



**BITS Pilani**  
KK Birla Goa Campus

**Indian Academy of Sciences**  
Bengaluru 560 080

# **89<sup>th</sup> ANNUAL MEETING**

**03–05 November, 2023**

**Host/Venue:** BITS-Pilani, KK Birla Goa Campus, Goa  
**Co-host:** National Centre for Polar and Ocean Research, Goa

**ABSTRACTS OF LECTURES**



# Contents

## Session 1A – Inaugural Session and Presidential Address

Metavalent bonding: Origins of unusual properties of group IV chalcogenide crystals	Umesh V Waghmare	01
---	------------------	----

## Session 1B – Symposium on “Catalysis for a sustainable society”

Catalysis for a sustainable society: A chemist's perspective	<i>Swadin K Mandal</i>	02
Expectation of chemistry: All-in to meet the needs of society	<i>Matthias Driess</i>	03
Catalyst designs in carbon recycling for sustainable energy	<i>Sebastian Chirambatte Peter</i>	04
Non-noble metal catalysis for sustainable development	<i>E Balaraman</i>	05

## Session 1C – Special Lecture

Connecting academic R&D with product innovation: A few case studies and a way forward	<i>Ramgopal V Rao</i>	06
---	-----------------------	----

## Session 1D – Lectures by Fellows and Associates

Coordination chemistry of diborane(4) and diborane(6)	<i>Sundargopal Ghosh</i>	07
Infinitely many quantum solutions to Euler's 36 officers problem	<i>Vijay Kodiyalam</i>	08

## Session 1E– Lectures by Fellows and Associates

Combinatorial games on random premises, their connections with percolation, probabilistic automata and statistical mechanics	<i>Moumanti Podder</i>	09
Electrocatalytic synthesis of green ammonia and green urea: Lab to library vs lab to land	<i>Uttam K Ghorai</i>	10

## Session 1F– Public Lecture

The art and science of design	<i>Dean D'Cruz</i>	11
-------------------------------	--------------------	----

## Session 2A – Lectures by Fellows and Associates

Modelling and control of large size nuclear reactors	<i>Bijnan Bandyopadhyay</i>	12
RTEL1 helicase regulates homologous recombination during DNA replication	<i>Ganesh Nagaraju</i>	13
Controlled two-dimensional (2D) assemblies from chromophore-appended poly(L-lactides)	<i>Anindita Das</i>	14
Some aspects of dark matter	<i>Biswarup Mukhopadhyaya</i>	15

## Session 2B – Symposium on “Landscape and Seascapes of Western India and Beyond”

Phenological monitoring: Sensing the pulse of the forest ecosystem	<i>CP Singh</i>	16
Forest monitoring studies in the Western Ghats – Connecting satellite and near surface observations to ground-based observations	<i>Rajiv Kumar Chaturvedi</i>	17
Indian Ocean observations	<i>MA Atmanand</i>	18
Mapping the hidden features and potential hazards in the exclusive economic zone of India	<i>V Sunil</i>	19

## Session 2C – Lectures by Fellows and Associates

Riverscape dynamics in the northwestern Himalaya and its non-contemporaneity to the Harappan civilization	<i>Rajiv Sinha</i>	20
Understanding the molecular mechanism underlying protein and metabolite cross-catalysis and coalescence using bio-physical approaches	<i>Bibin G Anand</i>	21
On some machine learning applications in biomedical research	<i>Sanghamitra Bandyopadhyay</i>	22
Large igneous provinces of the Indian shield: Insights and perspectives	<i>Amiya Kumar Samal</i>	23



## Session 2D–Public Lecture

The saga of laterite	<i>Gurmeet Kaur</i>	24
----------------------	---------------------	----

## Session 3A – Lectures by Fellows and Associates

‘Brain sex differentiation’ in bony fishes	<i>B Senthilkumaran</i>	25
Polar climate reconstructions and Indian monsoon teleconnections	<i>Vikash Kumar</i>	26
Decoding the molecular blueprint of regeneration in mammalian CNS neurons: Peeling back the regulatory layers	<i>Ishwariya Venkatesh</i>	27

## Session 3B – Lectures by Fellows and Associates

Functionalized polycyclic cage compounds as prospective high energy density materials	<i>INN Namboothiri</i>	28
A constrained Ando dilation problem	<i>Haripada Sau</i>	29
Evolution of the element lithium in the universe – A case of anomalously high lithium in red giant stars	<i>B Eswar Reddy</i>	30

## Session 3C – Special Lecture

Evolution of our understanding of the dynamics of the North Indian Ocean	<i>D Shankar</i>	31
--	------------------	----

# ABSTRACTS OF LECTURES

3 November 2023: 0930–1100

## Session 1A – Inaugural Session and Presidential Address



**Umesh V Waghmare**  
President, IASc

### **Metavalent bonding: Origins of unusual properties of group IV chalcogenide crystals**

A distinct type of metavalent (intermediate to metallic and covalent) bonding (MVB) was recently proposed to explain an unusual combination of anomalous functional properties of group IV chalcogenide crystals, whose electronic mechanisms and origins remain mysterious. Through theoretical analysis of the evolution of bonding along continuous paths in structural and chemical composition space, we demonstrate the emergence of MVB in rocksalt chalcogenides as a consequence of weakly broken symmetry of parent metallic simple-cubic crystals of Group V metalloids. Stronger symmetry-breaking structural and chemical fields, however, transform them discontinuously to covalent and ionic semiconducting states, respectively. MVB involves an electron engaged in bonding and antibonding pairwise interactions alternating along linear chains of atoms, which facilitate electronic delocalization and long-range electron transfer in response to polar fields and cause unusual properties. Understanding of MVB is central to the design of quantum materials exhibiting thermoelectric, ferroelectric and nontrivial electronic topological properties.

