e.g. Click Chemistry, A3 coupling, Glycoside synthesis etc. Besides, they prepared a series of bis-sila-thione/selenone/tellurone from the corresponding bis-silylene and showed their characteristic feature to display weak $\text{C}-\text{H} \cdots \text{Te}/\text{Se}/\text{S}$ interactions.



Main-group and transition metal compounds for catalysis

Carbon nanomaterials with their great applicability in diverse fields have been conventionally prepared by carbonization of natural products or synthetic polymers. Nonetheless, both precursors have severe drawbacks in terms of preparing custom-made carbon from natural products and involved tedious monomer syntheses in case of polymer precursors. Small organic molecules on the other hand with structural and compositional information within the molecular backbone, covalently bonded heteroatoms, integrated functional groups are ideal precursors for carbonization to carbon materials with tailored microstructures and compositions. Therefore, investigation on small organic molecular precursor is imperative for the translation of molecular information to carbon nanomaterials. Dr. Moumita Majumdar's group has established 1,4-bis(trimethylsilyl)-1,4-dihydropyrazine as the small molecule precursor for carbonization to *N,O*-functionalized carbon material via the formation of a polymeric intermediate upon simple air exposure (Figure). The carbonized material, thus obtained, showed promising anode performance in lithium-ion battery.

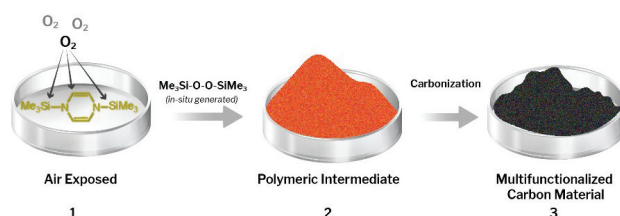


Figure 8:

1,4-bis(trimethylsilyl)-1,4-dihydropyrazine as the small molecule precursor for carbonization to *N,O*-functionalized carbon material (Dr. Moumita Majumdar's Group)

Codoping in perovskite semiconductors

$\text{Bi}^{3+}\text{-Ln}^{3+}$ ($\text{Ln} = \text{Er}$ and Yb) codoped $\text{Cs}_2\text{AgInCl}_6$ double perovskite as NIR emitter: $\text{Bi}^{3+}\text{-Ln}^{3+}$ codoping has been previously achieved in insulating metal oxides for both optical sensitization and emission. But such codoping has never been done in any kind of semiconductors, because of larger sized Bi^{3+} and Ln^{3+} ions do not fit into smaller (coordination number 4) cationic sites available in traditional semiconductors like CdSe, GaAs, InP, and Si. Only exception among semiconductors is the metal halide perovskites with coordination number 6, which has the potential to accommodate larger sized Bi^{3+} and Ln^{3+} . Such codoping in perovskite semiconductors might lead to efficient optoelectronic devices including near infrared (NIR) LEDs for optical fiber communication and remote sensing. This motivated Dr. Angshuman Nag's group to codope $\text{Bi}^{3+}\text{-Ln}^{3+}$, for the first time, in any halide perovskite. The choice of their host was $\text{Cs}_2\text{AgInCl}_6$ double perovskite, which is non-toxic and stable. But, $\text{Cs}_2\text{AgInCl}_6$ is optically inactive in both visible and near infrared region. Codoping $\text{Bi}^{3+}\text{-Ln}^{3+}$ tailor both the optical absorption and emission imparting interesting optical functionalities. Intense near infrared emission at 994 nm and 1540 nm are achieved from Yb^{3+} and Er^{3+} f-electrons respectively. Codoping Bi^{3+} tailors the optical absorption in such a way that the samples can be excited with commercial UV chips. Er^{3+} emission at 1540 nm is technologically very important, since the wavelength falls in to sweet spot of low-loss optical fiber communication.

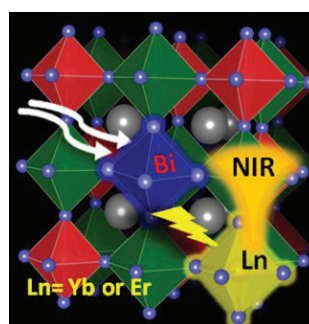


Figure 9:

Illustration depicts codoping of perovskite semiconductors with Bi^{3+} and Ln^{3+} ions (Dr. Angshuman Nag's Group)

Functional nanomaterials

Dr. Pramod Pillai's lab is interested in improving the optoelectronic properties of hybrid nanomaterials, through the precise control over the interparticle interactions at the nanoscale. This is achieved by decorating the surface of nanomaterials with functional groups of choice. In one of the recent examples, the idea of introducing favorable catalyst–reactant interaction led to an efficient photocatalytic regeneration of nicotinamide (NADH) cofactor by gold nanoparticles (AuNPs). The electrostatic attraction emanating from the ligands on the surface of NP enhanced the channeling and local concentration of reactants around AuNP photocatalysts, thereby enhancing the probability of the electron transfer process. In another prominent example, a fine control over the electrostatic interactions in InP/ZnS QD based triad system led to the photoregulation of electron and energy transfer processes, which ultimately resulted in the generation of high-contrast multicolor luminescent patterns. Furthermore, the ability to finely-tune the interplay of interparticle interactions proved to be decisive in choreographing a transient self-assembly process in charged nanoparticles.

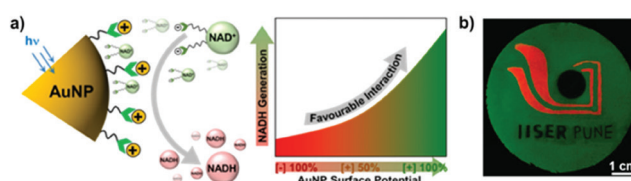


Figure 10:

Surface ligand directed photochemistry and photophysics. (a) Electrostatically driven photocatalytic regeneration of NADH cofactor by plasmonic AuNPs. (b) Photoregulation of electron and energy transfer processes, leading to the creation of high-contrast multicolor luminescent quantum dot patterns (Dr. Pramod Pillai's Group)

2.3 SPECTROSCOPY, THEORETICAL AND COMPUTATIONAL CHEMISTRY

DNA-Protein recognition, Conformational properties of block polyelectrolytes

Protein–DNA interactions play an important role in many biological processes such as transcription, DNA replication, and DNA damage repair. The most widely accepted theory of the target search process is the theory of facilitated diffusion according to which the protein slides along the DNA undergoing 1D Brownian motion in addition to 3D diffusion into the bulk solution. To understand the dynamic aspects of protein–DNA interactions, and the role of facilitated diffusion, Dr. Srabanti Chaudhury's group employed a discrete-state stochastic framework to study the role of DNA conformations and the role of macromolecules (crowders) that are present in the bulk environment of the living cell adjacent to the DNA. Their theory captures several such important dynamic features of the protein search for targets on DNA and compared with Monte Carlo computer simulations.

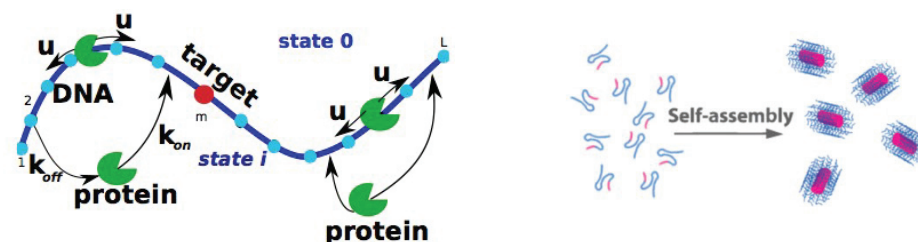


Figure 11:

(Left) Dynamic aspects of protein–DNA interactions;
(Right) Schematic of self-assembly of polyelectrolyte block copolymers
(Dr. Srabanti Chaudhury's Group)

Polyelectrolytes are the macromolecules that have ionizable groups and dissociate to give charged polymer chains and counterions when dissolved in solution. The study of polyelectrolytes is interesting as they mimic biologically relevant molecules and show how their properties change with different cellular environments (for example DNA condensation). Block polyelectrolytes are block copolymers in which at least one block is charged and the rest are neutral. Such charged systems find important technological applications in the field of polymer translocation. Many factors influence the properties of such charged polyelectrolyte solutions, such as the temperature, polymer concentration, dielectrics of the medium, size, and structure of the chain, the pH of the solution, salt concentration, etc. Dr. Srabanti Chaudhury's group studies the conformational properties of single diblock polyelectrolyte chain in aqueous solution using coarse-grained Langevin dynamics simulations.

The self-assembly of polyelectrolyte block copolymers is complicated and the self-assembled morphologies respond to changes in stimuli. But many of the studies on self-assembled morphologies of block polyelectrolytes are limited at the macroscopic scale and to understand the origin of the different morphologies of such self-assembled structures one needs to study such polyelectrolyte systems at the molecular level. Since all-atom simulations of the self-assembly of polyelectrolyte chains can be computationally expensive, Dr. Srabanti Chaudhury's group studies how the conformational properties of single di block polyelectrolyte changes with variation in the counterion valency, the fraction of charged residues, dielectrics, and salt concentration using coarse-grained molecular dynamics (MD) simulations. Such simulation studies will be useful for developing theoretical models to explain self-assembled morphologies.

Protein-RNA interactions

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

Another area of interest is the applicability of NMR to metabolomics where they collaborate with biology labs across India to find various problems that can be addressed by NMR. In this direction, ¹H NMR spectroscopy was performed to identify metabolic perturbations from tubers of five potato cultivars (Atlantic, Frito Lay-1533, Kufri Jyoti, Kufri Pukhraj, and PU1) differing in their cold-induced sweetening ability and processing characteristics at harvest and after cold storage (4°C). Thirty-nine water-soluble metabolites were detected wherein significantly affected metabolites after cold storage were categorized into sugars, sugar alcohols, amino acids, and organic acids. Multivariate statistical analysis indicated significant differences in the metabolic profiles among the potato cultivars. Pathway enrichment analysis revealed that carbohydrates, amino acids, and organic acids are the key players in CIS. Interestingly, one of the processing cultivars, FL-1533, exhibited a unique combination of metabolites represented by low levels of glucose, fructose, and asparagine accompanied by high citrate levels. Conversely,

non-processing cultivars (Kufri Pukhraj and Kufri Jyoti) showed elevated glucose, fructose, and malate levels. Results indicate that metabolites such as glucose, fructose, sucrose, asparagine, glutamine, citrate, malate, proline, 4-aminobutyrate can be potentially utilized for the prediction, selection, and development of potato cultivars for long-term storage, nutritional, as well as processing attributes. Dr. Jeetender Chugh's group is also looking at metabolic differences on the varieties of Honey available in the local regions of Pune.

Studying weak non-covalent interactions

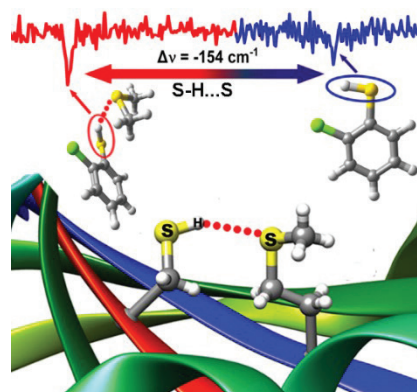
The research group of Prof. Alok Das is focused on molecular level understanding of various weak non-covalent interactions such as unconventional hydrogen bonding (S-H...S, S-H...O etc.), chalcogen interactions, $n \rightarrow \pi^*$ interaction etc. Detailed understanding of these weak interactions is very important for designing drugs, catalysts, and supramolecular assemblies of improved functionality. They employ various gas phase laser spectroscopy techniques in combination with quantum chemistry calculations to address their research problems.

The group studied the physical nature and strength of an extremely unconventional hydrogen bond namely S-H...S through gas phase IR/UV laser spectroscopy, quantum chemistry calculations and protein data bank (PDB) analysis. They have probed the S-H stretching frequency in a model complex of 2-chlorothiophenol (2-CTP) and dimethyl sulfide (Me_2S) bound by S-H...S hydrogen bond interaction. They have observed an unusually large IR red-shift ($>100 \text{ cm}^{-1}$), in the S-H stretching frequency of the 2-CTP... Me_2S complex, which is supported by the theoretical calculations. They have explained the observation of this large IR red-shift in the S-H...S hydrogen-bond in terms of the presence of the significant amount of charge-transfer interaction in addition to the usual electrostatic interaction. The existence of ~ 750 S-H...S interactions between the cysteine and methionine residues in 642 protein structures determined from extensive PDB analysis also indicates that this interaction is important for the structures of proteins.

They have also studied the sequence dependent folding motifs of small peptides in the gas phase using IR-UV double resonance spectroscopy, quantum chemistry calculations, X-ray diffraction (XRD) and 2D-NMR spectroscopy. Specifically, they have studied end-protected dipeptides i.e., Boc-D-Pro-Gly-NHBn-OMe and Boc-Gly-D-Pro-NHBn-OMe in the gas phase to understand the folding motifs of the peptides having Pro-Gly and Gly-Pro sequences. In general, the -Pro-Gly- sequence has a higher propensity of the formation of the β -turn conformation while the -Gly-Pro-sequence prefers to form an extended polyproline-II type conformation. They have found a one-to-one correlation between the structures obtained from gas phase spectroscopy, X-Ray crystal structure and 2D-NMR spectroscopy.

Figure 12:

IR spectrum showing red-shift in the S-H...S hydrogen bond in 2-CTP... Me_2S complex. Structure of a protein from PDB showing S-H...S hydrogen bond. (Prof. Alok Das's Group)

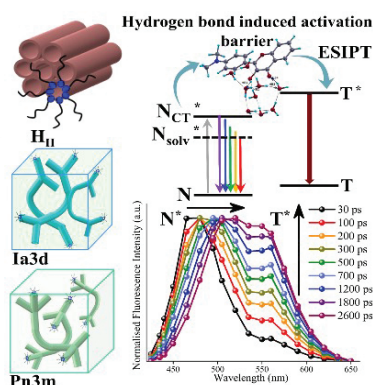


Photophysics of biologically important molecules

Dr. Partha Hazra's group is working on the lyotropic liquid crystalline (LLC) system, which has tremendous applications in the biomedical field. The polarity and hydrogen bonding effects of LLC water molecules were simultaneously explored using a single probe, 4'-N,N-Dimethylamino-3-hydroxyflavone (DMA3HF), by the unique multi-parametric sensitivity of the excited state proton coupled electron transfer (PCET) phenomenon. The decreased ESIPT efficiency and the significantly retarded ESIPT dynamics (> 20 times) of DMA3HF in the LLC phases suggests the dominant influence of strong hydrogen-bonded solute-solvent complexes that leads to a high activation barrier for ESIPT in the mesophases.

Figure 13:

Schematic topologies of LLC meso-phases, time-resolved area normalized emission spectra, and barrier associated of ESIPT process created for the stabilization of CT state
(Dr. Partha Hazra's Group)



In another work, Dr. Hazra's group designed organic luminogen with "all in one" type white light emitter together with stimuli-responsive behavior and highly efficient mitochondrial-tracking ability. They also have demonstrated that their organic dots can be used for the imaging, the early stage detection of amyloid fibril formation and the modulation of amyloid formation pathway.

Understanding properties of materials through simulation methods

Dr. Arun Venkatnathan's research group applies Molecular Dynamics (MD) simulation to calculate properties in various polymer electrolyte fuel cell membrane environments and battery electrolyte materials. In the battery project, the computational investigation focuses on thermal stability, interactions and ion transport in novel co-crystalline electrolytes for alkali metal (Li/Na) batteries synthesized by experimental collaborators at Temple University, U.S.A. A combination of experimental techniques and MD simulations show a crystalline solid, termed "solvate sponge crystal", which is a melt- and press-castable solid sodium ion conductor. The atomic interactions and clustering in a co-crystal composed of NaClO_4 and N,N -dimethylformamide (DMF) solvent in two different stoichiometries, 1:3 and 1:2, and their responses to the changes in physical environment are shown by state of the art MD simulations. The results provide a molecular level understanding of a solvate sponge crystal with desirable physical castability properties for device fabrication. Another field of research focuses on polymer electrolyte membrane for fuel cell applications. For example, the group examined the effect of various compositions of a N,N -diethyl- N -methylammonium triflate Ionic Liquid (IL) as a dopant in a Polybenzimidazole membrane on structure and dynamics. The MD simulation predicts ionic conductivity increases with wt% of IL, and temperature, with qualitative agreement with the experimental data.

DNA intercalation

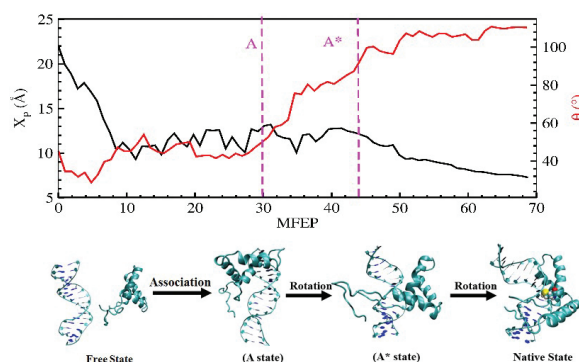
Dr. Arnab Mukherjee's group worked on the mechanism of intercalation of transcription factor protein SOX-4 into DNA. They showed that the mechanism involves binding of the protein to DNA in nonspecific manner, followed by a rotation of the protein and finally intercalation of the amino acid happens. During the intercalation process, both bending and kinking happen

simultaneously. They also showed that there are multiple pathways of binding of the protein to the DNA. However, the most probable binding pathway coincides with the unbinding pathway (work accepted for publication in *J. Phys. Chem. B*).

Figure 14:

The top panel shows the variation of the two collective variables along the minimum free energy path (MFEP) for the complete binding and intercalation process. Bottom panel shows the structures along the important intermediate steps (at the free state and different associated states leading to the final intercalated state).

(Dr. Arnab Mukherjee's Group)



The group has also worked on de novo drug design method and applied to find competitive binding partners to the spike protein of SARS-COV-2 virus. They have come up with several strong binders – both new and existing repurposed drugs. Their method is general and could be applicable to any receptor. The group is currently pursuing the methodology to several other COVID-19 targets such as RdRp, etc. Moreover, they are also using their method to target other diseases such as cancer where they target the hotspot of beta-catenin protein to prevent its interaction with tcf4 protein.

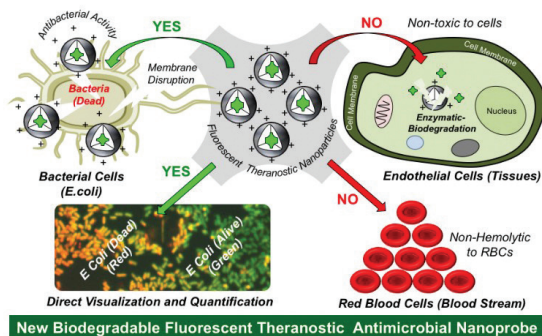
Biodegradable theranostic antibacterial nanoprobe

Treatment of infectious diseases caused by bacteria and virus are emerging as major challenges in addressing the healthcare issues and society. Multi-drug resistance and steadfast mutations of microorganisms severely obstruct the treatment with existing drugs or antibiotics, and this also further limits the fast detection of infectious diseases by existing diagnostic methods. This emphasises that the next generation candidates are essential to be smart multitasking probes having capability to exhibit both therapeutics and diagnostics together (theranostics) in single dose of drug administration. To address this important problem, Prof. M. Jayakannan's group has reported one of the first attempts in designing new biodegradable theranostic antibacterial nanoprobe based on biodegradable cationic polycaprolactone platform. The theranostic nanoprobe was successfully employed for direct visualization and qualitative determination of bactericidal activity by fluorescent imaging assay which could distinguish live and dead bacteria in real case scenario. The theranostic nanoprobe creates new platform for simultaneous probing and treating the bacterial infections in a single nano-design which is very useful for long-term impact in healthcare.

Figure 15:

Schematic of the functions of a new biodegradable fluorescent theranostic antimicrobial nanoprobe

(Prof. M. Jayakannan's Group)

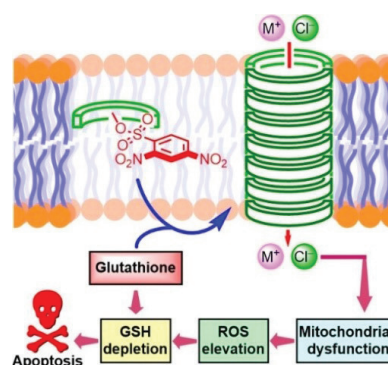


Ion transport systems

Prof. Pinaki Talukdar's research is aimed at the development of biomimicking ion transport systems for sensing and biomedical applications. He has applied the azobenzene switch to develop an ion transport system that can transport chloride ions in the *trans*-form and its activity can be switched off reversibly via *cis-trans* isomerization of the azobenzene moiety. His group has developed synthetic ion channels and carriers and applied synthetic ion transporters for inducing apoptosis in cancer cells by perturbing homeostasis of Cl^- , K^+ , and Na^+ ions. They have demonstrated that such ion channels can be activated by signals such as elevated levels of intracellular glutathione or esterase enzymes. The activation of ion transport by glutathione led to apoptosis-mediated cancer cell death that is comparable to doxorubicin. The activation of the ion channel by esterase enzymes also killed the cancer cells by inducing apoptosis as well as by disrupting the autophagy of the cells. These strategies have paved novel strategies in the development of anticancer drugs.

Figure 16:

Schematic representation on employing synthetic ion channels and to lead to cell death in cancer cells (Prof. Pinaki Talukdar's Group)



C-H functionalization, enantioselective organocatalysis, photoredox catalysis

Prof. Ramakrishna Bhat's research group has disclosed research works on C-H functionalization, enantioselective organocatalysis and photoredox catalysis during this period.

Prof. Ramakrishna Bhat's research group developed an efficient and straightforward method for the synthesis of β -benzyl-substituted five-membered heterocyclic carbaldehydes via transient directing group-enabled direct *ortho*- $\text{C}(\gamma\text{-sp}^3)\text{-H}$ arylation of 3-methylheteroarene-2-carbaldehydes (*J. Org. Chem.* 2020, 85, 11, 6924.)

The group developed a tertiary amine catalyzed highly diastereoselective and enantioselective [3 + 2] annulation between Morita–Baylis–Hillman (MBH) carbonates derived from isatin and pyrazolone 4,5-diones has been developed. A series of structurally diverse and multifunctional spirooxindole dihydrofuran fused pyrazolone derivatives with two adjacent quaternary spirocenters has been achieved. (*Org. Biomol. Chem.* 2020, 18, 1794.)

Prof. Bhat's group developed visible light mediated facile and selective dithiane deprotection under metal free conditions. Eosin Y (1 mol%) proved to be an effective catalyst for the dithiane deprotection under the ambient photoredox conditions. The standard household compact fluorescent light source (CFL bulb) proved to be effective under open-air conditions in aqueous acetonitrile at room temperature. (*Tetrahedron Lett.* 2020, 61, 151407.)

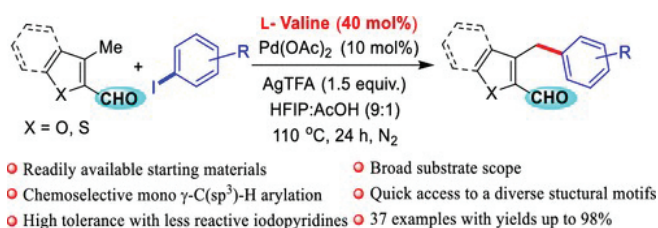


Figure 17:

Synthesis of β -benzyl-substituted five-membered heterocyclic carbaldehydes (Prof. Ramakrishna Bhat's Group)

The group also developed silver(I)-catalyzed novel access to spirooxiranes. Silver hexafluoroantimonate was found to be an efficient catalyst for the epoxidation of aldehydes using donor-/acceptor-substituted vinyl diazo succinimides as carbenoid precursors. The protocol has been found to be highly regio- and chemoselective that works well with aliphatic as well as aromatic aldehydes to afford spirooxiranes with a broad substrate scope. (*Asian. J. Org. Chem.* 2020, 9, 918.)

Polymer chemistry

Toughening poly (lactic acid) blends: Effectiveness of sequence controlled six-arm star-branched block copolymers of poly (L-lactic Acid) and poly (ϵ -caprolactone)

Prof. S. Sivaram's team prepared well-defined six-arm star-branched bio-degradable block copolymers of L-lactide and ϵ -caprolactone using controlled ring opening polymerization and a sequential monomer addition method using dipentaerythritol as the initiator core and organocatalysts at low temperatures in solution. Sequence of enchainment was changed by reversing the order of monomer addition giving, either, a crystalline PLA block or an amorphous PCL block as the outer segment. Segment chain length was also varied. Such sequence-controlled block copolymers showed interesting phase morphologies as evidenced by DSC studies. A six-arm poly (ϵ -caprolactone-*b*-L-lactide) (6s-PCL-*b*-PLA) showed two T_g and two T_m, characteristic of the amorphous and crystalline blocks. 6s-PCL-*b*-PLA and 6s-PLA-*b*-PCL with different segment chain lengths were solution blended (10 wt.%) with a commercially sourced PLA. All the blends were highly transparent. Structure and properties of the blend were examined by DSC, measurement of mechanical properties and SEM. The results show that a phase separated 6s-PCL-*b*-PLA copolymer results in two to three-fold improvement in tensile toughness without loss of modulus. A possible hypothesis for the mechanism of tensile toughness in the blend has been proposed.

Fully biodegradable six-arm star-branched block copolymers consisting of a sequence of poly (ϵ -caprolactone) or poly (L-lactide) chains as the outer segments were synthesized by sequential copolymerization of ϵ -caprolactone and L-lactide using organocatalysts under mild reaction conditions. Well-defined block copolymers were obtained with a range of segment molecular weights. The mild condition used for polymerization ensured the structural fidelity of the block-copolymer. DSC analysis provided interesting insights into the crystallization property of the block copolymer depending on their sequence of enchainment. When the PLA was present as the outer block, the block copolymer showed two T_m and T_g, characteristic of each segment, one crystalline and the other amorphous. This provides evidence for phase separation in six-arm star-branched 6s-PCL-*b*-PLA. 6s-PCL-*b*-PLA, upon solution blending with PLA (10 wt.%) gave clear and transparent films. Tensile property measurement showed that this blend showed two to three-fold improvement in % elongation at break without loss of modulus. Improvement in tensile toughness was attributed to favourable segmental miscibility contributed by the star-shaped branched-block copolymer and the availability of high concentration of an amorphous segment close to the initiating core acting as a stress concentrator.

In-situ formation of edge sulfur Functionalized graphene as a compatibilizer for the preparation of few layer Graphene-XNBR thin film nanocomposite: large scale processing, enhanced properties and in-silico mechanistic insights

Exceptional physical properties of graphene have stimulated much scientific research leading to several novel materials including elastomeric nanocomposites with improved physical and functional properties. The major challenges in preparing such nanocomposites using elastomer latexes are: (1) scalable dispersing processes to incorporate graphene in the latexes without



adversely affecting its colloidal stability, (2) ability to use well accepted methods for product formation (e.g. dip molding/dry rubber processing) (3) ensuring adequate improvement in physical and functional properties and; (4) finding a mechanism for interfacial interaction between graphene and the rubber. Prof. S. Sivaram's team report the preparation and characterization of a few layer graphene (FLG)-carboxylated nitrile rubber (XNBR) thin film nanocomposites using three different dispersion techniques, namely, (i) probe sonication (ii) high pressure homogenization and (iii) microfluidization. Amongst them, microfluidizer processed thin film FLG-XNBR nanocomposites show the highest tensile strength without any loss of tensile modulus and % elongation. The products of model reactions between FLG, sulfur and zinc mercaptobenzothiazole demonstrate the presence of sulfurated FLG, suggesting a possible chemical bonding between FLG and XNB during the vulcanization process. DFT studies support this hypothesis, and demonstrate a kinetically favorable sulfuration of both XNBR and FLG. The improved mechanical properties of the nanocomposites are attributed to the combined effect of superior dispersion accomplished in a microfluidizer and the formation of a chemical bond between FLG edges and the XNBR through the proposed intermediacy of sulfurated FLG. The proposed hypothesis and the associated evidence are unprecedented in the chemistry of sulfur cured FLG-rubber nanocomposites.

Stable dispersions of XNBR latexes with FLG were prepared using three different techniques viz. PS, HPH and MF. Transparent thin films FLG-XNBR nanocomposite were fabricated using a dip molding process. Thin film nanocomposites prepared using a microfluidizer showed better tensile strength without any adverse loss of modulus or elongation properties. TEM confirmed that microfluidization provides improved dispersion of FLG in XNBR. Higher equilibrium swelling and the lower crosslinking density were observed for the nanocomposite films compared to that of a XNBR film without FLG. The nature of non-covalent interaction between the rubber and FLG were investigated using Lorentz-Park and Cunneen-Russel models. The results suggest a strong interaction between FLG and XNBR. Furthermore, the likely presence of an S-S bond between FLG and the rubber was proposed based on the results of the model reactions between FLG and sulfur and ZMBT. Based on XPS analysis it was concluded that FLG forms edge S-S bonds, which can chemically react with XNBR during the curing process. This may lead to the formation of chemical linkages between FLG and XNBR. Such strong covalent interaction between the filler and the polymer could be the cause of improved mechanical property of the resulting thin film nanocomposites.

The DFT study revealed the mechanistic insights of ZMBT assisted S-S crosslinking between FLG and XNBR, using simple models viz. pyrene and 2-pentene, respectively. The computed energetics indicate that the H-abstraction step is the rate determining step for the sulfuration of pyrene/2-pentene. It also suggests the sulfuration of 2-pentene is kinetically more preferred than pyrene by +20.3 kcal/mol.

The method of dispersing FLG in a rubber latex reported in this paper using a microfluidizer is efficient and scalable. Additionally, sulfur curing such a dispersion results in thin film nanocomposites with improved tensile properties. This is most likely, a consequence of superior FLG dispersion in the latex and the formation of a chemical bond between FLG edges and XNBR through the proposed S-S bonds. Such a phenomenon could be general to many FLG thin film rubber nanocomposites cured using sulfur.

3. EARTH AND CLIMATE SCIENCE

3.1 EARTH SURFACE PROCESSES, CLIMATE

Stable isotope geology

Dr. Shreyas Managave's group continued their study on seasonality in the hydrogen isotopic composition of the leaf wax material. Periodic leaf growth measurements and leaf sampling of various tree species were carried out. Changes in the leaf mass per area of various species were estimated. Various leaf wax components were separated from a few batches of samples and average chain lengths were calculated. The samples are being processed for the hydrogen isotopic analysis of the alkane and acid fractions.

Fieldwork to know the effect of climate on soil formation was carried out at Koyana and Phaltan, Maharashtra. Sampling sites were selected based on the actual field and satellite data. Sites for future geophysical investigations were also identified.

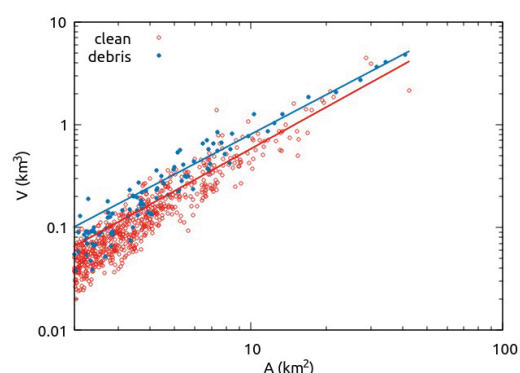
A collaborative effort is being initiated between IISER Pune and CWRDM, Kozhikode. The project deals with identifying signatures of the southwest and northeast monsoon signatures in the teak trees. Soil samples collected across the precipitation gradient in the western Ghat were processed for total organic matter content. The organic matter content varied from 5 to 60 mgC/g of soil.

Himalayan glaciers

A power-law relation between glacier area and volume has been extensively used for large-scale glacier change predictions, including those used to understand global sea-level rise. Dr. Argha Banerjee's group demonstrated certain intrinsic biases in these scaling-based predictions and provided new model parameterisations that is largely free of such biases. In a related study, they established that the above scaling relation needs to be modified to incorporate the effects of extensive supraglacial debris cover. The group showed that with the corrected scaling relation, the volume of ice stored in Himalayan debris-covered glaciers may be higher than that previously thought.

Figure 18:

The volume-area scaling plot showing the difference in the scaling relation for clean (red symbols) and debris-covered (blue symbols) Himalayan glaciers. (Dr. Argha Banerjee's Group)



Weather prediction and understanding natural variability

Dr. Neena Joseph Mani's group works on El Niño monsoon teleconnection and explores a lesser known relationship between boreal spring El Niño state and the Indian summer monsoon (ISM). The influence of atmospheric heating associated with the El Niño state over the Pacific Ocean is a critical factor to consider when studying the El Niño's impact on ISM. Using a dynamical framework, the group traced the pathways of energy dispersion by Rossby waves from the

Pacific to the ISM domain (see Figure). Two distinct eastward propagating Rossby waveguides were observed: one which reaches the northern Indian region and another interhemispheric waveguide which extends up to the southern Indian Ocean region. This leads to a change in the free tropospheric temperature distribution over the ISM domain in the month of May which in turn leads to a delay in the onset of monsoon. The boreal spring El Niño state hence turns out to be a critical factor to consider for predicting the monsoon onset.

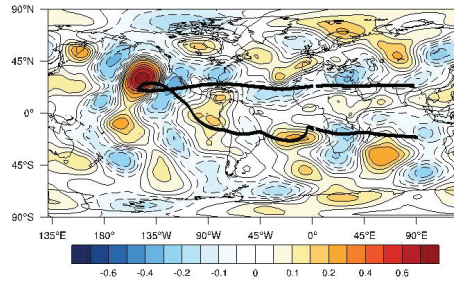


Figure 19:

Point-correlation map of 300 hPa stream function with respect to a subtropical Pacific reference time series, composited for all boreal spring OLR El Niño events during 1979–2018 (shaded contours). Overlaid (thick solid lines) are the permitted stationary waveguides obtained by solving the stationary Rossby wave dispersion relationship for initial zonal wavenumber 4 from the subtropical central Pacific. (Dr. Neena Joseph Mani's Group)

Organisation of tropical convection

Dr. Suhas Ettammal's group studied the Mixed-Rossby gravity wave (MRG), one of the important equatorial waves that modulates the major tropical modes which in turn influence the weather and climate in the tropics. The three-dimensional structure, horizontal and vertical propagation characteristics, and convection–circulation coupling of the convectively coupled MRG waves are examined by classifying the waves based on their amplitude.

Convective signals of the MRG waves were identified and isolated using empirical orthogonal function analysis of wavenumber–frequency-filtered outgoing longwave radiation (OLR) data. It was found that about 50% of the MRG waves occur during the August–November months, and this strong seasonality was considered while characterizing the MRG waves. Five strong and five weak MRG wave seasons were identified during 1979–2019, based on seasonal wave amplitude, and through this classification, significant differences in the strength of convection–circulation coupling, zonal scale of circulation, vertical structure, and propagation characteristics of MRG waves were brought out. It was also found that the seasonal mean background state is significantly different during strong and weak MRG wave seasons. While a La Niña–like background state was found to favor enhanced MRG wave activity, the MRG wave activity is mostly suppressed during an El Niño–like background state. The presence of extratropical wave intrusions is another factor that distinguishes the strong MRG wave seasons from the weak ones. Eastward and northeastward-propagating extratropical wave trains from the South Atlantic to the east Indian Ocean were observed during strong MRG wave seasons.

