Friday, 14 November 2025
10:30-11:15 AM

Session 1A

Presidential Address

Raghavan Varadarajan

IISc, Bengaluru

Raghavan Varadarajan is President of the Indian Academy of Sciences (2025-2027) and Professor in the Molecular Biophysics Unit at the Indian Institute of Science (IISc), Bengaluru. His research spans protein stability, folding and design, and extends to the development of viral immunogens (notably for influenza and SARS-CoV-2). His laboratory at IISc uses biophysical and structural approaches to engineer thermostable vaccine candidates and to probe fundamental questions of protein biophysics. His honours include the Shanti Swarup Bhatnagar Prize in Biological Sciences and the 2024 Tata Transformation Prize. He has also held key leadership roles at the Academy over the past decade.

Enhancing the stability and efficacy of viral vaccines

Most current viral vaccine formulations require low temperature storage. This is a major impediment to widespread deployment, and contributed to the highly skewed distribution of vaccines during the COVID-19 pandemic caused by SARS-CoV-2. Despite recent advances in the use of AI/ML for protein structure prediction and design, prediction of stabilizing mutations for complex, oligomeric proteins remains challenging. We have developed general approaches to rapidly isolate stabilized protein variants, and to map regions on the protein surface that are targeted by antibodies following immunization. Using this methodology, we have designed thermostable derivatives of an important domain of the Spike protein of SARS-CoV-2 and other sarbecoviruses. Several of these formulations can be stored at 37°C for several weeks without loss of protective efficacy. Using related approaches, we have developed multiple influenza vaccine formulations to protect against seasonal and pandemic influenza. One of these has been shown to be safe and well tolerated in a Phase 1 clinical trial in Australia and further clinical development in India is ongoing.

Friday, 14 November 2025
11:45 AM-12:30 PM

Session 1B

Public Lecture

Chairperson: **Raghavan Varadarajan**
IISc, Bengaluru

Shivkumar Kalyanaraman

CEO, ANRF, New Delhi

Shiv has been appointed by Hon'ble Prime Minister of India as CEO, Anusandhan National Research Foundation (ANRF). He was previously CTO, Energy Industry, Asia at Microsoft. Previously he was Executive General Manager of Growth Offerings at GE Power Conversion responsible for new Line of Business development in e-Mobility, Commercial & Industrial Solar and digital/AI innovations. Earlier he was at IBM Research - India, and the Chief Scientist of IBM Research - Australia. Before IBM, he was a tenured Full Professor at Rensselaer Polytechnic Institute in Troy, NY, USA. Shiv has degrees from Indian Institute of Technology, Madras (B.Tech, CS), Ohio State University (MS, PhD) and RPI (Executive MBA). Shiv is a Distinguished Alumnus Awardee of IIT Madras (2021, recognizing 0.3% of IITM's alumni over the years) & Ohio State University (2021), Fellow of the IEEE (2010), Fellow of Indian National Academy of Engineering (2015), ACM Distinguished Scientist (2010), Microsoft Gold Club (2024), MIT Technology Review TR100 Young Innovator (1999).

ANRF AI for science and engineering

ANRF Mission on AI for Science and Engineering (AI-SE) aims to accelerate the journey from deep science to deep tech by building a composable stack of scientific AI models, datasets, and workflows that can be combined like modular components. The talk explores how domain-centric neural operators, hybrid AI-HPC methods, multimodal scientific foundation models, and large-scale digital twins can unlock accelerated discovery in vast combinatorial spaces spanning materials, molecules, climate systems, biology, and engineered structures. A core theme is the shift from isolated, single-task models to interoperable, composable model ecosystems that enable AI agents to autonomously navigate design spaces and propose high-value candidates at machine speed.

The talk outlines how traditional scientific processes can be reimagined through tightly integrated AI pipelines, and how India can build the collaborative, cross-institutional data / modelling infrastructure needed for national-scale scientific acceleration.

Friday, 14 November 2025
14:00-14:20 PM

Session 1C

Lectures by Fellows/Associates

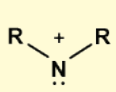
Chairperson: **Vijayamohanan Pillai**
IISER Tirupati, Tirupati

Prasad V. Bharatam
NIPER, Mohali

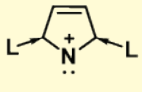
Prasad Bharatam is a medicinal chemist, who integrates quantum chemistry, organic synthesis for drug discovery. His group performs synthesis of compounds after carrying out homework with the help of chemical bonding, CADD and AI. He introduced the topic of Pharmacoinformatics as an integration of Chemoinformatics and Bioinformatics. His group identified a new class of compounds known as NITREONES, which carry coordination interaction between carbon and nitrogen atoms in drug molecules. This concept was proven with the help of crystal structure and electronic structure data of the compounds generated in his lab. The 3D thinking practice adopted in his lab help in exploring the drug action details. Nitreones with anti-bacterial, anti-malarial, anti-cancer, anti-diabetic and anti-leishmanial influence were obtained and many new lead molecules for drug discovery were suggested by his group. His work was recognized by AvH foundation, Royal Society of Chemistry, IBM, Ranbaxy and Johnson & Johnson.

Divalent cationic nitrogen species: Chemical bonding, synthesis and drug discovery

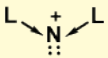
Classical quaternary ammonium salts (NR_4^+) are charged, thermally and chemically stable compounds; widely used in phase-transfer catalysis, surfactants, ionic liquids, and antimicrobial agents. Compounds with NR_2+ and NL_2^+ are also important. Open Chain Nitrenium ions (ONIs) generally have very short half-life and are non-isolable, except a few which are bench-stable and isolated. They are implicated in DNA alkylation, electrophilic substitution, and drug metabolism (bioactivation of arylamines). Cyclic nitrenium ions (CNIs) are bench-stable and are reported to exhibit Lewis acid (LA) catalytic and photocatalytic applications. NL_2^+ species are known as nitreones. They carry unique bonding nature where cationic nitrogen centre accepts electron density from electron-donating ligands and are depicted as L→N+←L'. These species have found major application in phase transfer catalysis and medicinally important compounds. NR_2^+ species are known as nitrenium ions. We have explored a variety of nitrenium ions and nitreones in detail by synthesizing and performing quantum chemical studies to study their properties. This work led to the identification of anti-cancer and anti-bacterial agent discovery.



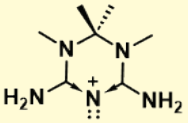
I
Nitrenium ions



II
Cyclic Nitrenium ions



III
Nitreones



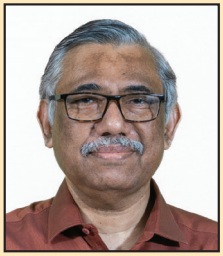
IV
Cyclic Nitreones

Friday, 14 November 2025
14:20-14:40 PM

Session 1C

Lectures by Fellows/Associates

Chairperson: **Vijayamohanan Pillai**
IISER Tirupati, Tirupati



Arindam Banerjee

IACS, Kolkata

Arindam Banerjee received Ph.D. from Indian Institute of Science, Bangalore (now Bengaluru), India in 1997. He joined as a lecturer in Indian Association for the Cultivation of Science (IACS), Calcutta (now Kolkata) in July, 1998 after a brief a post-doctoral research from Weizmmann Institute of Science, Israel. He became a full professor in 2009 December. He has published 183 research papers in various peer reviewed international journals and has supervised 27 Ph.D. candidates. His current research interest includes peptide based soft functional materials, gels in health care and environmental remediation, nanohybrids, nanoclusters and carbon nanodots. He is an Editorial Advisory Board member in Soft Matter, A RSC journal. He is a fellow of Indian Academy of Sciences (Bangalore) and also a Fellow, Royal Society of Chemistry (RSC), U.K. (2014). He was the Director (Additional charge) IACS, Kolkata from 15th April 2024 – 19th March, 2025.