Elected as Fellow in 2008.

\*Work done in collaboration with Raagya Arora and C N R Rao

# ABSTRACTS OF LECTURES

3 November 2023: 1130–1330

## Session 1B – Symposium on “Catalysis for a sustainable society”

Introduction: 1130–1145



Convener  
**Swadin K Mandal**  
IISER, Mohanpur

### Catalysis for a sustainable society: A chemist's perspective

Sustainability is defined as development that meets the needs of the present generation without compromising the needs of future generations. Catalytic methods are among the most valuable tools for sustainability. Today, chemical and associated industries are aiming to undergo a paradigm shift from traditional concepts by utilising alternative catalysts, avoiding toxic and hazardous materials, making atom-efficient processes to eliminate waste or transforming waste into wealth, adding value to greenhouse gases by converting them into fine chemicals and replacing fossil resources with renewable raw materials. Citing a few selected examples from recent literature on how catalysis can play key roles in building a sustainable society, the speaker's perspective as a chemist working in the area of catalysis will be brought out in this talk.

### Convener's Profile

Swadin K Mandal is a Professor at the Department of Chemical Sciences, IISER, Mohanpur. Previously, he has served as an Associate Professor at IISER Kolkata (2013–2014) and as an Assistant Professor at IISER Kolkata (2007–2013). He was an Alexander von Humboldt Fellow at the University of Göttingen (2006–2007). He specialises in organometallic chemistry and its application in catalysis, new drug development and material chemistry. He is a recipient of *Honors* from ACS (2014 and 2013) and the YIM Boston Young Scientist Award from YIM Boston at MIT, USA (2012). Elected as Fellow in 2021.

# ABSTRACTS OF LECTURES

**3 November 2023: 1145–1225**



**Matthias Driess**  
Technical University, Berlin

## **Expectation of chemistry: All-in to meet the needs of society**

Chemistry is the central science of transformation of matter and, thus, one of the drivers of civilization. The chemical industry has generated a system of gigantic material flows with a huge network of benefits worldwide, seemingly ensuring the prosperity of the Western world, but not without significant ecological and economic disadvantages for other countries on Earth. Now that resource scarcity and climate change can no longer be denied and swept under the rug, society expects chemistry, more urgently than ever, to respond to these radical changes with fast-track innovative developments and inventions. The presentation will illustrate, referring to selected significant challenges and achievements in catalysis research, how chemistry engenders sustainability by embracing a multidisciplinary and systemic approach.

## **Speaker's Profile**

Matthias Driess heads the Chair of Inorganic Chemistry/Metalorganic Chemistry and Inorganic Materials at the Institute of Chemistry, Technische Universität Berlin (Technical University, Berlin). He specializes in the synthesis of novel molecular functions based on compounds with heavier main group elements (e.g., silicon and phosphorus chemistry), organometallic chemistry yielding molecular models for heterogeneous catalysis (e.g., metal oxides), electron-transfer-complexes and the synthesis of molecular single source precursors for nanostructured inorganic materials. He is the Vice-Chair of the Cluster of Excellence Unifying Systems in Catalysis, UniSysCat; Director of the UniSysCat-BASF Joint Lab, BasCat; and the Director of the Chemical Invention Factory, CIF. He was selected as Member of the German National Academy of Sciences Leopoldina in 2012 and has been an Ordinary Member of the Berlin-Brandenburg Academy of Sciences and Humanities (BBAW) since 2014. He is a Member of the European Academy of Sciences since 2020.

# ABSTRACTS OF LECTURES

3 November 2023: 1225–1250



**Sebastian Chirambatte Peter**  
JNCASR, Bengaluru

## Catalyst designs in carbon recycling for sustainable energy

The two most imminent scientific and technological problems humanity faces now are energy and climate. Energy production and utilization in modern society is mostly based on the combustion of carbonaceous fuels like coal, petroleum and natural gas, which produces  $\text{CO}_2$ , which alters the Earth's carbon cycle. 30 billion tons of  $\text{CO}_2$  per year are emitted globally as waste from carbonaceous fuel burning and the industrial sector, which, if converted to valuable chemicals, has the potential to change the world's economy. Both issues are being addressed by us in our lab, and a strong emphasis is placed on translating their innovative technologies from the lab to the industrial and commercial scale. Our recent discoveries of materials based on intermetallics, chalcogenides, oxides, organic–inorganic hybrids, etc., as efficient catalysts for converting  $\text{CO}_2$  to chemicals/fuels will be discussed in this talk.  $\text{CO}_2$  from industrial flue streams is captured and converted into value-added chemicals/fuels such as methanol, CO, methane, dimethyl ether, C2-C5 and C5-C11 gasoline hydrocarbons. Catalyst design is at the heart of all these technologies; customized catalyst systems for targeted product conversions as per the needs of different industries have been developed by the team. Development of these catalysts via various methods, the driving force behind the enhancement in activity and the mechanistic pathways will be explained with the support of various in-situ (DRIFTS, IR, XAFS), ex-situ (XPS, XRD, IR, XAFS) and theoretical (DFT calculation) studies. The industrial viability of these catalysts will also be covered in the talk.