Confirming Arctic marine methane hydrate dissociation due to recent ocean warming

The effect of ocean warming is becoming more evident in the Arctic, such as the retreat of ice sheets and accelerated glacier melting. Ocean warming can destabilize methane hydrates that store methane in their molecular structure. The release of methane from hydrates is a concern for future warming. Plumes of methane bubbles emanating from the seafloor at the Arctic-Atlantic gateway located in the western Svalbard region indicate methane hydrate destabilization. It is likely to be caused by 1°C rise in bottom water temperature over the past 30 years (1978–2008). However, a recent hypothesis by Wallmann et al. (2018) doubts the role of ocean

warming behind hydrate destabilization. They found definite evidence of pore-water freshening, such as negative chlorine anomaly as an indicator of hydrate melting since hydrate dissociation releases freshwater. They emphasize depressurization as a cause for hydrate melting due to the relative sea-level fall that started around ~8000 years ago. Dr. Sudipta Sarkar's group tested the new hypothesis by conducting a numerical simulation of methane hydrates' behavior in response to the bottom water temperature changes (Rasmussen et al., 2014) and relative sea-level fall (Wallmann et al., 2018). The group assumed 14% initial hydrate saturation that completely melted 400 years before the present. The melting can reproduce the present-day chlorine anomaly. According to our modeling, melting was caused by relative sea-level fall and bottom water fluctuations. The system remained hydrate free and gas released from hydrates vented out. However, the group found that 60 years before the present hydrate reformed during colder bottom water temperature based on the instrumental record in a separate simulation. Subsequent warming completely melted the newly formed hydrate, causing methane release and can explain the observed pore-water freshening. Their results strongly suggest the recent bottom water warming plays a crucial role in destabilizing Arctic marine methane hydrates.

Climate system, COVID-19 data analysis

Dr. Joy Merwin Monteiro is working on the physics of heat waves in South Asia and the influence of Rossby waves on the same. The group published a paper which describes a method to identify Rossby waves (*Monthly Weather Review* 148(8)). They have also been curating and analysing COVID-19 data from the Pune Municipal Corporation since last May. This effort has resulted in Pune's COVID-19 data being among the highest quality among Indian cities and has allowed us to help design sampling strategies for the serological survey and (in planning) genome sequencing for variant detection in PMC as well as for epidemiological studies into the effects of lockdown and the contact pattern of patients in PMC.

Tunnel detection

Clandestine tunnels pose a serious challenge to the security apparatus as they facilitate drug/weapon smuggling, human trafficking, and terrorist-related activity. Many technologies have been developed for tunnel detection; however, no definitive silver bullet has been found for this problem. Dr. Rahul Dehiya's group carried out a numerical study to examine the feasibility of employing an electromagnetic gradiometer (EMG) in tunnel detection. They used a 3D modeling algorithm for these experiments. The 3D simulation facilitates modeling the response of various model scenarios, such as a conductor in the tunnel (EMG responses are shown in the figure below), the effect of heterogeneities on the EMG response. The EMG response depends on the radiation pattern of the transmitter. Therefore the effectiveness of different transmitter types is studied extensively.

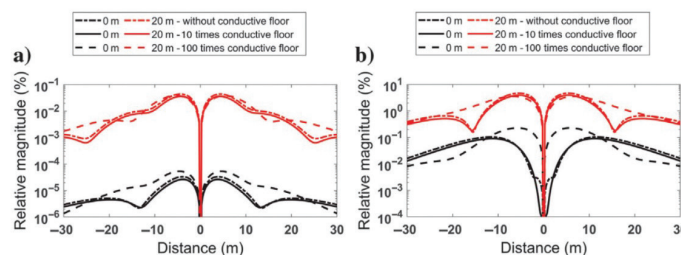


Figure 20:

The EMG responses of a tunnel model without a conductive floor, with a ten times more conductive floor and with a hundred times more conductive floor. The responses are simulated at two broadside offsets as 0.0 and 20.0 m: (a) the horizontal magnetic transmitter and horizontal magnetic receiver pair and (b) the vertical magnetic transmitter and horizontal magnetic receiver pair. (Dr. Rahul Dehiya's Group)

3.2 RESPONSE OF ECOSYSTEMS

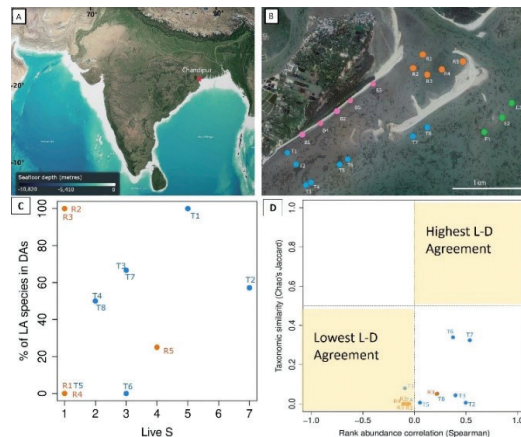
Ancient and recent marine ecosystems

Dr. Devapriya Chattopadhyay's group addresses questions related to the faunal response to physical and biological triggers in ancient and recent marine ecosystems using the fossil record and ecological samples. After joining IISER Pune in 2019, Dr. Chattopadhyay has established Paleobiology Research Laboratory housing curated Cenozoic fossil specimens collected from various sedimentary basins of India.

The reliability of the fossil record is an important theme in Paleobiology. In their recent work using Recent assemblage of marine molluscs from a shallow-marine environment of Chandipur in the eastern coast of India, they documented a significant difference between live- and death-assemblage. A statistical model based on the hydrodynamic properties of the shells and energy profile of the environments, further established the role of post-mortem transportation in creating regional assemblages. Their study highlights the significance of out-of-habitat transport in shaping the regional distribution of marine fossil assemblages, especially in storm dominated siliciclastic shallow-marine settings.

Figure 21:

A shallow-marine of Chandipur-on-sea (A) is sampled for live and death assemblage of molluscan fauna from multiple locations (B). The live assemblage is different from the death assemblage (C) and the disagreement is quite high in localities experiencing high energy environment (D).
(Dr. Devapriya Chattopadhyay's Group)



4. HUMANITIES AND SOCIAL SCIENCES

4.1 HISTORY OF SCIENCE, ARCHITECTURE, MATERIAL CULTURE

Material Culture

Material culture often tells a different story of past societies than textual sources. Architecture is one of the most articulated expressions of material culture, reflecting not just the aspirations and aesthetics of society, but also economic and social realities. Comprehending architecture as a language and language as artefact is at the heart of several of Dr. Pushkar Sohoni's research projects. Dr. Sohoni's research over the past year included the completion of a co-edited set of books for the Maharashtra Rajya Sahitya Sanskriti Mandal on the architecture of Maharashtra. He also co-edited and submitted a manuscript on Muharram observances among South Asian communities through the world, particularly historically in the diaspora. He gave talks at several conferences including one on the Indian Ocean world organised by The University of Chicago, titled *Interwoven: Sonic and Visual Histories of Indian Ocean Worlds*. He also presented on colonial scientific research at the International Congress of History of Science and Technology, and on historic architecture at the Historians of Islamic Art Association Biennial Symposium, University of Michigan. His research on colonial market-halls is supported by a fellowship from the Indian Council for Historical Research; he was recently awarded a residential scholarship by the Slovak Republic.



4.2 LITERATURE

Fictional worlds and their analyses

Dr. Pooja Sancheti has been exploring contemporary South Asian fiction and World Literature. She presented a paper on South Asian fiction and cartography at an online conference. A paper on the Pakistani writer in English, Mohammad Hanif, has been submitted to the *Canadian Journal of Comparative Literature* for review. Dr. Sancheti has translated into Hindi the short story collection of the Bhutanese writer in English, Kunzang Choden, and will soon be approaching publishing houses for a contract. She has also completed an online MOOC on TESOL (Teaching English as a Second Language) and will be presenting a paper in April 2021 on teaching writing to senior Science PhD students. The conference is hosted by the CWC at Ashoka University. Dr. Sancheti presented a paper on practical exercises for mixed-proficiency groups of adult learners at the annual conference hosted by ELTIS, Symbiosis Pune in Feb 2020.

4.3 DEVELOPMENT STUDIES

Water and environmental change

Along with students and collaborators, Dr. Bejoy Thomas has been looking at issues around water management in agrarian and peri-urban settings. A review investigating the factors behind the slow adoption of efficient water use technologies in agriculture was completed. Meetings were held with key stakeholders to initiate work around water management in Pune city and peri-urban areas. These activities and research will be taken forward as part of the newly established Centre for Water Research. Dr. Thomas and collaborators undertook a technical review in response to the claims about environmental improvements during COVID-19 lockdown. Using select environmental indicators and socio-economic data at the national scale, they argued that improvements in environmental conditions (such as air quality) during the lockdown were temporary. A realistic way to look at environmental sustainability would be to not consider it in isolation, but along with the socio-economic impact that the lock down had on livelihoods.

5. MATHEMATICS

5.1 ALGEBRA AND NUMBER THEORY

Special values of L-functions associated to automorphic forms

Dr. Baskar Balasubramanyam's research work has been focused on the study of special values of L-functions, and specifically on the Rankin triple product L-functions. He has also been working on studying p-adic properties of automorphic forms via the eigenvariety construction.

Analytic number theory and arithmetic of modular forms

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

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

Moduli of curves

Let Γ be a subgroup of finite index of $SL_2(\mathbb{Z})$. It acts holomorphically on the upper half-plane H . Consider the corresponding modular curve $Y_\Gamma = \Gamma \backslash H$, and its compactification obtained by adding the cusps X_Γ . We say that X_Γ satisfies the Manin-Drinfeld principle if any divisor of degree 0 supported on the cusp is torsion in the jacobian of X_Γ . Manin and Drinfeld proved that it is the case when Γ is a congruence subgroup.

In general, Murty and Ramakrishnan give an analytic criterion for the Manin-Drinfeld principle to be satisfied. In [Banerjee-Merel], Dr. Debargha Banerjee reconsiders this question and give an analytic criterion of a different nature based on Eisenstein series.

As an illustration, Murty and Ramakrishnan consider modular curves attached to certain subgroups of $\Gamma(2)$: Fermat curves, and what they propose to call Heisenberg curves. Dr. Banerjee's work revisits those examples also.

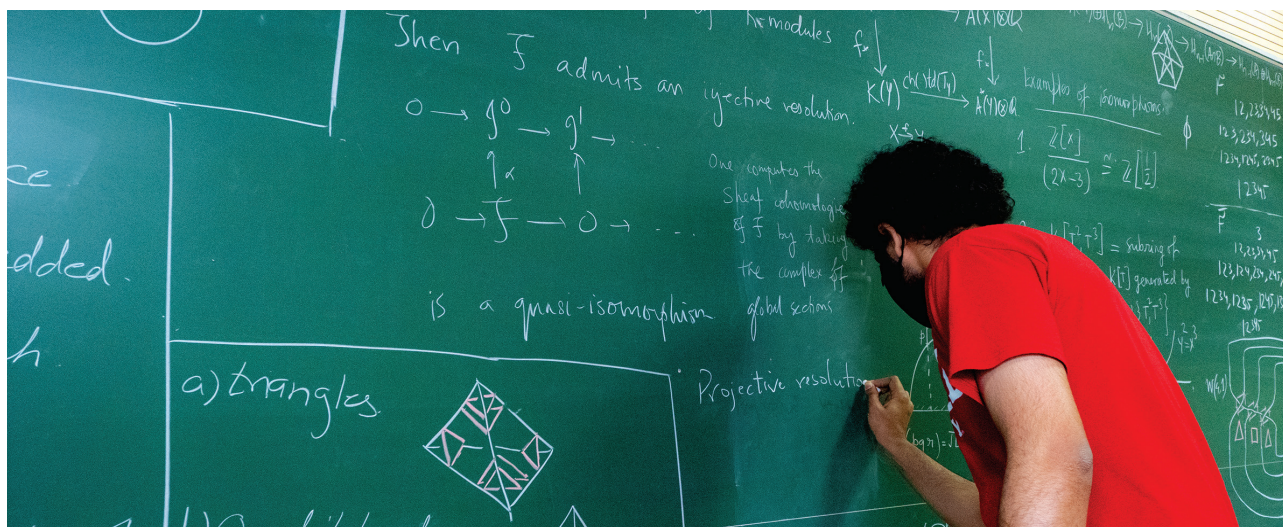
Such curves are defined as follows. Let A and B be the classes of the matrices

$\begin{pmatrix} 0 & 1 \\ 1 & 21 \end{pmatrix}$ respectively in $PG(2) = \Gamma(2)/\{\pm 1\}$. These matrices generate freely the group $PG(2)$. Let $C = ABA^{-1}B^{-1}$. Let N be an integer ≥ 1 . Denote by Φ_N be the kernel of the morphism $PG(2) \rightarrow (Z/NZ)^2$ which to A associates $(1, 0)$ and to B associates $(0, 1)$. The corresponding modular curve is the Fermat curve F_N .

Let Γ_N be the subgroup of Φ_N generated by A^N, B^N, C^N and the second term $[PG(2), [PG(2), PG(2)]]$ in the descending central series of $PG(2)$. An exact sequence of groups follows

$$1 \rightarrow \Gamma_N \rightarrow PG(2) \rightarrow H_N \rightarrow 1,$$

where H_N is a central extension of $(Z/NZ)^2$ by Z/NZ (coinciding with the Z/NZ -points of the Heisenberg group). The N -th Heisenberg curve, in the sense of Murty and Ramakrishnan, is the modular curve attached to Γ_N . We denote it by X_N . Curiously, these authors make no mention



of the fact Φ_N contains Γ_N , i.e. that the N -th Heisenberg curve covers the N -th Fermat curve. This is what we call the Heisenberg covering of the Fermat curve. In this paper, we study in detail this covering for N odd. We describe it and characterize it purely in terms of the covering of $P^1 - \{0, 1, \infty\}$ by F_N , without mention of any uniformisation by the upper half-plane.

Dr. Banerjee's work shows that both the Heisenberg curve and the covering are defined over $\mathbb{Q}$, that such a covering defines a cyclic subgroup scheme of order N of the jacobian J_N' of F_N . Rohrlich (and V'elu) have determined the cuspidal subgroup of F_N . In particular, they have shown that any divisor supported on the cusps of F_N are order dividing N . Their description plays a key role in justifying the existence of the Heisenberg covering.

They give a complex analytic description of the Heisenberg subgroup scheme, and deduce that it is orthogonal to the cuspidal group of F_N for the Weil pairing. They note that there has been a considerable interest in the cuspidal group of the Fermat curve. For instance, Mazur draws (or rather "stretches") an analogy between Fermat curves and modular curves. Such an analogy is somewhat strengthened by the fact that the Heisenberg covering is analogous to the familiar Shimura covering $X_1(N) \rightarrow X_0(N)$ between modular curves. Like Murty and Ramakrishnan, Dr. Banerjee's goal had been to illustrate the study of non-congruence subgroups by examining Heisenberg curves. Dr. Banerjee could not determine in general whether such curves satisfy the Manin-Drinfeld principle, but they could show easily that this is the case for $N = 3$.

In [Ozlem], the homology group of F_N relative to the whole set of cusps is thoroughly studied, by the method of Manin. Dr. Banerjee found fruitful in [Banerjee-Merel] to consider the following slightly different point of view: for Γ a subgroup of $\Gamma(2)$ containing $-Id$, the corresponding modular curve X_Γ covers $X(2)$, which admits three cusps: $\Gamma(2)0$, $\Gamma(2)1$ and $\Gamma(2)\infty$. Let $\partial\Gamma^+$ (resp. $\partial\Gamma^-$) be the set of cusps above $\Gamma(2)0 \cup \Gamma(2)\infty$ (resp. $\Gamma(2)1$). It is thus possible to consider the mixed homology group $H_1(X - \partial\Gamma^-, \partial\Gamma^+; \mathbb{Z})$ (and its dual $H_1(X - \partial\Gamma^+, \partial\Gamma^-; \mathbb{Z})$), which is isomorphic to $\mathbb{Z}[\Gamma \backslash \Gamma(2)]$ [?]. The question of the Manin-Drinfeld principle can be translated in terms of the Eisenstein part of this group.

By transport of structure, the Heisenberg covering defines a group homomorphism on the following mixed homology groups, which too Dr. Banerjee has studied.

$$H_1(XN^{-\partial\Gamma^-, \partial\Gamma^+}; \mathbb{Z}) \rightarrow H_1(FN^{-\partial\Gamma^-, \partial\Gamma^+}; \mathbb{Z})$$

Witt vector functors

The theory of Witt vectors is a evolving topic in modern number theory with lots of applications in representation theory. Dr. Supriya Pisolkar's current projects are about understanding and finding relations among the various constructions of Witt vector functors on the category of associative until rings. Let A be any unital associative, possibly non-commutative ring and let p be a prime number. Let $E(A)$ be the ring of p -typical Witt vectors as constructed by Cuntz and Deninger in [J. Algebra 440 (2015), pp. 545– 593] and let $W(A)$ be the abelian group constructed by Hesselholt in [Acta Math. 178 (1997), pp. 109–141] and [Acta Math. 195 (2005), pp. 55–60]. They had proved in [J. Algebra 506 (2018), pp. 379–396] that if $p = 2$ and A is a non-commutative unital torsion free ring, then there is no surjective continuous group homomorphism from $W(A) \rightarrow HH_0(E(A)) := E(A)/[E(A), E(A)]$ which commutes with the Verschiebung operator and the Teichmüller map. Dr. Pisolkar has now generalised this result to all primes p and simplify the arguments used for $p = 2$. They also prove that if A is a non-commutative unital ring, then there is no continuous map of sets $HH_0(E(A)) \rightarrow W(A)$ which commutes with the ghost maps.

5.2 ANALYSIS, DIFFERENTIAL EQUATIONS, APPLICABLE MATHEMATICS

Probability theory and control theory

Eigenvalue problem for elliptic system: Dr. Anup Biswas, in collaboration with Ari Arapostathis and Somnath Pradhan, investigated the notion of monotonicity of generalised principal eigenvalues and its equivalence with several other analytic properties. This work extended the earlier result of Arapostathis et. al. on the monotonicity property of generalised eigenvalues.

Eigenvalues of elliptic operators with rough kernel: This is a joint work with Ari Arapostathis and PhD student Prasun Roychowdhury with Dr. Biswas. In this work they developed a Harnack's inequality and used it to establish existence of generalised principal eigenpair.

Infinite Laplacian and nonlinear PDE: In collaboration with Huang-Hung Vo, Dr. Anup Biswas developed a theory of generalised principal eigenvalue for a general nonlinear equation involving infinity Laplacian and also proved the existence-uniqueness results for nonlinear KPP type equations.

Shape optimisation problems

Dr. Anisa Chorwadwala could generalise the results of [Anisa-Souvik] for $n = \text{odd}$ case, and the results of [ElSoufi-Kiwan] and [Anisa-Souvik] for the p Laplacian. This work was done with Mrityunjay Ghosh, a research scholar at IIT Madras.

In collaboration with Dr. Souvik Roy from University of Texas at Arlington, U.S.A., Dr. Chorwadwala has generalised the results of [Anisa-Souvik] for fundamental eigenvalue of a general divergence form elliptic operator. In this paper, they consider an obstacle placement problem inside a disk, represented by a shape optimisation problem to find the maximum or the minimum fundamental eigenvalue of a general divergence form elliptic operator. The obstacle is invariant under the action of a dihedral group, which is usually the case with regular polygons and ellipses. This is a generalisation of a previous work by the same authors concerning the fundamental Dirichlet eigenvalue optimisation. They show that when the order of symmetry of the obstacle is even, the extremal configurations for the fundamental eigenvalue, with respect to rotations of the obstacle, correspond to the cases where an axis of symmetry of the obstacle coincide with an axis of symmetry of the disk. For the case of odd order of symmetry, they provide conjectures

about the extremal configurations. Furthermore, for both even and odd symmetry cases, they characterise the global extremal configurations with respect to rotations and translations of the obstacle. Finally, they provide results of several numerical experiments for obstacles with different order of symmetries and two different types of elliptic operators, which validates our theoretical findings.

Dr. Chorwadwala studied the boundary value problem from a liquid crystal point of view and found energy minimisers among certain admissible domains.

Mathematical finance

Dr. Anindya Goswami proposed three different data-driven approaches for pricing European-style call options using supervised machine-learning algorithms. These approaches yield models that give a range of fair prices instead of a single price point. The performance of the models is tested on two stock market indices: NIFTY50 and BANKNIFTY from the Indian equity market. Although neither historical nor implied volatility is used as an input, the results show that the trained models have been able to capture the option pricing mechanism better than or similar to the Black-Scholes formula for all the experiments. Their choice of scale free I/O allows us to train models using combined data of multiple different assets from a financial market. This not only allows the models to achieve far better generalization and predictive capability, but also solves the problem of paucity of data, the primary limitation of using machine learning techniques. The group also illustrated the performance of the trained models in the period leading up to the 2020 Stock Market Crash (Jan 2019 to April 2020).



5.3 GEOMETRY AND TOPOLOGY

Toric vector bundles and tensor triangular geometry

Dr. Vivek Mallick's main area of research interest can be broadly characterised as algebraic geometry.

Equivariant tensor triangulated category: Tensor triangulated categories occur in various areas of mathematics including algebraic geometry, modular representation theory and stable homotopy theory. Dr. Vivek Mallick is studying tensor triangulated categories, which admit a group action, and the effect of the group action on invariants like Chow groups.

Toric vector bundles: Using their previous work on Multifiltrations describing equivariant vector bundles on a toric variety, Dr. Mallick is studying characteristic classes of such bundles.

Multihomogeneous spaces: Multihomogeneous spaces are generalizations of projective spaces. Projective spaces are well-understood geometric spaces and a wide range of useful geometric spaces can be embedded as subspaces of projective spaces. However, some varieties cannot be embedded in projective spaces and they include a class of geometric spaces called divisorial schemes. Brenner and Schroer showed that any divisorial scheme can be embedded into Multihomogeneous spaces. Along with student Kartik, Dr. Mallick is studying geometric properties of these spaces.

Toric vector bundles

It is a famous theorem of Grothendieck that a principal bundle over the projective line splits. Kaneyama generalized this to the case of torus equivariant vector bundles of small rank over

higher dimensional projective spaces. In Kaneyama's result the splitting is also equivariant. In a joint work with Prof. Indranil Biswas of TIFR, Dr. Arjit Dey of IIT Madras and postdoctoral fellows Dr. Jyoti Dasgupta and Dr. Bivas Khan of IISER Pune, Prof. Mainak Poddar has generalized Kaneyama's theorem to torus equivariant principal bundles over projective spaces under a suitable analogue of the small rank condition. They have also studied the classification, automorphism group, equivariant Levi reduction, and stability of such bundles.

Advances have been on some other projects like a) the construction of generalized complex structures on certain principal bundles over complex manifolds, b) a correspondence between logarithmic connections and equivariant structures on vector bundles over (singular) toric varieties, c) a study of sphere bundles over spheres, etc.

5.4 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 the satisfactory partition problem, upper defensive alliances in graphs, and the fair feedback vertex set problem.

6. PHYSICS

6.1 ATOMIC AND MOLECULAR PHYSICS, OPTICS, AND QUANTUM INFORMATION

Light-matter quantum systems

Dr. Bijay Kumar Agarwalla's group is working on investigating non-equilibrium quantum transport properties in transient and steady-state regimes. In this year's research, their primary focus was on the understanding theoretical bounds on non-equilibrium fluctuations and how they impact the performance of quantum devices operating both in finite time and the ones that are continuously coupled with the external sources. They provided theoretical insights about bounds on fluctuations and furthermore exemplify the validity of such bounds in two different experimental platforms, namely atomic scale quantum conductors and NMR setup. The group also provided a mechanism to understand quantum transport properties in quasi-periodic systems by coupling the system by two spatially qubits and then reading them out.

Plasmon enhanced Raman and fluorescence scattering in Fourier space

Dr. G.V. Pavan Kumar's group is in the process of construction of an optical/optothermal tweezer that can trap and interrogate nanoparticles (50 to 250nm range). They have been simultaneously working on numerical simulation methods to corroborate the optical forces generated in the experiments.

Ultra cold dipolar gases and Rydberg atoms

Dr. Rejish Nath's group studied various aspects of the dynamics of Rydberg excitations, and Rydberg dressed Bose-Einstein condensates (BECs). They have provided a thorough understanding of the Landau-Zener dynamics in a pair of interacting Rydberg atoms under the influence of a time-dependent field. For a light-field that varies periodically in time, they explored the unusual scenario of population trapping or dynamical stabilization in an array of Rydberg atoms. The group also studied the dynamics of Rydberg excitations in a chain of atoms coupled to a photonic crystal waveguide, which shows fascinating dynamics from quantum diffusion to bound state dynamics. In collaborative works with Prof. Weibin Li's group, the group analyzed the non-linear dynamics in Rydberg admixed BECs in a triple well potential, the dynamics of both roton and Maxon excitations under a quench in the interaction parameters.

Computational study of correlated quantum systems

Quantum Hall systems: Dr. Sreejith G.J.'s group constructed an exactly solvable model for FQHE, which shows qualitatively correct physics observed previously in experimental and numerical studies. The model is a rare example of an exactly solvable, strongly interacting system in 2D and provides a fresh perspective on a well-known flux attachment phenomenon. The group also made progress on understanding specific experimental results produced at SINP, Kolkata, on edge physics in FQH systems.

Quantum dimer models: The group designed and fine-tuned an efficient and ergodic quantum Monte Carlo algorithm to map the thermal phase diagram of a strongly constrained quantum problem.

Quantum dynamics using MPS techniques: This work involves developing local expertise in an algorithm for probing quantum many-body systems. The group was able to use the algorithm to study multiple aspects of out-of-equilibrium dynamics in a strongly interacting chain of spins. In a few other projects where undergraduate students had contributed to the research, the group



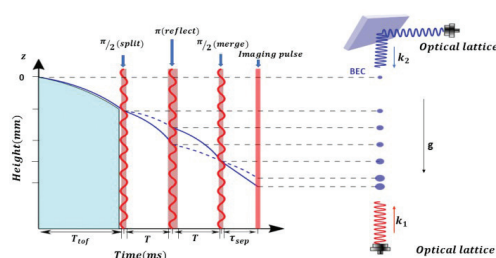
carried out analysis of machine learning systems using statistical mechanics and an analysis of disease spread in networks in terms of emergent distance measures.

Quantum information processing

Research in Dr. Umakant D. Rapol's group is focused on developing a platform for distributed quantum information processing and development of atom interferometers for precision sensing of inertial motion and gravitational acceleration. The group is developing a system of ultracold Sr atoms for transferring quantum information from an atomic qubit to a flying qubit. Ultracold strontium atoms will be trapped and stabilized near plasmonic nanostructures for achieving strong coupling of the atomic dipole moment with a plasmonic nanostructure. In another research project, the group is using ultracold atoms in a Bose-Einstein Condensate for Atom-Interferometry through different schemes. In one such scheme, they are developing techniques using Talbot resonances to build an atom interferometer.

In another method, Dr. Rapol's group is using conventional atom interferometry on a falling BEC through Bragg diffraction. They experimentally measured gravitational acceleration using an atom interferometer built with a Bose-Einstein Condensate of ^{87}Rb atoms. They use $\approx 5 \times 10^4$ atoms to split, reflect and merge coherent atomic wavepackets in a Mach-Zehnder configuration, where different atomic paths are interfered using a two-photon Bragg transition. The observed visibility of the fringes is about 20 % for $T = 4$ ms, and the measured sensitivity of local gravitational acceleration, $g=g$ is found to be 2.3×10^{-6} in 30 minutes of measurement time. The projected maximum intrinsic sensitivity of our current system is $(\Delta g/g)_{\text{limit}} = 8.8 \times 10^{-6}$ with an interferometric time of $T = 4$ ms. Modifications and improvements in the near future promise state-of-the-art sensitivity.

Figure 22:
Schematic of the Bragg interferometry
with atomic wavepackets of BEC
(Dr. Umakant Rapol's Group)



Dr. Umakant Rapol, in collaboration with Dr. Sunil Nair and alumni of IISER Pune, was involved in addressing the needs for a low-cost ICU ventilator. The team successfully developed a laboratory prototype low-cost ICU ventilator which is under industrial prototype development stage.

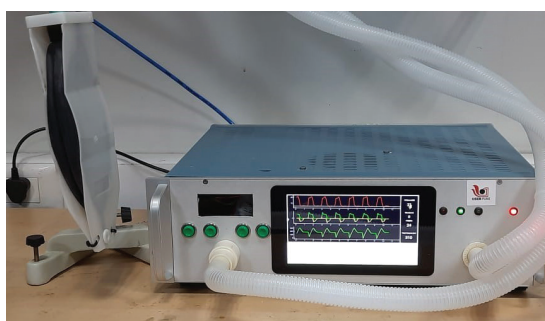


Figure 23:
Laboratory prototype of ICU ventilator (Dr. Umakant Rapol, Dr. Sunil Nair and team)

6.2 CONDENSED MATTER, STATISTICAL PHYSICS, MATERIALS

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

Dr. Arijit Bhattacharyay's group is working on the statistical mechanics of ratcheting transport and systems with coordinate-dependent diffusion. In this area, they have shown ratcheting in a dimer system that directly converts heat to work and have also developed a random walk model for simulation of Brownian motion with coordinate-dependent damping. The group has also shown ratcheting in nanofluidic medium within lubrication approximation. They are working on spinor Bose-Einstein condensate to develop a better method to explore ground state density profile beyond Thomas-Fermi approximation. Apart from these, Dr. Bhattacharyay developed a model based on perturbation of a Schwarzschild metric that can capture a wide band of rotation curves of spiral galaxies that highlights the role of pressure as a source for the existence of the extra curvature beyond the Newtonian limit of Schwarzschild geometry.

Soft condensed matter

Dr. Apratim Chatterji's group investigated the stress strain behaviour of "porous" poly-nano composites (nano-particles enmeshed in a gel of cross-linked polymers with large pores in the bulk of the material) to match with experimental measurements, and developed a microscopic understanding of the stress response. Given the multi-scale nature of the micro-structures in the porous material comprising of (a) polymers at the nm scale, (b) the NPs of diameter 22 nm, (c) the cross-linked polymer-NP mesh of width hundreds of nano-meters and (d) the percolating mesh network filled with voids (or empty voids) at the scale of millimeters, researchers have not attempted a microscopic modeling and investigation of the response of the porous micro-structure to externally applied strain.

The group is investigating the replication and the spontaneous segregation of replicating bacterial DNA and the role of entropic forces for the above phenomenon. In particular, they are trying to theoretically understand the experimental observations as reported in Genes and Development (2014). 28: 71-84 by Brenda Youngren, Suckjoon Jun et al.

Optoelectronics

Some of the topics that Dr. Shouvik Datta's group worked on during this year were: (i) Tailoring quantum oscillations of excitonic schrodinger cats as qubits; (ii) Methods of using excitonic BEC as qubits in semiconductors for quantum information technologies, for which they have begun a preliminary patent filing process; (iii) Dual measurements of temporal and spatial coherence of light in single experimental setup using a modified Michelson Interferometer; (iv) First principles investigations of structural, electronic and transport properties of $\text{BiI}_3\text{-ZrS}_2$ van der Waals heterostructure, published in collaboration with Dr. Prasenjit Ghosh.

Phase transitions, sorting dynamics

The Speed Process: In this work, Prof. Deepak Dhar discussed the approximate phenomenological descriptions of the motion of a single second-class particle in a two-species totally asymmetric simple exclusion process on a 1D lattice. Initially, the second class particle is located at the origin and to its left, all sites are occupied with first class particles while to its right, all sites are vacant. Ferrari and Kipnis proved that in any particular realization, the average velocity of the second class particle tends to a constant, but this mean value has a wide variation in different histories. They discuss this in three different approximations of increasing accuracy, treating the motion of



the second-class particle, always in continuous time, first as a simple biased random walk in a continuum Langevin equation description, then as a biased Markovian random walk on a lattice with space and time dependent jump rates, and finally as a Non- Markovian biased walk on a lattice, with a non-exponential distribution of waiting times between jumps. This work is done with Aanjaneya Kumar.

Chase -escape percolation: This is a variation of the standard percolation problem. It is a lattice model of interacting predators and preys. The prey spread in empty space by reproducing at neighboring empty sites, at a fixed rate. The predators can eat prey at a neighboring site at a faster rate. But it is possible that prey survive for ever, even if they spread at a smaller rate. Using Monte Carlo simulation, Prof. Dhar and team estimated the critical percolation threshold, and different critical exponents. They show that this problem is in the universality class of undirected percolation. There is a second depinning transition, which occurs when the rates of predator spread and prey are equal. They found that the critical exponents are in the Kardar -Parisi - Zhang universality class at this second transition. This work was done with Aanjaneya Kumar, and P. Grassberger (Julich).

Full packing of hard rods on hypercubical lattices: The behavior of a system of hard rigid rods on a lattice has been of longstanding interest in statistical mechanics. They have determined the asymptotic behavior of the entropy of full coverings of a $L \times M$ square lattice by long, rigid straight rods by rods of length k . For large L, M , this increases as $\exp[LMS(k)]$. Using exact upper and lower bounds on $S(k)$, they show that $\lim_{k \rightarrow \infty} S(k) k^2 / \log k = 1$.

Based on a perturbative series expansion, they also conjecture that this large- k behavior of entropy per site is super-universal and continues to hold on all d -dimensional hyper-cubic lattices, with $d \geq 2$. This work was done along with R. Rajesh (IMSc, Chennai).

Ferromagnetism in graphene

Dr. Mukul Kabir's group worked on two-dimensional magnetic materials and understanding emergent quantum phenomena in their heterostructures. While the two-dimensional magnets offer a new opportunity to design and manipulate the spin-based devices efficiently in the future, the current family of experimentally realized 2D magnetic materials order only at a very low-temperature. This essentially limits their technological applications. In this regard, the group addressed experimentally realizable manipulation of magnetism and the corresponding ordering temperature by the external perturbations such as electric field, light, etc. Further, they focused on the designer quantum van der Waals heterostructures involving 2D magnets and the other materials with different quantum phases such as superconductor, topological materials, and spin-liquid candidates.

Fabrication of nanodevices

Dr. Atikur Rahman's group made progress in fabricating and studying properties of mixed-dimensional van der Waals heterostructures. The group found nearly three orders of magnitude enhancement in photoresponse of 2D-3D hybrid structures by tuning the dielectric environment. Effect of substrates on 2D monolayer such as WS_2 has been studied optically by placing them on various nanopatterned substrates. They found that the relative contribution of charged exciton (Trion) increases when placed on holey substrates or suspended on micro-pillars. The group recently synthesized thin layers of single-crystalline $CsPbBr_3$ and made graphene- $CsPbBr_3$ heterostructures which show interesting photoresponse properties. They developed a new photolithography technique in the lab using which they can easily make nanodevices even on water-soluble materials. To study the effect of strain on monolayer WS_2 and MoS_2 ,

they have successfully fabricated nanodevices on flexible substrates. During the COVID-19 pandemic, the lab started developing hybrid-nanoparticle based coating, which will have both superhydrophobic and germicidal properties. They have successfully developed $\text{Ag}_2\text{O-SiO}_2$ based hybrid nanoparticle which shows strong photolysis properties.