Self-associating peptides for sustainable development

In our modern society, sustainable development is an urgent need due to the removal of environmental pollution, tackle the energy crisis and fight against drug resistant bacteria. Peptide are very good candidates to be self-assembled by using various non-covalent interactions such as hydrogen bonding, hydrophobic interaction, pi-pi interactions, electrostatic interactions to form nanofibrillar network structure that can be able to entrap a lot of solvent molecules in suitable conditions to form hydrogels/organogels depending upon the situation. These peptide hydrogels have been used for slow and sustained release for biologically important molecules, anti-cancer and other drugs. The peptide based gelators can be also be used for three-dimensional cell cultures and potential anti-microbial agents. Our recent work demonstrated anti-cancer properties of peptide-based gelators. Apart from using the peptide based soft biomaterials in health care system, these soft functional materials have been amazingly used in environmental remediation: (1) removal of toxic organic dyes and (2) hazardous of metal ions (Pb_2^+, Cd_2^+) from contaminated waste-water, oil spill recovery, and even for capturing the harmful and obnoxious HCl gas. A recent study of our research group includes a successful and convincing demonstration of peptide-based Ag containing metallo-hydrogels as a nanocatalyst for water splitting to produce hydrogen as a green energy resource by a clean and sustainable method.

Friday, 14 November 2025
14:40-15:00 PM

Session 1C

Lectures by Fellows/Associates

Chairperson: **Vijayamohanan Pillai**
IISER Tirupati, Tirupati

Divya Nayar
IIT, Delhi

Divya Nayar is an Assistant Professor in the Department of Materials Science and Engineering at Indian Institute of Technology Delhi. She holds a Ph.D. in Computational Chemistry from Indian Institute of Technology Delhi. Her research interests lie in soft matter simulations with a focus to obtain a fundamental understanding of the biomolecular self-assembly and employing the understanding to design bio-inspired nanomaterials with tailored applications. She was a postdoctoral associate at Technische Universitaet Darmstadt, Germany. She also worked as Assistant Professor at IIT Kharagpur at the Center for Computational and Data Sciences prior to joining IIT Delhi. Along with her research work, she is also passionate about encouraging young women to pursue career in STEM. She has been the initiator and Coordinator of the STEM Mentorship Program for High School Girls at IIT Delhi as part of the Academic Outreach activities.

Molecular crowding: Biomolecular processes to nanomaterials design

One of the prominent features of the living cell environment is that it is crowded with tightly packed macromolecules, small co-solutes, ions and has restricted water. Biomolecules evolve and function inside this milieu. This tight packing exerts crowding effects that are expected to crucially modulate biomolecular structure and dynamics. A comprehensive understanding of these effects remains elusive, since these effects have remained under-appreciated due to complexities associated with investigating concentrated environments. There are two schools of thought. The traditional understanding highlights that the crowded milieu induces compaction in biomolecules via entropic effects due to the volume exclusion effects of macromolecular crowders. The new view highlights that the biomolecular collapse may be either promoted or opposed where the soft interactions can play a crucial role. Moreover, crowding can be an attractive tool to design functional nanomaterials. Crowding can be employed to control molecular self-assembly for designing nanomaterials with tuneable properties in therapeutics. The talk will discuss microscopic mechanisms that shed light into the emerging view of crowding effects on biomolecular self-assembly and solvation. Additionally, the talk will discuss how the gap between biomolecular and nanomaterial self-assembly can be bridged by using intracellular crowding as a tool using computer simulations.

Friday, 14 November 2025
15:00-15:20 PM

Session 1C

Lectures by Fellows/Associates

Chairperson: **Vijayamohanan Pillai**
IISER Tirupati, Tirupati

Shibdas Banerjee
IISER Tirupati

Shibdas Banerjee earned his M.Sc. in Chemistry from IIT Roorkee, India, in 2008, followed by a Ph.D. in Chemical Sciences from the Tata Institute of Fundamental Research (TIFR), Mumbai, India, in 2014. Subsequently, he conducted postdoctoral research at Stanford University, USA, under Prof. Richard N. Zare. In 2017, he joined the Indian Institute of Science Education and Research (IISER) Tirupati as an Assistant Professor of chemistry, and he is currently an Associate Professor there. His research focuses on developing microdroplet-based mass spectrometric methodologies and imaging techniques for chemical and biomedical applications. His group specializes in the real-time *in situ* analysis of chemical and biological transformations within microdroplets, making pioneering contributions to the emerging field of microdroplet chemistry.

The alchemy with water microdroplets

Water microdroplets are widespread in nature and create a remarkably distinct chemical environment compared to bulk water. While bulk water is a benign universal solvent for many substances, its microdroplet form features a unique air–water interface where molecules experience partial solvation, specific orientation, extreme local pH and polarity, and ultrahigh intrinsic electric fields. These factors collectively lower activation barriers and enhance the chemical reactivity of reagents confined within the small volume of each droplet. At the interface, water becomes redox-active, enabling simultaneous oxidation and reduction processes often driven by reactive oxygen species generated *in situ*.

Our pioneering studies have unveiled and harnessed this multifaceted microenvironment to achieve remarkable outcomes: (i) accelerating chemical reactions by many orders of magnitude, (ii) triggering new chemical pathways inaccessible in bulk media, and (iii) capturing reactive intermediates normally too fleeting to detect. These advances underscore the critical role of the microdroplet surface in promoting unique chemical transformations without requiring external catalysts or harsh conditions. This chemistry points toward water microdroplets as green, efficient reactors for the synthesis of value-added chemicals and pharmaceuticals, paving the way for the development of scalable and sustainable synthetic platforms.

This presentation will delve into the mechanistic insights, experimental findings, and future opportunities in water microdroplet chemistry, underscoring its vital role in both fundamental and applied chemical sciences. It will spotlight the notion of 'Alchemy'—a metaphor that inspires curiosity and wonder—by illustrating how these minuscule reactors convert ordinary water into a potent medium capable of driving unprecedented chemical transformations.

Friday, 14 November 2025
16:00-16:40 PM

Session 1D

Special Lecture

Chairperson: **Satish K Gupta**
Gurgaon

Shinjini Bhatnagar

Shinjini Bhatnagar is Professor of Eminence and Head of Maternal and Child Health Research at the Translational Health Science and Technology Institute (THSTI), Faridabad. A paediatric gastroenterologist and clinical scientist, she is dedicated to advancing child and maternal health in low-resource settings. At THSTI, she leads large multidisciplinary programs investigating vaccine responsiveness, fetal growth restriction, and neonatal infections, while developing affordable diagnostics for childhood diseases. During her distinguished 25-year tenure at the All India Institute of Medical Sciences (AIIMS), New Delhi, she pioneered evidence-based interventions including protocols for persistent diarrhoea, low-osmolarity oral rehydration salts, and zinc supplementation. Elected Fellow of India's three national science academies and a WHO advisor on child diarrhoeal diseases, she continues to shape national and global health policy and practice.

From discovery to delivery: Translating science to improve maternal and child health

Advanced scientific methods have accelerated discovery with immense potential to transform clinical practice and public health, but their true impact emerges only when guided by societal needs. India bears a high burden of preterm birth and adverse pregnancy outcomes, driven by biological, environmental, and socio-economic factors.

Launched in 2015, GARBH-Ini (Interdisciplinary Group for Advanced Research on Birth Outcomes – DBT India Initiative) integrates clinical epidemiology, biotechnology, and data science to improve pregnancy outcomes. As DBT India's flagship longitudinal cohort, it has collected multidimensional data from over 12,000 women across trimesters in North India.

The programme has identified biomarkers, genetic panels, and vaginal microbiome-based assays to predict preterm birth, and developed a microbial consortia now translated into a nutraceutical product. AI-enabled ultrasound models, multimodal risk-prediction algorithms, and point-of-care tools are advancing clinical validation. The GARBH-Ini DRISHTI repository serves as a national resource, exemplifying how multidisciplinary, socially aligned science can translate discovery into scalable solutions for maternal and child health.