## Speaker's Profile

Sebastian Chirambatte Peter joined JNCASR, Bengaluru, in 2010 as a Ramanujan Fellow and has been an Associate Professor since 2017. He holds a PhD (2006) from Institut für Anorganische und Analytische Chemie and NRW Graduate School of Chemistry, Universität Münster, Germany, and pursued his post-doctoral research under Prof. Yuri Grin at the Max Planck Institute for Chemical Physics of Solids, Germany and Prof. M G Kanatzidis at Northwestern University, USA. His research interests include fuel cells, water splitting and  $\text{CO}_2$  reduction. He has been selected as a young research investigator by ACS, RSC, IOP and MRSI, and is the recipient of the prestigious Swarnajayanti Fellowship (2017–2018) and CRSI Bronze Medal (2021). Apart from fundamental research, he is involved in translational research and is the Founder and Director of the start-up Breathe India Pvt. Ltd., which aims to convert  $\text{CO}_2$  into chemicals and fuels. The technology received the National Award (2021) from the Technology Development Board, DST India.

# ABSTRACTS OF LECTURES

3 November 2023: 1250–1315



**E Balaraman**  
IISER, Tirupati

## Non-noble metal catalysis for sustainable development

Energy storage and the use of abundantly available feedstock without contributing to the carbon footprint are the two main challenges in sustainable development. In this regard, meeting the energy demand of society while avoiding environmental pollution requires the development of high-performance, low-cost, eco-benign, sustainable, and affordable catalytic systems. Design of catalysts for various important reactions using organometallic, nano-, and photo(redox) catalysis approaches for fundamental and applied research is the focus of our research group at IISER, Tirupati. Developing catalysts/catalytic materials based on non-precious metals that can enable sustainable and affordable chemical synthesis from feedstocks via dehydrogenation chemistry, hydrogen production from renewable sources, and CO<sub>2</sub> utilization for circular catalysis is our aim. The synthesis of electron donors for the Ziegler–Natta olefin polymerization catalysis is also being explored by our group. Our odyssey with dehydrogenation chemistry for sustainable and affordable chemical synthesis will be discussed briefly in this talk.

## Speaker's Profile

E Balaraman is an Associate Professor and Chair at the Department of Chemistry, IISER, Tirupati. He holds a PhD (2002–2008) from the University of Hyderabad. His group's research primarily focuses on generating resources for green energy and recycling atmospheric waste. Specifically, his research group works on designing and developing catalytic materials for hydrogen generation from feedstock chemicals, sustainable chemical synthesis, and conversion of CO<sub>2</sub> to value-added chemicals. He is also interested in developing new electron donors for Ziegler–Natta olefin polymerization catalysis.

# ABSTRACTS OF LECTURES

3 November 2023: 1430–1510

## Session 1C – Special Lecture

Chairperson: Partha P Majumder, Emeritus Professor, ISI, Kolkata



**Ramgopal V Rao**

Group Vice Chancellor, BITS, Pilani

### Connecting academic R&D with product innovation: A few case studies and a way forward

India's contribution to the world's R&D is steadily increasing. In certain specialized areas, such as nanotechnology, India is among the top 3 countries in the world in terms of research publications. Despite the low percentage of GDP spending for R&D in India, Indian researchers have excelled in research output when measured in terms of the number of research publications. Although these are excellent achievements, the situation is entirely different when looking at the country's innovation or product development potential. For example, India ranks very poorly on the Global Innovation Index (GII), and the research undertaken by Indian academic institutions, whether public or private, has not resulted in any major technological breakthroughs of significant commercial value. In this scenario, to make Indian research competitive and sustainable in terms of innovation and product development, a multitude of initiatives need to be undertaken at the institutional and national levels. The talk aims to discuss the changing scenario for product innovation in Indian academic and R&D institutions and highlight how one can accelerate the culture of product innovation in the country through a multi-disciplinary approach.

### Speaker's Profile

Ramgopal V Rao is the Group Vice-Chancellor for the BITS Pilani campuses in Pilani, Hyderabad, Goa, Dubai and Mumbai. Earlier, he served as the Director of IIT Delhi (2016–2021) and as a Chair Professor for nanoelectronics at IIT Bombay and IIT Delhi. Known for establishing major nanoelectronics programmes in the country, he is also the co-founder of two deep technology startups—Nanosniff and Soilsens—with successful commercial products in the market. He has 480 research papers and over 50 patents (including 20 issued US patents and 15 patents licensed to industries for commercialization) to his credit. His scientific and leadership contributions have been recognized with many awards and honours, including the Shanti Swarup Bhatnagar Prize in Engineering Sciences, Infosys Prize, and the IEEE EDS Education Award. He is an elected Fellow of IEEE, The World Academy of Sciences (TWAS), the Indian National Academy of Engineering (INAE) and all three major science academies in India. Elected as Fellow in 2009.