Energy storage

Prof. Satishchandra Ogale's group carried out a comparative evaluation of certain phases with unique physical properties in terms of their functional properties for applications in microwave absorption and Li ion battery anode applications. The phases studied were bulk MAX phase, MXene, nanosize MAX (or NanoMAX), and MXene-N (derived by etching of NanoMAX). Thin (0.03 mm) composite paint coatings made with graphite and NanoMAX or MXene-N were found to exhibit much superior microwave absorption performance. The ease of solution-processability of these materials, arising from the surface functional groups, is promising for the application of these systems as thin paint coats on aircrafts and devices for stealth application. In the case of LIB application, the MXene-N sample is observed to perform the best as the LIB anode material among all the other samples. It shows 330 mA g^{-1} specific capacity at 100 mA g^{-1} current density with a high cycling stability of 1000 cycles. The reduced particle size due to ball-milling and overall defect surface chemistry enhance the battery performance. (*Nanoscale*, 12, 8466, 2020)

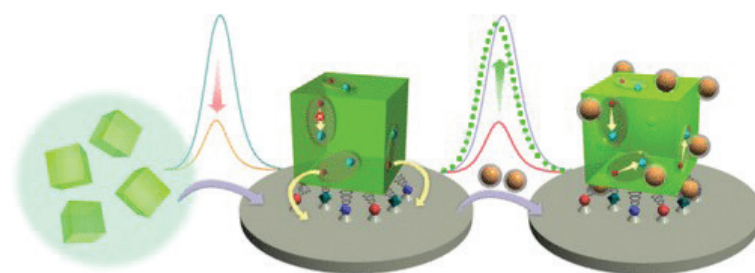


Figure 24: Schematic of a van der Waals heterostructure between all-inorganic CsPbBr_3 halide perovskite quantum dots (CPB QDs) and $\text{Ti}_3\text{C}_2\text{Tx}$ MXene (MXN) QDs and its analysis (Prof. Satishchandra Ogale)

Prof. Ogale's group synthetically integrated all-inorganic CsPbBr_3 perovskite QDs and $\text{Ti}_3\text{C}_2\text{Tx}$ MXene QDs into a nanocomposite. It is shown to cause significant quenching of PL intensity of perovskite QDs. The charge transfer effects relate well to the specifics of band alignment and hot electron and hole relaxations. Interestingly, introduction of Cd ions into the colloidal solution of the QD/QD composite recovers the PL intensity substantially and fairly linearly. Thus, the QD/QD system can serve as an excellent on–off–on PL probe for cadmium ion detection. It is further shown that the charge transfer from perovskite into the conducting MXene matrix presents it as an active material for photodetector application. (*ACS Applied Nano Materials*, 3, 3305, 2020)

3D carbide systems with their robust physical and mechanical properties have always attracted multiple application interests. Prof. Ogale's group synthesised a three-dimensional in-situ carbon coated cubic carbide, Vanadium Carbide (VC@C), by a simple, scalable and cost-effective room temperature mechano-chemical ball-milling procedure and researched its promise as effective anode material for Li and Na ion batteries. (*Carbon* 161, 108-116 (2020))

A Li-ion fuel cell study using LiCoO_2 as cathode also showed excellent promise in terms of practical application demonstrating a reversible capacity of 95 mAh g^{-1} after 100 cycles. Even for Na insertion/de-insertion VC@C shows a clear promise in terms of capacity, cyclic stability and rate performance.

Quantum magnetism

Highlights of research from Dr. Surjeet Singh's group during the year included: (i) understanding the structural and magnetic properties of trilayered nickelates $R_4Ni_3O_{10}$ ($R = La, Pr$ and Nd); and (ii) finding an unconventional magnetic state in the spin 1/2 pyrochlore iridate $Eu_2Ir_2O_7$. Under (i), besides providing comprehensive new details on the structural and magnetic properties of $R_4Ni_3O_{10}$, they give a simple interpretation of the large linear-term in the specific heat of $Nd_4Ni_3O_{10}$ based on the Schottky contribution due to low-lying crystal field levels. This which was misinterpreted in previous studies as arising due to a novel heavy Fermion ground state. Under (ii), they found a highly unconventional magnetic state wherein the growth of magnetic droplets (nucleated below T_N) is hindered due to the creation of magnetic hedgehog-like monopoles.

6.3 COSMOLOGY, PARTICLE PHYSICS, AND GRAVITY

Gravity and Yang-Mills

Attempts to quantize the gravitational force run into a range of issues and do not yield sensible predictions – producing infinity as the result of most calculations. Symmetries play a crucial role in physics since they often forbid the very processes responsible for these infinities. Prof. Sudarshan Ananth's work focused on examining the BMS symmetry. In particular, his group showed that the well understood Poincaré algebra could be extended to the BMS algebra. A key feature of their construction was the lack of any reference to asymptotic limits – making the symmetry valid in the bulk.

Experimental high energy physics

Dr. Sourabh Dube's group continued their analysis of data collected by the CMS experiment in 2016, 2017, and 2018. A model-independent search for physics beyond the standard model targeting three different models is underway – vector-like leptons, Type-III seesaw fermions, and Leptoquarks. The search has been bolstered by the addition of additional final states with more than one hadronically decaying tau, and by the use of multivariate algorithms.

Conformal field theory

Universal formulae were found for the correlation functions of a family of Conformal Field Theories, corresponding to Lie algebras in the Cvitanović-Deligne series. These theories have previously been argued to form coset pairs and new evidence was found for this property in the form of bilinear relations among products of 4-point functions in these models.

Using the Poincare series method, Prof. Sunil Mukhi computed partition functions of theories of gravity in three spacetime dimensions with a negative cosmological constant. These were found to be dual to averages over Rational Conformal Field Theories on the boundary. These are the first infinite families of unitary examples with this property. For the case of multiple boundaries, an approach was developed that reproduces both disconnected and connected contributions -- the latter corresponding to analogues of 3-manifold "wormholes" -- such that the expected average was correctly reproduced.

Probing new physics

Dr. Arun Thalappilil's research involved placing new bounds on beyond Standard Model physics and exotic particles through astrophysical and collider physics considerations. Along with collaborators, Dr. Thalappilil placed new constraints on neutrino charges from neutron star magnetic fields, weak gravity conjecture and terrestrial experiments. Astrophysical



manifestations of magnetically charged black holes were also investigated—from electromagnetic and gravitational wave emissions, Parker bounds on their abundance as dark matter, and computation of stable orbits. With collaborators, they also placed constraints on triple gluon effective operators by looking at top-pair production, and analysing distributions using Convolutional Neural Network techniques.

Gravitation and mathematical physics

Along with student Dhanya Menon, Dr. Suneeta Vardarajan studied nonlinear gravitational perturbations of Anti-de Sitter spacetime (AdS) in arbitrary dimensions. They followed the formalism by Ishibashi, Kodama and Seto to decompose the metric perturbations into tensor, vector and scalar sectors, and simplify the Einstein equations. The tensor perturbations are the new feature of higher dimensions and they were the first group to study them in weakly nonlinear perturbation theory on AdS spacetime. The team analyzed the resonant structure of the perturbed equations at second order for the five dimensional case, by a partial study of single mode tensor-type perturbations at the linear level. For the cases they studied, resonant terms vanish at second order.

With student Sreejith Nair, Dr. Suneeta Vardarajan is studying the black hole-black string phase transition in Einstein-Gauss-Bonnet gravity.



PUBLICATIONS AND PATENTS 2006-2020

Numbers in parenthesis are
for the calendar year 2020
TOTAL: 3334 (489)



586 (118)
BIOLOGY



1084 (117)
CHEMISTRY



67 (13)
EARTH AND
CLIMATE SCIENCE



32 (02)
HUMANITIES AND
SOCIAL SCIENCES



192 (43)
MATHEMATICS



1373 (196)
PHYSICS

Publications

IISER Pune has published a total of 3334 papers since inception to the end of 2020. During the 2020 calendar year, institute members published 489 research papers, 9 book chapters and 1 book.

The list of publications from IISER Pune members in the 2020 calendar year is given in the Appendix section of this report.

Patents

Since inception and as of December 31, 2020, IISER Pune has filed 45 patent applications, and had 34 published patents and 5 granted patents.

During the 2020 calendar year, IISER Pune filed 9 patent applications, had 10 patents published, and 1 patent granted.

PATENTS

Below is the list of patents filed / published / granted since inception to December 31, 2020.

Full list is being included here in the current annual report since this is the first time the list of filed and published patents is being reported in the annual report.

Updates pertaining to 2020 are shown through labels:



Filed in 2020



Published in 2020



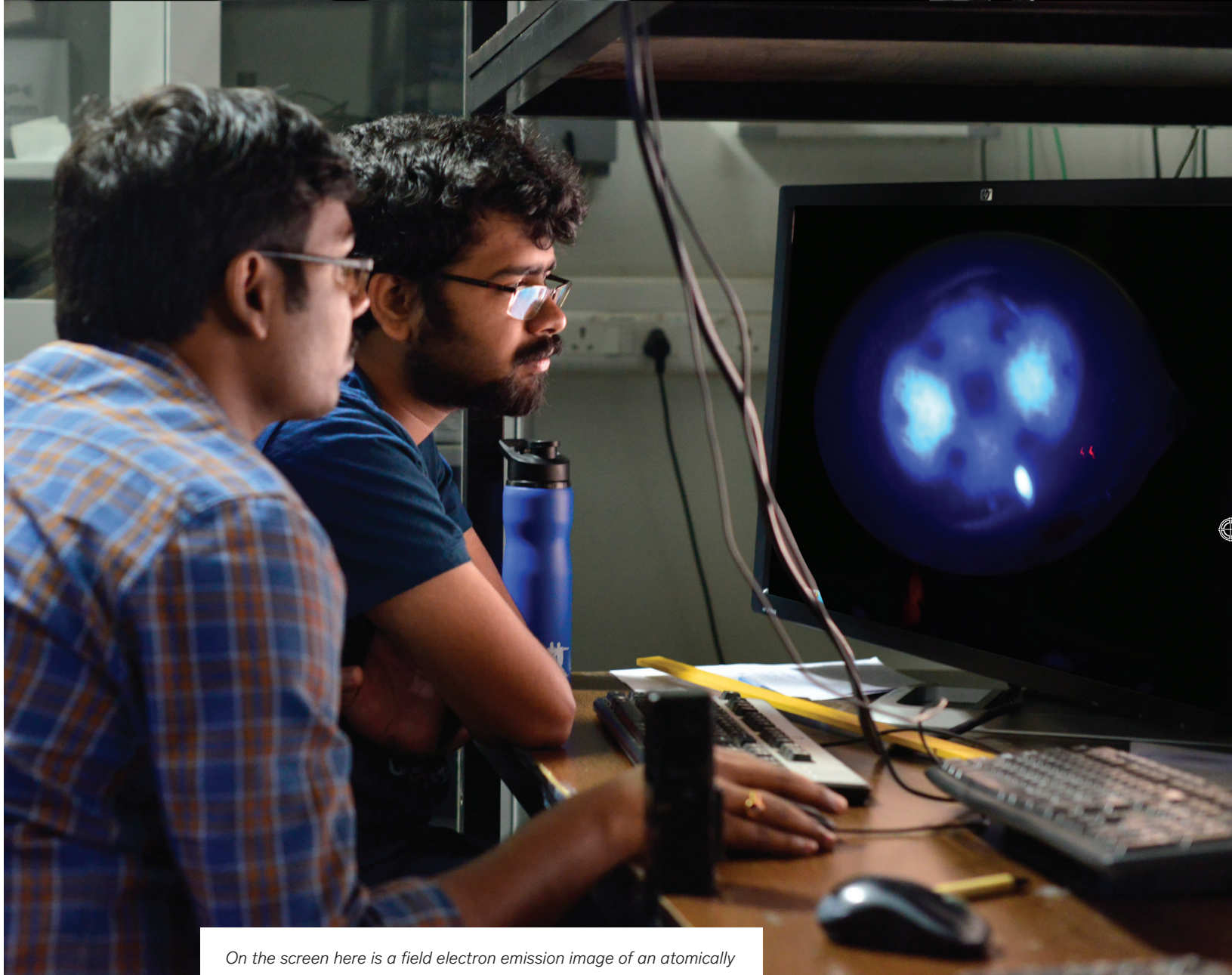
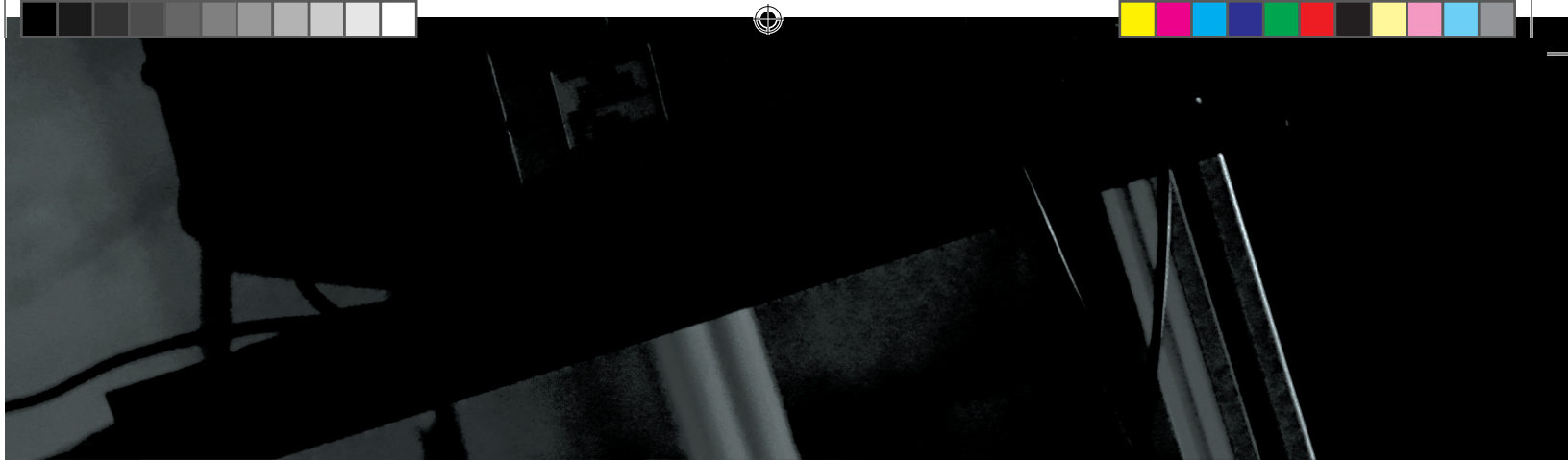
Granted in 2020

Sr. No.	Inventors	Title	Country and Patent Info
01	Chakrapani, Harinath; Malwal, Satish Ramesh	Thiol mediated/activated prodrugs of sulfur dioxide (SO ₂) having anti-bacterial activity	India Application No.: 3162/MUM/2012 Publication No: IN201203162I3
02	Chakrapani, Harinath; Malwal, Satish Ramesh	Thiol mediated/activated prodrugs of sulfur dioxide (SO ₂) having anti-bacterial activity	US Application No.: 13/690,842 Publication No.: US-2014-0121211-A1 Granted No: 9,079,870
03	Bhat, Ramakrishna Gopalkrishna; Mohite, Amar Ramchandra	Synthesis of α , β -unsaturated carboxylic acids and esters	India Application No.: 2437/MUM/2013 Publication No.: IN328495B Granted No.: 328495
04	Chaturvedi, Harsh; Sharma, Paritosh Kumar; Maheshwari, Neeraj Om	Process for separation of semiconducting and metallic single walled carbon nanotubes	India Application No.: 2513/MUM/2013 Publication No.: IN201302513I3
05	Ramanathan, Vaidhyanathan; Nandi, Shyamapada	Ultra-microporous metal organic frameworks based on isonicotinate and its derivatives for CO ₂ separation applications	India Application No.: 2381/MUM/2014 Publication No.: IN201402381I3
06	Hotha, Srinivas; Boddu, Vyankteswararao; Kumbhare, Sagar; Shah, Nisarg	Software Assisted Direct Extraction and Sampling Interface (SWADESI)	India Application No.: 562/MUM/2015 Publication No.: IN201500562I3
07	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
08	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
09	Ottakam Thotiyil, Muhammed Musthafa; Thimmappa, Ravikumar	Fuel and power producing galvanic cell	India Application No: 2898/MUM/2015 Publication No: IN201502898I3
10	Ramanathan, Vaidhyanathan; Mullangi, Dinesh; Nandi, Shyamapada	Covalent organic frameworks as porous supports for non-noble metal-based water splitting electrocatalysts	India Application No: 4301/MUM/2015 Publication No: IN201504301I3

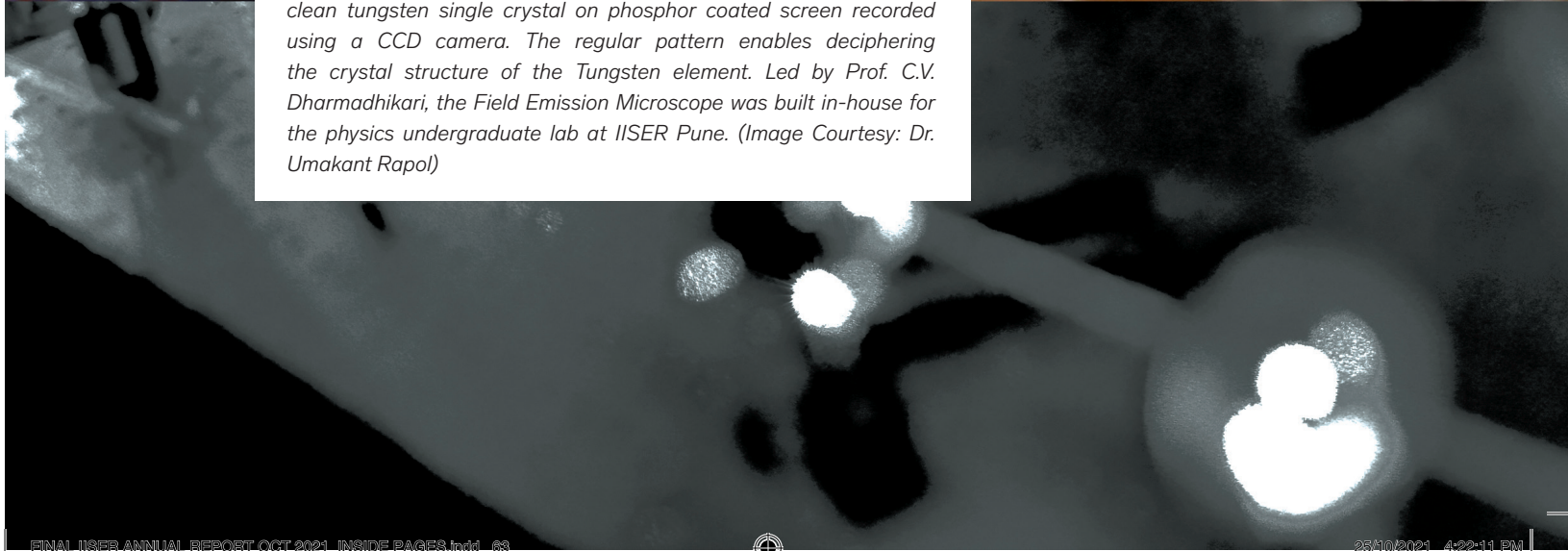
Sr. No.	Inventors	Title	Country and Patent Info
11	Ramanathan, Vaidhyanathan; Mullangi, Dinesh; Nandi, Shyamapada	Covalent organic frameworks as porous supports for non-noble metal-based water splitting electrocatalysts	US Application No.: 15/348,670; Publication No.: US-2017- 0130349-A1 Granted No.: 10,301,727
12	Britto, Sandanaraj Selvaraj; Reddy, Mullapudi Mohan; Bhandari, Pavankumar Janardhan; Rao, Kasuladevu Jagannadha	Hydrophobin mimics: Process for preparation thereof	India Application No.: 201621005378 Publication No.: IN201621005378A Granted No.: IN337949
13	Britto, Sandanaraj Selvaraj; Reddy, Mullapudi Mohan; Bhandari, Pavankumar Janardhan; Rao, Kasuladevu Jagannadha	Hydrophobin mimics: Process for preparation thereof	US Application No.: 15/435,055 Publication No.: US 2017-0231260 A1 Granted No.: 10,188,136
14	Ottakam Thotiyil, Muhammed Musthafa; Thimmappa, Ravikumar; Devendrachari, Mruthyunjayachari Chattanahalli; Aralekallu, Shambhulinga	Chemically chargeable photo battery	India Application No.: 201621010024 Publication No.: IN201621010024A
15	Jha, Plawan Kumar; Ballav, Nirmalya	A process for wet-chemical reduction of graphene oxide (GO) to reduced graphene oxide (RGO) for ultrahigh performance supercapacitor and energy storage applications	India Application No.: 201621023063 Publication No.: IN201621023063A
16	Ottakam Thotiyil, Musthafa; Thimmappa, Ravikumar; Devendrachari, Mruthyunjayachari Chattanahalli; Kottaichamy, Alagar Raja; Shafi, Shahid Pottachola	Precious metal free aqueous zinc battery with a freely diffusing electron acceptor	India Application No.: 201721000903 Publication No.: IN201721000903A
17	Halder, Sattwick; Roy, Kingshuk; Nandi, Shyamapada; Vaidhyanathan, Ramanathan	Self-exfoliated triazole-triformyl phloroglucinol based covalent organic nanosheets for high and reversible lithium ion storage	India Application No.: 201721019419 Publication No.: IN201721019419A
18	Halder, Sattwick; Roy, Kingshuk; Nandi, Shyamapada; Vaidhyanathan, Ramanathan	Self-exfoliated triazole-triformyl phloroglucinol based covalent organic nanosheets for high and reversible lithium ion storage	Korea Application No.: 10-2019-7037190 Publication No.: KR2020015566A
19	Halder, Sattwick; Roy, Kingshuk; Nandi, Shyamapada; Vaidhyanathan, Ramanathan	Self-exfoliated triazole-triformyl phloroglucinol based covalent organic nanosheets for high and reversible lithium ion storage	Japan Application No.: 2020-516978
20	Halder, Sattwick; Roy, Kingshuk; Nandi, Shyamapada; Vaidhyanathan, Ramanathan	Self-exfoliated triazole-triformyl phloroglucinol based covalent organic nanosheets for high and reversible lithium ion storage	US Application No.: 16/700,481 Publication No.: 10,981,925B2

Sr. No.	Inventors	Title	Country and Patent Info
21	Britto, Sandanaraj Selvaraj; Bhandari, Pavankumar Janardhan; Reddy, Mullapudi Mohan	Supramolecular protein assemblies with advanced functions and synthesis thereof	India Application No.: 201721034557 Publication No.: IN201721034557A
22	Britto, Sandanaraj Selvaraj; Bhandari, Pavankumar Janardhan; Reddy, Mullapudi Mohan	Supramolecular protein assemblies with advanced functions and synthesis thereof	US Application No.: 16/146,891 Publication No.: US20190134212A1
23	Britto, Sandanaraj Selvaraj; Bhandari, Pavankumar Janardhan; Reddy, Mullapudi Mohan	Generation-dependent supramolecular assemblies of protein-dendron conjugates	India Application No.: 201721044279 Publication No.: IN201721044279A
24	Britto, Sandanaraj Selvaraj; Bhandari, Pavankumar Janardhan; Reddy, Mullapudi Mohan	Generation-dependent supramolecular assemblies of protein-dendron conjugates	US Application No.: 16/771,124
25	Puthusseri, Dhanya; Wahid, Malik; Basu, Aniruddha; Ogale, Satishchandra Balkrishna	Doped carbon nano-onion film as scaffold for stabilizing lithium metal anode	India Application No.: 201821007031 Publication No.: IN201821007031A
26	Britto, Sandanaraj Selvaraj; Bathla, Punita	Imaging of enzyme activity with exquisite specificity using Activity based Reporter Gene Technology (AbRGT)	India Application No.: 201821016607 Publication No.: IN201821016607A
27	Britto, Sandanaraj Selvaraj; Bathla, Punita	Process for determining enzyme activity in a cell by Activity-based Reporter Gene Technology (AbRGT)	US Application No.: 16401906A Publication No.: US20190338373A1
28	Britto, Sandanaraj Selvaraj; Reddy, Mullapudi Mohan	Chemical method for synthesis of protein amphiphiles	India Application No.: 201821023023 Publication No.: IN201821023023A
29	Britto, Sandanaraj Selvaraj; Reddy, Mullapudi Mohan	Chemical method for synthesis of protein amphiphiles	US Application No.: 16/723,280 Publication No.: US20200199175A1
30	Halder, Sattwick; Chakraborty, Debanjan; Vaidhyanathan, Ramanathan	Covalent organic framework as flexible white light emitter	India Application No.: 201821028796
31	Galande, Sanjeev; Naik, Rutika	Combined expression pattern of SATB family chromatin organizers as improved biomarker tool for cancer prognosis	India Application No.: 201821029791 Publication No.: 201821029791A
32	David J. Hannapel; Anjan K. Banerjee	Nucleic acid constructs, plants with increased tuber yield, and methods for increasing tuber yield in a plant	US Application No.: 16/246321 Publication No.: US20190218565A1
33	Pandit, S.B. Ravi; Kshatriya, Tejas; Kelkar, Sarika; Suryawanshi, Anil; Gawli, Yogesh; Ogale, Satishchandra; Puthusseri, Dhanya	A high-power density sodium-ion battery	India Application No.: 201921007799 Publication No.: IN201921007799A

Sr. No.	Inventors	Title	Country and Patent Info
34	Hotha, Srinivas; Neralkar, Mahesh; Hotha, Sanjeev	Insect repellent	India Application No.: 201921017887 Publication No.: IN201921017887A
35	Ballav, Nirmalya; Prasoon, Anupam	Thin film metal-organic diodes with high electrical rectification ratio	India Application No.: 201921020782 Publication No.: IN201921020782A
36	Jose, Gregor; Pucadyil, Thomas	A novel bifunctional lipid probe for proximity labelling-based identification of membrane-associated proteins	India Application No.: 201921022074 Publication No.: IN201921022074A
37	Jose, Gregor; Pucadyil, Thomas	A novel bifunctional lipid probe for proximity labelling-based identification of membrane-associated proteins	US Application No.: 16/891373 Publication No.: US20200386764A1
38	Vaidhyanathan, Ramanathan	Covalent Organic Framework derived lightweight nanomagnets and a chemical method thereof	India Application No.: 202021004764
39	Haldar, Sattwick; Vaidhyanathan, Ramanathan	Method of tuning the electronic energy level of covalent organic framework for crafting high-rate Na-ion battery anode	India Application No.: 202021013731
40	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
41	Abraham, Nixon Mundathukudiyil	Olfactory-action meter for precise quantification of olfactory deficits	India Application No.: 202021035482
42	Hotha, Srinivas; Sutar, Yogesh; Walke, Gulab; Kasdekar, Niteshlal	Silver assisted gold catalysis for the preparation of fondaparinux pentasaccharide and intermediates	India Application No.: 202021050409
43	Sudhakaran Prabhakaran	Treatment of diseases associated with variant novel open reading frames	US Application No.: 63/123,454
44	Sudhakaran Prabhakaran	Treatment of cancer associated with dysregulated novel open reading frame products	US Application No.: 63/126,309
45	Sudhakaran Prabhakaran	Treatment of cancer associated with variant novel open reading frames (incl inhibitors)	US Application No.: 63/126,371



On the screen here is a field electron emission image of an atomically clean tungsten single crystal on phosphor coated screen recorded using a CCD camera. The regular pattern enables deciphering the crystal structure of the Tungsten element. Led by Prof. C.V. Dharmadhikari, the Field Emission Microscope was built in-house for the physics undergraduate lab at IISER Pune. (Image Courtesy: Dr. Umakant Rapol)



EXTRAMURAL GRANTS

IISER Pune faculty members have been consistently securing competitive research funds from various government science and technology departments. In the 2020–21 financial year, the institute has received Rs. 103.48 crores of research funds for 192 research projects.

The list of new extramural grants sanctioned during the 2020-21 financial year is given in the Appendix section of this report.

NEW PROJECTS SANCTIONED IN 2020–21

In the 2020–21 financial year, 55 new research projects have been initiated. Some of the high value projects include:

Inorganic organic hybrid solids as ion conduction membranes in charge storage devices - MHRD STARS: Awardee Dr. Ramanathan Vaidhyanathan; funded by MHRD

TCG-CREST Joint Centre for Sustainable Energy Project: Awardee Prof. Satishchandra Ogale; funded by the TCG CREST

Lanthanide doping in perovskite semiconductors: Visible to infrared electro-luminescence: Awardee Dr. Angshuman Nag, funded by the SERB

Superfluid spin transport in quantum antiferromagnets: Awardee Dr. Sunil Nair; funded by the SERB

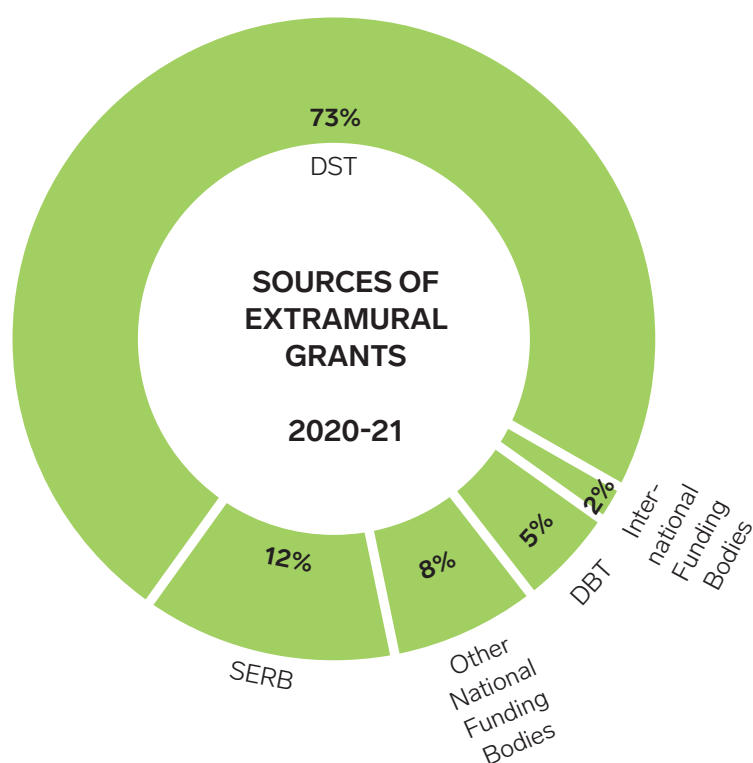
DST - FIST Program: Awardee Chemistry department- Dr. H.N. Gopi; funded by the DST

Transcription- translation uncoupling in bacteria: Dissecting the fundamental principles of a phenomenon unknown in bacteria: Awardee Dr. Sunish Radhakrishnan; funded by the SERB

Nuclear quantum effects on structural properties and dynamics at metal water interfaces: Coupling QMMM and Path Integral Molecular Dynamics: Awardee Dr. Prasenjit Ghosh; funded by the DST

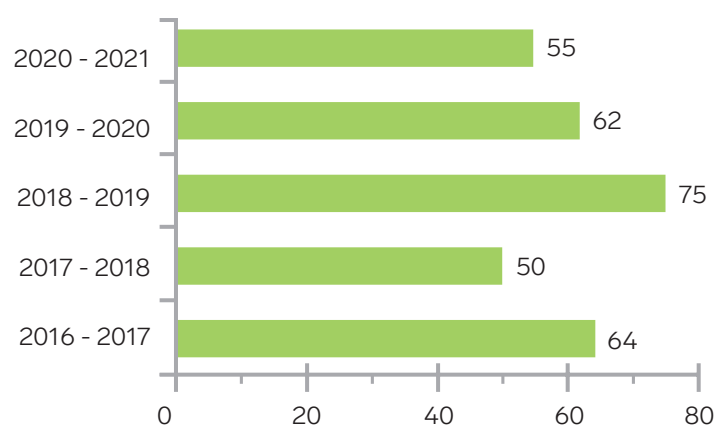
SOURCES OF EXTRAMURAL GRANTS, 2020-21

Majority of the funds received through extramural grants have been from government bodies, with research funds from DST contributing to 73%, followed by SERB (12%) and DBT (5%), of the research funds received (in 148 projects) in 2020–21. Funding from other Indian funding bodies (Wellcome Trust-DBT India Alliance, IFCPAR, MoES, MHRD, INSA, DRDO, DAE, IUCAA, etc) has contributed to 8% of funds for research in sectors such as education, defense, atomic energy, etc (in 36 projects). The international funding bodies (HHMI, IEEE, UEA, IUBS, EMBO, Swansea University, Max Planck, etc) have contributed to 2% of the total research funds (in 8 projects).



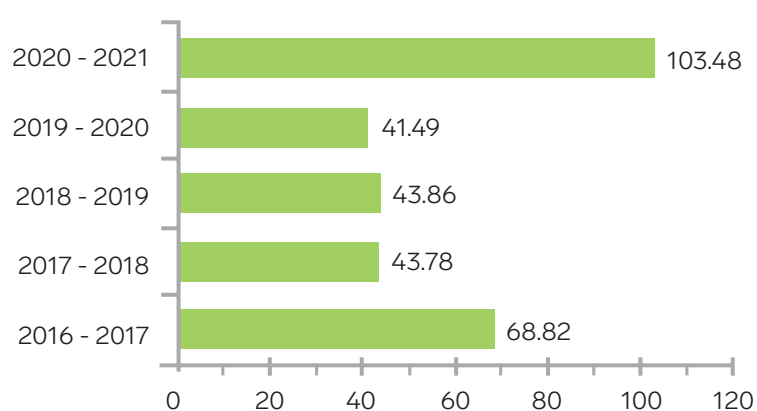
NUMBER OF NEW EXTRAMURAL GRANTS SANCTIONED

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



Prof. Anjan Banerjee

Professor

Elected as a Fellow of the Indian Academy of Sciences, Bengaluru; Elected as a Fellow of the National Academy of Sciences India, Prayagraj (Allahabad); and Awarded the Tata Innovation Fellowship 2020-21 by the Department of Biotechnology



Dr. Anup Biswas

Associate Professor

Selected as a Swarnajayanti Fellow by the Department of Science and Technology



Prof. Harinath Chakrapani

Professor

Selected to receive the 2021 CRSI Bronze Medal by the Chemical Research Society of India (CRSI); and won S. Ramachandran National Bioscience Award for Career Development for 2020-21 by the Department of Biotechnology



Dr. Partha Hazra

Associate Professor

Selected for Japan Society of Promotion of Science (JSPS) Invitation Fellowship for 2020 to stay and carry out collaborative research in Japan



Prof. M. Jayakannan

Professor

Selected as a Pioneering Investigator 2021 by Polymer Chemistry, an RSC Journal



Dr. Siddhesh S. Kamat

Associate Professor

Received CSIR-CDRI Award for Excellence in Drug Research (Life Science Category) for 2021



Dr. Shabana Khan

Associate Professor

Received the DST's 2021 Science and Engineering Research Board (SERB) POWER Fellowship; Received Humboldt Experienced Researcher Fellowship (2020)



Dr. Moumita Majumdar

Associate Professor

Named as ChemComm 2020 Emerging Investigator



Dr. Nishad Matange
Assistant Professor
 Awarded Intermediate
 Fellowship of DBT/Wellcome
 Trust India Alliance



Dr. Joy Merwin Monteiro
Assistant Professor
 Invited to be Member
 of the Editorial Board of
 Communications Earth and
 Environment (October 2020 -)



Dr. Angshuman Nag
Associate Professor
 Selected as a Swarnajayanti
 Fellow by the Department of
 Science and Technology



Dr. Rejish Nath
Associate Professor
 Selected as a Swarnajayanti
 Fellow by the Department of
 Science and Technology



Prof. Thomas Pucadyil
Professor
 Elected as a Fellow of the
 Indian Academy of Sciences,
 Bengaluru; and Elected as a
 Fellow of the Indian National
 Science Academy, New Delhi



**Dr. Sunish Kumar
 Radhakrishnan**
Associate Professor
 Awarded Senior Fellowship
 of DBT/Wellcome Trust India
 Alliance



Dr. Sudipta Sarkar
Assistant Professor
 Elected as a Fellow of
 Geological Society of London,
 U.K.