Friday, 14 November 2025
16:40-16:45 PM

Session 1E

Special Session

Chairperson: **Amol Dighe**
TIFR, Mumbai

Vinod K Gaur
CSIR Fourth Paradigm Institute, Bengaluru

Vinod Kumar Gaur is an Honorary Emeritus Scientist at the CSIR Fourth Paradigm Institute, Bengaluru, and a distinguished geophysicist whose six-decade career has advanced the understanding of Earth system processes from India's shield to the Himalayan collision zone. He earned his M.Sc. (Gold Medal) from Banaras Hindu University in 1955, followed by a D.I.C. at Imperial College London and a Ph.D. from the University of London in 1959. His pioneering work led to the discovery of the "host-rock effect" in geo-electromagnetics and the initiation of seismic tomography in India, including the first quantitative GPS measurement of the Indian plate's motion. He has served as Director, National Geophysical Research Institute (1983–1989), and Secretary, Department of Ocean Development (1989–1992). A recipient of the Shanti Swarup Bhatnagar Prize (1979) and Fellow of all three national science academies, Prof. Gaur continues to contribute to geophysical research, education, and outreach.

Underground science facility as a multi-science activity

Farsighted recognition of the high potential of underground science facilities for spawning imaginative ideas for testing and formulating incisive hypotheses has led to the creation of multiple such facilities worldwide. These USFs provide opportunities for bringing expertise from diverse fields together. For example, a USF would provide an excellent site for locating an ultra-long period seismograph that would record the normal modes of the Earth at a high signal/noise ratio. Estimating the density field of the Earth independently from normal mode seismology and neutrino tomography can synergize a widespread use of numerical mantle convection models to elucidate and explore the many complex problems of the Earth and its dynamics from first principles. These two independent theoretical formalisms involving a shared quantity with constraints provided by the density functional theory, would yield better estimates of matter density field in the deep Earth, than either would do singly, through a joint inversion or data assimilation framework.

Other exciting areas of scientific enquiry are also bound to get energized, not only in particle or nuclear physics, but also in life-related sciences, not to mention the new abilities in technology that would accrue in the process of setting up such a facility. I fondly hope that our deliberations here, bringing out the high desirability of setting up a USF in the country, will be strongly endorsed by the Academy and, in turn, by the authorities whose early decision will ensure that we are not too late in venturing into a scientific arena where several forward-looking societies have already gone ahead.

Friday, 14 November 2025
16:45-17:00 PM

Session 1E

Special Session

Chairperson: **Amol Dighe**
TIFR, Mumbai

Arjun Datta
IISER, Pune

Arjun Datta is Assistant Professor in the Department of Earth and Climate Sciences at the Indian Institute of Science Education and Research, Pune (IISER Pune). He obtained his Ph.D. from the University of Cambridge in 2017 after earlier degrees in Physics (St. Stephen's College, Delhi) and Applied Geophysics (IIT Roorkee). His research focuses on theoretical and computational seismology, including seismic tomography, ambient-noise interferometry and inverse theory, aimed at high-resolution crustal imaging and earthquake hazard assessment across India.

Underground science facility for studying earth's density structure

Much of what is known about the internal structure of the Earth, is due to seismology. Beyond providing evidence for the radial stratification of the Earth into crust, mantle, core, seismology enables finer-scale studies of Earth structure in three dimensions, shedding light on the planet's internal dynamics.

However, the readily observable, short-period, seismic waves are not directly sensitive to density, because seismic wave speeds depend on density as well as elastic constants. Only the very long-period, 'free oscillations' or normal modes of the Earth, are sensitive to density. Therefore, the study of the Earth's density structure relies specifically on normal mode seismology. Another independent approach to studying density within the Earth is neutrino tomography. Both approaches will be made possible by an Underground Science Facility, thereby opening up the exciting possibility of obtaining a better joint estimate of the Earth density field, than either approach can yield by itself.

Friday, 14 November 2025
17:00-17:15 PM

Session 1E

Special Session

Chairperson: **Amol Dighe**
TIFR, Mumbai

Basudeb Dasgupta
TIFR, Mumbai

Basudeb Dasgupta is a Professor in the Department of Theoretical Physics at the Tata Institute of Fundamental Research (TIFR), Mumbai. A theoretical physicist, his research focuses on neutrinos, dark matter, and astroparticle physics. After earning his Ph.D. from TIFR in 2009, he held postdoctoral positions at the Max Planck Institute for Physics, Ohio State University, and the International Centre for Theoretical Physics. Since returning to TIFR, he has led pioneering studies on neutrino oscillations and particle cosmology, including conditions for collective flavor instabilities in supernovae and the early universe. His scientific contributions have been recognized with the ICTP Prize (2019) and the Shanti Swarup Bhatnagar Prize (2022).

Underground science laboratory: Neutrino and dark matter frontiers

Underground laboratories provide the low-background conditions essential for addressing fundamental questions in particle and astroparticle physics. By suppressing cosmic-ray–induced signals, they enable measurements that are otherwise impossible at the surface. A key opportunity is the deployment of a deuterated liquid scintillator (DLS) detector, which will allow solar and supernova neutrinos to be studied with pioneering sensitivity. Such measurements can open the next frontier in neutrino physics. Equally compelling is the search for dark matter, where unprecedented background control is required to push sensitivity to subtle and rare nuclear recoils. Advances in detector materials, shielding, and veto systems rely crucially on underground settings for probing candidate particles across a wide mass range. Together, these efforts define a core scientific case for a national Underground Science Laboratory.

Friday, 14 November 2025
17:15-17:30 PM

Session 1E

Special Session

Chairperson: **Amol Dighe**
TIFR, Mumbai

Prakash C. Rout

BARC, Mumbai

Prakash Chandra Rout is a Scientific Officer in the Physics Group at BARC, Mumbai. He earned his Ph.D. in Nuclear Physics from HBNI, Mumbai, after graduating from the 46th batch of the BARC Training School (Physics). An accomplished experimental nuclear physicist, his research focuses on nuclear level density and nuclear reaction mechanisms using the BARC–TIFR Pelletron and Linac facilities. He has contributed extensively to the development of radiation detector systems, including deuterated liquid scintillation detectors for neutron and neutrino measurements. Dr Rout is a recipient of the INSA Medal for Young Scientists (2014), DAE Science and Technology Excellence Award (2019), and several other honours. He is a Fellow of the National Academy of Sciences, India (NASI) and former member of the Indian National Young Academy of Sciences (INYAS).

Underground science facility for nuclear astrophysics research

Underground laboratories can play a central role in nuclear astrophysics by enabling direct measurements of stellar reaction rates through suppression of cosmic-ray backgrounds. Pioneering efforts at LUNA (Gran Sasso, Italy) delivered precise data on hydrogen- and helium-burning reactions, setting benchmarks for low-background accelerator techniques. Facilities such as JUNA (China), CASPAR (USA), and Felsenkeller (Germany) have extended this approach to CNO cycles, s-process neutron sources, and a wider range of reaction studies, thereby broadening the experimental reach.

Looking ahead, the community envisions a high-current, 5 MV underground accelerator with ultra-low-background detection systems. These next-generation setups, combined with advanced targets, recoil separators, and active background-rejection techniques, will provide access to critical reactions such as $^{12}C(\alpha,\gamma)^{16}O$, $^{14}N(p,\gamma)^{15}O$, and $^{22}Ne(\alpha,n)^{25}Mg$. Precise measurements of these reactions will significantly reduce astrophysical uncertainties, strengthen stellar evolution and nucleosynthesis models, and refine predictions of element formation in diverse stellar environments, from main-sequence stars to supernovae and asymptotic giant branch stars.

Friday, 14 November 2025
18:10-18:35 PM

Session 1F

Lectures by Fellows/Associates

Chairperson: **Anirban Basu**
NBRC, Manesar

Pawan Malhotra
ICGEB, New Delhi

Pawan Malhotra is a molecular biologist with extensive research experience in malaria biology, protein chemistry, and vaccine development. He obtained his M.Sc. in Zoology (Biochemistry) in 1981 and his Ph.D. in Protein Chemistry and Vaccine/ Reproductive Biology in 1988, both from the University of Delhi.