# ABSTRACTS OF LECTURES

3 November 2023: 1515–1600

## Session 1D – Lectures by Fellows and Associates

Chairperson: Shridhar R Gadre, Honorary Distinguished Professor,  
SPP University, Pune

3 November 2023: 1515–1535



**Sundargopal Ghosh**  
IIT, Chennai

### Coordination chemistry of diborane(4) and diborane(6)

The fascinating aspect of metallaborane chemistry is that several classic organometallic complexes that define fundamental structural and bonding paradigms are mimicked by many isoelectronic metallaborane analogues. In this connection, diborane compounds not only mimic several classic organometallic compounds, but they have also been extensively explored for a broad understanding of chemical bonding and catalysis. For example, we have recently synthesised and structurally characterised a bimetallic diborane(4), which mimics Cotton's dimolybdenum–alkyne complex [ $\{\text{CpMo}(\text{CO})_2\}_2\text{C}_2\text{H}_2$ ]. Also, we have isolated the first classical diborane(5)  $[\text{B}_2\text{H}_5]^-$ , in which the  $\text{sp}^2\text{-B}$  centre is stabilised by the electron donation from tantalum. Very recently, we have developed an uncatalysed synthetic pathway to generate the doubly base stabilised symmetrical and unsymmetrical diborane(4) species from the thermolysis reaction of 2-mercaptopyridine with  $[\text{BH}_3\cdot\text{THF}]$ . The key results of this work will be described in the talk.

### Speaker's Profile

Sundargopal Ghosh is a Professor at the Department of Chemistry, IIT Madras. He received his B Sc and M Sc from the University of Calcutta and PhD from IIT Bombay in 1998. He joined the Department of Chemistry at IIT Madras in 2005, following a postdoctoral fellowship at the University of Notre Dame, USA. His research interests are transition metal–boron compounds and their applications in catalysis and small molecule activation, and he has over 272 scientific publications in internationally acclaimed journals. He is a recipient of many awards, including the Professor Priyadarajan Ray Memorial Award (2019), the Institute Research and Development Award of IIT Madras (2014), and the Bronze Medal of the Chemical Research Society of India (CRSI) (2013). He has supervised 29 PhD students, was an editorial board member of *Organometallics* (ACS, 2018–2020) and is currently the Editor of *Inorganica Chimica Acta*. He is an elected Fellow of the Indian Academy of Sciences (2017) and the National Academy of Sciences (India).

# ABSTRACTS OF LECTURES

**3 November 2023: 1540–1600**



**Vijay Kodiyalam**  
IMSc, Chennai

## **Infinitely many quantum solutions to Euler's 36 officers problem**

While Euler's 36 officers problem is known not to have a classical solution, we show, in joint work with Suhail Rather, N Ramadas and Arul Lakshminarayanan, that it does admit infinitely many distinct quantum solutions.

### **Speaker's Profile**

Vijay Kodiyalam has a B Tech. in computer science from IIT Madras and an MSc and PhD in mathematics from Purdue University. He works in the areas of commutative algebra and subfactor theory. He is a recipient of the Birla Science Prize. He is an elected Fellow of the Indian Academy of Sciences (2017) and the Indian National Science Academy.

# ABSTRACTS OF LECTURES

**3 November 2023: 1630–1715**

## **Session 1E– Lectures by Fellows and Associates**

**Chairperson: Meena B Mahajan, IMSc, Chennai**

**3 November 2023: 1630–1650**



**Moumanti Podder**

IISER, Pune

### **Combinatorial games on random premises, their connections with percolation, probabilistic automata and statistical mechanics**

Percolation games and their intimate ties with the popularly studied topic of percolation in physics can be of particular interest to researchers. The talk will briefly discuss the various versions of percolation games studied on directed 2-dimensional lattices and rooted random trees, with emphasis upon the phenomenon of phase transition pertaining to the probability of draw (i.e., exploring the ‘regimes’, in terms of the parameter(s) involved, where the probability of draw in such a game is 0, and where it is strictly positive). Such phase transition phenomena also bear close connections with the ergodicity of suitably related probabilistic cellular automata/probabilistic tree automata, as well as weak spatial mixing properties of suitably related models of statistical mechanics.

### **Speaker’s Profile**

Moumanti Podder completed her Bachelor of Statistics (Hons.) and Master of Statistics, with a specialization in mathematical statistics and probability, from the Indian Statistical Institute, Kolkata (2008–2011 and 2011–2013 respectively). She then went on to complete her PhD in mathematics from the Courant Institute of Mathematical Sciences, New York University, under the supervision of Prof. Joel Spencer (2013–2017). She served as a Postdoctoral Fellow at the School of Mathematics, Georgia Institute of Technology (2017–2018), an Acting Assistant Professor at the Department of Mathematics, University of Washington (2018–2019), and an Assistant Professor of Practice (non-tenure-track) at the NYU-ECNU Institute of Mathematical Sciences at New York University’s Shanghai Campus (2019–2020), before starting as an Assistant Professor (tenure-track) at the Department of Mathematics, Indian Institute of Science Education and Research (IISER) Pune (2021–present). She primarily works on two-player combinatorial games played on random graphs, percolation games, etc. Selected as Associate in 2023.