Dr. Seema Sharma
Associate Professor
 Elected as a Fellow of the
 Indian Academy of Sciences,
 Bengaluru



Dr. Sreejith G.J.
Assistant Professor
 Awarded Young Scientist
 Medal for 2020, Indian
 National Science Academy,
 New Delhi



Prof. S.G. Srivatsan
Professor
 Received Sun Pharma
 Research Award in
 Pharmaceutical Sciences
 2020; Received National Prize
 for Research on Chemistry of
 Peptides and Nucleic Acids
 2020 sponsored by Prof. CNR
 Rao Education Foundation;
 Bronze Medal for 2020 of the
 Chemical Research Society of
 India (CRSI)

MEMBERSHIPS AND AFFILIATIONS

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

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

Sudarshan Ananth Member, National Academy of Sciences India (NASI) (since 2013)

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

Vineeta Bal Member, COVID-19 related committees constituted by DBT/BIRAC/National BioPharma Mission: COVID-19 Vaccine Expert Committee; COVID Suraksha Mission - Scientific Advisory Group; APEX Committee for COVID Suraksha Mission; INSACOG on Indian SARS-CoV2 genome sequencing; COVID-19 Task Force, SERB, Gol; Member, Senior and Intermediate Fellowship Programme of DBT-Wellcome Trust India Alliance (until November 2020); Member, Finance Committee and Member, Governing Body, National Centre for Cell Sciences, Pune; Member, Governing Body, Eklavya Foundation, Bhopal; Member, Human Ethics Committee, Indian Law Society, Pune

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

Argha Banerjee Scientific Editor, *Journal of Glaciology*

Deepak Barua Associate Editor, *Journal of Ecology*, 2017- present

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

Ramakrishna G. Bhat Treasurer, Royal Society of India (RSC); Life Member, Chemical Research Society of India

Bejoy Thomas Adjunct Fellow, Ashoka Trust for Research in Ecology and the Environment (ATREE), Bengaluru

Anup Biswas Life Member, Indian Society of Industrial and Applied Mathematics (ISIAM); Life Member of IISA (International Indian Statistical Association); Editorial Board Member, *Annals of Applied Probability*; Editorial Board Member, *Pure and Applied Functional Analysis*

Devapriya Chattopadhyay Scientific Editor, *Ameghiniana* (2020-Present)

Srabanti Chaudhury Associate Editor, *Frontiers in Physics* (Biophysics section); Life Member of Polymer Society India; Life Member of CRSI India

Anisa Chorwadwala IMU-CWM (International Mathematical Union - Committee for Women in Mathematics) Ambassador since August, 2016; Member, Executive Committee, Indian Women and Mathematics (since 2015); Board of Studies in Mathematics of MCE Society's Abeda Inamdar Senior College of Arts Science and Commerce, Pune (since March 2021); Board of Studies (BoS) of the Department of Mathematics and Statistics of Guru Nanak Khalsa College of Arts, Science and Commerce, Matunga, Mumbai (for the 2019-2020 academic year); Board of Studies (BOS) of SIES College of Arts, Science and Commerce, Sion (W), Mumbai as subject expert in Mathematics (since June 2018)

Jeetender Chugh Executive Committee Member, Indian Biophysical Society (IBS), India, 2019–2022; Executive Committee Member, National Magnetic Resonance Society (NMRS), India, 2019–2022; Selected as first President of the India-Sakura Science Club Alumni Association (ISAA); Life Member, Indian Biophysical Society (IBS), India; Life Member, National Magnetic Resonance Society (NMRS), India

Aloke Das Steering Committee Member, Asian Spectroscopy Conference, 2021-2025

Arjun Datta Member, American Geophysical Union

Rahul Dehiya Active Membership of Society of Exploration Geophysicist

Sutirth Dey Editorial Board Member, *Dialogue: Science, Scientists and Society*; Founding Member and Member of the Executive Council, Indian Society of Evolutionary Biologists; Associate Editor, *Evolution* (2021-2024)

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

Sourabh Dube Member, CMS Collaboration, CERN, Geneva; Member, India-CMS Collaboration; Member, Indian Association of Physics Teachers; Chief Editor, *Physics Education* (An IAPT Journal); Member, Board of Studies, Fergusson College, Pune

Sanjeev Galande Fellow, Indian Academy of Sciences, Bengaluru; Fellow, Indian National Science Academy, New Delhi; Fellow, National Academy of Sciences India, Allahabad; Editorial Board Member, *Genes and Genetic Systems*; Editor, *Zoology*; Advisor, *Trends in Genetics*

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

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

Sujit K. Ghosh Advisory Board, *ChemCommun*; International Advisory Board, *ChemPlusChem*; Life Member, Chemical Research Society of India; Life Member, Materials Research Society of India (MRSI); Life Member, Society of Materials Chemistry (SMC), India

Boopathy Gnanaprakasam Regular Member, Flow Chemistry Society, Switzerland (2020–2022); Life Member, Chemical Research Society of India; Life Member, Humboldt Academy, Pune Chapter

Partha Hazra Editorial Board Member, *Scientific Reports* (since January 2017); Life Member, Chemical Research Society of India

Sreejith G.J. Member, American Physical Society

M. Jayakannan Editorial Advisory Board Member, *Biomacromolecules* (ACS journal), January 2021; Editorial Advisory Board Member, *ACS Applied Polymeric Materials*, February 2021; Editorial Advisory Board Member, *ACS Polymers Au*, April 2021; Expert Member, Project Advisor Committee, Inorganic and Physical Chemistry, SERB, India; Expert Member, Project Advisor Committee, TERI Scheme, SERB, New Delhi; Expert Member, Project Advisor Committee, HEMRL, DRDO, Pune

Siddhesh S. Kamat Adjunct Faculty, Department of Biological Sciences, Tata Institute of Fundamental Research (TIFR), Mumbai (May 2020 onwards); Core Member (Proteomics Vertical), Indian Cancer Genome Atlas Initiative (August 2020 onwards)

Krishanpal Karmodiya Member, Malaria Research and Reference Reagent Resource Center (MR4); Editorial Board Member, *Scientific Reports*; Member, The Indian Society for Parasitology

Shabana Khan Editorial Advisory Board, *Organometallics*; Life Member of CRSI, India

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

Joy Merwin Monteiro Editorial Board Member, *Communications Earth and Environment* (October 2020 onwards); Review Editor, *Frontiers in Climate Services* (March 2021 onwards)

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

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

Angshuman Nag Editorial Advisory Board Member, *Nano Letters*; Editorial Advisory Board Member, *Chemistry of Materials*; Member, Chemical Research Society of India (CRSI)

A.A. Natu DAAD Research Ambassador; Editorial Board Member, *Indian Drugs*; Chairperson, Board of Governors, IISER Kolkata; Chairperson (Additional Charge), Board of Governors, IISER Thiruvananthapuram

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

Gayathri Pananghat Review Editor, *Frontiers in Molecular Biosciences* for the specialty section "Structural Biology" from June 2020

G.V. Pavan Kumar Elected Senior Member, Optical Society of America; Guest Editor, Special Issue on Advances in Optics in India, *Journal of Optics*

Thomas Pucadyil Fellow, Indian Academy of Sciences; Fellow, Indian National Science Academy; Editorial Board Member, *Traffic*; Guest Editor, *Current Opinions in Cell Biology – Membrane Trafficking Series* for 2021

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

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

Atikur Rahman Guest Editor, Special topic on hybrid 2D materials, *Frontiers in Physics*

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

Raghav Rajan Member, Society for Neuroscience

Umakant Rapol Editorial Board Member, *EPJ Quantum Technology*

Satyajit Rath Guest Faculty (2021), Ashoka University, Sonapat; Adjunct Faculty Member, Translational Health Science and Technology Institute (THSTI), Faridabad (since 2009); Adviser, Diabetes Unit, KEM Hospital Research Centre, Pune, India (2019-2020); Senior Editor, *eLife*; Editorial Board Member, *Clinical and Translational Immunology*; Editorial Board Member, *Immunotherapy Advances*; Non-Executive Director, Ahammune Biosciences Private Limited, Pune; Scientific Advisory Board Member, Curadev Pharma Private Limited, Noida; Scientific Advisory Board Member, Mynvax Private Limited, Bengaluru

Girish Ratnaparkhi Subject Editor, Biochemistry & Genetics, *Current Science*; Guest Editor, *Frontiers in Cell and Developmental Biology*

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

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

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

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

Surjeet Singh Member, National Committee IUCr; Member of the Board of Subjects, Vishwakarma Institute of Information Technology, Pune; Member of the Board of Studies for Engineering Sciences, Vishwakarma University, Pune

Kaneenika Sinha Corresponding Editor, *Bhāvanā: The Mathematics Magazine*; Editorial Board Member, *Resonance: Journal of Science Education* (Indian Academy of Sciences)

S. Sivaram Elected Fellow, Indian National Science Academy; Indian Academy of Science; National Academy of Science; Indian National Academy of Engineering; Indian Institute of Chemical Engineering; Elected Fellow, The World Academy of Sciences (TWAS), Trieste, Italy; Honorary Professor, Indian Institute of Science Education and Research, Mohanpur, Kolkata; Chair Professor of Eminence in Polymer Science, Somaiya College of Science and Commerce, Mumbai, India; Visiting Professor, Center for Rapid and Sustainable Product Development, Polytecnico de Leiria, Marinha Grande, Leiria, Portugal, 2018-22; Scientific Advisory Boards: Vyome Therapeutics Limited, New Delhi (Chair), Apollo Tyres Limited, Gurgaon, Asian Paints Limited, Mumbai; Praj Matrix, Praj Industries, Pune; Reimagining Innovation and Science Policy (CRISP), Mumbai; CO₂ India Network, Mumbai; Science Alliance for Environment (SAFE), Mumbai; Consultant: TCG Life Sciences Limited & Haldia Petrochemicals Limited Kolkata; Expanded Polymer Systems, Mumbai; Aquapharm Chemicals Ltd., Pune, Atul Chemicals Ltd, Atul, Gujarat; Reliance technology Group, Navi Mumbai; Chairman, Search-cum-Selection Committee, of the J.C. Bose and Ramanujan Fellowships, SERB, Government of India, 2021-24; Chairman, Screening Committee, CSIR Diamond Jubilee Technology Award, 2020, CSIR, New Delhi, 2021; Chairman, Monitoring Committee, CSIR-NMITLI Project on the 'Development of Innovative eco-friendly / formaldehyde free fluorescent pigments for vast array of water and solvent based applications', CSIR, New Delhi, 2021-22; Chairman, Research Advisory Committee, CSIR-Central Salt & Marine Chemicals Research Institute, Bhavnagar, 2020-2023; Chairman, Board of Studies, Applied and Interdisciplinary Sciences Programme, The Indian Association for the Cultivation of Science, Kolkata, 2021-24; Chairman, Programme Advisory Committee, IMPRINT-IIC 2 (Consortium Mode), SERB, Government of India, 2021-22; Chairman, Peer Review Committee, Discipline of Chemistry, Indian Institute of Technology, Palakkad, 2021-2022; Chairman, Programme Advisory Committee, Domain: VIII. Manufacturing Technology, Imprint-2, SERB, DST and MHRD, Government of India, 2018-20; Chairman, Board of Studies, Post graduate Course in Polymer Science, Somaiya Vidyavihar, Mumbai, 2019- ; Chairman of The Jury, Chemical Sciences and Technology, Vasvik Awards (2011-Present); Chairman, Expert Group on Project Mission, "Coal to Methanol", CSIR, New Delhi, 2020; Chairman, SUPRA Project Advisory Committee, DST-SERB, New Delhi, 2019-21; Chairman, Review Committee of Ramanujam Fellows, DST-SERB, New Delhi, 2019-21; Member, Programme Advisory Committee, Chemical and Environmental Engineering, SERB, Government of India, 2021-24; Member of the Jury, Goyal Prize in Applied Sciences, Kurukshetra University, Kurukshetra, Haryana, 2020-2021; Member, Search-cum-Selection Committee of the J.C. Bose and Ramanujan Fellowships, SERB, Government of India, 2018-21; Member, INSPIRE Faculty Fellows in Engineering Sciences Selection Committee, Indian National Science Academy, New Delhi, 2021; Advisor, External Research Advisory Committee, Indian Institute of Technology, Guwahati, 2020-23.; Member, Screening and Expert Committee to Review and Recommend Facility Creation Projects, CSIR, New Delhi, 2021; Member Sub-Committee, CSIR Laboratory-Industry Interaction, CSIR Reorientation Committee, 2020-21; Member, High Level Committee, CSIR-Diamond Jubilee Technology Awards, 2020; Member, Advisory Committee, CIPET, Chennai, Department of Chemicals and Petrochemicals, Government of India, 2020-2022; Member, CSIR High-Level Committee to Suggest Integration of Laboratories under the Information Sciences Area, CSIR, New Delhi, 2020; Member, MSc Curriculum Development Committee, IIT-Palakkad (2018-20); Member, Abdul Kalam National Fellow Selection Committee, INAE-SERB, New Delhi, 2017-2023; Member, National Advisory Committee, Technical Research Center, Jawaharlal Nehru Center for Advanced Scientific Research, Bangalore (2017-21); Member, Faculty Promotions and Assessment Committee, Indian Institute of Science, Bangalore, 2010-22

Sudipta Sarkar Elected as a Fellow of Geological Society of London; Associate Member, European Association of Geoscientists and Engineers (EAGE); Member of Society of Exploration Geophysicists; Member of European Association of Geoscientists and Engineers

Kundan Sengupta Associate Editor, Section: Nuclear Organization and Dynamics, *Frontiers in Cell and Developmental Biology*; Editorial Board, Associate Editor, *Journal of Biosciences*; Handling Editor, *Science Matters*

Pushkar Sohoni Associate Editor, *South Asian Studies* (journal of the British Association of South Asian Studies; since 2016); Member, Committee for Professional Equivalence in Architecture (Department of Science and Technology), Savitribai Phule Pune University (SPPU), Pune (since 2019); Member, Board of Studies, Department of Architecture, Vishwakarma University, Pune (since 2019); Member, Board of Studies, Architecture (Department of Science and Technology), Savitribai Phule Pune University (SPPU), Pune (since 2018); Life Member: Bombay Natural History Society; Friends of Museum Society, L.D. Museum, Ahmedabad; Indian National Trust for Art and Cultural Heritage (INTACH), Pune Chapter, India; Green College, University of British Columbia, Vancouver, Canada; Bhandarkar Oriental Research Institute (BORI), Pune, India; Council of Architecture, India

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

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

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

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

Arun Venkatnathan Member, Chemical Research Society of India; Member, Indian Society for Radiation and Photochemical Sciences; Member, American Chemical Society; Life Member, Society for Polymer Science, India

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 2020–2021 is given in the Appendix section of this report.





Academic Programmes

PhD Programme	76
Integrated PhD Programme	81
BS-MS Programme	85
List of Courses	93



PhD PROGRAMME

PhD STUDENT NUMBERS
ACROSS DEPARTMENTS
as on March 31, 2021
TOTAL: 382



111

BIOLOGY



148

CHEMISTRY



23

EARTH AND
CLIMATE SCIENCE



11

HUMANITIES AND
SOCIAL SCIENCES



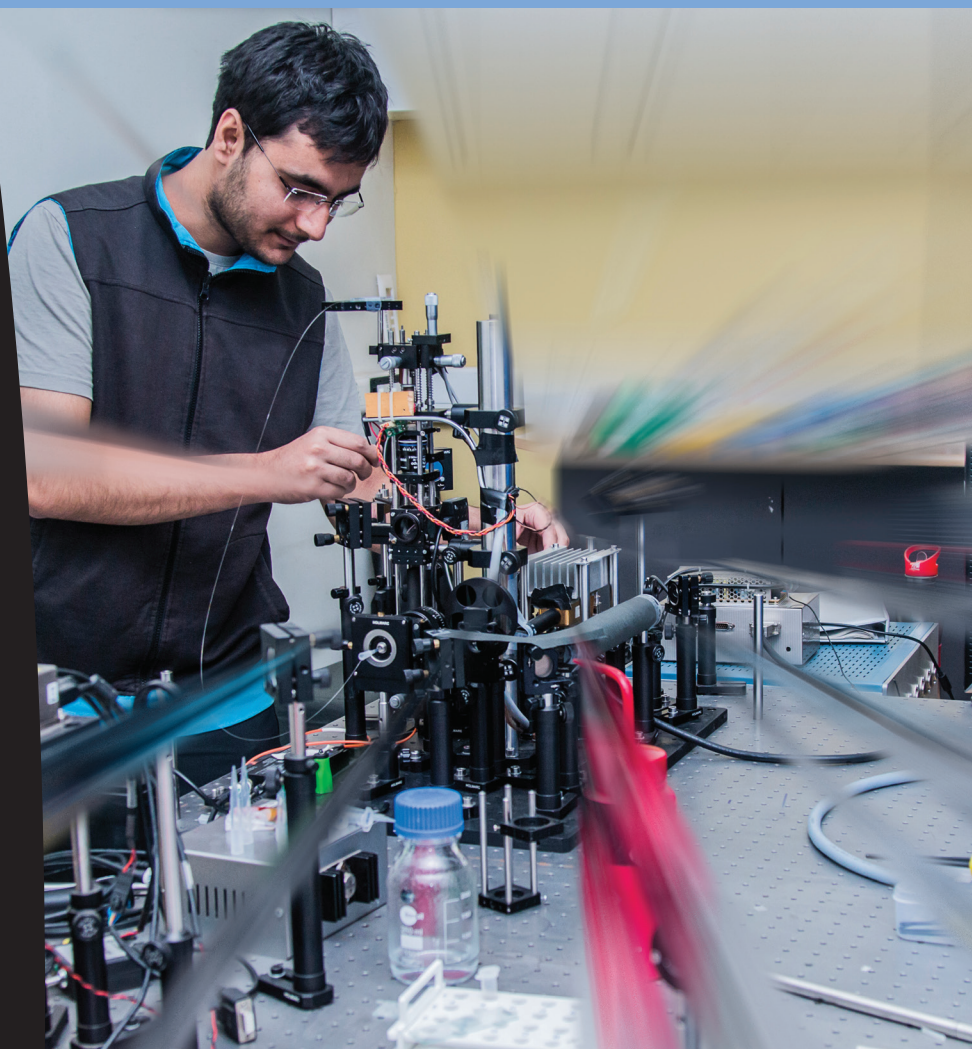
26

MATHEMATICS



63

PHYSICS



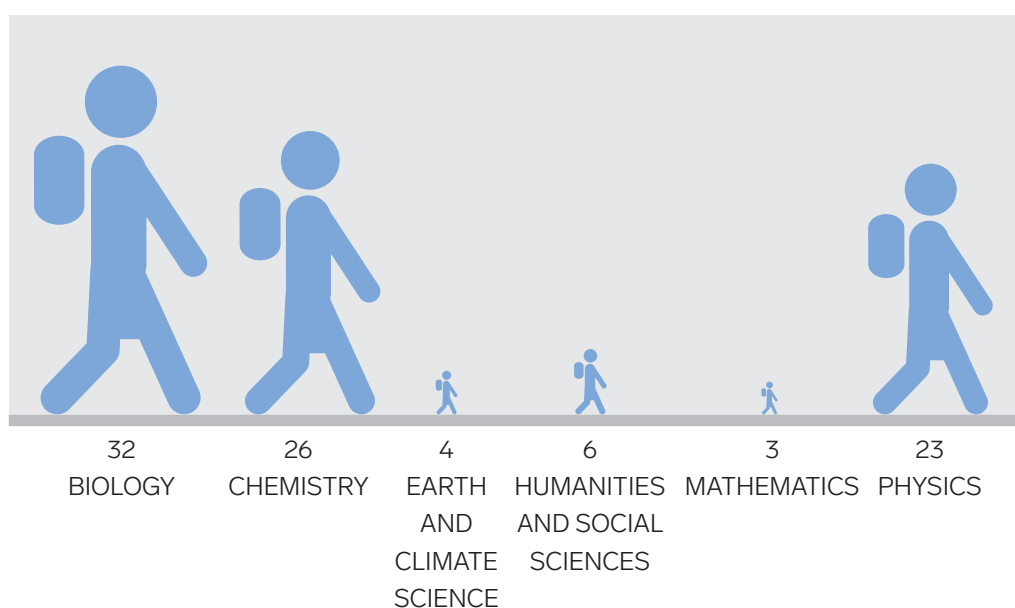
PhD students are the main driving force in the research programmes at the Institute. The PhD programme has a year-long coursework before the research work begins. Admission to PhD programmes at the Institute is through national-level tests followed by interviews conducted separately for each department.



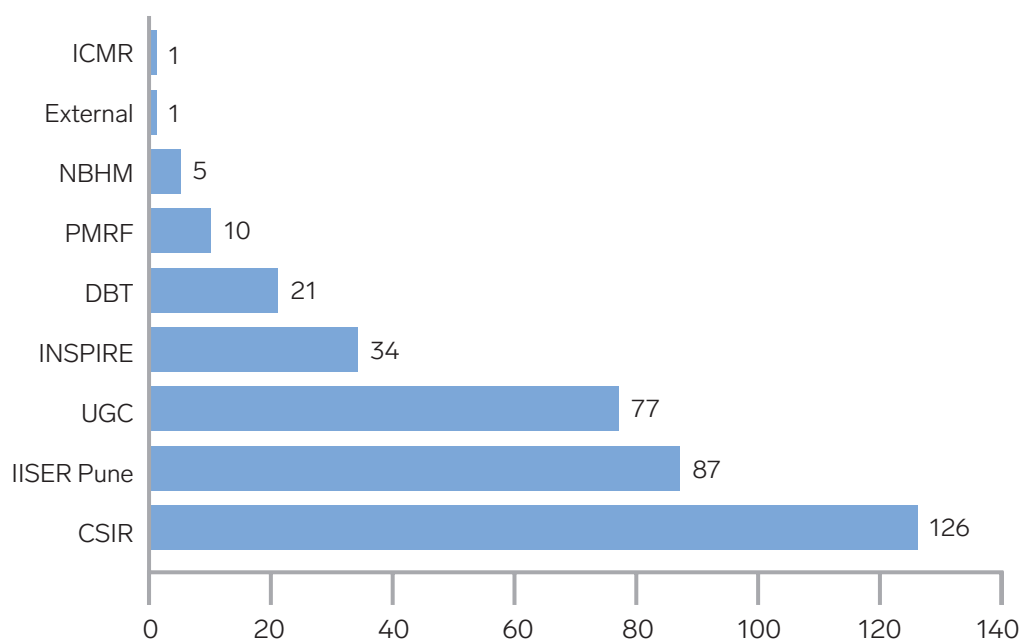
During the August 2020 and January 2021 admission sessions, 94 (Men 59, Women 35) PhD students were admitted to the PhD programme: 32 (Men 12, Women 20) in Biology, 26 (Men 18, Women 08) in Chemistry, 04 (Men 03, Women 01) in Earth and Climate Science, 06 (Men 03, Women 03) in Humanities and Social Sciences, 03 (Men 03) in Mathematics, and 23 (Men 20, Women 03) in Physics. The list of enrolled students is available on the IISER Pune website. The strength of PhD students at the Institute as of March 31, 2021 is 382 (Men 232, Women 150). Student numbers across departments: 111 (Men 50, Women 61) in Biology, 148 (Men 96, Women 52) in Chemistry, 23 (Men 17, Women 06) in Earth and Climate Science, 11 (Men 02, Women 09) in Humanities and Social Sciences, 26 (Men 21, Women 05) in Mathematics, and 63 (Men 46, Women 17) in Physics.

PhD STUDENT ENROLLMENT DURING AUGUST 2020 AND JANUARY 2021 SESSIONS

The subject-wise distribution of the 94 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, 2021

Gender	GE	OBC	SC	ST	PD	EWS	Total
Men	165	40	15	2	5	5	232
Women	116	24	7	1	0	2	150
Total	281	64	22	3	5	7	382

During the May 2020 and January 2021 rounds of selection for the Prime Minister's Research Fellowship (PMRF), eight PhD students were selected to receive the fellowship: Ankit Kumar (Physics); Ajinkya Ramdas Gaikwad (Mathematics); Achyuth Venugopal (Earth and Climate Science); Bhawakshi Punia (Chemistry); Anushka Kaushik (Chemistry); Cavya Jose (Chemistry); Swagata Dutta (Chemistry); and Ritam Pal (Physics)

Due to the COVID-19 pandemic during the year, travel for the purpose of participating in conferences or research work has been minimal, even as students attended some of the international conferences online. Two PhD students secured **travel grants for carrying out collaborative research work**. The funding agencies they received support from were UKIERI and EMBO.

Considering the pandemic situation, to celebrate the graduation of students, a Valedictory Ceremony was held on November 20, 2020, in lieu of the 9th Convocation. During this ceremony, **55 students were conferred PhD degree**.

The following 36 students have successfully completed their requirements for the award of PhD degree (completed thesis defense between April 1, 2020 and March 31, 2021). Of these, 14 students have received their degrees as well in the Valedictory Ceremony of November 20, 2020.

Sr. No.	Student	Department	Advisor	Thesis Title
01	Paithankar Harshad Vaijanath 20143299	Chemistry	Jeetender Chugh	Dynamics-based recognition mechanism of dsRBD-dsRNA interaction
02	Javid Ahmad Malla 20153373	Chemistry	Pinaki Talukdar	Development of supramolecular non-gated and stimuli-responsive channels for selective ion transport and chemotherapeutic applications
03	Ambhore Madan Digambar 20143325	Chemistry	V.G. Anand	Exploring redox chemistry, conformational dynamics and diradical properties of expanded porphyrinoids
04	T. Vijayakanth 20143306	Chemistry	R. Boomi Shankar	Organo and amino phosphonium cation derived ferro and piezoelectric materials and their utility in mechanical energy harvesting applications
05	Debanjan Chakraborty 20153365	Chemistry	Ramanathan Vaidhyanathan	Porous framework materials for gas separation and catalysis
06	Rajasekar P. 20143300	Chemistry	R. Boomi Shankar	Syntheses and functional studies of chiral metal-organic cages and supramolecular assemblies derived from imido and amido P(V) scaffolds

Sr. No.	Student	Department	Advisor	Thesis Title
07	Phanse Advait Sudhir 20143347	Mathematics	Tejas Kalelkar	Pachner moves on geometric triangulations
08	K. Veeresh 20143295	Chemistry	Hosahudya N. Gopi	Exploring structural and chemical reactivity of γ -amino acids in the design of peptide foldamers and small molecule peptidomimetics
09	Soumendu Roy 20153383	Chemistry	Pramod Pillai	Regulation of nanoparticle - reactant interaction outplays ligand poisoning in metal nanoparticle catalyzed reactions
10	Aakanksha Kapoor 20143349	Physics	Ashna Bajpai	Encapsulation of functional magnetic-oxides inside carbon nanotubes
11	Mohan M. 20143333	Chemistry	Britto S. Sandanaraj	Rational design, synthesis and self-assembly studies of Facially Amphiphilic Proteins (FAPs)
12	Bhandari Pavankumar Janardan 20143335	Chemistry	Sandanaraj Britto	Design, synthesis, self-assembly, and dis-assembly studies of monodisperse protein-dendron conjugates
13	Bhingardeve Pramod Prabhakar 20143338	Chemistry	Krishna N. Ganesh	Peptide Nucleic Acid (PNA)-GalNAc conjugates for targeted cellular delivery and Cy (S/R)-Janus PNAs for double duplex formation with cDNA
14	Unni Manu Krishnan 20113147	Biology	Sanjeev Galande	Regulation of <i>Hydra</i> regeneration by hippo pathway effector YAP and biomechanical forces
15	Chinmayee Mishra 20143351	Physics	Rejish Nath	Dipole orientation induced effects in dipolar Bose-Einstein condensates
16	Walunj Manisha Balasaheb 20143327	Chemistry	S.G. Srivatsan	Postsynthetic modification of nucleic acids and generation of nucleoside supramolecular synthons by palladium-mediated reactions
17	Abhishek Mishra 20153395	Biology	Sutirth Dey	Investigation of dispersal ecology and evolution using laboratory populations of <i>Drosophila melanogaster</i>
18	Gulab Sudam Walke 20153376	Chemistry	Srinivas Hotha	Exploration of silver-assisted gold catalysis for the synthesis of anticoagulant heparin pentasaccharide and a heptasaccharide of <i>Mycobacterium tuberculosis</i> cell surface
19	Sattwick Halder 20153405	Chemistry	Ramanathan Vaidhyathan	Molecular level tuning of redox-active 2D-Covalent organic frameworks for energy storage
20	Manidipa Pal 20123165	Mathematics	Baskar Balasubramanyam	Automorphic forms and L-functions for symplectic groups of genus 3
21	Samraj Mollick 20153362	Chemistry	Sujit K. Ghosh	Advanced Porous Materials (APMs) as host to develop composite materials: Stability and functional studies
22	Sanket Sandeep Nagarkar 20153357	Biology	L.S. Shahsidhara	Identification and characterization of novel tumor suppressors using in vivo tumor model in <i>Drosophila melanogaster</i>

Sr. No.	Student	Department	Advisor	Thesis Title
23	Raut Ravindra Krushnaji 20153361	Chemistry	Moumita Majumdar	Synthesis and characterization of novel low-valent compounds of main group elements: Application in organic transformations
24	Devatha Gayathri 20153379	Chemistry	Pramod P. Pillai	Surface ligand controlled photophysics and photopatterning with InP/ZnS quantum dots
25	Madhumita Chakladar 20143312	Biology	L.S. Shashidhara	Negative growth regulatory role of PTPN11/ SHP2 in breast epithelial tumorigenesis
26	Shweta Tendulkar 20143317	Biology	Girish Ratnaparkhi	Understanding amyotrophic lateral sclerosis using the <i>Drosophila</i> tripartite synapse
27	Inchanalkar Siddhi Maruti Neelam 20143318	Biology	Nagaraj Balasubramanian	Adhesion dependent regulation of Aurora Kinase A and its role in RalA mediated anchorage-independence
28	Avirup De 20133278	Physics	Sunil Nair	Interplay between spin, heat, and charge currents in strongly correlated systems
29	Nasrina Parvin 20153368	Chemistry	Shabana Khan	Silylene: Application as an alluring ligand in transition metals and catalysis
30	Saleem Yousf 20153380	Chemistry	Jeetender Chugh	Applications of NMR-based metabolomics: From cells to human body fluids to food
31	Joshi Niharika Hemant 20143294	Chemistry	Prasenjit Ghosh	First principles investigations of layered materials and their interaction with support
32	Alagar Raja K. 20153382	Chemistry	Muhammed Musthafa	Isomerism-activity relation in molecular electrocatalysis and molecular charge storage
33	Chethan D.S. 20143293	Chemistry	Raghavendra Kikkeri	Deciphering structure-functional relationship of heparan sulfate using iduronic acid glycans
34	C.S. Sudheer Kumar 20133285	Physics	T.S. Mahesh	Exploring quantum foundations by NMR: Quantum correlations and measurements
35	Akula Naveenkumar 20153363	Chemistry	Moumita Majumdar	Preparation of main group- and transition metal- graphenic nanocomposites for energy applications
36	Divya Singh 20153406	Chemistry	Srabanti Chaudhury	Probing dynamic disorder in the single-molecule event statistics

INTEGRATED PhD PROGRAMME

INTEGRATED PhD
STUDENT NUMBERS
ACROSS DEPARTMENTS
as on March 31, 2021
TOTAL: 201



77
BIOLOGY



53
CHEMISTRY



18
MATHEMATICS



53
PHYSICS

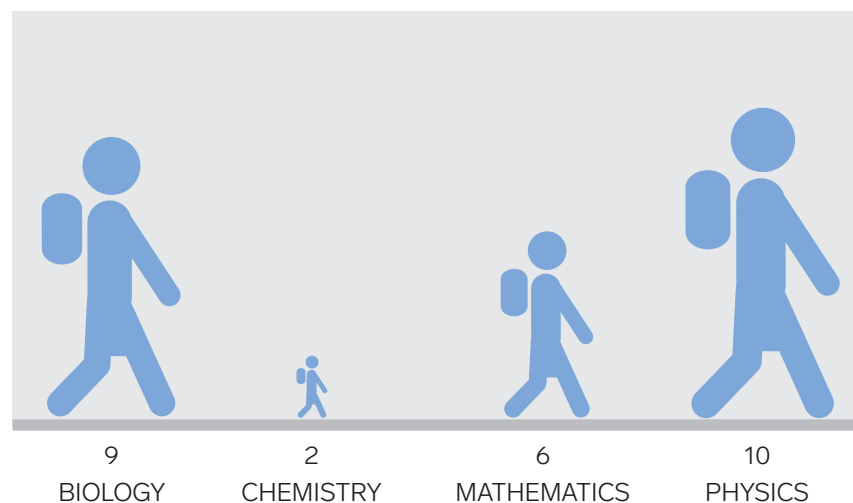


The Integrated PhD programme offers students with a bachelor's degree in science a head-start in identifying an area of research leading to a PhD. Offered in the departments of Biology, Chemistry, Mathematics, and Physics, the programme begins with a 1.5–2 years of coursework followed by research. Admission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



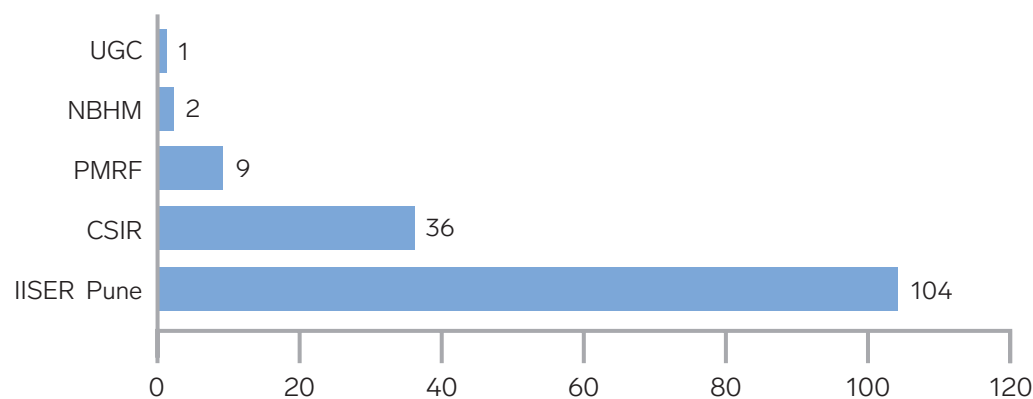
During the August 2020 session, 27 (Men 21, Women 06) students took admission to post-BSc Integrated PhD programme: 09 (Men 05, Women 04) in Biology, 02 (Men 01, Women 01) in Chemistry, 06 (Men 06) in Mathematics, and 10 (Men 09, Women 01) in Physics. The list of enrolled students is available on the IISER Pune website.