At ICGEB, Dr Malhotra leads the Malaria Group, where his research focuses on understanding the molecular mechanisms underlying *Plasmodium* biology, host-parasite interactions, and the identification of novel vaccine and therapeutic targets. As an Arturo Falaschi Emeritus Scientist, he continues to contribute to the Centre's scientific and mentoring programmes, fostering translational malaria research aimed at global health impact.

Plasmodium falciparum secretome/surfactome at asexual blood stages – A hidden treasure for new antimalarial development

Cells talk to each other and to their respective host cells in case of pathogens by cell surface/secretory molecules. Secretory proteins from all cells make up a complex subset of molecules referred as 'secretome' and cell surface molecules are referred as surfactome. These secretory/surface proteins play important roles in cell to cell communication, host cell invasion and in case of vertebrates, these proteins help in keeping a delicate balance between protective immunity of the host and pathogenic immune evasion responses thereby mainitaining homeostasis and eliminating the the infectious probes. Here, we describe the proteomic approaches to illustrate *Plasmodium falciparum* 'secretome' as well as surfactome. In total 33 proteins were identified from *P. falciparum* secretome and ~ 300 proteins were identified from *P. falciparum* surfactome. Sequence analysis of many of these putative *Plasmodium* secretory antigens revealed that they possessed important extracellular binding/signalling modules required for parasite establishment, pathogenesis and immunomodulation. Important among these proteins are the proteins that share homology with the *Caenorhabiditis elegans* Sel 1 protein, an extracellular protein shown to be shown to be a negative regulator of Notch Pathway genes; lin-12 and glp-1 referred here as PfSel1 & PfSel 2 proteins, a Complement control protein (CCP1) that modulates complement activation, a putative serine protease (DegP), a protein kinase, a tyrosine phosphatase and GBP-130 that are involved in pathogenesis as well virulence. Many of these aspects will be discussed in detail in my talk.

Friday, 14 November 2025
18:35-19:00 PM

Session 1F

Lectures by Fellows/Associates

Chairperson: **Anirban Basu**
NBRC, Manesar

P. V. Shivaprasad
NCBS, Bangalore

P. V. Shivaprasad is a plant biologist who uses less-studied plant model systems to understand how phenotypes are regulated by small RNAs and epigenetics. He has extensive training in molecular virology, small RNAs, epigenetics, plant-pathogen interactions and plant development. His lab uses various model systems including rice, its wild relatives, cauliflower and *Arabidopsis*. He is a recipient of Swiss Society for Phytiatry award (2006) and a Fellow of all three Indian Science academies (IASc, INSA and NASI). He obtained EMBO fellowship during 2006, Ramanujan fellowship during 2013 and also a recipient of C.V. Raman award from Karnataka State Science and technology in 2019. He is currently a Professor and Associate Dean of Research at National Centre for Biological Sciences, Bangalore, India.

Histone variant H4.V: A gatekeeper to H4K5Ac marks and salt stress transcriptome

Paralogous variants of canonical histones guide accessibility to DNA and function as additional layers of genome regulation. Across eukaryotes, mechanism of action and functional significance of several variants of core histones are well-known except that of histone H4. We identified a novel variant of H4 (H4.V) expressing tissue-specifically among *Oryza* genera members including wild and cultivated rice species. This variant mediated specific epigenetic changes contributing to seed development as well as in salt tolerance. H4.V was incorporated to specific chromosomal locations where it blocked deposition of active histone marks. Stress dependent re-distribution of H4.V enabled incorporation of active H4 Lysine5 Acetylation (H4K5Ac) marks. Mis-expression of H4.V led to defects in seedling growth, reproductive tissue development and in mounting stress responses. H4.V mediated these alterations by condensing chromatin as seen with cryo-EM structures of reconstituted nucleosomes. These results not only uncovered the presence of a H4 variant among plants, but also of a novel chromatin regulation that might have contributed to the adaptation of semi-aquatic plants to varying levels of water and salt concentrations.

Friday, 14 November 2025
19:00-19:30 PM

Session 1F

Lectures by Fellows/Associates

Chairperson: **Anirban Basu**
NBRC, Manesar

Harsha Bajaj
NIIST, Thiruvananthapuram

Harsha Bajaj earned her Ph.D. in Biochemical Engineering from Jacobs University Bremen, Germany, under the mentorship of Prof. Mathias Winterhalter, followed by a postdoctoral tenure in collaboration with University of Cambridge. She began her independent career at CSIR-NIIST, Thiruvananthapuram, as a DBT BioCARe Fellow and DBT Har-Govind Khorana Innovative Biotechnologist Awardee, before joining as a Scientist. At NIIST, she leads a vibrant research group specializing in membrane and synthetic biology, with core expertise in condensate biology, antimicrobial resistance, and membrane biophysics. Her research advances understanding of how condensates and membranes influence cellular organization and function, with implications for both fundamental biology and therapeutic strategies. She is the recipient of several prestigious recognitions, including the Merck Young Scientist Award and the CSIR Young Scientist Award.

When liquid droplets meet lipid membranes: A dynamic partnership

Biomolecular condensates interfacing with lipid membranes is crucial for several key cellular functions. However, the role of lipid membranes in regulating condensates in cells remains obscure. Here, in-depth interactions between condensates and lipid membranes are probed and unraveled by employing cell-mimetic systems like Giant unilamellar vesicles (GUVs). An unprecedented influence of the coacervate size and their electrostatic interaction with lipid membranes is revealed on the membrane properties and deformation. Importantly, these findings demonstrate that the large relative size of coacervates and minimal electrostatic interaction strength with membranes allow for budding transitions at the interface. Membranes act as nucleation site for coacervates when the charge-charge interaction is high, giving a wrinkled vesicle surface appearance. Molecular diffusion property of lipids, quantified using Fluorescence recovery after photobleaching (FRAP), is modulated at the coacervate-membrane interaction site restricting the coarsening of coacervates. Notably, these results reveal coacervate droplets are intertwined in between membrane folds and invaginations discerned using Transmission electron microscopy (TEM) and high-resolution imaging, which further controls the dimension of droplets resembling size distributions observed in cells. Finally, these findings provide mechanistic insights of lipid bilayers controlling condensate sizes that play a prominent role in comprehending nucleation and localization of cellular condensates.

Saturday, 15 November 2025
09:30-9:50 AM

Session 2A

Lectures by Fellows/Associates

Chairperson: **Sanjay Kumar**
BHU, Varanasi

Bedangadas Mohanty

NISER, Bhubaneswar

Bedangadas Mohanty is Senior Professor of Physics at the School of Physical Sciences, NISER, Bhubaneswar, and Deputy Spokesperson of the ALICE experiment at CERN's Large Hadron Collider. He earlier served as Deputy Spokesperson of the STAR experiment at Brookhaven National Laboratory, USA. After a gold-medal Master's from Utkal University (1996) and a Ph.D. from the Institute of Physics, Bhubaneswar (2002), he pursued postdoctoral research at Lawrence Berkeley National Laboratory. He was a scientist at VECC, Kolkata (2002–2012). Dr Mohanty is a Fellow of the American Physical Society and all three Indian science academies, and recipient of India's top honors including the Infosys Prize (2021), Shanti Swarup Bhatnagar Prize (2015), and Swarna Jayanti Fellowship (2010). He has over 800 publications with 96,000+ citations (h-index 154) and has guided 20 Ph.D. students. His research focuses on the QCD phase diagram, the quark–gluon plasma, and searches for rare events like dark matter, fractionally charged particles and coherent neutrino-nucleus elastic scattering.

Phase diagram of strong interactions

We present an overview of studies related to the phase diagram of strong interactions through high-energy nuclear collisions. Both theoretical and experimental progress toward establishing key features of the phase diagram will be discussed, including thermalization, the quark–gluon phase, quark–hadron crossover, crossover temperature, phase boundary, and the critical point.