# ABSTRACTS OF LECTURES

3 November 2023: 1655–1715



**Uttam K Ghorai**

Ramakrishna Mission Vidyamandira, Belur Math, Howrah

## **Electrocatalytic synthesis of green ammonia and green urea: Lab to library vs lab to land**

Numerous varieties of fertilizers primarily consist of macronutrients such as phosphorus, potassium, and nitrogen. As fixed nitrogen is typically the rate-limiting macronutrient for plant growth, producing nitrogen-based fertilizers (ammonia, nitrate, and urea) has always posed a significant global challenge. To combat global starvation over the next three decades, nitrogen-based fertilizer usage will continue to rise, significantly affecting energy and the environment, as nearly all nitrogen-based fertilizers are manufactured from ammonia and nitric acid, with high energy and carbon footprints. To produce ammonia, urea, and nitric acid without using fossil fuels, new technological solutions must be invented. Electrocatalytic methods to produce green ammonia, green urea, and nitric acid under ambient conditions using electrocatalysts have been designed and developed in the speaker's laboratory. All these processes are protected with appropriate IPR. The field trial of the green ammonia synthesis has been completed, and the technology transfer and process of licensing for pilot-scale production of green ammonia with a multinational company has been initiated.

## **Speaker's Profile**

Uttam K Ghorai is currently an Assistant Professor and Head of the Department of Industrial Chemistry and Applied Chemistry, Ramakrishna Mission Vidyamandira, Belur Math. His study focuses primarily on electrochemical methods for synthesising ammonia, urea, and nitric acid under ambient conditions. He has published 120 research papers in peer-reviewed international journals (*h*-index: 32 and total citations ~3016) and has been jointly involved in seven patents. In recognition of his contributions to the Materials Science and Engineering field, he received the Young Engineer Award (2019) from the Indian National Academy of Engineering (INAE) and the Young Scientist Platinum Jubilee Award (2020) from the National Academy of Sciences. Additionally, he was awarded the BRICS Young Innovator Prize in 2022. He has been elected as an Associate of INAE and IASc in 2021.

# ABSTRACTS OF LECTURES

**3 November 2023: 1800–1900**

## **Session 1F– Public Lecture**

**Chairperson: Umesh V Waghmare, JNCASR, Bengaluru**



**Dean D'Cruz**  
Goa Foundation, Goa

### **The art and science of design**

In the last couple of decades, design has been visibly at the forefront of shaping the lives and aspirations of people, but very few have understood what design is all about. Its broad footprint spans seemingly frivolous areas like fashion design to serious technologically intense iconic multi storey buildings. We have seen companies like Apple and Tesla using design to drive their products where designers not just cater to user needs but create products that set the future. Besides this, design is now playing a great role in addressing the world's environmental and social problems and not just catering to an elite. Design involves many stages of researching user needs, defining the problems, challenging assumptions and creating ideas, prototyping possible solutions and testing these solutions out before actually making the product. It involves the rigour of the engineering sciences with the creativity and human connect of the arts. Thus, like the sciences and the arts, which develop and change through the years, design is also dynamic, responding to our lifestyle, materials and technologies that are available at the time. This presentation will touch upon these aspects and also share examples of works by Mozaic over the last few decades.

### **Speaker's Profile**

Dean D'Cruz, a graduate of Sir J J College of Architecture, Mumbai, set up practice in Goa in 1989, continuing to co-found Mozaic Design architectural wing in 2001. Sustainability has been at the core of his design ethos, gradually gaining shape and recognition with the urgency of climate change since 2012. He has conducted numerous workshops and seminars on architecture, planning and environment, with works and articles published in leading magazines in India and abroad. He has collaborated with the Royal Institute of Art, Stockholm, Oxford Brookes University UK, and PRATT Institute New York, on architectural and planning programs in Goa. Having designed over 250 houses, 50 hotels, 30 housing complexes, 30 institutions, offices, and factories, he is a recipient of multiple awards. His strength today is in the hospitality industry, from boutique hotels and jungle lodges to 200+ room resorts. His current efforts are aimed at improving academic standards across the country through awareness of criteria that address environmental and social issues in architecture and planning.

# ABSTRACTS OF LECTURES

**4 November 2023: 0900–1030**

## **Session 2A – Lectures by Fellows and Associates**

**Chairperson: Appa Rao Podile, University of Hyderabad, Hyderabad**

**4 November 2023: 0900–0920**



**Bijnan Bandyopadhyay**  
IIT, Jodhpur

### **Modelling and control of large size nuclear reactors**

In this talk, the speaker will discuss the modelling and controlling of a large pressurized heavy water reactor (PHWR). At first, the flux equations of two energy groups will be discussed. It will be shown how these two group equations are converted into ordinary differential equations using the nodal techniques. By applying one and half group theory, these equations are converted into one group power equations for all the nodes. Finally, a linear model of 70th order, 14 inputs and 14 outputs are obtained in state space. The design of the controller will be discussed for this reactor model, and its efficacy will be illustrated by nonlinear simulation.

#### **Speaker's Profile**

Bijnan Bandyopadhyay is currently serving as a Visiting Professor at IIT Jodhpur. He received his BE in electronics and telecommunication engineering from the University of Calcutta in 1978 and his PhD in electrical engineering from IIT Delhi in 1986. He specialises in multi-rate output feedback-based discrete time sliding mode control and nuclear reactor control. In 1987, he joined the Systems and Control Engineering group at IIT Bombay as a faculty member, where he served as Chair Professor between 2015 and 2021. In 1996, he was with the Lehrstuhl für Elektrische Steuerung und Regelung, RUB, Bochum, Germany, as an Alexander von Humboldt Fellow. He has 450 publications to his credit and is a recipient of the IEEE Distinguished Lecturer Award of the IEEE IES Society (2019). He was a Distinguished Visiting Fellow of the Royal Academy of Engineering, London (2009 and 2012), is an elected Fellow of all three major science academies in India and is a Life Fellow of IEEE. Elected as Fellow in 2020.