INTEGRATED PhD STUDENT ENROLLMENT DURING AUGUST 2020 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, 2021 is 201 (Men 126, Women 75). Student numbers across departments: 77 (Men 30, Women 47) students in Biology; 53 (Men 37, Women 16) in Chemistry; 18 (Men 15, Women 03) in Mathematics; and 53 (Men 44, Women 09) in Physics.

Category-wise Numbers of Integrated PhD Students

Gender	GE	OBC	SC	ST	Total
Men	115	10	1	0	126
Women	74	1	0	0	75
Total	189	11	1	0	201

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. Details pertaining to 2020-21 period were not yet finalised at the time of preparation of this annual report. Once available, details will be noted for inclusion in the next year's annual report.

During the May 2020 and January 2021 rounds of selection for the Prime Minister's Research Fellowship (PMRF), five Integrated PhD students were selected to receive the fellowship: Sandip Chattopadhyay (Chemistry); Karthik G. Shanbhag (Biology); Sajid Saikia (Chemistry); Saurabh Pant (Physics); and Tamaghna Chowdhury (Physics).

Due to the COVID-19 pandemic during the year, travel for the purpose of participating in conferences or research work has been minimal, even as students attended some of the international conferences online. One of our Integrated PhD students received a travel grant from Newton Bhabha Fund for participating in international conferences and for carrying out collaborative research work.

Considering the pandemic situation, to celebrate the graduation of students, a Valedictory Ceremony was held, in lieu of the 9th Convocation, on November 20, 2020. During this ceremony, **21 Integrated PhD students were awarded dual Master's and PhD degrees and 05 students took MS degree with Exit option.**

The following 21 students have successfully completed their requirements for the award of Integrated PhD degree (completed thesis defense between April 1, 2020 and March 31, 2021). Of these, 09 students have received their degrees as well in the Valedictory Ceremony of November 20, 2020.

Sr. No.	Student	Department	Advisor	Thesis Title
01	Mukul Rawat 20122024	Biology	Krishanpal Karmodiya	Investigation of stress responses as determinants of artemisinin resistance and cellular heterogeneity in <i>Plasmodium falciparum</i>
02	Rahi Masoom Reja 20122029	Chemistry	Hosahudya N. Gopi	Exploring delta amino acids in the design of new peptide foldamers and biomaterials
03	Anish Rao 20132009	Chemistry	Pramod Pillai	Regulating interparticle interactions to control the spatio-temporal assembly of gold nanoparticles
04	Tomin K. James 20122039	Physics	Prasad Subramanian	Investigating small scale particle acceleration events at the Sun and its implications for coronal heating
05	Prachi Dhananjay Telang 20122034	Physics	Surjeet Singh	Tuning the ground state of pyrochlore oxides using chemical pressure
06	Om Shanker Tiwari 20142013	Chemistry	Krishna N. Ganesh	Effects of nucleoside and PNA conjugation on self-assembly of diphenylalanine (Phe-Phe)
07	Tejal Agarwal 20142035	Physics	Apratim Chatterji	A study of bacterial chromosome organization using bead-spring polymer model

Sr. No.	Student	Department	Advisor	Thesis Title
08	Dubal Dnyanesh Subhash 20122023	Biology	Richa Rikhy	Analysis of mitochondrial dynamics and oxidative phosphorylation function in neuroblast differentiation in <i>Drosophila melanogaster</i>
09	Kingshuk Roy 20142010	Chemistry	R. Vaidhyanathan, Satishchandra Ogale	Designing novel high-performance anode materials for Li-ion batteries
10	Neha Khetan 20122021	Biology	Chaitanya Athale	Modeling collective mechanics of microtubule aster motility and positioning by molecular motors
11	Neeladri Sen 20132006	Biology	M.S. Madhusudhan	Characterizing protein surfaces for binding associations
12	Vikash Kumar Ravi 20142018	Chemistry	Angshuman Nag	Synthesis, surface engineering and stability of CsPbX ₃ (X = Cl, Br, I) and BaZrS ₃ perovskite nanocrystals
13	Shivani Sharma 20132012	Chemistry	Sujit K. Ghosh	Design and syntheses of functional MOFs for environmental applications
14	Kriti Gupta 20142012	Chemistry	Nirmalya Ballav	Anchoring Cu(II) -based low-dimensional S=1/2 spin lattices onto functionalized graphene
15	Shetty Ankitha Ramesh Shambhavi 20122019	Biology	Sanjeev Galande	Understanding regulatory mechanisms of human T-helper 17 differentiation
16	Girish Singh Bisht 20142009	Chemistry	Boopathy Gnanaprakasam	C3 functionalization of 2-oxindole towards drugs and natural products using metal and metal-free approaches
17	Chetan Kumar Vishwakarma 20122035	Physics	Umakant Rapol	Laser cooling and trapping of strontium atoms for experiments towards precision measurements and frequency metrology
18	Prashant Jain 20142014	Chemistry	Raghavendra Kikkeri	Synthesis of heterogeneous heparan sulfate oligosaccharides to investigate Structure-Activity Relationship (SAR)
19	Deepak Sharma 20142028	Physics	Bhas Bapat	Orientation dependence of ionization in ion-molecule collisions
20	Charu Garg 20132016	Physics	Sunil Nair	Exploring structure property relationships in layered perovskite iridates
21	Rajesh Mandal 20142027	Physics	Shouvik Datta & Satishchandra Ogale	Investigation of polar and magnetic ordering in transition metal oxide thin film heterostructures

BS-MS PROGRAMME

FIFTH-YEAR PROJECTS BY
THE OUTGOING BATCH
OF BS-MS STUDENTS
during 2020–21
TOTAL: 82



16

BIOLOGY



03

CHEMISTRY



07

EARTH AND
CLIMATE SCIENCE



10

INTER-DISCIPLINARY



03

HUMANITIES AND
SOCIAL SCIENCES



17

MATHEMATICS



26

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. Basic training in Biology, Chemistry, Earth and Climate Science, Humanities and Social Sciences, Mathematics, and Physics is imparted in the first two years. In the next two years, students can choose courses offered by one or more departments according to their liking and future career perspective. The fifth year is allocated to a research project or an internship, leading to a thesis.

FIFTH-YEAR PROJECTS AS PER HOST ORGANISATION

49

IISER PUNE

24

NATIONAL

09

INTERNATIONAL

The academic year 2020–21 saw 278 students (183 boys and 95 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; 23 through the IIT-JEE stream; and 27 through the KVPY stream. The list of enrolled students is available on the IISER Pune website.

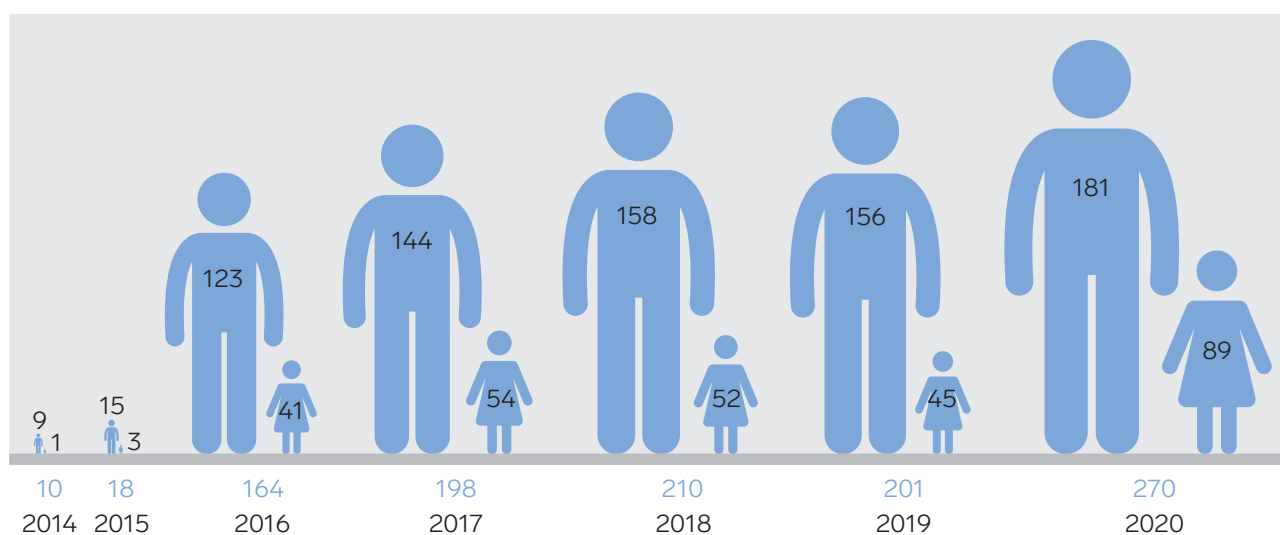
Category-wise Distribution of Students Enrolled in 2020

Gender	EWS	GE	KM	OBC	PD	SC	ST	Total
Boys	18	97	1	38	5	15	9	183
Girls	3	27	2	34	1	20	8	95
Total	21	124	3	72	6	35	17	278

Overall Category-wise Distribution of Existing BS-MS Students (as of March 31, 2021)

Gender	EWS	GE	KM	OBC	PD	SC	ST	Total
Boys	28	394	5	204	13	102	40	786
Girls	4	122	3	84	4	48	20	285
Total	32	516	8	288	17	150	60	1071

TOTAL BS-MS STUDENT STRENGTH DURING 2020–21



Subsequent to admission, 08 students discontinued from the programme, as they got admission in other courses, making the final number of students enrolled in 2020 to 270. In addition, from the previous batches, 01 student opted to discontinue the programme.

From the 2020 batch, 86 students were found eligible for receiving DST-INSPIRE scholarship and 44 students qualified for KVPY scholarship.

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

DST-INSPIRE=306, KVPY=241

Details of the fifth-year projects carried out by the outgoing batch of BS-MS students during 2020-21.

Due to the COVID-19 pandemic, some of the projects were carried out remotely.

Sr. No.	Student	Supervisor	Project Title
 BIOLOGY			
01	Ankur Biswas 20141044	Chaitanya Athale, IISER Pune	Optimizing Cell free system (CFS) with Transcription and Translation (TxTr) for synthetic gene circuits
02	V.K. Sirisha 20151030	Sunish Radhakrishnan, IISER Pune	Deciphering the role of oxidative stress response in bactericidal antibiotic resistance
03	Sahiti Chebolu 20161009	Dr. Kevin Lloyd, MPI for Biological Cybernetics, Tübingen, Germany	The computational role of phasic acetylcholine
04	Kasturi Lele 20161025	Sutirth Dey, IISER Pune	The influence of fluctuating antibiotic exposures and population sizes on the evolution of multi-drug resistance
05	Koustav Halder 20161039	Vishwesha Guttal, IISc, Bengaluru	Investigating cluster dynamics in ecological systems
06	Amruta Swaminathan 20161061	Richa Rikhy, IISER Pune	Role of Myosin II and its regulators in cortical cap remodelling in the syncytial <i>Drosophila</i> embryo
07	Divya S. 20161083	Richa Rikhy, IISER Pune	Analysis of the role of GRAF in regulation of actin dynamics in <i>Drosophila</i> cellularization
08	Akhila Mudunuri 20161092	Sutirth Dey, IISER Pune	Effect of microbiota on behavior in <i>Drosophila melanogaster</i>
09	Badeer Hassan U. 20161093	Chaitanya Athale, IISER Pune	Modelling microtubule organisation in neurites
10	Harshavardhan B.V. 20161100	Sutirth Dey, IISER Pune	Studying the effects of competition on adaptive therapy through agent-based modelling
11	Kabir Vinay Dabholkar 20161121	Omri Barak, Technion, Haifa, Israel	Investigating the reservoir computing paradigm of cortical computation
12	Subhashree Subhadarsini 20161146	Sutirth Dey, IISER Pune	Experimental evolution for dispersal and chronic larval malnutrition in <i>Drosophila melanogaster</i>
13	Jhelam Nitin Deshpande 20161156	Emanuel A. Fronhofer, ISEM, Montpellier, France	Gene regulatory networks and evolution of dispersal plasticity
14	Megha Roy 20161160	Chaitanya Athale, IISER Pune	Modeling microtubule-motor dependent migration of the male pronucleus in <i>C.elegans</i>
15	Patel Vishrut Yogesh 20141022	Chaitanya Athale, IISER Pune	Spatial genetic demixing in microbial colonies with growth delay
16	Arijit Bokshi 20151190	Aurnab Ghose, IISER Pune	Developing an assay for risk-taking behaviour in mice

Sr. No.	Student	Supervisor	Project Title
 CHEMISTRY			
01	Manish Kumar 20161102	Nirmalya Ballav, IISER Pune	Growth study and electrical transport of thin films of coordination network
02	Dontireddy Gopi Madhav Reddy 20161120	Bulusu Venkata Sarada, CSEM, ACRI Hyderabad	Electrochemical synthesis of electrodes for Li-S battery applications
03	Bagal Viraj Bhagwan 20161150	Deva Priyakumar, IIIT Hyderabad	Denovo drug generation conditioned on protein binding pocket using invertible generators

 EARTH AND CLIMATE SCIENCE			
01	Aleena M.J. 20161072	Suhas Ettammal, IISER Pune	Characterization of convectively coupled Kelvin wave
02	Sohan S. 20161078	Neena Joseph Mani, IISER Pune	Understanding tropical teleconnections using the quasi-equilibrium tropical circulation model
03	Snigdha Samantaray 20161096	Suhas Ettammal, IISER Pune	Sensitivity of entrainment formulation and its effects on the Single Column Community Atmosphere Model simulations
04	Sarin T.S. 20161197	V. Vinoj, IIT, Bhubaneswar	Surface temperature changes associated with aerosols using Satellite Observations over India
05	Sanjay Sriraj 20161198	Sabin Thazhe Purayil, IITM Pune	Declining aerosols and recovering monsoons: projected changes in near-future
06	Janaani Sri R. 20161201	Thara Prabhakaran, IITM Pune	The role of the turbulent eddies in the cloudy boundary layer
07	Dhawale Mayur Shashikant 20151128	Soumyajit Mukherjee, IIT Bombay	Tectonics of Kachchh basin based on field structural geological studies and paleostress analysis in Bhuj, Gujarat, India

 HUMANITIES AND SOCIAL SCIENCES			
01	Shirsath Praful Kailas 20161118	Bejoy Thomas, IISER Pune	Interactions between SDGs: A systematic literature review focusing on SDG 2 and SDG 6
02	Ayushman Singh 20151183	Bejoy Thomas, IISER Pune	Urban floods vulnerability: A study of Pune city

Sr. No.	Student	Supervisor	Project Title
03	Sayantani Choudhury 20161059	Karen Gabriel, St Stephen's College, Delhi	Looking at feminism and nationalism through the study of contemporary women's writing



INTERDISCIPLINARY

01	Dhvale Athang Ujjwal 20141061	Pushkar Sohoni, IISER Pune	Characterization of historical mortars
02	Abhishek Choudhary 20141150	Prabhanjan Borwankar, Asquared IoT Pvt. Ltd., Pune	Applications of Deep Learning: Sequence modelling in industrial sound analytics
03	Mrityunjay Samanta 20161027	Aniruddha Pant, AlgoAnalytics Pvt. Ltd., Pune	Explainable AI: ICD coding
04	Aniket Kumar Mohan 20161030	Prabhanjan Borwankar, Asquared IoT Pvt. Ltd., Pune	Application of machine learning in sound analytics
05	Pawan Kumar Gupta 20161038	Viraj Kulkarni, DeepTek Medical Imaging Private Limited, Baner Road, Pune	Automatic radiology report generation based on multiview image fusion
06	Jitesh Seth 20161101	Aniruddha Pant, AlgoAnalytics Pvt. Ltd., Pune	Working with small datasets
07	Yadav Yasharth Bachubhai 20161154	Areejit Samal, IMSc Chennai	Geometry-inspired measures for network science
08	Arya Samanta 20161157	Bipin Kumar, IITM Pune	Applications of Artificial Intelligence in Atmospheric Sciences
09	Harshit Madaan 20161164	Viraj Kulkarni, DeepTek Medical Imaging Private Limited, Baner Road, Pune	Privacy preserving distributed learning in the healthcare sector
10	Arya P.V. 20151007	Härkänen Tommi, National Institute of Health and Welfare Helsinki, Finland	Population as a Cohort - Increasing statistical power in a cohort analysis using register data in addition to population survey datasets



MATHEMATICS

01	Nima Rose Manjila 20151182	Parameswaran A.J., TIFR Mumbai	Topology of complex varieties
02	D.V.S. Abhijit 20161005	Anindya Goswami, IISER Pune	Computation of option price by fitting a general model of asset price
03	Suraj Yadav 20161013	Vaibhav Rajan, NUS Singapore	Neural network based clustering through gradient-based optimization on manifolds
04	Avinash Roy 20161016	Anupam Kumar Singh, IISER Pune	Algebras with involutions and the classical groups

Sr. No.	Student	Supervisor	Project Title
05	Shambhavi S. 20161052	Priyavrat Deshpande, Chennai Mathematical Institute	Applications of topology to data analysis
06	Adarsh Srinivasan 20161056	Ayan Mahalanobis, IISER Pune	Permutation error-correcting codes and public key cryptography
07	Manraj Singh Ghuman 20161057	Anup Biswas, IISER Pune	Lipschitz Extension Problem
08	Jangle Ashutosh Suresh 20161075	Dipendra Prasad, IIT Bombay	Class Field Theory
09	Sudheesh Surendranath 20161135	Anup Biswas, IISER Pune	Stochastic partial differential equations
10	Arijit Chakraborty 20161136	Kaneenika Sinha, IISER Pune	Frobenius distribution over families of elliptic curves
11	Joshi Purva Chandrashekar 20161161	Anindya Goswami, IISER Pune	Implied volatility vector in a regime- switching model
12	Srishti Gupta 20161163	Anindya Goswami, IISER Pune	Semi Markov Model in High Frequency Trading
13	Adithya Shetty 20161191	Anisa Chorwadwala, IISER Pune	Shape optimization problem for the second Dirichlet eigenvalue of the Laplacian
14	Vyshnav V. 20141182	Vivek Mohan Mallick, IISER Pune	Introduction to algebraic geometry
15	Siddhant Sharma 20161026	Supriya Pisolkar, IISER Pune	Topics In inverse Galois problem
16	Shubhalaxmi Mukherjee 20161148	Anisa Chorwadwala, IISER Pune	Eigenvalue optimisation problems for triangles and quadrilaterals
17	Aysa B. 20151002	Uttara Naik-Nimbalkar, IISER Pune	Clustering techniques



PHYSICS

01	Akhil Mithran 20151102	Sadhana Dash, IIT Bombay	Study of underlying events in hadronic collisions at LHC energies
02	Nukulsinh Rajanikant Parmar 20161002	Florenca Canelli, University of Zurich, Switzerland	Developing and testing new unfolding methods for collider measurements
03	Sadekar Onkar Ravindra 20161004	M.S. Santhanam, IISER Pune	Spreading processes on complex networks and infectious diseases hazard Map for India
04	Sagnik Ghosh 20161007	Rajdeep Sensarma, TIFR, Mumbai	Phonon-electron equilibration: A Keldysh field theoretic study

Sr. No.	Student	Supervisor	Project Title
05	Utkarsh Khandelwal 20161018	Pavan Kumar G.V., IISER Pune	Particle tracking at fluid-fluid interface using micro-PIV
06	Gopal Chandra Santra 20161019	Rejish Nath, IISER Pune	Two-band Bose-Hubbard model in a lattice of Rydberg-admixed atoms
07	S. Adithya 20161033	Sachin Jain, IISER Pune	Conformal Field Theory in momentum space
08	Pranay Nayak 20161037	Rejish Nath, IISER Pune	Structural engineering of dipolar condensates via inter-layer interactions
09	Surya Narayan Banerjee 20161040	Pavan Kumar G.V., IISER Pune	Differential dynamic microscopy of liquid crystals
10	M. Harshanth Ram 20161050	T.S. Mahesh, IISER Pune	Control of open quantum systems
11	Dinesh P.R. 20161079	Arijit Bhattacharyay, IISER Pune	Deep learning of phase transitions and RG in classical systems
12	Yatharth Gandhi 20161086	Sachin Jain, IISER Pune	Quantum field theory, Quantum information theory and their applications
13	Mohamed Hashim K. 20161104	Prasenjit Ghosh, IISER Pune	Identifying resonant dopants for BaCu_2S_2 from first principles for thermoelectric applications
14	Jha Rounak 20161112	Dieter Suter, Dortmund, Germany	Quantum Information Processing using nitrogen vacancy centres in diamond
15	Rakshitha T. 20161124	Paolo Salucci, SISSA, Trieste, Italy	The nature of dark matter from its distribution in galaxies
16	Dayal Singh 20161127	Sreejith Ganesh Jaya, IISER Pune	Statistical physics of deep learning
17	Vighnesh Dattatraya Naik 20161128	Rejish Nath, IISER Pune	Analyzing spin models using different numerical techniques
18	Valecha Bhavesh Deewan 20161131	Bijay Kumar Agarwalla, IISER Pune	Dependence of thermodynamic uncertainty relation on system size
19	Panchal Ankur Rajendra 20161162	Rahul Srivastava, IISER Bhopal	Renormalization group evolution of neutrino mixing angles
20	Duttatreya 20161165	Rahul Srivastava, IISER Bhopal	Anomaly free baryon and lepton number symmetries and their Implications
21	Ananya Bandopadhyay 20161171	Sanjit Mitra, IUCAA, Pune	Joint estimation of binary population parameters from the observations of gravitational waves from individual mergers and the stochastic background
22	Pandit Atharva Uday 20161185	Vijayakumar Chikkadi, IISER Pune	Slow glassy dynamics in active colloidal suspensions
23	Sankalp Choudhuri 20161194	Yvette Perrott, Victoria University of Wellington, New Zealand	Modelling mass distribution of galaxy clusters via their Sunyaev-Zel'dovich signal and non-thermal emission

Sr. No.	Student	Supervisor	Project Title
24	Suman Satish Kulkarni 20161008	Deepak Dhar, IISER Pune	The study of the structure of Dulmage-Mendelsohn clusters and zero-energy eigenmodes on weakly diluted bipartite lattices
25	Viraj Meruliya 20161074	Sunil Mukhi, IISER Pune	AdS/CFT: Operator dictionaries and partition functions
26	Anjali Nambudiripad 20141149	M.S. Santhanam, IISER Pune	Many body linear kicked rotor

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During the Valedictory Ceremony held on November 20, 2020, in lieu of 9th Convocation of the Institute, **164 students graduated with BS-MS dual degrees, and 04 students took BS degree with Exit option.**

Sriram Raghunath who secured a CGPA of 9.9 was awarded the Institute Gold Medal.

The following 27 students passed with Distinction (CGPA>9.0):

Devesh Verma	Rohit Shashikant Patil	Radhika A.C.
Adithyan P.	Shreya Lakhera	Lomte Shivani Sanjay
Rajdeep Halder	Nevin Korath Zacharia	Sayantika Mondal
Sheryl Sreyas	Joshi Yash Jayant	Arghya Rakshit
Vishnu N.	Sachin Verlekar	Bhakti Prasad Rout
Kush Mohan	Patki Raagini Abhay	Madhav Sinha
Koparkar Avani Prasad	Jayakrishnan Muhunden Nallappa	Sinjini Bhattacharjee
Ashwin Gopal	Palash Jitendra Singh	Bapat Dhar Nishad
Sriram Raghunath	Bhalerao Sujeet Ganesh	
Aarcha Thadi		



LIST OF COURSES

August 2020 Semester 1

BS-MS/ iPhD Course Code	Credits BS-MS/ iPhD	Course Title	Semester	Coordinator/Instructor
BI1113	3	Introductory Biology - I	1	Kundan Sengupta, Nagaraj Balasubramanian
BI1213	3	Introduction to Biomolecules	1	M.S. Madhusudhan, Sudha Rajamani, Girish Ratnaparkhi, Tressa Jacob
CH1113	3	Principles of Organic Chemistry	1	Ramakrishna G. Bhat, Srinivas Hotha
EC1213	3	Evolution of Earth and Life	1	Gyan Ranjan Tripathy, Devapriya Chattopadhyay
HS1113	3	Academic Communication Skills	1	Pooja Sancheti
HS1213	3	History of Science	1	Pushkar Sohoni
MT1113	3	Calculus - I	1	Diganta Borah, Mousomi Bhakta
PH1113	3	Introductory Mechanics	1	Rejish Nath, Mukul Kabir

August 2020 Semester 3

Course Code	Credits	Course Title	Semester	Coordinator/Instructor
BI2113	3	Ecology and Evolution	3	Sutirth Dey
CH2113	3	Principles of Inorganic Chemistry	3	R. Vaidhyanathan, R. Boomi Shankar
EC2113	3	Introduction to Climate Science	3	Neena Joseph Mani
HS2113	3	Science and Society	3	Pushkar Sohoni, Chaitra Redkar
MT2113	3	Probability and Statistics	3	Anup Biswas, Vivek Mohan Mallick
PH2113	3	Introductory Quantum Physics	3	T.S. Mahesh, Sunil Mukhi
BI2123	3	Biology of Systems (E)	3	Aurnab Ghose, Collins Assisi
CH2223	3	Principles of Organic Chemistry II (E)	3	Harinath Chakrapani
MT2123	3	Advanced Linear Algebra (E)	3	A. Raghuram, Chitrabhanu Chaudhari
PH2123	3	Mathematical Methods for Physics (E)	3	Bijay Kumar Agarwalla, Diptimoy Ghosh

August 2020 Semesters 5 and 7

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	Credits BS- MS/ iPhD	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/Instructor
BIO301	3			Lab Training/ Theory Project	5	Collins Assisi
		BIO610	4	Biostatistics	21	Ramana Athreya
BIO310	4			Biostatistics	5,7,11,13	Pranay Goel, Raghav Rajan
BIO311	4	BIO611	4	Advanced Cell Biology	5,11,21	Nagaraj Balasubramanian, Thomas Pucadyil
BIO313	4	BIO654	4	Advanced Molecular Biology	5,11,21	Mayurika Lahiri, Gayathri Pananghat
BIO314	4	BIO637	4	Bioinformatics	5,7,11,13,21	M.S. Madhusudhan
BIO315	4	BIO606	4	Cellular Biophysics I	5,7,11,13,21	Chaitanya Athale
BIO316	4	BIO668	4	Neurobiology - I	5,7,11,13,21	Nixon M. Abraham, Suhita Nadkarni
BIO320	4	BIO622	4	Genetics	5,7,11,13,21	Richa Rikhy, Girish Ratnaparkhi
BIO321	4	BIO623	4	Plant Biology - I	5,7,11,13,21	Anjan Banerjee
BIO352	3	BIO626	3	Animal Physiology - II	7,13,21	Anand Krishnan
BIO353	3	BIO669	3	Advanced Immunology	7,13,21	Vineeta Bal
BIO401	3			Lab Training/ Theory Project	7	Collins Assisi
BIO410	4	BIO616	4	Advanced Biochemistry - I	5,7,11,13,21	Siddhesh Kamat, Sudha Rajamani
BIO411	4	BIO617	4	Ecology - I	5,7,11,13,21	Deepak Barua
BIO431	3	BIO619	3	Epigenetics	5,7,11,13,21	Sanjeev Galande

BS-MS/ iPhD Course Code	Credits BS- MS/ iPhD	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/Instructor
BIO454	3	BIO634	3	Structural Biology	5,7,11,13,21	Saikrishnan Kayarat
BIO491	3			Literature Review	7	Sunish Radhakrishnan
LRB101	3			Lab Training	11	Deepak Barua
LRB201	3			Lab Training	13	Deepak Barua
LRB203	3			Lab Training	13	Deepak Barua
BIO355	3	BIO648	3	Vertebrate Zoology	5,7,11,13,21	Anand Krishnan
CHM301	3			Lab Training/ Theory Project - I	5	Angshuman Nag
CHM311	4	CHM611	4	Physical Organic Chemistry	5,7,11,13,21	Hosahudya N. Gopi
CHM312	4	CHM612	4	Main Group Chemistry	5,7,11,13,21	Moumita Majumdar
CHM320	4	CHM610	4	Symmetry and Group Theory	5,7,11,13,21	Jeetender Chugh
CHM332	3	CHM614	4	Separation Principles and techniques	5,7,11,13,21	S. Sandanaraj Britto
CHM331	3	CHM613	4	Self-Assembly in Chemistry	5,7,11,13,21	Pinaki Talukdar
CHM334	3	CHM631	4	Physical Chemistry of Solutions	5,7,11,13,21	Arnab Mukherjee
CHM351	3	CHM641	4	Biorganic Chemistry	5,7,11,13,21	S.G. Srivatsan
CHM401	3			Lab Training/ Theory Project - II	7	Angshuman Nag
CHM411	4	CHM616	4	Organic Synthesis - II	7,13,21	Boopathy Gnanaprakasam
CHM413	4	CHM629	4	Bioinorganic Chemistry	7,13,21	V.G. Anand
CHM421	4	CHM625	4	Polymer Chemistry	7,13,21	M. Jayakannan
CHM422	4	CHM640	4	Statistical Thermodynamics	7,13,21	Anirban Hazra, Srabanti Chaudhury
CHM433	3	CHM627	4	Photochemistry and Photophysics	7,13,21	Pramod Pillai
CHM431	3	CHM618	4	Chemical Biology	7,13,21	Amrita Hazra
CHM432	3	CHM619	4	Solid State Chemistry	7,13,21	Partha Hazra
CHM445	3	CHM632	4	Electrochemistry	7,13,21	Nirmalya Ballav
CHM446	4	CHM644 (also NKN)	4	Fundamentals of Solution-State NMR Spectroscopy: Principles and Applications	7,13,21	Jeetender Chugh
ECS301	3			Lab Training/ Theory Project	5	Shreyas Managave
ECS310	4	ECS625	4	Numerical Computation	5,21	Suhas Ettammal
ECS312	4	ECS615	4	Physics of Atmosphere and Ocean	5,7,21	Ramesh Vellore (IITM Pune), Neena Joseph Mani
ECS336	4	ECS616	4	Earth and Planetary Materials	5,7,21	Durga Mohanty (SPPU, Pune), Shreyas Managave
ECS323	4	ECS661	4	Applied Mathematical Methods	5,21	Joy Merwin Monteiro
ECS411	4	ECS641	4	Exploration Seismology	7,21	Rahul Dehiya
ECS401	3			Lab Training/ Theory Project	7	Shreyas Managave
ECS324	4	ECS624	4	Introduction to Geophysics	5,7,21	Shyam Rai
ECS333	3	ECS626	4	Sedimentology and Stratigraphy	5,21	Sudipta Sarkar

BS-MS/ iPhD Course Code	Credits BS- MS/ iPhD	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/Instructor
ECS458	4	ECS658	4	Structural Geology and Tectonics	5,7,21	Sudipta Sarkar, Soumyajit Mukherjee (IIT Bombay)
ECS334	3	ECS664	4	Hydrology	5,7,21	Argha Banerjee
ECS459	3	ECS659	4	Parameter Estimation and Inverse Theory	5,7,21	Rahul Dehiya
ECS318	4	ECS627	4	Atmosphere and Ocean Dynamics	7,21	Suhas Ettammal
ECS453	4	ECS628	4	Tropical Meteorology	5,7,21	Suhas Ettammal, Sibin T.P. (IITM, Pune)
ECS460	4	ECS660	4	Igneous and Metamorphic Petrology	7,21	Shreyas Managave, Raymond Duraiswamy (SPPU, Pune)
ECS457	3	ECS634	4	Sequence Stratigraphy	7,21	Alok Dave
HSS364	3	HSS652	4	Economics and Public Policy	5,7,21	Bejoy K. Thomas
HSS365	4	HSS653	4	Disasters and Society	5,7,21	Shalini Sharma
HSS351	3	HSS651	4	Evolution of Cinema	5,7,21	Anil Zankar
HSS366	4	HSS654	4	Select Key Political Concepts	5,7,21	Chaitra Redkar
HSS401	3			Lab Training/ Theory Project	7	Pushkar Sohoni
HSS301	3			Lab Training/ Theory Project	5	Pushkar Sohoni
MTH301	3			Lab Training/ Theory Project	5	Baskar Balasubramanyam
MTH310	4			Group Theory	5,7,11	Manish Mishra
MTH311	4			Analysis	5,7,11	Mainak Poddar
MTH312	4			Point Set Topology	5,7,11	Amit Hogadi
MTH314	4			Statistical Inference	5,7,11	Chandrasheel Bhagwat
MTH318	4			Combinatorics	5,7,11	Ayan Mahalanobis
MTH401	3			Lab Training/ Theory Project	7	Baskar Balasubramanyam
MTH410	4			Galois Theory	7,11,13	Debargha Banerjee
MTH412	4			Algebraic Topology	7,11,13	Tejas Kalelkar
MTH413	4	MTH618	4	Algorithms	7,11,13,21	Soumen Maity
MTH415	4	MTH619	4	Probability	7,11,13,21	Anindya Goswami
MTH417	4			Ordinary Differential Equations	7,11,13	Steven Spallone
MTH421	4			Measure Theory and Integration	7,11,13	Anisa Chorwadwala
MTH423	4			Commutative Algebra	7,11,13	Supriya Pisolkar
MTH447	4			Random Processes and Queueing Models	5,11,13	Pallavi Manohar, Anindya Goswami
MTH510	4	MTH610	4	Algebra - I	13,21	Rabeya Basu
MTH511	4	MTH611	4	Analysis - I	13,21	Kaneenika Sinha

BS-MS/ iPhD Course Code	Credits BS- MS/ iPhD	PhD Course Code	PhD Credits	Course Title	Open to Semester	Coordinator/Instructor
MTH512	4	MTH612	4	Topology - I	13,21	Rama Mishra
MRP501	14			Research Project	13	Krishna Kaipa
MSP401	3			Semester Project	11	Krishna Kaipa
MSP501	3			Semester Project	13	Krishna Kaipa
PHY301	3			Lab Training/ Theory Project	5	G.V. Pavan Kumar
PHY310	4	PHY620	4	Mathematical Methods in Physics	5,7,11,21	Tarun Souradeep
PHY311	4	PHY611	4	Classical Mechanics	5,7,11,21	Arun M. Thalapillil
PHY312	4	PHY612	4	Electrodynamics	5,7,11,21	Rajeev Bhalerao
PHY313	4			Quantum Mechanics - I	5,7,11	Arijit Bhattacharyay
PHY341	3	PHY647	4	Physics at Nanoscales	5,7,11,13,21	Ashna Bajpai
PHY356	3	PHY632	4	Group Theory in Physics	7,13,21	Sudarshan Ananth
PHY351	3	PHY631	4	Gravitation and Cosmology	7,13,21	Suneeta Vardarajan
PHY340	3	PHY624	4	Methods of Experimental Physics	5,7,11,13,21	Shivprasad Patil
PHY401	3			Lab Training/ Theory Project	7	G.V. Pavan Kumar
PHY411	4	PHY621	4	Condensed Matter Physics - I	7,13,21	Prasenjit Ghosh
PHY412	4	PHY614	4	Statistical Mechanics - II	7,13,21	Deepak Dhar
PHY453	3	PHY634	4	Computational Physics	7,13,21	Apratim Chatterji
PHY461	3	PHY655	4	Quantum Field Theory	7,13,21	Sachin Jain
LRP101	2			Lab Training/ Theory Project	11	G.V. Pavan Kumar
LRP201	4			Lab Training/ Theory Project	13	G.V. Pavan Kumar
PHY335	3			Electronics I	5,7,11,13	Sunil Nair
PHY452	3			Fluid Dynamics	5,7,11,13	Prasad Subramanian
PHY465	3	PHY665	3	Physics of Soft Matter	5,7,11,13,21	Vijayakumar Chikkadi
PHY421	4	PHY641	4	Advanced Optics	7,13,21	Shouvik Dutta