Saturday, 15 November 2025
09:50-10:10 AM

Session 2A

Lectures by Fellows/Associates

Chairperson: **Sanjay Kumar**
BHU, Varanasi

Satyaprasad Senanayak
NISER, Bhubaneswar

Satyaprasad P Senanayak is Reader in Physics who heads the Nanoelectronics and Device Physics Lab at the National Institute of Science Education at Research (NISER), Bhubaneswar. He received his Ph.D. in Physics from JNCASR, Bangalore (2009 – 2015) for his work on developing high performance, low power, fast switching polymer field effect transistors. He then pursued his postdoctoral research at the Cavendish Laboratory, University of Cambridge working on developing Perovskite Field effect transistors. He is awarded the prestigious Royal Society Newton Fellowship, EPSRC Global Challenge Award, Royal Society Alumni Fellowship, Indo-US Science and Technology Forum Fellowship and Young Scientist Award from the Odisha Bigyan Academy. He is an Early career member of American Physical Society and Associate of Indian Academy of Sciences. His current research at NISER addresses three focused areas: (a) Development of high performance perovskite optoelectronic devices; (b) Thermoelectric Devices; (c) Neuromorphic Computing.

Polarization engineering for artificial neural circuits

Neuromorphic computing architectures that emulate brain-like information processing offer transformative potential for developing energy-efficient artificial intelligence and next-generation in-memory computing systems. In this talk, we present two complementary strategies for realizing neuromorphic device functionalities using solution-processed organic and hybrid materials. The first approach leverages ionotronic mechanisms, where mobile ions within the active layer dynamically modulate the channel conductance, thereby mimicking short-term and long-term synaptic plasticity through ion migration and accumulation. The second strategy exploits ferroelectric polarization switching, in which the reversible alignment of electric dipoles induces non-volatile modulation of charge carrier density, leading to stable bi-stable states suitable for long-term memory and programmable synaptic weights. The devices exhibit robust memory retention and endurance, enabling effective handwritten pattern recognition. Overall, this work establishes a materials- and mechanism-driven framework for developing energy-efficient, non—von Neumann computing architectures that can bridge the gap between artificial and biological intelligence.

Saturday, 15 November 2025
10:10-10:30 AM

Session 2A

Lectures by Fellows/Associates

Chairperson: **Sanjay Kumar**
BHU, Varanasi

Sukanya Ghosh
CUK, Tulmulla Campus

Sukanya Ghosh is an Assistant Professor in the Department of Physics at the Central University of Kashmir, India, and a Young Associate of the Indian Academy of Sciences (2024–2027). She is a theoretical physicist specializing in computational materials science and condensed matter physics. Her research focuses on first-principles modelling of two-dimensional (2D) materials, magnetism, and spintronic phenomena. She earned her Ph.D. from the Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru, and has held postdoctoral positions at ICTP (Italy), Uppsala University (Sweden), and the University of Edinburgh (UK). Her current work explores quantum states in 2D magnetic systems and their potential spintronic applications.

Interplay of unusual structural reconstruction, exchange mechanism and electron correlation in high-temperature 2D van-der-Waals magnets

In recent years, the discovery of van der Waals (vdW) magnets has opened up numerous possibilities in fundamental science and technological applications. Their tunable structural, electronic, and magnetic properties make these materials promising candidates for low-power spintronic devices. Among these, the family of metallic magnets Fe_nGeTe_2 (where n = 3, 4, 5) has garnered significant attention due to their high Curie temperatures and fascinating physical characteristics. Our research on the FenGeTe systems began with an investigation into the unusual structural reconstructions observed in Fe_5GeTe_2, the most complex member of this family. By conducting density functional theory (DFT) calculations and Monte Carlo simulations, we discovered that the magnetic peculiarities associated with a specific iron (Fe) site are responsible for this structural behaviour. Once we resolved this puzzle, we became interested in exploring the entire Fe_nGeTe_2 family. However, we soon realized that the literature lacked a suitable computational approach to accurately capture the site-dependent electronic and magnetic properties, as well as the correct spectral features of these systems. The presence of Fe-site-dependent electron correlation effects further complicated this task. To address this, we employed three different *ab initio* approaches: (i) standard DFT, (ii) DFT with static electron correlation (DFT + U), and (iii) DFT combined with dynamic electron correlation effects (DFT + DMFT). Our results indicate that DFT + DMFT is the most accurate technique for capturing the many-body effects present in FenGeTe systems and reproducing the experimentally reported transition temperatures and spectral properties. Additionally, we explored ways to enhance the magnetism of this class of systems beyond room temperature. My talk will cover the intricate story of the FGT family in the monolayer limit, proposing their applicability in spintronic applications.

Saturday, 15 November 2025
11:00-11:20 AM

Session 2B

Invited Lectures

Chairperson : **Ekambaram Balaraman**
IISER Tirupati

Co-Chairperson : **Vasudharani Devanathan**
IISER Tirupati

Anilatmaja Aryasomayajula
IISER Tirupati, Tirupati

Anilatmaja Aryasomayajula is an Associate Professor and Chair of the Department of Mathematics at the Indian Institute of Science Education and Research (IISER), Tirupati. He obtained his Bachelor's degree in Mathematics from the Indian Statistical Institute, Bengaluru, in 2005, and pursued the ALGANT Master's programme in Mathematics at the University of Padova, Italy, and the University of Leiden, Netherlands (2005–2007). He earned his Ph.D. from Humboldt University of Berlin in 2013 as part of the Berlin Mathematical School. His research interests lie in automorphic forms and complex geometry, with a particular focus on sub-convexity estimates of automorphic forms using techniques from complex geometry.

Estimates of automorphic forms

In this survey talk, we discuss estimates of automorphic forms and their applications in Geometry and Dynamical Systems, and string theory from Physics. The talk is non-technical and accessible to anyone with basic knowledge of Mathematics, at the level of undergraduate curriculum.

Saturday, 15 November 2025 (11:20-11:40 AM)

Session 2B

Invited Lectures

Chairperson : **Ekambaram Balaraman**
IISER Tirupati

Co-Chairperson: **Vasudharani Devanathan**
IISER Tirupati

Arunima Banerjee

IISER Tirupati

Arunima Banerjee, an Associate Professor and the Chair at the Department of Physics, Indian Institute of Science Education and Research, Tirupati. Her research interest is Theoretical Astrophysics, focussing on Dynamics of Galaxies using high resolution N-body + hydrodynamical simulations and machine learning techniques. Earlier, she was a DST-INSPIRE Faculty Fellow at the Inter-University Centre for Astronomy & Astrophysics, Pune, India (2014-2017), before that a Postdoctoral Visiting Scientist at the National Centre for Radio Astrophysics, Tata Institute of Fundamental Research, Pune, India (2012-2014) and prior to that an Integrated Ph.D. student at the Indian Institute of Science, Bangalore, India, obtaining a Masters in Physics and a Doctorate in Astrophysics from the Department of Physics in 2007 and 2012, respectively. She did her Bachelor's in Physics (Hons.) from St. Xavier's College, University of Calcutta in 2004. She received the Best Thesis Award in Theoretical Physics 2012 from IISc, Bangalore, the Justice Oak Best Thesis Award 2012, and the K.D. Abhayankar Best Thesis Award 2012, both from the Astronomical Society of India.

She is a member of the Astronomical Society of India, the International Astronomical Union, a Visiting Associate of IUCAA, Pune, and also serves as an Editorial Board of the Journal of Astronomy & Astrophysics, Indian Academy of Sciences.

Identifying lopsidedness in spiral galaxies using a deep convolutional neural network

About 30% of disk galaxies show lopsidedness in their stellar disk. Although such a large-scale asymmetry in the disk can be primarily looked upon as a long-lived mode ($m=1$), the physical origin of the lopsidedness in the disk continues to be a puzzle. In this work, we develop an automated approach to identify lopsided galaxies from the SDSS DR18 using a Deep Convolutional Neural Network (DCNN) based on the publicly available AlexNet architecture. We select nearly face-on spiral galaxies from SDSS DR18 with the Petrosian 90% light radius (\textit{petroR90_i}) greater than $20^{''}$. Based on the visual inspection, we choose 106 lopsided spiral galaxies and 105 symmetric spiral galaxies, as our training set. Our trained model achieves a testing accuracy of 92.8% at the end of 150 epochs. We then employ the trained model on a set of 813 face-on spiral galaxies from SDSS DR18 with $17^{''} \le petroR90_i \le 20^{''} $ and identify 452 new lopsided spiral galaxies. We next investigate the cosmic web environments in which the galaxies are located, using the Hessian matrix of the density field. We find that 39% of the lopsided galaxies are located in sparser environments such as sheets and voids. This may provide interesting clues towards understanding the origin of lopsidedness in isolated galaxies, where distortion due to the tidal interactions is less frequent.