# ABSTRACTS OF LECTURES

4 November 2023: 0925–0945



**Ganesh Nagaraju**  
IISc, Bengaluru

## **RTEL1 helicase regulates homologous recombination during DNA replication**

Homologous recombination (HR) plays an essential role in the repair of DNA double-strand breaks (DSBs), replication stress responses, and genome maintenance. However, unregulated HR during replication can impair genome duplication and compromise genome stability. Factors and mechanisms underlying HR regulation during DNA replication are largely unclear. Here, we show that RTEL1, RAD51, and RAD51 paralogs localize to replicating sites upon recovery from replication stress. The absence of RTEL1 leads to hyper-recombination during replication and affects genome-wide replication, which can be rescued by co-depleting RAD51 and RAD51 paralogs. Interestingly, co-depletion of fork remodelers such as SMARCAL1/ZRANB3/HLTF/FBH1 and expression of HR defective RAD51 mutants rescues replication defect in RTEL1 deficient cells. The anti-recombinase function of RTEL1 during replication depends on its interaction with PCNA and helicase activity. Together, their data identify a novel role of RTEL1 helicase in restricting RAD51-mediated fork reversal and HR activity to facilitate error-free genome duplication.

### **Speaker's Profile**

Ganesh Nagaraju has been a Professor at the Department of Biochemistry, IISc, since 2007. He received his BSc and MSc from the University of Mysore and his PhD (2003) from the Department of Biochemistry, IISc, Bengaluru. He pursued his postdoctoral studies (2003–2007) in DNA repair, genome stability, and cancer biology at Beth Israel Deaconess Medical Centre and Harvard Medical School, Boston, USA, before joining IISc in 2007. His research is focused on DNA damage responses and cancer biology. He is a recipient of several awards and honours, including the K V Giri Memorial Award for best PhD thesis, B M Birla Science Prize in Biology, the National Bioscience Award for Career Development from DBT, Sir C V Raman Young Scientist Award from Government of Karnataka, Shanti Swarup Bhatnagar Prize in Biological Sciences, Sreenivasaya Memorial Award from SBC(I), and Sir J C Bose Fellowship. He is an elected Fellow of all three major science academies in India. Elected as Fellow in 2023.



# ABSTRACTS OF LECTURES

4 November 2023: 09.50–1010



**Anindita Das**  
IACS, Kolkata

## **Controlled two-dimensional (2D) assemblies from chromophore-appended poly(L-lactides)**

Supramolecular assemblies of functional  $\pi$ -conjugated systems are mostly restricted to spherical or one-dimensional structures, with only a few examples of their two-dimensional architectures reported. Crystallization-driven self-assembly (CDSA) of semicrystalline block copolymers (BCPs) has recently emerged as a powerful technique for the fabrication of a wide range of hierarchical anisotropic structures, including 2D architectures. A novel CDSA method for the programmed synthesis of discrete 2D architectures with exciting photophysical properties and predictable morphologies from chromophore-conjugated poly(L-lactides) (PLLAs) will be presented in the talk. PLLA homopolymers, end-functionalized with different dipolar chromophores, crystallize into precise diamond-shaped 2D platelets in isopropanol under suitable conditions. This causes the terminally attached chromophores to assemble into a 2D-array on the platelet surface by either dipole–dipole interactions or aromatic stacking, which leads to aggregation-induced enhanced emission (AIEE) with tunable emission wavelengths within the 2D crystals, depending upon the nature of the end-capped chromophores. The 'living' CDSA method employed to achieve hierarchical segmented block co-platelet structures using one of the homopolymer platelets as the 'seed' and the unimer of the other as the 'monomer reservoir' will be discussed. By incorporating the same donor and acceptor dyes that hold the FRET relationship at the chain ends of the two enantiomers, we were able to monitor the stereo-complex co-platelet formation in the solution phase, whose similar diamond-shaped 2D structure showed enhanced stability as compared to the individual homocrystals.

## **Speaker's Profile**

Anindita Das is an Assistant Professor in the School of Applied and Interdisciplinary Sciences at IACS, Kolkata. She has worked as an Alexander von Humboldt Postdoctoral Fellow at the University of Hamburg, Germany and has done a second postdoctoral stint at Eindhoven University of Technology, The Netherlands. Her research interests include supramolecular assemblies of functional  $\pi$ -systems and macromolecules employing halogen bonding and other underexplored supramolecular interactions, crystallization-driven macromolecular assemblies, and biodegradable polymers. She is the recipient of the Alexander von Humboldt Postdoctoral Fellowship (2014) and the DAE-BRNS Young Scientist Research Award (2022). She is an Early Career Advisory Board Member of *ChemNanoMat* and Editorial Board Member of the *Journal of Macromolecular Science, Part A: Pure and Applied Chemistry*. She is a selected Associate of the Indian Academy of Sciences (2022) and of the Indian National Science Academy (2023).