January 2021 Semester 2

BS-MS/ iPhD Code	PhD Code	Credits	Course	Semester	Coordinator/Instructor
BI1223		3	Experiments in Biology	2	Krishanpal Karmodiya, Nixon M. Abraham, Mayurika Lahiri, Siddhesh Kamat, Mridula Nambiar
CH1213		3	Principles of Physical Chemistry	2	Anirban Hazra, Angshuman Nag
CH1223		3	General Chemistry Practicals I	2	Ramanathan Vaidhyanathan, R. Boomi Shankar, Moumita Majumdar, Britto S. Sandanaraj, Boopathy Gnanaprakasam
MT1213		3	Calculus II	2	Krishna Kaipa, Amit Hogadi
MT1223		3	Linear Algebra	2	Moumanti Podder, Baskar Balasubramanyam

BS-MS/ iPhD Code	PhD Code	Credits	Course	Semester	Coordinator/Instructor
PH1213		3	World of Physics 2 - Electricity and Magnetism	2	Diptimoy Ghosh, Sudarshan Ananth
PH1223		3	Physics Lab I	2	Aparna Deshpande, Atikur Rahman, Bhas Bapat, Seema Sharma
TD1213		3	Introduction to Computing	2	Umakant D. Rapol, Sourabh Dube, M.S. Santhanam, G.J. Sreejith

January 2021 Semester 4

BS-MS/ iPhD Code	PhD Code	Credits	Course	Semester	Coordinator/Instructor
BI2213		3	Cell Biology	4	Nagaraj Balasubramanian, Thomas Pucadyil
BI2223		3	Physiology	4	Nishad Matange, Aurnab Ghose, Satyajit Rath
BI2233		3	Genetics	4	Richa Rikhy, Girish Ratnaparkhi
CH2223		3	Analytical Chemistry	4	M. Jayakannan
CH2233		3	Fundamentals of Molecular Spectroscopy	4	Pramod Pillai, Pankaj Mandal
CH2243		3	General Chemistry Practicals II	4	Jeetender Chugh, Arun Venkatnathan, Shabana Khan, Sujit K. Ghosh, S.G. Srivatsan, Harinath Chakrapani
EC2213		3	Principles of Planetary Climate	4	Joy Merwin Monteiro
EC2223		3	Landscapes and their Evolution	4	Argha Banerjee
EC2233		3	The Solid Earth	4	Utsav Mannu
MT2213		3	Undergraduate Algebra I	4	Anupam Kumar Singh
MT2223		3	Real Analysis I	4	Anup Biswas
MT2233		3	Discrete Structures	4	Kaneenika Sinha
PH2213		3	Classical mechanics	4	Arijit Bhattacharyay, Prasenjit Ghosh
PH2223		3	Thermal & Statistical Physics	4	Vijayakumar Chikkadi, Seema Sharma
TD2213		3	Thermodynamics	4	Srabanti Chaudhury, Muhammed Musthafa O.T.
PH2233		3	Physics Lab - II	4	Sourabh Dube, Surjeet Singh, Rejish Nath, Mukul Kabir, Satish Ogale
TD2223		3	Data Analysis	4	M.S. Santhanam, Snehal Shekatkar (SPPU)

January 2021 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 Code	PhD Code	Credits	Course	Semester	Coordinator/Instructor
Semester VI and VIII					
BIO312	BIO612	4	Animal Physiology I	6,8,12,14,22	Nixon M. Abraham, Nishikant Subhedar
BIO324	BIO646	4	Introductory Immunology	6,8,12,14,22	Satyajit Rath, Vineeta Bal
BIO325	BIO648	4	Animal Behaviour	6,8,12,14,22	Raghav Rajan, Nixon M. Abraham
BIO354	BIO627	3	Neurobiology II	6,8,12,14,22	Suhita Nadkarni, Raghav Rajan
BIO412	BIO655	4	Microbiology	6,8,12,14,22	Sunish Radhakrishnan, Gayathri Pananghat
BIO414	BIO647	4	Mathematical & Computational Biology	6,8,12,14,22	Collins Assisi, Suhita Nadkarni
BIO415	BIO607	4	Chemical Ecology	6,8,12,14,22	Sagar Pandit
BIO417	BIO628	4	Advanced Biochemistry II	6,8,12,14,22	Thomas Pucadyil, Amrita B. Hazra
BIO433	BIO649	3	Applied Plant Biology	6,8,12,14,22	Anjan Banerjee
BIO435	BIO632	3	Cellular Biophysics II	6,8,12,14,22	Chaitanya Athale
BIO442	BIO671	3	Physical Biochemistry	6,8,12,14,22	Jayant B. Udgaonkar
BIO451-IDC451	BIO656	3	Data Science	6,8,12,14,22	Pranay Goel
BIO461	BIO639	4	Genome Biology	6,8,12,14,22	Krishanpal Karmodiya, Kundan Sengupta
BIO463	BIO650	4	Biology and Disease	8,12,14,22	Mayurika Lahiri, Siddhesh S. Kamat
BIO591	BIO631	4	Literature Review	14,22	Sai Krishnan Kayarath
BIO302		3	Lab/Theory Project	6	Mridula Nambiar
BIO402		3	Lab/Theory Project	8	Mridula Nambiar
LRB102		3	Lab Training	12	Deepak Barua
PRB201		10	Research Project	14	Deepak Barua
SRB201		5	Research Seminar	14	Deepak Barua
CHM310	CHM620	4	Quantum Chemistry	6,8,12,22	Arun Venkatnathan
CHM321	CHM621	4	Organic Synthesis - I	6,8,12,22	Srinivas Hotha
CHM322	CHM622	4	Transition Metal Chemistry	6,8,12,22	Sujit Kumar Ghosh
CHM323	CHM623	4	Fundamentals of Molecular Spectroscopy	6,8,12,22	Pramod Pillai, Pankaj Mandal
CHM420	CHM624	4	Structural Methods and Analysis	8,14,22	Pinaki Talukdar, S.G. Srivatsan
CHM410	CHM615	4	Advanced Molecular Spectroscopy	8,14,22	Aloke Das
CHM423	CHM628	4	Medicinal Chemistry	8,14,22	Raghavendra Kikkeri
CHM441	CHM643	3/4	Advanced Material Science	8,12,14,22	Ramanathan Vaidhyathan, R. Boomi Shankar
CHM442	CHM630	3/4	Organometallic Chemistry	8,12,14,22	Ramakrishna G. Bhat

BS-MS/ iPhD Code	PhD Code	Credits	Course	Semester	Coordinator/Instructor
CHM302		3	Lab Training/ Theory Project	6	Angshuman Nag
CHM402		3	Lab Training/ Theory Project	8	Angshuman Nag
LRC101		2	Lab Training	12	Jeetender Chugh
PRC201		5	Research Project	14	Jeetender Chugh
SRC202		2	Research Seminar	14	Jeetender Chugh
CHM428	CHM633	4	Chemistry for Alternative Energy	8,12,14,22	Angshuman Nag, Muhammed Musthafa O.T.
CHM437	CHM637	3/4	Organotransition Metal Catalysis	8,12,14,22	Shabana Khan
CHM340		3	Advanced Organic Chemistry Laboratory	6,8,12	Raghavendra Kikkeri
CHM360		3	Advanced Inorganic Chemistry Laboratory	6,8,12	Nirmalya Ballav, V.G. Anand
CHM430		3	Advanced Physical Chemistry Laboratory	6,8,14	Pramod Pillai, Pankaj Mandal, Muhammed Musthafa O.T.
ECS332	ECS620	3	Geochemistry	6,8,22	Shreyas Managave
ECS321	ECS653	4	Geophysical Fluid Dynamics	6,8,22	Suhas Ettammam
ECS461	ECS662	4	Physical Oceanography	6,8,22	Joy Merwin Monteiro
ECS455	ECS630	4	Geoelectromagnetic Exploration	6,8,22	Rahul Dehiya
ECS456	ECS633	3	Glacial Dynamics	6,8,22	Argha Banerjee
ECS420	ECS652	4	Satellite Data Analysis & Image Processing	6,8,22	Sudipta Sarkar
ECS317	ECS612	3	Isotope Geochemistry	6,8,22	Gyana Ranjan Tripathy
ECS302		3	Lab Training/ Theory Project	6	Shreyas Managave
ECS402		3	Lab Training/ Theory Project	8	Shreyas Managave
HSS361	HSS616	3	History of Mathematics in India	6,8,22	Venketeswara R. Pai
HSS362	HSS617	3	Development Studies: Concepts, Applications and Perspectives	6,8,22	Bejoy Thomas
HSS363	HSS618	4	Science as Narrative in Literature and Cinema	6,8,22	Anil Zankar
HSS302		3	Lab Training/ Theory Project	6	Pushkar Sohoni
HSS402		3	Lab Training/ Theory Project	8	Pushkar Sohoni
HSS367	HSS667	4	Political Thought in India: A Study of Select Texts	6,8,22	Chaitra Redkar

BS-MS/ iPhD Code	PhD Code	Credits	Course	Semester	Coordinator/Instructor
HSS368	HSS668	3	Introduction to Political Ecology: Selected Approaches	6,8,22	Shalini Sharma
	HSS669	4	Research Methods, Fieldwork, and Ethics	22	Shalini Sharma, Anil Zankar, Bejoy Thomas, Chaitra Redkar, Pooja Sancheti
MTH320		4	Vector Spaces, Rings and Modules	6,8,12	Vivek Mohan Mallick
MTH321		4	Complex Analysis	6,8,12	Debargha Banerjee
MTH322		4	Calculus on Manifolds	6,8,12	Rama Mishra
MTH323	MTH626	4	Graph Theory	6,8,12,14,22	Soumen Maity
MTH329		4	Cryptography	6,8,12	Ayan Mahalanobis
MTH448		4	Mathematical Optimization	6,12,14	Pallavi Manohar, Anindya Goswami
MTH420		4	Algebraic Number Theory	8,12,14	Manish Mishra
MTH411		4	Functional Analysis	8,12,14	Chandrasheel Bhagwat
MTH422		4	Differential Geometry	8,12,14	Tejas Kalelkar
MTH426	MTH656	4	Stochastic Processes	8,12,14,22	Anindya Goswami
MTH424		4	Partial Differential Equations	8,12,14	Anisa Chorwadwala
MTH442		4	Introduction to Algebraic Geometry	8,12,14	Nitin Nitsure, Chandrasheel Bhagwat
MTH302		3	Theory Project	6	Baskar Balasubramanyam
MTH402		3	Theory Project	8	Baskar Balasubramanyam
MSP402		4	Theory Project	12	Krishna Kaipa
MSP502		4	Theory Project	14	Krishna Kaipa
MTH520	MTH620	4	Algebra II	14,22	Steven Spallone
MTH521	MTH621	4	Analysis II	14,22	Mousomi Bhakta, Diganta Borah
MTH522	MTH622	4	Topology II	14,22	Mainak Poddar
	MTH602	4	Theory Project	22	Soumen Maity
MRP502		14	Research Project	14	Kaneenika Sinha
PHY322		4	Statistical Mechanics I	6,12	Deepak Dhar
PHY334	PHY646	3/4	Astronomy & Astrophysics	6,8,12,14,22	Ramana Athreya
PHY342	PHY642	3/4	Nonlinear Dynamics	6,8,12,14,22	M.S. Santhanam
PHY350	PHY645	3/4	Electronics II	6,8,12,14,22	Umakant D. Rapol
PHY362	PHY656	3/4	Plasma Physics	6,8,12,14,22	Prasad Subramanian
PHY321	PHY613	3/4	Quantum Mechanics II	6,8,12,14,22	T.S. Mahesh
PHY420	PHY623	3/4	Atomic and Molecular Physics	8,14,22	Bijay Kumar Agarwalla, Bhas Bapat
PHY422	PHY622	3/4	Nuclear and Particle Physics	8,14,22	Rajeev Bhalerao
PHY441	PHY636	3/4	Quantum Information	6,8,12,14,22	Sachin Jain

BS-MS/ iPhD Code	PhD Code	Credits	Course	Semester	Coordinator/Instructor
PHY463	PHY658	3/4	Adv Condensed Matter Physics	8,14,22	Sreejith Ganesh Jaya
PHY557	PHY657	3/4	Quantum Field Theory II	8,14,22	Arun M. Thalapillil
PHY302		3	Lab Training/ Theory Project	6	Suneeta Vardarajan
PHY402		3	Lab Training/ Theory Project	8	Suneeta Vardarajan
LRP102		3	Lab Training/ Theory Project	12	Suneeta Vardarajan
LRP202		3	Lab Training/ Theory Project	14	Suneeta Vardarajan
PHY330		3	Physics Lab - IV	6,12	Shivprasad Patil, Aparna Deshpande
PHY320		4	Physics Lab V	6,12	Sunil Nair, Atikur Rahman
PHY410		4	Physics Lab - VI	8,14	Shouvik Dutta, Ashna Bajpai
PHY430		3	Physics Lab VII	8,14	G.V. Pavan Kumar, Satish Ogale



News, Events, and Initiatives

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NEWS AND EVENTS

VALEDICTORY CEREMONY

November 20, 2020

A Valedictory Ceremony was held in lieu of the ninth convocation of the Institute to congratulate the graduating batch of students. During the event, 164 BS-MS students, 21 Integrated PhD students, and 55 PhD students received their degrees. Further, 04 students graduated with a BS degree, and 05 students from the Integrated PhD programme graduated with an MS degree.

The Institute Gold Medal for the BS-MS Programme was presented to Sriram Raghunath. Xytel Best MS Thesis Awards were given to three Integrated PhD students (Shana Shirin V., Devesh Verma, and J. Bharathi Kannan) and Xytel Best PhD Thesis Awards were given to four PhD students (Amit Kumar, Vijayakanth T., Kulkarni Girish Murlidhar, and Amit Bhunia).

ONLINE HINDI FORTNIGHT CELEBRATIONS

September 10-24, 2020

During the online Hindi Fortnight, several competitions were organised for the institute members. These included Hindi essay writing (Topic: *Online Education: Advantages and Disadvantages*), poetry writing, and story writing. Events on storytelling and performance, literature hunt and crossword puzzles were also conducted. Winners of the competitions were given prizes and certificates.

GOLD MEDAL AT IGEM-2020 TO THE IISER PUNE TEAM

November 22, 2020

A team of 14 students won a gold medal at the 2020 international Genetically Engineered Machines (iGEM) contest. The International Giant Jamboree of the event was held virtually during November 13-22, 2020. Close to 250 teams participated in the competition internationally, which consisted of poster presentations, workshops, keynote speeches and networking events. The students worked on developing a library of protein-based therapeutics and a simple diagnostic kit to combat malaria. This is the first gold medal from iGEM competition to a team from IISER Pune. The team also bagged the iGEMer's Prize, i.e., they were officially voted the best undergraduate team by all the other teams in the competition.

TWO NEW RESEARCH INITIATIVES AT IISER PUNE

The year 2020-21 saw two new research initiatives from the institute: the Centre for Water Research and the I-Hub Quantum Technology Foundation.



The **Centre for Water Research** (CWR) was constituted in November 2020. It draws upon expertise from faculty across different departments at the institute including Biology, Earth and Climate Science, and Humanities and Social Sciences. The CWR aims to generate interdisciplinary knowledge about water systems, including their history and

heritage, resource management and sustainable use, and to train the next generation of scholars to look at water from an integrated/multi-dimensional lens.



The **I-Hub Quantum Technology Foundation** has been set up as a Section 8 company at IISER Pune, with support from the Department of Science and Technology. The I-Hub has been set up with the aim to develop quantum computers and novel quantum materials for day-to-day applications. Led by members from the Physics department of the institute, this hub will have participation from up to 13 research groups from the institute and will network with over 20 participating institutes from within the country and with several collaborators from foreign universities and institutions.

MIMAMSA 2020

January 18, 2020; February 07, 2021

Mimamsa is a nation-wide inter-college science competition organised by IISER Pune students annually. Held in partnership with Praj Industries, the preliminary round of Mimamsa 2020, the 12th edition of the event, was held at 19 cities and 21 centers across India on January 18, 2020 with an overwhelming participation of 3628 students. Due to the COVID-19 pandemic, the Mains round was postponed and held later as an online event in February 07, 2021. Four teams competed in the final round: IISc Bengaluru, IISER Kolkata, IIT Bombay, and IIT Delhi. IISc Bengaluru team emerged as the winner.

NATIONAL SCIENCE DAY 2021

February 28, 2021

IISER Pune celebrated the 2021 National Science Day by conducting various public events. Due to the COVID-19 pandemic, all programmes were held online all-day long on the IISER Pune Science Activity Centre's YouTube channel and Facebook and Twitter pages.

The events included live demo sessions, talks through the "Let's meet the scientists" session, and Toyfest 2021 event which included demo of science models curated by school children and teachers. The screening of the award-winning film produced by the Science Media Centre, "The Trials and Triumphs of G N Ramachandran", was followed by a panel discussion on the impact made by Dr. Ramachandran on Indian Science.

INTERNATIONAL WOMEN'S DAY 2021

March 08, 2021

Organised by the Women in Science Committee of the institute, the 2021 International Women's Day event included talks and panel discussion on the topic of 'Doing Science in Unprecedented Times'. Dr. Gagandeep Kang from CMC, Vellore, Dr. Anindya Sinha from NIAS, Bengaluru, and Dr. Collins Assisi, Ms. Swapna Joshi, and Dr. Shanti Kalipatnapu from IISER Pune were on the panel. The discussions included how scientists and research institutions are responding to the COVID-19 pandemic both to combat the infection as well as to sustain our efforts towards gender parity.

THEME-BASED EVENTS, EVENTS BY STUDENT TEAMS

The Institute celebrated these events during the year: International Day of Yoga (June 21, 2020); Independence Day (August 15, 2020); Fit India Movement (October 01, 2020); Vigilance Awareness Week (October 27 to November 02, 2020); National Unity Day (Rashtriya Ekta Diwas Pledge, October 31, 2020); Constitution Day (November 26, 2020); and Republic Day (January 26, 2021). These events were coordinated by the Administration section of the Institute with support from student club members and other members from the institute.

The Sports Club organised a Fitness and Kickboxing session on October 01, 2020 as part of Fit India Movement. The Math department of the institute, along with the Math Club organised the 2021 Math Day virtual celebrations spread over four days between March 12 to March 15, 2021.

The Science Club organised a series of talks by scientists during February–March 2021 on the occasion of National Science Day and during November 2020 as part of Nobel Evening series. On February 28, 2021, the institute Science Club was involved in the launch of *Inventa*, a science magazine and youth-led science communication platform. *Inventa* magazine is a collaborative venture between undergraduate and postgraduate students at all seven IISERs, the National Institute of Science Education and Research (NISER), the Centre for Excellence in Basic Sciences, and the Indian Institute of Science.

PRODIGIOUS WOMEN IN CHEMICAL SCIENCES: A MENTORING PROGRAMME

December 14, 2020

Hosted by the Chemistry department and organised by faculty member Dr. Moumita Majumdar, this event aims to foster women's retention and progression in the field of chemical sciences. As part of this programme, Prof. Jyotirmoyee Dash from the Indian Association for the Cultivation of Science (IACS) Kolkata gave two invited talks, one on her journey in science and the other on the topic of organic chemistry tools for nucleic acid targeted therapeutics.

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.

Due to the COVID-19 pandemic and travel restrictions, all interactions with international partners and stakeholders were held in the virtual environment.

MEMORANDA OF UNDERSTANDING (MOU) AND AGREEMENTS SIGNED DURING 2020-21

A total of 28 collaborations, 25 ongoing and 3 new, were pursued during the year 2020-21.

Partner Organisation/s	Purpose
<i>July 02, 2020</i> MoU with University of Glasgow, U.K. (was renewed for the next 3 years)	Bilateral student exchanges and EU funding to support the collaboration
<i>Oct 02, 2020</i> MoU with King's College, London, U.K.	Dr. Sunil Nair, Dr. Umakant Rapol from IISER Pune, and Dr. Prashant Jha from King's College London had worked together during the year to jointly develop a mechanical ventilator. To further develop the partnership, this MoU was signed to enable us to jointly apply for funding and support faculty / student exchange between two organisations
<i>Oct 12, 2020</i> MoU with School of Engineering, Osaka University, Japan	To support bilateral student and faculty exchanges between the organisations and also to develop academic and research partnerships
<i>Nov 05, 2020</i> MoU with Max-Planck-Gesellschaft (MPG), Germany (with all seven IISERs, was renewed)	To support research collaboration and faculty exchange between both organisations
<i>Dec 07, 2020</i> MoU with Johns Hopkins University, U.S.A.	To formalise the intent of academic and research collaboration between the two organisations

ACTIVITIES UNDER EXISTING MoUs

With University of Glasgow, U.K.

Discussions are ongoing towards developing a joint-certification programme for teacher training in the higher education sector. A few workshops are being planned for the coming year in this direction.

November 25, 2020: Faculty member Dr. Anirban Hazra and BS-MS student Nikita Gupta participated in an online panel discussion and webinar on online teaching experiences. Titled “Global perspectives from academics and students on taking Higher Education online”, this virtual event was held between the University of Glasgow, University of Sydney, and IISER Pune.

With ENS Network

IISER-ENS Network meetings were organised to discuss collaborative programmes like virtual workshop/seminars, student team projects, and joint online courses. In this context, it was highlighted that Dr. Amrita Hazra from IISER Pune and Prof. Jens Hasserodt from ENS Lyon have planned joint teaching for each other’s classes. It was agreed to organise a virtual workshop on pedagogy and teaching during May 10-11, 2021.

With University of Göttingen, Germany

Namaste+ project meetings were organised online by the University of Göttingen, Germany and all the project partners participated. Partner institutions shared their COVID-19 status report and plans to either continue or to postpone the mobilities were discussed. Alternatives to physical mobility, i.e., conducting virtual activities, were discussed. NAMASTE+ project report for 2019 and activities for the upcoming months of 2020 were also discussed.

Prof. Quadt from Experimental Physics, the University of Göttingen organised a virtual meeting under NAMASTE+ to discuss Experimental Physics modules. This meeting was attended by physics professors from Indian partner institutions. Dr. Sourabh Dube participated on behalf of IISER Pune. Prof. Quadt had filmed a series of experimental physics videos in English and made them available to Indian partners as a resource. A possibility of collaboration in the digitalization of some of the physics experiments as an online teaching resource was discussed.

The workshop “India-Germany cultural exchange” for administration staff was completed in the month of October 2020 as a virtual event under NAMASTE+ project. Dr. Shanti Kalipatnapu (PTO, Research Communications) participated in this workshop from IISER Pune.

On October 28, 2020, NAMASTE+ project hosted a series of Web Talks promoting an intensive dialogue between Germany and India. The Web Talk “German Higher Education System” offered insights into the different aspects of Germany’s education system. It also highlighted the conditions and requirements for international students, as well as aspects to take into account when establishing cooperation with German universities.

October 29-30, 2020: A virtual meeting titled “Connecting Germany and South Asia- Fostering Partnerships in Higher Education” of the stakeholders of different DAAD funded cooperation projects was organised by DAAD India in association with DAAD Germany and UGC India. The objective was to facilitate cross-learning and enable future collaborations. Dr. Naresh Sharma represented IISER Pune in this meeting in association with Ms. Valia Carvalho, NAMASTE+ project coordinator from the University of Göttingen, and presented the status update on NAMASTE+ project.

December 08, 2020: Dr. Naresh Sharma represented IISER Pune in partners meeting on the SWAGTA project which is the Erasmus+ mobility project in partnership with the University of Gottingen. This was an introductory meeting to get to know the representatives from the partnering institutions and discuss the modalities of the project.

MEETINGS WITH INTERNATIONAL DELEGATIONS / REPRESENTATIVES

Academicians, policymakers, and delegations of administrators and other professionals from foreign universities, research organisations, high commissions, consulates, and embassies interacted with IISER Pune to explore and discuss research collaborations and academic programmes. These comprised 13 such meetings (number of interactions shown in parenthesis) from 6 countries: Australia (01); Finland (02); France (01); U.K. (01); Russia (01); and U.S.A. (07).

OTHER ACTIVITIES

The year 2019-20 saw several online events on facilitating research and academic activities of research institutions through building partnerships. Some of the events, where Dr. Naresh Sharma from the International Relations Office was invited as a speaker and panel member and represented IISER Pune, included a webinar titled "Developing and managing international partnerships for research" organised by India Alliance IRMI initiative, July 17, 2020; Virtual workshop organised by Leibniz University, September 09, 2020; and First Annual Conference of India Research Management Initiative (IRMI), February 02-05, 2021.

The International Relations Office is working towards setting up a virtual centre for teaching excellence and pedagogy in collaboration with international partners. Plans are underway to introduce a Certificate Program in Science Education (CPSE) within the ambit of this centre. In this regard, discussions have been initiated with leading universities from Australia and the U.K.

OUTGOING STUDENTS

Due to the COVID-19 pandemic and travel restrictions the outgoing mobility was suspended. A total of 7 (3 PhD and 4 BS-MS) students were provided NOCs to travel abroad for their 5th year project/collaborative research.

INCOMING STUDENTS

Due to the COVID-19 pandemic no incoming mobility was organised. A total of three remote internships were conducted. Two students from MIT and one from the University of Pennsylvania worked with the faculty members in IISER Pune for their summer internship.

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 15 agreements / MoU during FY 2020-21 with industries and academic organisations. Of these, ten were new partnerships, initiated with the following organisations for collaborative research projects: Bombay Natural History Society; Accurate Gauging & Instruments Pvt. Ltd.; IARI-Pune; ACTREC Mumbai; Shiv Nadar University; C-CAMP Bengaluru; University of East Anglia (U.K.); Venbiotech Pvt. Ltd.; University of Edinburgh; and Rudra Nanotech Pvt. Ltd.

The agreements with Pilkington Technologies Management Limited, England; KPIT Technologies Limited; Dentsply Sirona Implants, Sweden; and Zumator Biologics Inc. received an extended term of partnership. Agreement with Cipla Foundation enabled support to IISER Pune COVID-19 testing centre.

Considering the COVID-19 situation and physical distancing measures, the institute moved most of the activities to the virtual mode. 'IISER Pune-Industry Connect' events were conducted on January 19, 2021 and on February 26, 2021 to share with industry leaders a yearly update of IISER Pune's work, specifically in response to the COVID-19 pandemic situation. Forty nine industry / corporate representatives participated in the event. The event is part of our activities for bringing together industry leaders, professionals, and academicians who have a shared interest in scientific research and development.

ENDOWMENTS

During the period April 2020-March 2021, in response to the COVID-19 pandemic, IISER Pune launched "Tackling COVID-19 Together", an initiative to address the pandemic through exchange of information and resources. A combined effort of IISER Pune faculty members, students, and staff along with partnering organisations, this programme included setting up of a testing centre on the campus, carrying out research on COVID-19, and reaching out to communities beyond the campus.

Support received for COVID-19 Testing Centre established at IISER Pune

Several corporates came forward and supported the operations of the COVID-19 Testing Centre (CTC) at IISER Pune.

- **ICICI Lombard General Insurance Ltd** supported the procurement of an RT-PCR machine for IISER Pune.
- **Cipla Foundation** supported procurement of safety gears for the volunteers at CTC.
- **Integrated Decisions and Systems India Pvt (IDeaS), Pune** provided support for consumables required for testing of samples.

- **CAF Target Funds** supported IISER Pune's CTC to process the samples received from the Pune Municipality area.

Support for COVID-19 and related Research Activities

- **Persistent Foundation** supported 'sero-surveillance of COVID-19 in Pune city'. The project is implemented by IISER Pune in collaboration with Savitribai Phule Pune University (SPPU).
- **Xytel India Ltd** extended generous support for procurement of equipment required for research activities on infectious diseases.

Support for other Research Activities

- **Precision Wires Ltd** in 2017 had provided support for Research on 'String Theory and Quantum Gravity'. This year the research grant was used in providing a low-cost Wacom Graphic Tablet to one BS-MS student for continued research interactions.
- **Dr. Sara Ahmed** provided a generous endowment for the newly established Centre for Water Research (CWR) at IISER Pune. The endowment is to be used for activities such as organising formal lecture / seminar / colloquium, engaging in formal and informal discussions with undergraduate and graduate students, and undertaking collaborative research with faculty or staff.
- **Coriolis Technologies Pvt. Ltd.** supported the research activities of the Biology Department at IISER Pune through purchase of equipment viz High-resolution gel document system, PCR thermal cycler and pH-conductivity meter.

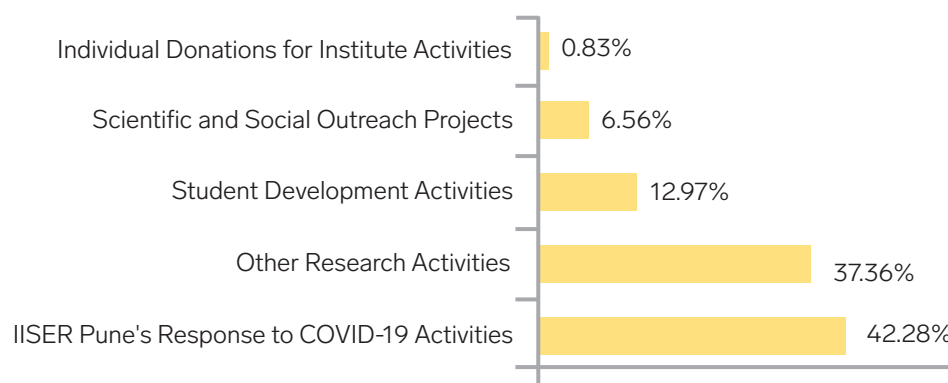
Support for Student Development Activities

- **Infosys Foundation Endowment Fund:** In 2016 Infosys Foundation provided an endowment to IISER Pune for student development activities. During the reporting period of 2020-21, tuition fee waiver was extended to 45 BS-MS students and 3 Integrated PhD students; one Integrated PhD student was also supported for the registration in a virtual conference.
- **IISER Pune - Siemens Ltd PhD Fellowship:** In 2019, Siemens Industry Software (India) Pvt Ltd (SISW) committed to instituting one PhD fellowship at IISER Pune. With the release of a second installment in March 2021, 'IISER Pune - Siemens Ltd. PhD Fellowship' is all set to be instituted during the Academic year 2021-2022.
- **IISER Pune-Xytel Best Thesis:** Seven students were declared as winners by the Thesis Evaluation Committees. In the year 2018, Xytel India Pvt. Ltd. provided endowment for instituting Best MS and PhD Thesis Award in all departments at IISER Pune.
- **IISER Pune-IDeaS Scholarships** Through the yearly contribution from Integrated Decisions and Systems (India) Private Limited (IDeaS), 6 students pursuing their BS-MS course, 5 students pursuing their Integrated PhD course, and 10 students pursuing their PhD course have been awarded scholarships.
- **IISER Pune-Innoplexus Ltd. Travel Awards:** Innoplexus Consulting Services Pvt. Ltd. gave a one-time financial support to IISER Pune in 2019-2020 for instituting a Travel Award. The disbursement for the travel was deferred due to the pandemic. During the reporting period (FY 2020-21), Innoplexus Ltd. further topped up the earlier grant amount. The donated amounts in these two years will now be given to students during the Academic Year 2021-22.
- **Support for Extended PhD Duration:** The financial contribution from Scivic Engineering Ltd will support the extended PhD duration of select students affected by the lockdown situation.
- **Top-up Research Grant for BS-MS, Integrated PhD, and PhD students:** Trimurti Fabricators Private Limited and Twenty-Twenty Interior Design Software India (P) Ltd. provided one time donation towards research grants to Integrated PhD and PhD students (3rd year) and BS-MS students (5th year) to carry out exemplary research work.

Support for Outreach Activities

- **Molecular biology training programme for school and undergraduate students:** In January 2019, Eppendorf India Ltd. committed financial support to IISER Pune for a period of three years to hold Molecular Biology training programmes for school and undergraduate students. Between January 2021 to February 2021, 9 workshops were organised benefiting 57 students.
- **IISER Pune - Praj Mimamsa 2020:** The 12th edition of IISER Pune's flagship event, was conducted over two Spring semesters of 2020 and 2021. A National-Level Inter-College Science Challenge, *Mimamsa* lays emphasis on conceptual and critical thinking while approaching science. After lots of work put in by the team to adapt to an online setting owing to COVID-19 situation, the Mains was held on the February 06-07, 2021 in which IISc emerged as winners, followed by IIT-Delhi, IIT-Bombay and IISER Kolkata.
- **Smt. Indrani Balan Science Activity Centre (SAC)** on our campus is established with an objective of strengthening school education, specifically teaching and learning of science and mathematics, by the use of simple toys and hands-on activities. Due to the pandemic situation, the SAC team engaged with the audience through online programmes. The SAC team intended to expand their free digital resources and hence reached out to its patrons for support. The fundraiser "#Support Science Activity Centre @ IISER Pune" received overwhelming response from the general public.
- **Community Service Group**
A Community Service Group (CSG) comprising IISER Pune community members and staff ensured dissemination of accurate information about the pandemic and safety measures, to the localities around the Institute and among families associated with the Institute. The CSG also coordinated efforts by the Abhyasika initiative of *Disha*, a student volunteer group at the institute, to help children of the staff with online schooling and additional help with education. The CSG crowdsourced the acquisition of masks, soaps, sanitizers, and hygiene kits for IISER Pune staff workers, and these were distributed to staff and their families and visitors to the campus. Given the urgency of the situation, the CSG focused on construction workers and their families, about eighty of them, that were stranded on campus. A fundraising appeal was sent to IISER Pune staff and students. These funds were used to provide two rounds of dry ration, some fresh produce, clothes, toys, and books during the first lockdown. Some of the other contributions made by the CSG included primary health care and medical advice.

SUMMARY OF PURPOSES OF ENDOWMENTS RECEIVED DURING FY 2020-2021



OUTREACH ACTIVITIES

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

SMT. INDRANI BALAN SCIENCE ACTIVITY CENTRE (SAC)

Established under the broad aegis of the Centre of Excellence in Science and Mathematics Education, the SAC develops innovative science toys with easily available material, to give students a hands-on flavour of the subject.

The COVID-19 pandemic brought school and college education to a standstill, especially in the early months of the pandemic. Shortly after the lockdown began, Smt. Indrani Balan Science Activity Centre (SAC) at IISER Pune moved their activities online. SAC initiated a series of online demonstrations of Science and Math activities for school students and teachers on the IISER Pune Science Activity Centre YouTube channel. SAC has conducted a total of 54 successful online demonstrations through YouTube live sessions and via webinars which connected more than 1 lakh people including students and teachers from different parts of the country.

Next-Gen science camps:

Exploring fun activities at your doorstep, with hands-on science and mathematics

Sundays, June 07, 2020 to March 28, 2021

This was a weekly live session on the SMC Youtube channel with concepts based on the syllabi for classes V to XII. 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, and air blower and other household materials.



The event received a very positive response from the audience with an active participation from a total of 11,905 students and teachers via video feedback and emails for the series. More than 1000 viewers watched the demonstrations live. The total number of views have crossed more than 6,45,751 for last year.