Saturday, 15 November 2025
11:40 AM-12:00 PM

Session 2B

Invited Lectures

Chairperson : **Ekambaram Balaraman**
IISER Tirupati

Co-Chairperson: **Vasudharani Devanathan**
IISER Tirupati

K. Saikranthi
IISER Tirupati

Saikranthi is an Assistant Professor in the Department of Earth and Climate Sciences at IISER Tirupati. A gold medallist in M.Sc. Physics from the University of Mysore, she earned her Ph.D. from the National Atmospheric Research Laboratory and completed postdoctoral research at IISc Bangalore. Her research focuses on radar meteorology, rain microphysics, and radar remote sensing. She employs space-borne radars such as TRMM and GPM to study precipitation structure, variability, and extreme weather events. At IISER Tirupati, she established an atmospheric laboratory to study radiative processes and soil-atmosphere interactions. She has published extensively in international journals and leads several research projects funded by DST, SERB, and IISER Tirupati.

Daily scale rainfall extremes in India

Heavy rainfall events (HREs) cause flash floods, severe landslides, damage crops, menace natural ecosystems and are vulnerable as they can devastate lives and economy. The understanding of HREs' characteristics, prediction skills, and future trends are highly essential for minimizing disaster losses. Self-recording rain gauges hourly rainfall data from India meteorological Department (IMD) during 1969 to 2010 have been utilized to identify rain events at a sub-daily scale. A significant decrease in the frequency of heavy rainfall events is observed over central India and northeast India, while an increase is observed over the northern west coast of India. Frequency of short-duration (< 24 h) HREs over central India and long duration (≥ 24 h) HREs over northern west coast of India is increased in the recent than in earlier decades. Incongruity with the observations, CMIP6 historical and AMIP high temporal resolution models are not able to simulate the short-duration HREs and, in turn, the observed trends at a sub-daily scale over the India landmass. Further, the impact of HREs on surface energetics and soil variables has been studied using the high resolution in situ data over a tropical station Yerpedu, Tirupati.

Saturday, 15 November 2025
12:00-12:20 PM

Session 2B

Invited Lectures

Chairperson : **Ekambaram Balaraman**
IISER Tirupati

Co-Chairperson: **Vasudharani Devanathan**
IISER Tirupati

Suresh Jain
IIT Tirupati

Suresh Jain is Professor and Head of the Department of Civil and Environmental Engineering at the Indian Institute of Technology Tirupati, India. With over two decades of academic and research experience, his expertise spans air quality modelling, urban transport emissions, and sustainable environmental systems. He holds a PhD in Urban Transport Emission Modelling from IIT Delhi and an M.Tech. in Environmental Engineering and Management from IIT Kanpur. A recipient of the Vice-Chancellor's Faculty of the Year Award (2017), Commonwealth Professional Fellowship (2016–17), and International Visitors Leadership Program (IVLP) Fellowship, USA, Jain has contributed extensively to national and international environmental research and policy. He served as Dean (Academic Affairs) at IIT Tirupati and as Nodal Officer for the Andhra Pradesh Pollution Control Board under India's National Clean Air Programme (NCAP). His collaborations include partnerships with leading universities in the UK, USA, and Australia.

Advancing urban transport sustainability through AI-Based emission mapping, policy scenario modelling, and the built environment—Health nexus

This presentation outlines a multi-scale scientific framework connecting artificial intelligence, emission modelling, and human health to advance sustainable urban transport systems. Three independent studies demonstrate this continuum: (i) real-time vehicular emission mapping in Tirupati using YOLOv8 and COPERT for spatiotemporal inventories; (ii) scenario-based policy analysis in Vijayawada assessing the climate and air quality co-benefits of road transport emission reduction policies; and (iii) a systems review of the Built Environment—Travel Behaviour—Human Health (BETH) nexus for Delhi. Together, these studies integrate micro-level AI innovation, city-scale modelling, and macro-level behavioural insights, illustrating how data, design, and decision science can jointly inform cleaner, healthier, and smarter cities. The talk highlights methodological advances, cross-sectoral implications, and future research directions aligned with SDGs 3, 11, and 13.

Saturday, 15 November 2025
14:00-14:20 PM

Session 2C

Lectures by Fellows/Associates

Chairperson: **K. N. Raghavan**
Krea University, Sri City

S. K. Khanduja

IISER, Mohali

Sudesh Kaur Khanduja, FTWAS, FNA, FASc, FNASc currently holds the position of INSA Honorary Scientist at IISER Mohali, in addition to being an Emeritus Professor in the Department of Mathematics , Panjab University, Chandigarh. She has been recognized with numerous awards and honors, including the prestigious Srinivasa Ramanujan Medal (2022) of the Indian National Science Academy. Graduating as one of the top students in both her undergraduate and postgraduate studies at Panjab University Chandigarh, she obtained her PhD in Mathematics from the same institution in 1978. With extensive teaching experience spanning over 46 years, she has published nearly 100 research papers, supervised 13 PhD students, and served as the Principal Investigator for 7 research projects. Prof. Khanduja has also taken on the role of Coordinator for the NBHM research awardees test and NBHM M.A/M.Sc. scholarship test from 2003 to 2010, and has been guiding students through the Summer Research Fellowship Program of Science Academies since 2008. She actively participates in programs that promote the advancement of mathematics and has organized and delivered lectures at prestigious conferences in India and abroad. Her research interests lie in the fields of Algebra, Algebraic Number Theory, and Valuation Theory.

Glimpses of algebraic number theory

We briefly describe the origin and development of classical Algebraic Number Theory. We state some latest results regarding discriminants and integral bases of pure number fields.

Saturday, 15 November 2025
14:20-14:40 PM

Session 2C

Lectures by Fellows/Associates

Chairperson: **K. N. Raghavan**
Krea University, Sri City

Dishant Pancholi

IMSc, Chennai

Dishant M. Pancholi is a Professor at the Institute of Mathematical Sciences, Chennai. He obtained his Ph.D. from the School of Mathematics, Tata Institute of Fundamental Research (TIFR), Mumbai, in 2007. His research interests lie in the geometry and topology of contact and symplectic manifolds. A recipient of the Shanti Swarup Bhatnagar Prize (2019) and the B. M. Birla Science Prize (2018), he has held visiting positions at IAS Princeton, ICTP Trieste, and ICMAT Madrid. His contributions have advanced understanding in symplectic and contact topology.

Embeddings of 4-manifolds in ℂP1 × ℂP1 × ℂP1

We discuss embeddings of 4-manifolds in co-dimension 2. In particular, we show that every closed orientable smooth 4-manifold embeds in ℂP1 × ℂP1 × ℂP1.

Saturday, 15 November 2025
14:40-15:00 PM

Session 2C

Lectures by Fellows/Associates

Chairperson: **K. N. Raghavan**
Krea University, Sri City

Tarak Karmakar

IIT Delhi

Tarak Karmakar is an Associate Professor in the Department of Chemistry at the Indian Institute of Technology Delhi. He joined IIT Delhi as an Assistant Professor in June 2021, following a postdoctoral fellowship (2017–2021) in the group of Prof. Michele Parrinello at ETH Zurich, USI Lugano, Switzerland, and IIT Genova, Italy. He obtained his Ph.D. from Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, in 2016. His research group at IIT Delhi works on developing advanced simulation methodologies, machine learning interatomic potentials (MLIPs) for materials, AI-driven applications in chemistry, and multiscale modeling of nano–bio systems. He has been awarded the Early Career Researchers prize from Molecular Physics (Taylor & Francis) in 2022, received Teaching Excellence Award from IIT Delhi in 2024, and elected into the Indian Academy of Sciences Associateship with effect from the year 2023.