# ABSTRACTS OF LECTURES

4 November 2023: 1015–1035



**Biswarup Mukhopadhyaya**  
IISER, Kolkata

## Some aspects of dark matter

Discussing some open issues of dark matter will be the focus of the talk. In particular, extracting information about the nature of dark matter particles from extra-terrestrial data will be discussed while qualitatively touching upon some of the recent work by the speaker.

## Speaker's Profile

Biswarup Mukhopadhyaya is currently HAG Professor, Faculty Affairs, IISER, Kolkata. Previously, he has served as Dean, Faculty Affairs, IISER Kolkata (2020–2022) and Professor-I and Co-ordinator, Regional Centre for Accelerator-based Particle Physics at Harish-Chandra Research Institute, Allahabad. His research focuses on physics beyond the standard model of elementary particles, physics of high energy colliders, particularly the LHC, supersymmetry, Higgs-related studies, astroparticle physics in the context of dark matter, neutrino physics, etc. To his credit, he has about 200 research papers in international journals, along with many articles in books/anthologies and popular science articles in English and Bengali. He is the recipient of many awards and honours, including the Shanti Swarup Bhatnagar Prize and the HBNI Distinguished Faculty Award from the Department of Atomic Energy, Government of India. He is an elected Fellow of the Indian Academy of Sciences (2018) and the National Academy of Sciences (India).

# ABSTRACTS OF LECTURES

**4 November 2023: 1100–1300**

## **Session 2B – Symposium on “Landscape and Seascapes of Western India and Beyond”**

**Chairperson: Binod Sreenivasan, IISc, Bengaluru**

**Convener – Rajiv Kumar Chaturvedi, BITS-Pilani, Goa**

**4 November 2023: 1105–1130**



**C P Singh**

ISRO, Ahmedabad

### **Phenological monitoring: Sensing the pulse of the forest ecosystem**

Phenology of plants is a sensitive indicator of climate change and is crucial in regulating biosphere functions. Satellite remote sensing with synoptic coverage, frequent revisits and suitable wavelengths to monitor finer changes in greenness is gaining importance to understand ecosystem dynamics in changing climate scenarios. This has implications for forest fire regime, CO<sub>2</sub> fluxes, and energy and mass exchange. These variations, as captured and quantified spatially at the landscape level using time-series satellite remote sensing observations and validated with Phenocam network data, can prove to be potent means to understand ecosystem dynamics, including functional traits of forests. Phenocams fitted with automatic weather monitoring systems can further help us understand the meteorological/climatic drivers of these changes on a temporal scale. With our HIMADRI network data, we have observed upward treeline shifts and lengthening of the growing season, thermophilization, and treeline species missing flowering events. However, there is no systematic observation being done in the country; therefore, ISRO's Geosphere and Biosphere Programme has taken up systematic observation through the PhenoMet network covering major forest types. This is expected to generate well-calibrated and validated phenological matrices and investigate the drivers of changes in the forest ecosystem.

### **Speaker's Profile**

C P Singh joined the Space Applications Centre, ISRO, in 2002 and is currently working as Scientist/Engineer–SF in the Earth and Planetary Sciences and Applications Area. He has played a key role in various prestigious research projects related to satellite remote sensing applications in the fields of environment, forestry and ecology. He has designed an active forest fire algorithm for INSAT-3D/3DR. A long-term, first-of-its-kind ecological monitoring network called Himalayan Alpine Dynamics Research Initiative (HIMADRI) in India and the first PhenoMet network for Indian forests has been initiated under his guidance. He is also interested in ecosystem modelling, phenology, lichenology, palaeobotany and climate change impact studies. He has been the focal point for many sponsored research collaborations of ISRO with academia. He has represented India in various international forums, including the 39th Indian Scientific Expedition to Antarctica (2019–2020). He has to his credit more than 100 publications. He is the recipient of the prestigious P R Pisharoty Memorial Award from the Indian Society of Remote Sensing and the President's Appreciation Medal from the Indian Society of Geomatics.

# ABSTRACTS OF LECTURES

**4 November 2023: 1130–1155**



**Rajiv Kumar Chaturvedi**  
BITS-Pilani, Goa

## **Forest monitoring studies in the Western Ghats – Connecting satellite and near surface observations to ground-based observations**

Assessing the impact of global change through satellite, near-surface, and ground observations in the Netravali Wildlife Sanctuary (WLS) in Goa has been the aim of our long-term work. This long-term forest monitoring site is being managed by BITS Pilani's Goa campus in collaboration with the Goa Forest Department and ISRO as part of its IGBP network. While the IGBP project links satellite observations with near-surface observations at the Netravali site, we go a step further and connect these to ground observations. At Netravali WLS, a 1 ha vegetation monitoring plot in the field view of the PhenoCAM has been established, following rigorous international protocols. The 1 ha plot comprises about 5375 individuals, holds 260 tonnes of carbon in vegetation and soils and demonstrates a high level of tree biodiversity with 84 tree species. The BITS team is working with the International Institute for Applied Systems Analysis, Vienna, to develop and calibrate a plot-based dynamic vegetation model named 'Plant-FATE'. A range of additional measurements in the plot, including tree census, biomass and soil-related parameters, photosynthesis measurements under temperature and GHG control, hydrological measurements and 3D mapping of the forest understorey using LIDAR applications, are being undertaken. The collaborative model of research centred around this plot will be talked about and how this could help the forest department better manage these forests will be discussed.