Webinars playlist:

<https://youtube.com/playlist?list=PLNsl4FmzN-wka0IRUQsWfOm27lcRqYKMg>

The 21st century teacher: Teaching the Next-Gen

Saturdays, September 12, 2020 to December 05, 2020

Conducted in collaboration with the Royal Society of Chemistry, this online webinar series was on digital pedagogies and their applicability in digital classrooms. Webinars covered topics such as addressing learners' psychology, student engagement, assessment techniques, simulation-based learning, taxonomies for digital learning, etc. This online series brought together experts in the field of education, and aimed to bridge the gap between the theory and practice of digital education.

On an average, around 200 teachers actively participated in the webinar every week. Each webinar about 5,000 views on the SAC YouTube channel. In total, these webinar series attracted over 55,000 views. The webinar series was targeted to middle and high school teachers; however, we found educators at all levels, from primary school teachers to higher education faculty and research scholars participated in the webinars.

Webinars playlist:

<https://youtube.com/playlist?list=PLNsl4FmzN-wlxViG-eRmWZbBJto9ZBxfb>

मैत्री करुया विज्ञान - गणिताशी (Let's make friends with Science and Maths)

Saturdays, October 03, 2020 to January 31, 2021

This 10-episode series was in collaboration with Maharashtra State Council of Education Research and Training (MSCERT) with school teachers of Maharashtra as the target audience. This workshop series aimed to train the teachers to make their classes interactive by adopting the hands-on models for teaching. The live sessions were conducted in Marathi, the regional language for the state of Maharashtra, with concepts related to a topics from the syllabi taught in classes V to X through various hands-on activities. Teachers participated in online mode by sending videos and images of activities designed by them. For the opening session of this event, nearly 6352 teachers joined live and later the series had nearly 7,06, 094 views throughout the country in the past year.

Webinars playlist:

https://youtube.com/playlist?list=PLNsl4FmzN-wkEbpOBghIAYqZ4AKA_CTct

National Science Day

February 28, 2021

This is a major public event celebrated all over the country every year on 28th February with great enthusiasm. This year due to COVID-19 pandemic related restrictions, this occasion was observed on different SAC social pages in the form of scientific talks like "Let's Meet the Scientists", online live demonstrations of science activities, virtual tour of Science Gallery along with virtual demonstrations of Science models curated by the school children. It concluded with a panel discussion on "Inculcating Scientific Temperament: Going beyond the curriculum." Total 1,172 were the concurrent viewers for the event and nearly 50,244 have seen the recorded session over the last five months.

Session weblink:

<https://youtu.be/3242yeXHjM>

More activities

As a part of the ongoing teacher-training project, "STEP for STEM", sponsored by Tata Technologies, from the pool of 200 teachers in Level I workshop, 50 teachers were selected for Level II workshops to use activity-based teaching tools, and to develop resources with the SAC team in the form of Text Lesson Plans (TLPs) and Video Lesson Plans (VLPs) to be widely used by the school teachers. Last year, 5 out of 10 Level II workshops were conducted physically and this year the remaining 5 workshops are scheduled for online mode.

Last year SAC also conducted 10 webinars on hands-on activities for 309 school students out of which 239 students were from Pune region and 70 students had participated from Bhugaon. The centre also conducted online sessions for State Institute of Science Education, Nagpur on 25/02/2021 and for District Institute of Education and Training - SCERT at Nanded on 16/03/2021 engaging nearly 12,000 teachers via webinar along with Youtube live session that was streamed simultaneously.

To conceptualise novel toys and games under the 'AatmaNirbhar Bharat Abhiyan', *Toycathon-2021* was initiated by Hon'ble Prime Minister, Shri. Narendra Modi. SAC has actively participated in this national event. On February, 22, 2021 two toys and one teaching aid were selected for the Toycathon grand finale. The toy "Solar viewer" was selected under the 'Environment (TYCH12)' category, the toy "Merry-Go-Round" was selected for 'learning, education and schooling (TYCH45) category' and "Science Playbook" - a teaching aid was selected under out of the box, creative and logical thinking (TYCH22) category specially for 3-12 years old children. All the toys and teaching aids selected for grand finale will be presented for final rounds at the respective nodal centres in the coming year.

SCIENCE MEDIA CENTRE

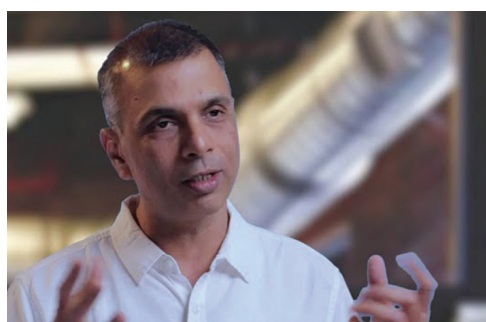
The Science Media Centre (SMC) at IISER Pune works in four different areas: training in science and scientific communication; production of online content for higher education; research communication for laypersons; and institutional promotional materials and event documentation.

COVID-19 related productions

Towards creating awareness pertaining to COVID-19, the SMC made a film titled "Bats are our friends". The SMC broadcasted four English and three Marathi episodes in a series called, "10 Questions to 10 PuneKars". The centre produced a film, "COVID-19 Testing Centre, IISER Pune; The story of unconditional volunteering", that featured efforts of COVID-19 warriors at the COVID-19 Testing Centre at IISER Pune.

Video production and editing of online courses

During the reporting period, the SMC recorded and edited 289 educational videos for 6

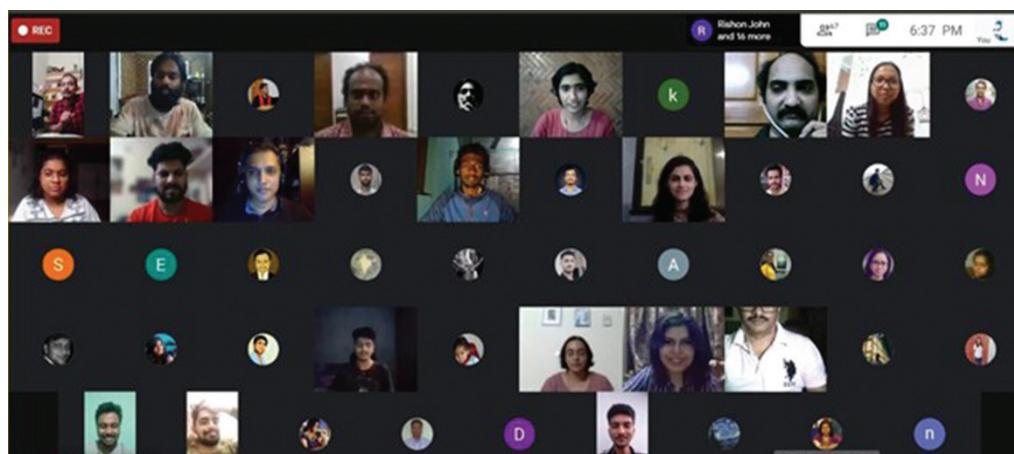


Prof. Prasad Subramaniam of IISER Pune introducing the NPTEL Course on Fluid Dynamics for Astrophysics

courses run by IISER Pune faculty members under the NPTEL programme. Along with this, the SMC also supported the Science Activity Centre for video recording and editing 24 educational videos, for an initiative supported by Maharashtra Knowledge Corporation Limited (MKCL), and script writing, video recording and editing of 102 lesson plans, for a project funded by Tata Technologies.

Workshops and Webinars

In the year 2020-21, the SMC conducted five workshops, of which, three were supported by National Council for Science & Technology Communication (NCSTC), one by IUCAA Pune, and one was funded by Vigyan Prasar. Along with these, two webinars were conducted that were supported by National Council for Science & Technology Communication (NCSTC). These workshops and webinars aimed to train participants in science communication, science news writing, science writing in regional languages, film making for science communication as well as scientific illustrations.



Online workshop- Filmmaking as a tool for Science Communication, supported by DST- NCSTC

SciTalk@SMC

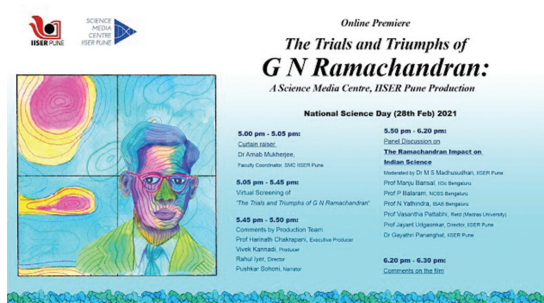
In 2020, SMC launched the second season of 'SciTalk@SMC'. A series of interviews of distinguished scientists, science communication practitioners, from IISER Pune and other known entities in this domain. The SMC produced ten videos in this season.

Support to the Institute

The SMC plays an important role in supporting the institute for various types of graphic designs, illustration artwork at the institute. During the reporting period, a total of 23 such graphics, and cover art designs were developed by SMC team members in support of the faculty members' research projects and events at IISER Pune. More than 30 events were supported by SMC for photography and videography.

Films

Films/Videos produced have also been recognised and appreciated widely. In 2020, the following films produced by the SMC received awards:



"The Trials and Triumphs of G N Ramachandran", Awarded in the 6th International Science Film Festival of India (ISFFI) under the category of Best of Festival Award on the theme 'Science for self-reliant India and/or Science for global welfare'.

"Sir Fred Hoyle; The Man Ahead of Time", awarded in the 10th National Science Film Festival of India (NSFF) under the category of 'Poonam Chaurasia Memorial Award for Best Female Science Filmmaker/ Cinematographer / Editor'.

"Superhydrophobic and Germicidal Nano-coating for PPE" won third prize In the Science Through My Eyes (Film Competition 2020) by INSA-SERB under the category of Working Professionals.

SOCIAL OUTREACH

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

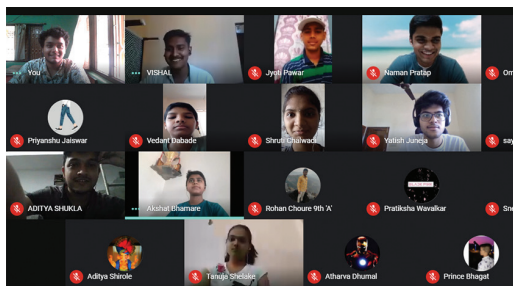
Disha is a student run social outreach organisation at IISER Pune. It is a platform for IISER Pune students to work towards the goal of socioeconomic equity. *Disha* works for making education accessible for children from underprivileged and marginalised communities from nearby localities.

Abhyasika and Pradnya programmes of Disha aim at educating students residing in Lamanvasthi, a vasthi neighbouring IISER Pune. Due to the COVID-19 pandemic during the year, it was not possible to go to the vasthi anymore, as none of the volunteers was on campus. Abhyasika volunteers conducted online one-on-one classes for the older students (between 8th to 10th std) in the vasthi. Volunteers tutored students on the topics they were to cover in school in the subjects of Science, English, Mathematics and Social Science. Later, through Dr. Suhita Nadkarni, one of the volunteers of the community service programme initiated on the campus during the lockdown, Disha members extended the programme to children of the various housekeeping staff at IISER Pune.

Mindspark programme focuses on teaching English, Maths and General Studies to 8th standard students from neighbouring municipal schools. In association with a teacher from *Sant Tukaram High School* located in the Pashan locality of Pune, Disha helped students prepare for the 8th Standard Maharashtra Scholarship exam. The tutoring was online and reached out to 3-4 students on a regular basis.

Science Nurture Programme aims to popularise science and increase scientific temper amongst 9th standard students who come from underprivileged backgrounds. Having shifted to online platform, the team contacted three different schools and took online sessions on weekends over various topics in science. Over the course of two semesters and the summer, they conducted sessions on nearly twenty-five weekends and reached out to twenty students who regularly attended the sessions.

Prerna programme aims to prepare students in the 11th and 12th for their board examinations and various competitive exams required for admission into undergraduate courses in India. This year, starting from May 2021, Prerna started taking online classes. They are teaching students who were affiliated to an NGO (Poonawalla Foundation) till their 10th, and are teaching them physics, chemistry, biology and mathematics on a regular basis. The volunteers are primarily PhD, Integrated PhD, and senior BS-MS students.



Talk for Twenty: This is a platform for students from IISER Pune and speakers from outside to speak about the issues that they are passionate about and attempt to educate others about the issue. In the academic year 2020-21, three talks were conducted. One by Dr. Bejoy Thomas from IISER Pune, who gave a talk titled "Analyst, advisor or activist? Role of the scientist in problem-driven research", and another one by Mr. Makarand Saharabuddhe on the topic of "Social work by organizations and individuals". Finally, there was a student talk by L.S. Srikuttan (IVth Year BS-MS), on the topic of "Social media, and its psychological effects".

In addition to running various programmes, Disha volunteers work in teams to organise and maintain resources, to translate content required in their programmes, and put together *Pahal*, the annual magazine of Disha. The Resource team worked on maintaining a database for the various online resources of Disha and making videos that other Disha programmes could use. The translation team helped with translating various documents to Marathi and also helped in making certain videos in Marathi in order to make them accessible to our students. *Pahal 2020* was released online in December 2020.

With Door Step School (in collaboration with the Community Service Group) - This year, Disha, along with the Community Service Group, (in particular with Dr. Pooja Sancheti), made an arrangement with The Society for Door Step Schools (DSS), which involves two teachers from DSS coming to IISER Pune daily, and teaching the children of construction workers residing in the campus. The long-term aim of this endeavour is to bring the children into the mainstream education system, as they currently are not attending school.

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



One of the photo contributions to the wildlife photography drive: "Mushrooms growing on fallen coconut trees, Kerala, 2007" by Sreejith G.J.

walks, clothes donation drives, and activities around management of waste. Some of these activities took a hit due to COVID-19 lockdown and with volunteers having been away from campus. However, the team resumed activities online from early 2021. In February 2021, Prutha organised a campus bird count through four sessions, each of which were led by some of our faculty members and student experts on birds and joined by 50-60 enthusiastic participants. The team also organised a photography drive on wildlife photography in March 2021 on the occasion of World Wildlife Day on March 03.



Support Structure

Support Structure and Facilities

120

SUPPORT STRUCTURE AND FACILITIES

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

Matters related to general administration, finance, human resource management, IT requirements, procurement of equipment and consumables, civil, electrical and other engineering infrastructure are all handled by qualified staff members in 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 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 **Academic** section handles all aspects pertaining to the student admission process, timetable and classroom requirements, conducting exams, and maintaining student records.

The campus is connected through a dedicated leased line of 1 Gbps National Knowledge Network and a 300 Mbps line for uninterrupted internet access. The institute has a centrally controlled indoor and outdoor dual band campus wide Wi-Fi access network along with the recently upgraded IT security perimeter protection. The **Information Technology (IT)** section manages setting up and operations of these facilities along with hosting infrastructure services such as email, website, DNS, Eduroam, Institute Information Management System, computer laboratory, virtual reality laboratory, dining management system, biometric attendance system, and admissions software. The IT team provides support for high performance clusters across the research groups at the institute. The team also manages institute machines and a local area network, voice over internet phones (VoIP), VPN, and audio-video equipment during on-campus events, and offers support in the running of campus facilities such as the auditorium and e-classrooms.

During the year, the IT section successfully ran the operations of the PARAM Brahma supercomputer at the Institute 24x7, during prolonged lockdowns. The 797 Teraflops facility helped many researchers of the institute as well as other institutes to successfully carry on

their computational oriented research from their residences. The facility was securely available for authentic users on a continual basis, in spite of major cyber security attacks world over, especially on supercomputing facilities. Being a year of the pandemic, online classes were given a major boost, which was facilitated successfully, in addition to the conduct of online exams. Recruitment written examinations were successfully conducted by the institute too.

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 teaching, learning, and research programmes of the institute with over 27000 print books, 4000 e-journals, and over 6000 e-books. Library facilitates access to electronic, print, and multimedia resources and provides essential and specialised online information and research support services. Several online resources and 922 print books have been added to the library collection during 2020–21. 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 circulation kiosk integrated with RFID technology and biometric user authentication system.

The Library provides online access to various research tools and research support services such as Plagiarism Checking Service, Remote Access Portal for e-Resources, Current Awareness Service, Document Delivery Service, Inter Library Loan, conducting Author Workshops, Orientation, Training and Digital Literacy Programmes. Digital Repository (DR) has been set up to preserve and provide instant access to scholarly output of IISER Pune faculty, students, staff, and others associated with the institute. It serves as a platform 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 a total of 151 faculty members (131 regular faculty members + 20 faculty fellows, independent scientists, and visiting faculty); 131 non-teaching staff members; 62 postdoctoral fellows; 1654 students (382 PhD, 201 Integrated PhD, and 1071 BS-MS); and 112 research and management staff recruited through extramural projects. The numbers are as of March 31, 2021.





Accounts at a Glance

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<u>Income and Expenditure Statement</u>	126



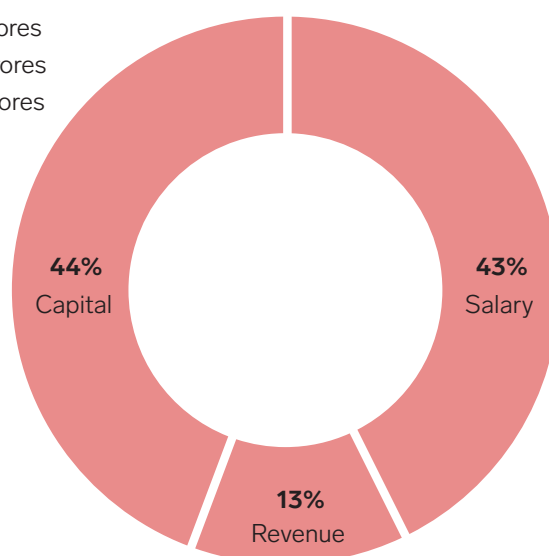
ACCOUNTS AT A GLANCE

The Annual Accounts of the Institute were approved by the Finance Committee and the Board of Governors during its meeting held on May 21, 2021. The annual audit for the Financial Year 2020–21 was carried out during June 17–July 07, 2021. The balance sheet and the income and expenditure statement for the Financial Year 2020–21 are given in the following pages.

Revenue ₹ 14.00 crores

Capital ₹ 48.50 crores

Salary ₹ 46.49 crores



FUNDS RECEIVED FROM THE MINISTRY OF EDUCATION

During the Financial Year 2020–21, IISER Pune received an amount of Rs. 108.99 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, 2021 from the Internal Revenue generated is Rs. 73.88 crores. The Institute generated an amount of Rs. 11.99 crores during the Financial Year 2020–21 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 2020–21, a total of Rs. 103.48 crores have been received by the Institute via extramural grants. New grants initiated during the Financial Year 2020–21 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 2020-21, Rs. 3.07 crores was received via endowments. Details are given in the Chapter titled “Partnerships and Endowments” of this report.

BALANCE SHEET

as on March 31, 2021

Amount in ₹

Sources of Funds	Schedule	Current Year 2020-21	Previous Year 2019-20
Corpus/Capital Fund	1	678,21,94,867	681,60,15,159
Designated/Earmarked/Endowment Funds	2	36,72,08,888	16,45,29,184
Current Liabilities and Provisions	3	103,58,81,215	88,00,22,010
Total		818,52,84,970	786,05,66,353

Application of Funds	Schedule	Current Year 2020-21	Previous Year 2019-20
Fixed Assets	4		
Tangible Assets		597,51,38,227	604,10,38,059
Intangible Assets		5,52,76,519	4,94,55,401
Capital Works-In-Progress		1,29,31,858	10,65,75,958
Investments From Earmarked / Endowment Funds	5		
Long Term		-	-
Short Term		16,03,15,103	15,35,22,078
Investments - Others	6	172,60,76,078	116,22,12,698
Current Assets	7	3,87,22,685	15,41,45,736
Loans, Advances & Deposits	8	21,68,24,496	19,36,16,420
Total		818,52,84,970	786,05,66,353
		0	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 04, 2021

INCOME AND EXPENDITURE STATEMENT

For the year ended March 31, 2021

Amount in ₹

Particulars	Schedule	Current Year 2020-21	Previous Year 2019-20
INCOME			
Academic Receipts	9	6,00,58,697	5,96,25,266
Grants/Subsidies	10	94,12,05,186	112,68,00,000
Income from Investments	11	-	-
Interest Earned	12	-	-
Other Income	13	2,68,48,221	5,68,69,687
Prior Period Income	14	9,92,948	3,17,01,521
Total (A)		102,91,05,052	127,49,96,474
EXPENDITURE			
Staff Payments & Benefits (<i>Establishment Expenses</i>)	15	47,50,95,632	49,85,33,629
Academic Expenses	16	14,88,44,334	13,94,70,907
Administrative and General Expenses	17	23,40,83,367	27,95,59,682
Transportation Expenses	18	47,84,633	57,70,186
Repairs & Maintenance	19	7,05,82,319	13,55,85,067
Finance Costs	20	60,560	2,39,743
Depreciation	4	35,60,89,134	33,98,01,466
Other Expenses	21	10,75,567	11,65,901
Prior Period Expenses	22	76,71,721	7,39,452
Total (B)		129,82,87,267	140,08,66,033
Balance being excess of Income over Expenditure (A-B)		(26,91,82,215)	(12,58,69,559)
Less: Transfer to Designated Fund			
Others - Institute Reserve Fund (Sch 9 + Sch 13)		-	(11,64,94,953)
Less : Excess Revenue Expenses adjusted from Corpus		-	2,33,93,859
Net To be taken to Institute Reserve Fund		-	(9,31,01,094)
Transfer to Capital Fund (Depreciation)		35,60,89,134	33,98,01,466
Over Utilisation of Grant in Aid for Revenue Exps (Schedule 3C)			
Under Utilisation of Grant in Aid for Revenue Exps (Schedule 3C)			12,08,30,813
Balance being surplus/deficit carried to Institute Corpus Fund		8,69,06,919	
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 04, 2021



Appendix

<u>Publications in 2020</u>	128
<u>Invited Lectures</u>	151
<u>Academic Events Organised</u>	155
<u>New Extramural Grants Garnered</u>	155



PUBLICATIONS IN 2020

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.



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02. DASGUPTA, RAJARSHI; **KHAN, SHABANA**. 2020. Chapter Three - N-heterocyclic germylenes and stannylenes: Synthesis, reactivity and catalytic application in a nutshell. In *Advances in Organometallic Chemistry Book Series*, 74, 105-152.
<https://doi.org/10.1016/bs.adomc.2020.04.001>
03. WALUNJ, MANISHA B.; **SRIVATSAN, SEERGAZI G.** 2020. Post-transcriptional Suzuki-Miyaura cross-coupling yields labeled RNA for conformational analysis and imaging. In *RNA Tagging: Methods and Protocols*, 473-486.
https://doi.org/10.1007/978-1-0716-0712-1_27
04. **SOHONI, PUSHKAR**. 2020. The Fort of Janjira. In *African Rulers and Generals in India, vol. 1 of Afro-South Asia in the Global African Diaspora*, 167-184.
05. **SOHONI, PUSHKAR**. 2020. Postal Project: Rocket Mail and the Creation of the Aero-Philatelic Market in India. In *Culture, Continuity and Tradition: Disquisitions in Honour of Prof. Vasant Shinde*, 815-823.
06. GAIKWAD, AJINKYA; **MAITY, SOUMEN**; TRIPATHI, SHUVAM KANT. 2020. Parameterized complexity of satisfactory partition problem. *Combinatorial Optimization and Applications*, 76-90.
https://doi.org/10.1007/978-3-030-64843-5_6
07. Kanesh, Lawqueen; **MAITY, SOUMEN**; MULUK, KOMAL; Saurabh, Saket. 2020. Parameterized complexity of fair feedback vertex set problem. *Computer Science – Theory and Applications*, 250-262.
https://doi.org/10.1007/978-3-030-50026-9_18
08. **MAITY, SOUMEN**. 2020. The small set vertex expansion problem. *Combinatorial Optimization and Applications*, 257-269.
https://doi.org/10.1007/978-3-030-64843-5_18
09. BHOSALE, RESHMA; Tonda, Surendar; Kumar, Santosh; **OGALE, SATISHCHANDRA B.** 2020. Two-dimensional materials for photocatalytic water splitting and CO₂ reduction. In *Nanostructured Photocatalysts: From Materials to Applications in Solar Fuels and Environmental Remediation*, 173-227.
<https://doi.org/10.1016/C2018-0-01802-2>



BOOK REVIEW

01. **Pushkar Sohoni**. 2020. Keelan Overton (ed.): *Iran and the Deccan: Persianate Art, Culture, and Talent in Circulation, 1400–1700*. 468 pp. Bloomington, IN: Indiana University Press, 2020. Bulletin of the School of Oriental and African Studies-University of London, 83(3), 538-539.
<https://doi.org/10.1017/S0041977X20003006>

INVITED LECTURES

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

Nixon M. Abraham

2020: Quantitative assessment of olfactory dysfunction accurately detects asymptomatic COVID-19 carriers Invited speaker in the International Conference on Applications in Computational Engineering and Sciences (IConACES), October 31, 2020 • *Annual Meeting: Behavioral phenotyping using optogenetics: Insights on neural circuit mechanisms of olfactory learning and memory* Invited speaker in the International Mouse Phenotyping Consortium (IMPC), November 02, 2020 • *2020: Measuring olfactory fitness for detecting asymptomatic COVID-19 carriers* Invited speaker in the NeuroUpdate, Kolkata, November 28, 2020

Bijay Kumar Agarwalla

Invited talk on *Thermodynamic uncertainty relation in quantum transport: Theory and experiment* Center for Theoretical Physics of Complex Systems (PCS), Institute of Basic Science (IBS), Daejeon, Republic of Korea, October 13, 2020; 11th Dynamics Days Asia Pacific (DDAP), Singapore, November 16–20, 2020; QFTA-2020 IISER Mohali India Conference, December 04–09, 2020; Department of Theoretical Physics, Tata Institute of Fundamental Research, Mumbai, December 08, 2020; International Centre for Theoretical Physics (ICTS), Bengaluru, December 23, 2020 • Series of Lectures given at the school on *Quantum transport and thermodynamics at nanoscale* Nanoscale Central Department of Physics TU/ ICTP Trieste, October 05–08, 2020 • Invited Panelist at the Vaishwik Bharatiya Vaigyanik Summit (VAIBHAV), a collaborative initiative by S&T and Academic Organisations of India, October 02–31, 2020 • Invited talk on *Photonic and electronic properties in quantum dot circuit-QED systems* International Conference on Non-Hermitian physics, International Centre for Theoretical Physics (ICTS), Bengaluru, March 25, 2021

Sudarshan Ananth

An intricate path to Gravity ICTS Seminar, January 27, 2021

Baskar Balasubramanyam

Construction of p -adic L -functions Invited talk in the “CMI online seminar series”, Chennai Mathematical Institute, Chennai, June 11, 2020 • *p -adic adjoint L -functions for Hilbert modular forms* Invited talk in the “Representation theory and automorphic forms” web-seminar, University of Vienna, Austria, May 12, 2020

Nirmalya Ballav

SAIS Symposium 2020, Exploring Chemistry at Solid-Liquid Interface (Webinar), IACS Kolkata, December 04–05, 2020 • *Graphene-Based supercapacitors: Challenges and opportunities (Webinar)* International Symposium on Materials Science and Innovation for Sustainable Society, DCAS Goa, August 26–27, 2020; RVCE Bengaluru, June 24, 2020

Argha Banerjee

Climate sensitivity of Himalayan glaciers, rivers, and landscape ICTS Monsoon Seminar Series, December 08, 2020; CORAL, IIT Kharagpur, December 22, 2020

Debargha Banerjee

Manin-Drinfeld properties Invited colloquium talk by zoom, TIFR, Mumbai, July 2020; Invited talk by Zoom, Inter IISER Maths Meeting, July 2020 • *Fermat's last theorem* West Bengal University of Technology, June 2020

Deepak Barua

Plant tolerance to drought and extreme temperature: Implications for tropical forest responses to climate change Webinar on Climate Change, Climate Change Mitigation and Disaster Resilience: Emerging challenges for India's ecosystems, organized by the National Biodiversity Mission, October 27, 2020

Bejoy Thomas

Panelist in a discussion on *Post pandemic India* organized by International Society for Ecological Economics (online), January 19, 2021 • Panelist in a session on *Drinking water, sanitation, and health improvement in rural areas* at the inauguration of IRMA Water Centre, Institute of Rural Management, Anand, Gujarat (online), December 14, 2020 • Invited lecture on *Assessing poverty and well-being: Concepts and tools* at a training workshop (online) on 'Ecosystem Approaches to Food and Water Security for Rural Wellbeing', organized by ATREE Bengaluru, December 13, 2020 • Panelist in a session on *Dilemmas in development at DOCMAD 2020* Institute of Rural Management, Anand, Gujarat (online), November 05, 2020

Ramakrishna G. Bhat

Invited Lecture Dr. A. V. Baliga College Kumta, Karnataka, August 18, 2020 • Invited Lecture on 'National Webinar on Role of Chemistry in Engineering and Society' JNN College of Engineering, Shimogga, Karnataka, August 14, 2020 • Invited Lecture Kanpur-Lucknow Local Chapter of CRSI, IIT Kanpur, September 05, 2020 • Invited Lecture-Teachers Training Programme, HRDC UoH Refresher Course on Chemistry Sant Gadge Baba Amravati University, December 07, 2020; University of Hyderabad, February 08, 2021 • Invited Lecture on the Occasion of Youth Day Science and Spirituality Bharati Vidyapeeth (College Students), Pune, January 12, 2021 • Invited Lecture on the Science Day, Abhinav School, Pune, February 28, 2021

Arijit Bhattacharyay

Coordinate dependent diffusion and modified Boltzmann distribution 11th Dynamic Days Asia-Pacific, Singapore, November 16–20, 2020 • *Ratcheting by equilibrium fluctuations: SNP Lectures* at SUNY Buffalo, US, February 20, 2021

Anup Biswas

Probabilistic methods in nonlocal PDE Recent trends in Nonlocal PDE and applications, IIT Kanpur Webinar, March 20, 2021; IISER Mohali Webinar, February 04, 2021; IIT Guwahati Webinar, January 27, 2021 • *Recent developments in the theory of generalised principal eigenvalue in R^n* Virtual MathFest, Webinar, July 22, 2020; Inter IISER-NISER mathematics meet, Webinar, July 16, 2020

S. Sandanaraj Britto

Dr. S.J. Arulraj & Rev. Dr. Mathew J. Moolel S.J. Endowment Lecture on *Rational design of semi-synthetic proteins utilizing an organic chemistry approach* Chemistry Department, St. Joseph's College, Tiruchirappalli, Tamil Nadu, February 11, 2021

Apratim Chatterji

Title of presentation: *Emergence of structure and organization in bio-polymeric systems: A physics perspective* Trends in Physics and Future Prospects over Zoom, IIT Jammu, January 11–13, 2021

Devapriya Chattopadhyay

Conference: *A model-based approach to evaluate the effect of sampling and community structure on the inferred predation estimates* Topical session T78: Biotic Interactions through Time, Geological Society of America Annual Meeting, October 29, 2020; **Outreach:** *Knowing the long-lost life with fossils* Invited speaker, Next Gen Science Camp, IISER Pune, September 26, 2020 • *Sixth mass extinction: Myth or reality* Invited speaker, IISER Bhopal Biology Club, August 03, 2020

Srabanti Chaudhury

Dynamics of end-pulled polymer translocation through a nanopore Invited talk, CompFlu, IIT Mumbai, December 12, 2020

Anisa Chorwadwala

Shape optimisation problems Online Alumni Talk for Present Students, Department of Mathematics, University of Mumbai, October 17, 2020 • Virtual talk *Being a Scientist* for WoMentor. Connect Time to STEM up organisation for women in STEM, July 26, 2020

Jeetender Chugh

Invited Speaker *NMR-based metabolomics – a versatile tool to understand the effect of stressors on cells, tissues, and organisms* Chemotsav'21 organized by Department of Chemistry, Rajdhani College, University of Delhi, March 09, 2021; National Webinar on Emerging Trends and Future Challenges in Chemical Sciences (ETFC-2021) organized by Department of Chemistry, Kirori Mal College, University of Delhi, March 04–05, 2021; Indo-Finnish work shop on Tools and Techniques for Analysis of Skin Microbiome and Metabolome an international online workshop sponsored by SPARC, MHRD, India, Department of Zoology, Savitribai Phule Pune University (formerly University of Pune), January 04–05, 2021

Aloke Das

Can unconventional hydrogen-bonds be conventional in strength Chemistry Day 2021–Commemorating the centenary of the discovery of hydrogen bonds, IISER Tirupati, January 23, 2021

Sutirth Dey

Critically reading a scientific article Webinar titled “Recent Trends and Approaches in Research Methodology”, Arihant College, Pune, September 26, 2020 • *Evolution of dispersal in laboratory populations: The Drosophila story* IMSc Chennai (online webinar), December 22, 2020

Deepak Dhar

A watched kettle never boils in quantum mechanics a talk for Science Club, IISER Pune, November 08, 2020 • *States of matter* web seminar organized by Department of Physics, University of Dhaka, December 01, 2020 • *Chase escape percolation on the square lattice* web seminar organized by ICTS (TIFR) Bengaluru, December 16, 2020 • *Chase escape percolation* Monday Colloquium, IISER Pune, February 15, 2021

Sourabh Dube

Careers in Science NPTEL lecture given with Prof. Bhas Bapat, June 16, 2020 • *Introduction to neural networks* India-CMS Lecture Series, August 10, 2020 • *Unsolved problems in particle physics* invited talk at Inquest 5.0, NIT Surat, February 20, 2021

G.V. Pavan Kumar

Soft-matter optics: A cabinet of curiosities ACS Science Talk: Virtual Lecture Series, May 22, 2020 • *Optothermal assembly of colloids* RRI seminar, June 05, 2020 • *Colloids near a plasmonic nanowire: Assembly and optical manipulation* Compflu 2020, December 10, 2020 • *Thermoplasmonic assembly: Colloidal swarms, networks and crystals* Seminar in Department of Physical Chemistry, TU Dresden, Germany, December 15, 2020 • *Colloidal dynamics in thermoplasmonic traps* Student Conference on Advances in Optics (SCAO 2021), TIFR Mumbai, February 05, 2021 • Student Conference on Photonics and Quantum Technology (SCPQT), NISER Bhubaneswar, February 26, 2021 • *Plasmonic trapping: Harnessing optothermal potentials*, Recent Trends in Condensed Matter Physics 2021, Indian Association for the Cultivation of Science, Kolkata, March 09, 2021 • *Plasmon-mediated optothermal trapping* Physics Departmental webinar, IISER Tirupati, March 18, 2021

Sujit K. Ghosh

Emerging areas in chemical sciences: Challenges and opportunities Department of Chemistry, Guru Ghasidas Central University in collaboration with Chemical Research Society India, Bengaluru, August 12–13, 2020 • *Advance Metal Organic Frameworks (AMOF-2020)* Veer Surendra Sai University of Technology (VSSUT), Burla, Sambalpur, Odisha, September 25–26, 2020

Sreejith G.J.