From atoms to algorithms: Computer simulations in the age of AI

Computer simulations have long served as essential tools for investigating the behaviour of molecules, materials, and biological systems at the microscopic and dynamic levels. Traditionally, computer simulations, particularly molecular dynamics simulations, have relied on well-defined physical models and rigorous numerical methods, with their scope often constrained by computational resources. Rapid development of artificial intelligence (AI) and advances in computer technology are now transforming the execution, acceleration, and conceptualization of simulations. AI is fundamentally reshaping computer simulations by enabling the modeling of molecular interactions in condensed phase systems with improved speed and accuracy, facilitating the exploration of rare events, allowing the calculation of thermodynamic and kinetic properties, and advancing the design of new materials and pharmaceuticals.

The integration of physics-based models with data-driven approaches marks the beginning of a new era in which simulations function not only as analytical tools, but also as drivers of scientific and technological innovation.

Saturday, 15 November 2025
18:00-19:00 PM

Session 2D

Public Lecture

Chairperson: **Raghavan Varadarajan**
IISc, Bengaluru

Vijay Chandru
IISc, Bengaluru

Vijay Chandru is a Visiting Faculty in the Department of Bioengineering at the Indian Institute of Science (IISc), Bengaluru. An academic and entrepreneur, he earned his Ph.D. in the mathematics of decision sciences from MIT in 1982. He has served on the faculty of Purdue University and the Indian Institute of Science, conducting research in computational mathematics, optimization, logic, and biology. A Fellow of the Indian Academy of Sciences, he is also a founder of Strand Life Sciences, a pioneer in genomics-based precision medicine in India. His many recognitions include the Hari Om Trust Award (UGC), the INFORMS President's Medal, and the World Economic Forum's Technology Pioneer distinction.

From human-engineered intelligence to re-engineered biology: A journey

Historians of science will note that the last 50 years have marked two interwoven timelines marking great progress in both information and life sciences and their remarkable crossings. The idea of using variational calculus to solve problems of logical inference was anticipated by Gottfried Wilhelm Leibniz (the last universal genius) who posited in the late 17th century that *Characteristica Universalis* and *Calculus Ratiocinator* represent two intertwined concepts that reflected his vision for a universal framework for reasoning and computation. These ideas gathered great momentum in the late 20th and early 21st centuries, with the inexorable, exponential Moore's law of computer engineering, racing us to an age of intelligent machines. In this period, the life sciences too saw exquisite development of instrumentation and techniques that accelerated understanding of cells, genes, chemical processes and information flows moving the science from the descriptive towards grand ideas about life, organisation and complexity. This talk will describe the speaker's journey through these timelines and his attempts to thread the crossings with translational intent.

Sunday, 16 November 2025
09:30-10:00 AM

Session 3A

Symposium on Evolutionary Ecology in the Wild

Chairperson: **Renee Borges**
IISc, Bengaluru

Uma Ramakrishnan
NCBS, Bengaluru

Uma Ramakrishnan is a Professor at the National Centre for Biological Sciences (NCBS), Bengaluru. Her research explores how species respond to environmental change, combining field ecology, population genetics, and evolutionary biology to study mammals across the Indian subcontinent. Her work provides critical insights into genetic diversity, population structure, and the impacts of habitat fragmentation and climate change. By integrating molecular and ecological approaches, Prof. Ramakrishnan's research informs conservation strategies for threatened wildlife and enhances understanding of India's unique biodiversity.

Indian small mammals: Biogeography, communities and zoonoses

Many species of small mammals (including rodents) surround us. Yet our understanding of their biogeography and community ecology remains poor, especially in India. We attempted to understand speciation and geographic origins of small mammals using phylogeny of Murinae lineages in the Indian subcontinent and their affinities. Murinae is a 704-species-rich subfamily of rodents that began diversifying 20 million years ago and has several endemic lineages in Peninsular India. We built a robust phylogeny for more than 400 species of the subfamily with available sequences, and generated sequence data for 12 endemic species. Three nuclear markers (GHR, Rbp3, and RAG1) and one mitochondrial marker (Cytb) were used to construct maximum likelihood and Bayesian estimated phylogenies. A time-calibrated phylogeny was built using nine fossil calibration points, which was then used to reconstruct ancestral areas. Our biogeographic analyses considered the Indian subcontinent, Africa, and Southeast Asia as separate realms. We found multiple dispersals from Africa and Southeast Asia into the Indian subcontinent, and relatively few back dispersals.

Biogeographic origins are important in the context of community assembly, vectors and associated zoonoses. We characterized *Bartonella* spp. (a Gram-negative bacterium) in a small mammal community and their ectoparasites in the biodiverse Western Ghats. We investigated ecological correlates of *Bartonella* prevalence in small mammal hosts and evolutionary relationships between *Bartonella* spp. and various hosts and ectoparasites to gain insight into pathogen movement pathways within ecological communities. We detected *Bartonella* in five out of eight small mammal species and in 86 (40.56%) out of 212 individuals, but prevalence varied widely among species (0%—75.8%). We found that *Bartonella* prevalence in hosts was positively correlated with their aggregated ectoparasite loads, further emphasizing the crucial role that ectoparasites may play in these transmission pathways. Our cophylogenetic analysis and ancestral trait (host) reconstruction revealed incongruence between small mammal and *Bartonella* phylogenies, indicating historic host shifts and validating the potential for contemporary spillover events. We found that small mammal hosts in this fragmented landscape often move across habitat boundaries, creating a transmission pathway (via shared ectoparasites) to novel hosts, which may include synanthropic species like *Rattus rattus*. Our results highlight the necessity to disentangle the complex relationship among hosts, ectoparasites, and bacterial pathogens to understand the implications of undetected spillover events.

Sunday, 16 November 2025
10:00-10:30 AM

Session 3A

Symposium on Evolutionary Ecology in the Wild

Chairperson: **Renee Borges**
IISc, Bengaluru

Robin Vijayan
IISER Tirupati

Robin Vijayan is Associate Professor in the Department of Biology at Indian Institute of Science Education and Research, Tirupati. His research focuses on ecology, biogeography and evolutionary ecology of birds in montane "sky-island" habitats, integrating fieldwork, bioacoustics, genetics and conservation approaches. He has described new genera and species, and his work highlights how ancient geographic features and recent anthropogenic changes shape bird diversity. A recipient of the National Geographic Explorer award and a Fulbright Fellow, Robin Vijayan's lab also engages in citizen science and young naturalist outreach initiatives.

Population trends inferred from field and genomic data indicate differential roles for climate and landscape change for Sky Island birds

Biphasic habitats—where two distinct habitat types coexist in the same climate zone—allow us to separate habitat structure effects from climate when studying species' responses to environmental change. The Shola Sky Islands of the Western Ghats exemplify this system, with montane cloud forests and grasslands supporting distinct endemic species. Our research has documented century-long habitat changes, particularly from invasive woody species transforming grasslands.

I will present findings from three complementary studies spanning 25 years: Four-year monitoring of marked birds shows stable populations in intact forests but reduced survival in disturbed areas. Landscape-scale surveys reveal forest birds colonizing woody invasive habitats in grasslands, while grassland specialists decline. Whole-genome data from 100 individuals across 15 species show montane specialists maintain stable populations (Ne) over millions of years, while generalists fluctuate with paleoclimatic events.

Together, these findings demonstrate that vegetation structure affects short-term survival, while climate-ecology interactions shape long-term demographics—an integrated approach applicable to understudied landscapes like the Eastern Ghats.

Sunday, 16 November 2025
10:30-11:00 AM

Session 3A

Symposium on Evolutionary Ecology in the Wild

Chairperson: **Renee Borges**
IISc, Bengaluru

Ullasa Kodandaramiah
IISER Thiruvananthapuram

Ullasa Kodandaramaiah is Professor in the School of Biology at the Indian Institute of Science Education and Research Thiruvananthapuram and Principal Investigator of the Vanasiri Evolutionary Ecology Lab. He earned his Ph.D. in Animal Ecology from Stockholm University, with post-doctoral research at the University of Cambridge. Prof. Kodandaramaiah's work focuses on evolutionary ecology, phylogeography and diversification of butterflies and other taxa in the Western Ghats and tropical landscapes. He explores how environmental history, species traits and biogeography interact to shape biodiversity. He has been elected Fellow of the Indian Academy of Sciences in recognition of his scientific contributions.

Hybridization and diversification of *Impatiens* in the Western Ghats

The Western Ghats mountain system harbours exceptional diversity of *Impatiens* plants, shaped by isolation, adaptation, and hybridization. I present results from two studies on *Impatiens* of the northern Western Ghats — one on ecological specialization and local adaptation, and another on hybridization dynamics. Populations of *I. lawii*, confined to high-elevation "sky islands," show striking floral divergence among nearby populations. Common-garden experiments confirmed that these differences are genetically based rather than environmentally induced. Floral variation was not explained by pollinator assemblages or by genetic and environmental distances, suggesting strong localized selection on floral traits. In a second study, we discovered a narrow hybrid zone between *I. rosea* and *I. balsamina*. Greenhouse and genetic analyses confirmed hybrid identity and indicate that the zone arose through secondary contact between species with incomplete prezygotic barriers. The narrowness of the hybrid zone likely reflects the combined effects of inbreeding, local adaptation and pollinator preferences, with evidence for unidirectional introgression by *I. balsamina*. Together, these studies reveal how niche specialization, geographic isolation, and hybridization drive Impatiens diversification in the Western Ghats.

Sunday, 16 November 2025
11:00-11:30 AM

Session 3A

Symposium on Evolutionary Ecology in the Wild

Chairperson: **Renee Borges**
IISc, Bengaluru

Meghana Krishnadas
NCBS, Bengaluru

Meghna Krishnadas is a Professor at the National Centre for Biological Sciences (NCBS), Bengaluru. Her research focuses on the ecological processes that enable species coexistence and shape plant community dynamics across diverse ecosystems, from tropical forests to alpine grasslands. By integrating field ecology with trait-based and interaction-driven approaches, her work examines how abiotic factors, soil microbes, seed dispersers, and herbivores influence biodiversity and ecosystem resilience under environmental change. Her studies advance understanding of species interactions and their role in maintaining ecosystem stability.

Traits of trees shape community assembly, but intraspecific variation is substantial and meaningful

Understanding the factors shaping species distributions and community assembly is essential for predicting biodiversity loss with global environmental changes. Community structure emerges from species' performance governed by functional traits, heritable features representing fundamental ecological properties such as life history, resource use, and competitive ability, and trade-offs therein. There has been a groundswell of trait-based studies in the past decade, but tropical dry ecosystems (TDEs) remain understudied. We assessed the degree to which traits explain community assembly of trees in response to natural and anthropogenic gradients in a TDE of the Eastern Ghats. First, we examined trait-mediated filtering across broad climate gradients. Then, we investigated whether traits explain woody species' response to the invasion of a savanna understorey by *Lantana camara*. Finally, we assessed whether within-species trait variation explained species abundances and landscape-scale niche properties. Inter-species variation in traits explained assembly in response to abiotic gradients and invasion, but within-species variation was substantial and affected landscape-level niche properties, indicating why species-level mean traits yield noisy patterns in assembly.

Sunday, 16 November 2025
12:10-12:30 PM

Session 3B

Lectures by Fellows/ Associates

Chairperson: **Tarun Kant**
IIT Bombay, Mumbai

Pradeep K Singh
Former Director
(CIMFR, Dhanbad)

Pradeep K. Singh is the former Director of the CSIR-Central Institute of Mining and Fuel Research (CIMFR), Dhanbad. He obtained his M.Sc. (Tech) from Banaras Hindu University and Ph.D. from the Technical University, Clausthal, Germany, followed by postdoctoral research at the University of Toronto, Canada. With over three decades at CSIR-CIMFR, he led pioneering work in controlled blasting, mine-water reclamation, and coal-to-methanol technology. A Fellow of the Indian Academy of Sciences and the National Academy of Sciences, India, he has authored 13 books, over 280 publications, and numerous technical reports. His many honours include the National Mineral Award (2007) and multiple CSIR Technology Awards (2017–2019).

Ulwe hill flattened by controlled blasting technique for construction of Navi Mumbai International Airport - A success story

Controlled blasting techniques was deployed for flattening the 92 m high Ulwe hill for the construction of Navi Mumbai International Airport (NMIA). Huge excavation work was required as the Ulwe hill was extended in a stretch of 2.2 km in length and 1.6 km in width. The hill was surrounded by densely populated villages, so the controlled blasting techniques were adopted to mitigate the associated environmental impacts like ground vibrations, air overpressure, flyrock etc. The controlled blasting techniques were also required to get the desired rock sizes of 300 mm to 700 mm to be used in foundation of the runway. These sizes of fragmented rock have strong compactness and cohesive interlocking for stable runway. In addition to the flattening of Ulwe hill work, another big challenge was diversion of Ulwe river because runway was planned at the natural flow of Ulwe river. The diversion of Ulwe river was only option for construction of airport runway. The Project implementing authority (CIDCO) decided that diversion of river must be completed before the on-set of monsoon season and diverted river flow should be parallel to the proposed airport to add beauty to the surrounding area of airport. To accomplish this herculean task, 8550 numbers of blasts were conducted and approximately 62 million cubic meters of rocks were excavated through precision drilling and blasting operations. This paper highlights the controlled blasting techniques implemented at the NMIA project site to flatten the Ulwe hill height from 92 mRL to 8 mRL and also diversion of Ulwe river. Altogether, 8550 blasts were conducted and 19,665 blast vibration records were documented in the nearby villages in the foot hills and critical locations in the periphery of NMIA sites. These efforts also helped enable the construction of Navi Mumbai International Airport which was inaugurated on 8th October, 2025 by Hon'ble Prime Minister of India. The cooperation of nearby villagers are praise worth and thankfully acknowledged. It gives immense pleasure to the team members who were associated with controlled blasting operations at NMIA site.

Sunday, 16 November 2025
12:40-13:20 PM

Session 3C

Special Lecture

Chairperson: **Parthasarathi Mukhopadhyay**
IISER Berhampur, Berhampur

Ravi S. Nanjundiah
IISc, Bengaluru

Ravi Nanjundiah is Professor at the Centre for Atmospheric and Oceanic Sciences and the Divecha Centre for Climate Change, IISc Bengaluru. He served as Director of the Indian Institute of Tropical Meteorology, Pune (2017–2021). His research focuses on monsoon dynamics, climate variability, and the use of machine learning in weather and climate modelling. A Fellow of the Indian Academy of Sciences and the India Meteorological Society, he received the Sir C. V. Raman Young Scientist Award and the Nvidia Innovation Award. He has guided numerous doctoral and postdoctoral researchers and contributed extensively to national climate missions.

Heat stress forecasts: Its importance in present day changing climate

Rising temperatures due to anthropogenic activity is likely to increase the probability of hot weather events. According to many studies, India is likely to be one of the most severely impacted countries with increased probability of extreme hot weather events. However hot weather events could be due to both increased temperatures and humidity. Forecasting this as heat stress, a term combining various factors including moisture and temperature is a difficult task. One of the reasons for this could be that heat stress and related discomfort for a person depends on one's adaptation to the surroundings e.g. a resident adapted to a hotter climate may tolerate heat stress better than one from cooler climates.

In this work, I will discuss our efforts to forecast heat-related events for Karnataka using AI-based models, which are further enhanced with local data to generate finer-grain, community-relevant forecasts. Importantly, this work also attempts to provide a translational research component aimed at democratising data, models, and insights, so that scientific advancements can directly support public health, local governance, and climate resilience planning.

Notes