An exactly solvable model for FQHE APS March Meeting 2021, March 2021 • *Quantum dimer model: An efficient Monte Carlo algorithm with winding number updates* Young Investigators Meet on Quantum Condensed Matter Theory, NISER Bhubaneswar, December 2020 • *FQHE: Perspectives from microscopic approaches* Theory Colloquium,

Tata Institute of Fundamental Research, July 2020 • *An exactly solvable model for FQHE* QMAT Conference, IISc, Bengaluru, September 2020 • *FQHE: Perspectives from numerics* IISER Pune Colloquium, May 11, 2020

Boopathy Gnanaprakasam

Invited virtual lecture on *Heterocyclic peroxides: Beyond oxidation chemistry* in national conference on “Advanced Functional Molecules and Materials (NCAFM-2021)”, Karunya Deemed University, Coimbatore, March 12–13, 2021

Anindya Goswami

The scope of AI application in mathematical finance IEEE YESIST12-2020, July 28, 2020 • *Applications of artificial intelligence in mathematical finance* International Online Workshop on Advanced Topics in Mathematics (IWATM20) IIIT-Naya Raipur, October 01, 2020 • *What is mathematical finance? “What is...?”* talk series by Math Club, IISER Pune, October 29, 2020 • *European option pricing in regime switching model* Guest lecture in an MStat course in ISI Kolkata, November 25, 2020

Partha Hazra

Delivered a *webinar* entitled *Establishing structure-property relationship of solid state multi-stimuli responsive mechanochromic smart materials* in two day National Webinar on Current Challenges in Experimental Physical Chemistry, Organized by IIT Dhanbad, in association with the Royal Society of Chemistry, July 31, 2020

M. Jayakannan

SERB VORTEX Brain storming Conference: Future Perspectives of Organic Materials, IIT Bombay, February 13–14, 2021 • Outreach Talk: *Recent advancements in chemistry for cancer treatment* E-Lecture Workshop on Advances in Chemical Sciences, Organized by CRSI Tiruchy- Madurai Local Chapter and VHNSN College Virudhunagar, (E-conference), January 29, 2021 • Invited Talk: *Polymersomes in cancer drug delivery* International Conference on Recent Advances in Applied Sciences, Technology and Health (RASTH-2021), SRM Institute of Science and Technology, Kattankulathur, Tamil Nadu, (E-conference), March 03–05, 2021 • Outreach talk: *The role of chemistry in cancer treatment* Department of Chemistry, Shri Shivaji Mahavidyalaya Barshi's (E-conference), March 29, 2021

Mukul Kabir

Correct magnetic description of two-dimensional honeycomb CrI_3 QMAT 2020 – 3rd Annual Conference of Quantum Condensed Matter, S. N. Bose Centre, Kolkata, September 07–11, 2020 • *Gate-tunable magnetic ordering in 2D materials* Young Investigators Meet on Quantum Condensed Matter Theory-2020, National Institute of Science Education and Research, Bhubaneswar, December 15–18, 2020

Siddhesh S. Kamat

A chemical biology approach towards understanding a human neurological disorder Biological Seminar Series*, TIFR Hyderabad, February, 2021; Annual Talks*, TIFR Mumbai, January, 2021; CCMB Biologue*, CCMB, Hyderabad, October, 2020

Krishanpal Karmodiya

Title of the talk: *Cellular heterogeneity during stress conditions in synchronized Plasmodium falciparum* Talk in the virtual meeting Molecular Parasitology Meeting XXXI, Woods Hole, USA, September 21–24, 2020

Saikrishnan Kayarat

The rotary mechanism of GTP hydrolysis by the MrcBC endonuclease Multiscale Simulation & Mathematical Modelling of Complex Biological Systems 2021, Jawaharlal Nehru University, New Delhi, March 01–06, 2021 • International Conference on Emerging Strategies in Antimicrobial Agents and Bio-innovations, RK University, Rajkot, December 18–19, 2020 • International Conference on Chemical and Environmental Sciences (ICCAES 2020), IEM Kolkata, December 18–20, 2020 • Annual Biological Sciences and Bioengineering Day Symposium, Indian Institute of Technology, Kanpur, November 07, 2020 • *Cryo-EM structure of Mrcbc reveals the mechanism of GTP hydrolysis by a AAA+ motor* Asia-Pacific Microscopy Conference (APMC 12) 2020, Hyderabad, January 06–10, 2020

Shabana Khan

Synthesis & application of low-valent compounds—Development of

superior catalysts Organised by iDREAM — Interdisciplinary Division for Renewable Energy & Advanced Materials, Centre of Excellence (CoE), National Institute of Technology (NIT) Srinagar, November 05, 2020 • *N-Heterocyclic silylenes: Application as an alluring ligand* IIT Kanpur/LCC-CNRS joint CEFIPRA/IFCPAR virtual symposium on organometallic chemistry and catalysis, December 10, 2020 • *N-Heterocyclic silylenes: powerful ligand in transition metal chemistry* 1st National Conference on Advanced Functional Molecules and Materials (NCAFMM-2021), March 12, 2021

Soumen Maity

Parameterized complexity of satisfactory partition problem The 14th Annual International Conference on Combinatorial Optimization and Applications (COCOA'20), Dallas, Texas, USA, December 11–13, 2020 • *The small set vertex expansion problem* The 14th Annual International Conference on Combinatorial Optimization and Applications (COCOA'20), Dallas, Texas, USA, December 11–13, 2020 • *Parameterized complexity of defensive and offensive alliances in graphs* 17th International Conference on Distributed Computing and Internet Technology (ICDCIT 2021), Bhubaneswar, January 07–10, 2021 • *The balanced satisfactory partition problem* The 47th International Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM 2021), Bolzano-Bozen, Italy, January 25–29, 2021 • *Parameterized complexity of locally minimal defensive alliance* The 7th International Conference on Algorithms and Discrete Applied Mathematics (CALDAM 2021), IIT Ropar, February 11–13, 2021

Moumita Majumdar

Organometallic approach to main-group materials syntheses 1st Virtual Conference of Chemistry-An Asian Journal: Chemistry in India, August 26, 2020 • *Threading molecules and materials on organometallic platform* 'Progress in Physical Chemistry: Since and Then', NIT Manipur, November 04, 2020 • *Main-group materials syntheses* 'Women in Chemical Sciences-CRSI Week', North Bengal Chapter, November 05, 2020

Joy Merwin Monteiro

Research Talks: *Heat stress in South Asia: An overview* Hydrometeorological and Extreme Events Disaster Risk Management Training Programme, IIT Indore, June 11, 2020 (Invited Talk) • Invited Panelist for the Atmospheric Sciences group of the Vaibhav Summit organised by Government of India, Oct–Nov, 2020 • *AI/ML in weather and climate modelling* Workshop on AI/ML for ocean-atmosphere applications, IITM Pune, February 19, 2021 (Keynote Lecture)

Outreach Talks: *How do we measure climate change?* CCMB Climate Challenge, August 08, 2020 • *Podcast on climate change with lights, camera, Azaadi* <https://lightscameraazadi.in/>, February 28, 2021

Arnab Mukherjee

Taught *Statistical thermodynamics* 5-day Faculty Enrichment Program, Organized by PG Department of Chemistry, Payanur College, Kerala in association with CRSI, September 21–25, 2020 • Presented an invited talk *Statistical Mechanics in Chemistry and Biology (SMCB – 2021)* held online over zoom, January 23–26, 2021 • Presented a "National Webinar Lecture" on *Entrop: Classical and statistical perspective* Dhruva Chand Halder College, West Bengal, August 03, 2020

Sunil Mukhi

Technical Talks: *Holomorphic modular bootstrap for 2d CFT* University of Cambridge, May 21, 2020 • *Conformal invariance in physics* IIT Gandhinagar Physics Colloquium, May 28, 2020 • *Self-dual lattices, cosets and RCFT* Dual Mysteries of Gauge Theory and Gravity, a Conference in honour of David J. Gross, IIT Madras, October 22, 2020 • *Lattices, cosets and rational CFT* Workshop on Strings and Fields, Yukawa Institute of Theoretical Physics, Kyoto, November 17, 2020 • *Quantum gravity in 3 space-time dimensions* Physics Colloquium, IISER Pune, February 22, 2021

Non-technical/Popular Talks: *Spin and the Quantum World* Jidnyasa Virtual Learning Platform, Praj Matrix R&D Centre, Pune, April 29, 2020 • *The particles predicted by theory* India-Based Neutrino Observatory Lecture Series, July 20, 2020 • *Mathematical physics and reality, Two Worlds or One?* Coherence Lecture Series, IISc Bengaluru, December 20, 2020; Physics Society, IISER Thiruvananthapuram, January 18, 2021; Assam University, Silchar, March 19, 2021 • *The Hows and Whys of Scientific Research* Science Day Programme, IISER Pune, February 28, 2021 • *Remarkable outcomes of mathematical physics* Science Academies

Online Lecture Workshop on "Trans-disciplinary Areas of Research and Teaching", March 26, 2021

Angshuman Nag

Perovskite semiconductor nanocrystals: Lights, electrons, action American Chemical Society (ACS) Science Talks (Virtual), June 12, 2020 • *Optoelectronic properties of perovskite semiconductor nanocrystals* Department of Chemistry, SRM University-AP, Andhra Pradesh, Online lecture, July 07, 2020 • *Optical properties of layered hybrid perovskites: Nano @ Bulk* International webinar series on Current Trends in Condensed Matter Physics, Goa University, September 29–October 01, 2020; Nanoscience Global Webinar organised by Nano Letters (ACS), December 10, 2020; Applied Nanotechnology and Nanoscience International Conference – ANNIC 2021, a virtual addition, March 24–26, 2021 • *Designing nanoscale interfaces for optoelectronic properties of layered hybrid perovskite* Digital (India Germany) INDOGFOE-Symposium, February 24–26, 2021

Rejish Nath

Ultra-cold dipolar atoms Invited talk at Quantum glue meetings, UPV/EHU in Leioa Campus, Spain, March 09, 2021 • *Doubly dipolar Bose-Einstein condensates* Invited talk at a conference on photonics and Quantum technology, NISER Bhubaneswar, February 24, 2021 • *Ultracold quantum gases* Invited lecture, Sacred Heart College Thevara, Cochin, Kerala Greenhorn meeting, November 27, 2020

A.A. Natu

Gave ~60 lectures online on topics such as opportunities in basic sciences, new education policy, what we learn from Nature, and more to audiences that included students, teachers, doctors and other professionals.

Gayathri Pananghat

Structural insights on distinct features of prokaryotic small Ras-like GTPases Online event by the Indian Crystallographic Association, July 25, 2020 • *Bacterial cytoskeleton for cell shape and motility* at the conference "Her-story of Science: Celebrating women in research", organized by *Biologically Speaking* and sponsored by *BiasWatchIndia*, March 06, 2021 • *Protein purification workflow and applications in protein crystallography* One Day Workshop on Cloning, Purification of Recombinant Proteins, Osmania University, Hyderabad, March 19, 2021 (Online lecture)

Pramod Pillai

Career in nanoscience: How BIG is Small Sree Narayana College, Kerala, August 17, 2020 • *Catalysis and light harvesting by nanomaterials* National Seminar on Frontiers in Materials and Chemical Sciences (NSFMC 20), Jain (deemed to be University), Bangalore, August 31–September 04, 2020 • *Ligand directed light harvesting by nanomaterials* Departmental Talk in Chemical Sciences, TIFR Mumbai, October 19, 2020 • *Ligand directed catalysis by nanomaterials* Virtual National Seminar on Catalysis and Photocatalysis for Clean Energy (CPCE 2020), NIT Jamshedpur, October 09–10, 2020 • *Surface ligand directed catalysis by nanomaterials* Emerging Frontiers in Chemical Sciences (EFCS 2020), Farook College, Calicut, Kerala, December 04–05, 2020 • *Photophysics and photopatterning with surface engineered Quantum Dots* ChemSci2020, Leaders in the Field Symposium (RSC Sponsored Chemical Science Virtual Symposium), IISER Kolkata, December 07–10, 2020 • *Photochemistry and photophysics with surface engineered Quantum Dots* Covid-19 Lecture Series-Spring 2021, University of Miami, Florida, U.S.A., February 27, 2021

Supriya Pisolkar

Invited to give a series of lectures and tutorial from January 2021 to March 2021 on arithmetic of local field in the advanced instructional course by National Center for Mathematics, Mumbai

Mainak Poddar

A floor theory for toric orbifolds Colloquium (online), Tata Institute of Fundamental Research, Bombay, July 09, 2020; Plenary talk, Inter IISER NISER Mathematics Webmeet 2020, July 17, 2020 • *Equivariant splitting of toric principal bundles over projective spaces* Algebraic Geometry Seminar, IIT Bombay (online), October 05, 2020 • *Some applications of mathematics in contemporary life* National Mathematics Day celebration, Arihant College, Pune, December 22, 2020

Thomas Pucadyil

Membrane fission: Insights from reconstituting organelle form and chemistry Regional Centre for Biotechnology Contemporary Webinar Series, January 22, 2021; Annual Biophysical Society Meeting, USA, February 25, 2021; ASCB-EMBO Annual Meeting, U.S.A., December 08, 2020

Atikur Rahman

Self-assembly based nanopatterning for Energy Harvesting and Self-Cleaning Applications International Webinar Series on Current Trends in Condensed Matter Physics, Department of Physics, Goa University, Goa, October 01, 2020 • *Nature-inspired nanotechnology: Solutions for energy harvesting and self-cleaning* Webinar on science awareness among students, Ramakrishna Mission Vivekananda Centenary College, Rahara, Kolkata, WB, July 10, 2020

Raghav Rajan

How does the brain control movements Invited talk as part of Muktangan Online SciTalk Life Sciences Lecture Series, September 27, 2020 • *Using songbirds to understand how the brain initiates movements* Keynote lecture as part of Brain Awareness Week, 2021 organized online by IIT, Gandhinagar, March 15, 2021

Umakant D. Rapol

Invited talk *Atom-optic kicked rotor: From quantum chaos to atom interferometry* 8th Topical conference on Atomic and Molecular Collisions for Plasma Applications, Department of Physics, Indian Institute of Technology, Roorkee, March 03–05, 2020; International Conference on Complex Quantum Systems, Bhabha Atomic Research Centre, Mumbai, March 04–07, 2020 • Invited talk *Introduction to atom interferometry at IISER Pune* Quantum Workshop, Raman Research Institute (Online), Bengaluru, August 17–18, 2020 • Invited talk titled *Introduction to atom interferometers and atomic clocks* SPCOM - Current Trends in quantum information processing, Indian Institute of Science, Bengaluru, July 24, 2020 • Panelist on a webinar on the pandemic's impact on the Manufacturing sector with a particular focus on the Indian Laser and Photonics industry. We shall discuss about the challenges and opportunities pertaining to the laser manufacturing industry. Organised by Messe Muenchen India. Topic: "Challenges and opportunities for Laser applications in diverse industry segments post COVID", April 24, 2020 • Moderator and panelist in the Vaibhav Summit (2020) in the vertical Quantum Technologies vertical, October 03-25, 2020

Pooja Sancheti

Discipline-specific ignorance as facilitating factor in teaching scientific writing National Conference on "Challenges/Strategies in Teaching English for Academic Purposes in Higher Education in India" hosted by the CWC, Ashoka University, Sonapat, April 23–24, 2021 • *Workshop on Presentation skills in academic contexts* LIGO-INDIA Education and Public Outreach, hosted by SMC (IISER Pune) and IUCAA, February 06–07, 2021 • *Whose map is it anyway?: Mapping in contemporary South Asian fiction* International e-conference on "Re-thinking the Postcolonial: Texts and Contexts" hosted by *New Literaria* and Department of English, Assam University, Silchar, September 25–27, 2020 • *Writing tasks for a large mixed-proficiency/ability first year undergraduate class* ELTIS-SIFIL 10th National Conference on "A 360° View of Language Teaching Materials: Development, Utilization, and Evaluation" hosted by ELTIS, Symbiosis, Pune, February 07–08, 2020

Kundan Sengupta

EMP and chromosomal instability International online webinar course on "Measuring and modeling the Epithelial/Mesenchymal Plasticity (EMP) spectrum" organized by IISc Bengaluru, October 07, 2020

Kaneenika Sinha

102 years of the circle method Gonit Sora Webinar, September 27, 2020 • *Central limit theorems for the error terms in Sato-Tate sequences* IMSc Number Theory Seminar, IMSc Chennai, October 07, 2020 (conducted online); Algebra and Number Theory Seminar, Florida State University, March 18, 2021 • *Explicit constructions of unbalanced Ramanujan bigraphs* Balu Fest (International Number Theory Conference to celebrate Professor R. Balasubramanian's 70th birthday), IMSc Chennai, March 12, 2021

S. Sivaram

Sustainable chemistry: Challenges and implication to research and education Dr. B. R. Ambedkar University, Srikakulam, Faculty Development Programme for Science, Engineering & Arts Faculty on the Role of Academia in Sustainable Development, July 10, 2020 • *One hundred years of macromolecules: Looking back looking ahead* Department of Applied Chemistry, M S University of Baroda, October 16, 2010; M G University, Kottayam, November 13, 2020 • *Transition to renewable energy: How sustainable are they* Santappa-Raghavan Memorial Lecture, CSIR-Central Leather Research Institute, Chennai, October 28, 2020 • *Future of chemistry and its impact on education* Association of Chemistry Teachers, National Convention, International Webcon on Recent Advances in Chemistry Education and Research, December 01, 2020 The Future of Chemistry, E-teach with Eminent Personalities, Department of Chemistry, St. Joseph's College for Women, Alappuzha, Kerala, January 05, 2021 • *The Art and Craft of successful technology licensing* DST-IISER Pune Training Programme on Scientific Project Management, IISER Pune, January 08, 2021 • *What is chemistry* Orientation Programme for MSc students, Department of Chemistry, SP Pune University, January 15, 2021 • *Evolution of polymer science: What does the future hold* Changing Trends in Polymer Science and Technology (CTPST-2021), Department of Chemistry, NIT, Calicut, January 20, 2021 • *"Leveraging science for a clean, green and sustainable future"* The InfoTech (Innovation – Collaboration – Technology) Series Symposium 2021, Tata Chemicals Limited, January 23, 2021 • *Managing talent for fostering research and innovation: Key challenges* Mahindra Automotive and Farm Services Technology Symposium 2021, January 23, 2021 • *What is chemistry?* UGC Refresher Course for Chemistry Teachers, Kumaun University, Nainital, February 16, 2021 • *Writing a winning research proposal: Secrets of success* UGC Refresher Course for Chemistry Teachers, Kumaun University, Nainital, February 18, 2021 • *Polymer science, an exciting 20th century science* UGC Refresher Course for Chemistry Teachers, Kumaun University, Nainital, February 23, 2021 • *Industry-academia relationships: Myths and realities* Science Day Lecture, Dr Reddy's Laboratories, Hyderabad, March 01, 2021 • *Writing a winning research proposal: Secrets of success* UGC Refresher Course for Newly Recruited Teachers, Kumaun University, Nainital, March 05, 2021 • *The future of chemical sciences and engineering: Research, industry and education* Indrashil University, Ahmedabad, March 23, 2021

S.G. Srivatsan

Probing mood (structure) swings of therapeutic nucleic acid motifs First DNA Nanotechnology India Virtual Symposium, IIT Gandhinagar, September 04–05, 2020; Faculty Development Programme lecture series, SRM Chennai, July 18, 2020 • *In-cell NMR technology for probing structures of therapeutic nucleic acid motifs* Conference on Organic Medicinal and Biological Chemistry, VIT, Vellore, July 08–09, 2020; Chemical Sciences for Drug Discovery & Therapy (CSDDT 2020), VNIT Nagpur, July 22–26, 2020 • *Clickable nucleotide toolbox for displaying small molecules on gene targets* Asian Chemical Biology Initiative online meeting 2021, February 24–25, 2021

Pinaki Talukdar

Synthetic Ion transport systems for targeting cancer SAIS Symposium 2020, IACS Kolkata, December 04–05, 2020 (as webinars) • *Stimuli-induced artificial Ion transport: Novel therapeutic strategies to kill cancer cells* CHEMBIOSIS 2020 Mini-Conference, IISER Tirupati, May 25, 2020 (as webinars)

Arun Thalapillil

DAE-BRNS High Energy Physics Symposium Mini-review talk: Jets and jet substructure, XXIV DAE-BRNS High Energy Physics Symposium, NISER, Bhubaneswar, December 14–18, 2020

Arun Venkatnathan

Online talk titled *Computer simulations of co-crystalline electrolytes for all-solid alkali metal batteries* Center for Computational Energy Research (CCER), Netherlands, May 28, 2020 • Online talk titled *Can Molecular Dynamics effectively probe structure and dynamics in Polymer Electrolyte Membranes?* Complex Fluids Symposium, India, December 10–12, 2020

ACADEMIC EVENTS ORGANISED

Debargha Banerjee

Co-Organiser, Recent Developments Around P-Adic Modular Forms (Online), November 30-December 04, 2020

Apratim Chatterji

Session Chair, Statistical Physics in Soft Matter, Compflu-2020, Organised by IITB, December 10-12, 2020 • Organised and hosted online talk at IISER Pune, March 17, 2021 by Jayajit Das, Ohio State University & Battelle Center for Mathematical Medicine, Ohio, Title: *Modeling Synergy in our Immune System using a Physicist's Toolkit*

Anisa Chorwadwala

Member, Scientific Committee for the Winter School in Mathematics for Young Women, Department of Mathematics & Statistics, Manipal University, Jaipur, March 20-26, 2021 • Co-organised Mathematics Day 2021, March 12-15, 2021

G.V. Pavan Kumar

Webinar series of Physics of Soft and Living Matter, IISER Pune

Soumen Maity

Program Committee Member of the 40th conference on Foundations of Software Technology and Theoretical Computer Science (FSTTCS 2020).

Moumita Majumdar

Organiser, Women in Chemical Science...mentoring program, December 14, 2020. Invited Speaker: Prof. Dr. Jyotirmoyee Dash, IACS Kolkata (Shanti Swarup Bhatnagar awardee 2020) • Organiser, International Women's Day Celebration at IISER Pune, March 08, 2021

Angshuman Nag

Co-Organiser, "nanoGe" international conference: International Conference on Perovskites for Energy Harvesting: from Fundamentals to Devices (PERENHAR)", November 19-20, 2020

Supriya Pisolkar

Co-Organiser, NCM Advanced Instructional Course on Local Arithmetic, it is funded by NCM (National Center for Mathematics), January 2021-May 2021

Sudipta Sarkar

Coordinator, Indian Institute of Remote Sensing (IIRS) outreach and network programme

Kundan Sengupta

Convener, International Conference on Phase Separated Systems in the Nucleus (PSINU2021), jointly organized by Indian Academy of Sciences and IISER Pune

Surjeet Singh

Member, Organizing Team, New Horizons in Physics-IPA50, online event, September-December, 2020

Suneeta Vardarajan

Chair, Parallel session on Quantum Gravity, Indian Association for General Relativity and Gravitation (IAGRG) online meeting, IIT Gandhinagar, December 19-20, 2020

NEW EXTRAMURAL GRANTS GARNERED

Amount in ₹

Sr. No.	Name of the Project	Project Leader	Project Code	Funding Agency	Period From-To	Funds Received During the Year
01	UK India GTRF Grant	Prof. Satishchandra Ogale	EPSRC/PHY-20-491	Swansea University	17.04.2020 31.03.2021	565440.00
02	Inorganic organic hybrid solids as ion conduction membranes in charge storage devices - MHRD STARS	Dr. Ramanathan Vaidhyanathan	GAP/MHRD/CHE-20-492	MHRD	15.05.2020 14.05.2023	4536000.00
03	Disentangling the role of the spin mixing conductance on the spin Seebeck effect - MHRD STARS	Dr. Sunil Nair	GAP/MHRD/PHY-20-493	MHRD	15.05.2020 14.05.2023	3948000.00
04	Women Scientist A WOS-A - Analytical modeling of DNA drug intercalative binding mechanism	Dr. Vanitha Marimuthu	GAP/DST/CHE-20-494	DST	02.04.2020 01.04.2023	938199.00
05	TCG-CREST Joint Centre for Sustainable Energy Project	Prof. Satishchandra Ogale	INDL/TCG/PHY-20-495	TCG CREST	04.05.2020 03.05.2023	8454950.00
06	Yusuf Hamied Inspirational Science Program	Prof. Harinath Chakrapani	RCIF/20-496	Royal Chemistry India Foundation	24.03.2020 13.10.2020	3511316.00
07	MHRD-STARS - Transforming natural antimicrobial peptides into peptidomimetics to access potential antibiotics	Prof. H.N. Gopi	GAP/MHRD/CHE-20-497	MHRD	10.06.2020 09.06.2023	2310000.00

Amount in ₹

Sr. No.	Name of the Project	Project Leader	Project Code	Funding Agency	Period From-To	Funds Received During the Year
08	Real time infectious diseases hazard map for India based on transportation networks	Dr. M.S. Santhanam	GAP/SERB/PHY-20-498	SERB	16.07.2020 15.07.2021	430000.00
09	IFCPAR-CEFIPRA res project - 6305-1 Srinivas Hotha	Dr. Srinivas Hotha	GAP/IFCPAR/CHE-20-499	IFCPAR-CEFIPRA	21.07.2020 20.07.2023	2161280.00
10	IFCPAR-CEFIPRA res project - 6301-1 Rabeya Basu	Dr. Rabeya Basu	GAP/IFCPAR/MTH-20-500	IFCPAR-CEFIPRA	21.07.2020 20.07.2023	64948.00
11	Between open bazaars and enclosed markets: New public market halls of colonial India	Dr. Pushkar Sohoni	GAP/ICHR/HSS-20-501	ICHR	21.07.2020 31.03.2022	38000.00
12	Research Scientist Scheme Fellowship to Dr. Nishad Matange	Dr. Nishad Matange	GAP/SERB/BIO-20-502	SERB	25.08.2020 24.08.2022	2300000.00
13	Local probe of impurity effects in Kitaev systems (STARS-Project) Dr. Surjeet Singh	Dr. Surjeet Singh	GAP/MHRD/PHY-20-503	MHRD	17.07.2020 16.07.2023	191750.00
14	Non Abelian cryptography	Dr. Ayan Mahalanobis	GAP/DAE/MTH-20-504	DAE-NBHM	14.09.2020 13.09.2023	392000.00
15	Heparinoids based adjuvants for flaviviruses vaccine development	Dr. Raghavendra Kikkeri	GAP/DBT/CHE-20-505	DBT	07.10.2020 06.10.2023	2074360.00
16	Aim to build a robust supply-chain network of Indian MSMEs capable of producing reagents	Dr. S.G. Srivatsan	GAP/CCAMP/CHE-20-506	CCAMP	16.10.2020 15.10.2021	7960400.00
17	Creation of Technology Innovation Hubs (TIHs) under National Mission on Interdisciplinary Cyber Physical Systems (NM-ICPS)	Prof. Tarun Sourdeep Ghosh	GAP/DST/PHY-20-507	DST	26.10.2020 25.10.2025	77500000.00
18	BRICS Research Project-LDMHWBEATAILED-Low dimensional metal halides with broadband emission and their application in light emitting diode	Dr. Angshuman Nag	GAP/DST/CHE-20-508	DST	14.10.2020 13.10.2023	1295309.00
19	Support for safety gears for IISER Pune's COVID-19 Testing Centre	Prof. Sanjeev Galande	GAP/CIPLA/BIO-20-509	CIPLA Ltd.	01.10.2020 31.12.2020	483300.00
20	A comparative study of thermally activated delayed fluorescence (TADF) in twisted and planar organic molecular	Dr. Partha Hazra	GAP/SERB/CHE-20-510	SERB	03.12.2020 02.12.2023	2338000.00
21	Mechanistic basis of generation of meiotic errors due to prolonged dictyate arrest	Dr. Mridula Nambiar	GAP/SERB/BIO-20-511	SERB	02.12.2020 01.12.2022	1852000.00
22	The Physics of Extreme Wet Bulb Temperatures (PEWTER)	Dr. Joy Merwin Monteiro	GAP/SERB/ECS-20-512	SERB	03.12.2020 02.12.2022	2200000.00
23	Swarnajayanti Fellowship- Dr. Anup Biswas	Dr. Anup Biswas	GAP/SERB/MTH-2020-513	DST	09.12.2020 08.12.2025	300000.00
24	Swarnajayanti Fellowship- Dr. Rejish Nath	Dr. Rejish Nath	GAP/SERB/PHY-2020-514	DST	09.12.2020 08.12.2025	300000.00
25	Swarnajayanti Fellowship- Dr. Angshuman Nag	Dr. Angshuman Nag	GAP/SERB/CHE-2020-515	DST	09.12.2020 08.12.2025	300000.00
26	Shastri Covid-19 Pandemic Response Grant (SCPRG): Call for Innovative Solutions	Dr. Chaitanya Athale	GAP/SHASTRI/BIO-20-516	Shastri Indo Canadian Institute	10.11.2020 09.11.2021	1700000.00

Amount in ₹

Sr. No.	Name of the Project	Project Leader	Project Code	Funding Agency	Period From-To	Funds Received During the Year
27	Design & synthesis of heparan sulphate mimetic to target Wnt signalling pathway via immunomodulation: An active anti-cancer therapy	Dr. Preeti Bhoge (Chaudhary)	GAP/DST/CHE-20-517	DST-WoS-A	19.12.2020 18.12.2023	1234400.00
28	Modulation of intra- and inter-molecular weak $n \rightarrow \pi^*$ non-covalent interaction using gas-phase laser spectroscopy	Dr. Aloke Das	GAP/DST/CHE-20-518	SERB	18.12.2020 17.12.2023	5801218.00
29	Lanthanide doping in perovskite semiconductors: Visible to infrared electroluminescence	Dr. Angshuman Nag	GAP/DST/CHE-20-519	SERB	18.12.2020 17.12.2025	27049360.00
30	Engineering quantum matter and quantum states in dipolar systems towards quantum technological applications	Dr. Rejish Nath	GAP/DST/PHY-20-520	SERB	18.12.2020 17.12.2025	1672405.00
31	Nanotechnological design of the non-precious metal electrocatalysts for oxygen and hydrogen involving energy conversion reactions for clean energy appliances	Dr. Seema Verma	GAP/DST/PHY-20-520	DST-WoS-A	11.12.2020 10.12.2023	1482872.00
32	Isomerism directed molecular architectures for electrochemical energy storage and conversion devices	Dr. Muhammed Musthafa O.T.	GAP/DST/CHE-20-522	SERB	19.12.2020 18.12.2023	3888684.00
33	Analysis of nonlinear nonlocal partial differential equations: A probabilistic viewpoint	Dr. Anup Biswas	GAP/DST/MTH-20-523	SERB	19.12.2020 18.12.2023	952872.00
34	Understanding the role of mitochondrial-associated membrane proteins (MAMs) modulated type-I interferon signaling for targeted cell death in ageing breast cancer patients	Dr. Siddhesh Kamat	GAP/DBT/BIO-20/524	DBT	31.12.2020 30.12.2023	623140.00
35	Theoretical study of full-counting statics of energy fluctuations for driven dissipative quantum systems-- Keldysh non equilibrium Green's Function approach?	Dr. Bijay Kumar Agarwalla	GAP/SERB/PHY-20-525	SERB	28.12.2020 27.12.2023	220000.00
36	Teachers Associateship for Research Excellence (TARE) to Dr. Sambhaji Subhas Warule, Modern Education Society Nowrojee Wadia College	Dr. Angshuman Nag	GAP/SERB/CHE-20-526	SERB	22.12.2020 21.12.2023	335000.00
37	Investigation of novel magnetic configurations in low dimensional triangular lattice antiferromagnet	Dr. Dibyata Rout (Supervisor: Dr. Surjeet Singh)	GAP/IEEE/PHY-20-527	IEEE	11.01.2021 10.01.2022	522936.00
38	Advancing climate justice in India: The Movement from below	Dr. Shalini Sharma	GAP/UEA/BIO-20-528	UEA	01.01.2021 31.07.2021	979400.00
39	Shimura curves at infinity	Dr. Debargha Banerjee	GAP/DST/MATHS-20-529	SERB	30.12.2020 29.12.2023	1239731.00

Amount in ₹

Sr. No.	Name of the Project	Project Leader	Project Code	Funding Agency	Period From-To	Funds Received During the Year
40	To uncover the molecular mechanisms of nucleoporin Nup93 and its crosstalk with the genome organizer CTCF in the spatiotemporal organization of the genome	Dr. Kundan Sengupta	GAP/DST/BIO-20-530	SERB	31.12.2020 30.12.2023	3350000.00
41	Mapping signalling pathways by bioactive lysophosphatidylserine lipids	Dr. Siddhesh Kamat	GAP/DST/BIO-20-531	SERB	31.12.2020 30.12.2023	2013100.00
42	Role of carrier-phonon dynamics in determining thermoelectric properties	Dr. Pankaj Mandal	GAP/DST/CHE-20-532	SERB	21.12.2020 20.12.2023	4093333.00
43	Yang-Mills Theories: An alternate perspective	Dr. Sudarshan Ananth	GAP/SERB/PHY-20-533	SERB	11.01.2021 10.01.2024	220000.00
44	Chemistry as solid-liquid interface: Thin films of semiconducting 2D coordination polymers	Dr. Nirmalya Ballav	GAP/SERB/CHE-20-534	SERB	22.12.2020 21.12.2023	3770000.00
45	Synthesis of evaluation of PNA	Prof. K.N. Ganesh		Amount Transfer from IISER Tirupati	12.11.2020 Till Claim Settlement	500000.00
46	Water desalination with simultaneous electricity generation by harnessing the energy of neutralization	Dr. Muhammed Musthafa O.T.	GAP/DST/CHE-20-536	DST	16.02.2021 15.02.2024	3036182.00
47	EMBO Young Investigators Small Grant	Dr. Siddhesh Kamat	GAP/OHTERS/BIO-20-537	EMBO Young Investigators Small Grant	16.02.2021 15.02.2024	2142900.00
48	NASI Senior Scientist Platinum Jubilee Fellowship to Prof. Shyam Sundar Rai	Prof. Shyam S. Rai	GAP/INSA/ECS-20-538	NASI	14.01.2021 13.01.2022	460000.00
49	INSPIRE Faculty Award - Arjun Datta	Dr. Arjun Datta	GAP/DST/INSPIRE/ECT-20-539	DST-INSPIRE	16.02.2021 15.02.2026	700000.00
50	Quantum thermal machines based on quantum thermodynamic principles	Dr. Bijay Kumar Agarwalla	GAP/SHASTRI/PHY-20-540	Indo-Canada Shastri research grant (SICRG)	30.01.2021 29.01.2023	500000.00
51	Tetrellyenes stabilized metal nanoparticles and their application in carbon dioxide reduction, water splitting, and organic transformations	Dr. Shabana Khan	GAP/SERB/CHE-20-541	SERB	22.03.2021 21.03.2024	1270000.00
52	Molecular mechanism of ATP-dependent Type III restriction-modification enzyme	Dr. Saikrishnan Kayarat	GAP/SERB/BIO-21-542	SERB	25.03.2021 24.03.2024	2767000.00
53	Transcription- translation uncoupling in bacteria: Dissecting the fundamental principles of a phenomenon unknown in bacteria	Dr. Sunish Radhakrishnan	GAP/SERB/BIO-21-543	SERB	30.03.2021 29.03.2024	2368080.00
54	Superfluid spin transport in quantum antiferromagnets	Dr. Sunil Nair	GAP/SERB/PHY-21-544	SERB	26.03.2021 25.03.2024	16854150.00
55	DST - FIST Program	Dr. H.N. Gopi	GAP/DST/FIST/CHE-20-546	DST-FIST	30.03.2021 29.03.2026	20000000.00





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