## **Speaker's Profile**

Rajiv Kumar Chaturvedi is an Assistant Professor at BITS-Pilani, Goa campus. He received his PhD in ecology from the Centre for Ecological Sciences, IISc, Bangalore, and a Master's in geography from Delhi School of Economics, Delhi University. He has been a National Environmental Sciences Fellow at IISc and has contributed to more than 40 peer-reviewed articles and to two books in the areas related to forestry, environment, and climate change. He has worked extensively with communities, Government officials, NGOs, and UN organizations. He is presently the co-chair of IUCN's forest ecosystems group and is listed as a UN expert on GHG inventory in the land-use and forestry sector. He is currently involved with India's national greenhouse gas inventory programme and has been a lead author for the regional assessment reports of the UNEP (United Nations Environment Programme) and IPBES (Intergovernmental Panel on Biodiversity and Ecosystem Services).

# ABSTRACTS OF LECTURES

**4 November 2023: 1155–1220**



**M A Atmanand**  
IIT, Chennai

## Indian Ocean observations

The United Nations General Assembly proclaimed the Decade of Ocean Science for Sustainable Development (2021 to 2030) to mobilise ocean stakeholders worldwide behind a common framework ensuring that ocean science can fully support countries in achieving the 2030 agenda for sustainable development. More coordinated and consolidated observations and research will contribute to the UN processes protecting the ocean and its resources, such as the Aichi Biodiversity targets, the SAMOA Pathway, the United Nations Convention for the Law of the Sea and the Sendai Framework for Disaster Risk Reduction. As per the latest IPCC report, global warming, reaching 1.5°C in the near term, would cause unavoidable increases in multiple climate hazards and present multiple risks to ecosystems and humans (very high confidence). To assess the planet's health, measuring the condition of the oceans is a particular necessity. The number of ocean observations is far below the requirement by modellers to assimilate and predict climate change globally. Among the world's oceans, the Indian Ocean is warming faster due to its landlocked nature. It is, hence, all the more important to enhance ocean observations in this region. There are two types of observation platforms: the Lagrangian, which moves along with the current and waves in the ocean, and the Eulerian, which is moored and hence stationary in the ocean. The measurements from the moored observatories for underwater, surface and above water are essential for understanding the heat transfer characteristics and, hence, cyclone prediction and studies. There are multiple types of floats working on the principle of variable buoyancy, called Argo floats, gliders, etc. There is another class—Autonomous Underwater Vehicles (AUV)—on which various types of sensors could be integrated. All the measurements are transmitted online through satellite to the mainland for dissemination to the Indian Meteorological Department, researchers and international agencies. Details of these platforms will be covered during the presentation.

## Speaker's Profile

M A Atmanand is a Visiting Professor at IIT Madras, Chennai. With 38 years of experience in the field of ocean technology, he retired as the Director of the National Institute of Ocean Technology, Chennai. He is nominated as Chair, Marine Systems Panel, Naval Research Board, DRDO, Govt of India, and is the Governor's nominee to the planning board of Bharathidasan University. He is also an elected member of the Society for Underwater Technology Council and a former member of the Executive Planning Group and the Interim Decade Advisory Board for preparation of the UN Decade of Ocean Science for Sustainable Development (2021–2030) of the Intergovernmental Oceanographic Commission of UNESCO. He was elected as Chair of the Intergovernmental Oceanographic Commission Regional Committee for the Central Indian Ocean of IOC, UNESCO (2016–2021). He is the recipient of many prestigious awards, including the Ministry of Earth Sciences National Award of Excellence in Ocean Technology, and the International Society for Ocean and Polar Engineers Award (2020).

# ABSTRACTS OF LECTURES

**4 November 2023: 1220–1245**



**V Sunil**  
NCPOR, Goa

## **Mapping the hidden features and potential hazards in the exclusive economic zone of India**

India's exclusive economic zone (EEZ), extending 200 nautical miles from its coastline, is a vast expanse of ocean teeming with various resources. For the optimum utilisation of resources available in the oceanic region and to enhance our knowledge about the scientific issues related to them, the Government of India initiated a project on comprehensive mapping of the EEZ of India. The project under the aegis of the Ministry of Earth Sciences is organised and implemented by the National Centre for Polar and Ocean Research (nodal organisation). The National Institute of Ocean Technology, National Institute of Oceanography, and Geological Survey of India, Mangaluru, are participating in the project. State-of-the-art multibeam swath bathymetric surveying of the EEZ is the main focus of this national project, apart from gathering all other possible marine geophysical data. An area of about ~1.7 million sq km has been surveyed so far using a multibeam echosounder, comprising over 90% of the deep-water blocks. The data have unveiled many morphological features within the EEZ of India, including many bathymetric highs, submarine canyons, and submarine landslides, etc., many mapped and identified for the first time. Along the western continental margin of India, a total of 33 bathymetric highs were mapped, elevations varying from 200–2300 m, and classified based on morphometric parameters. Accurate charting of these features is crucial for ensuring safe navigation. Bathymetric highs are significant for their role as biodiversity hubs and, consequently, important fishing areas, and can also serve as host sites for valuable mineral deposits containing various rare earth elements. Potential geohazards, such as submarine landslides, were identified on both the western and eastern continental margins, with paleo landslides observed off the coasts of Kerala and Chennai. Cracks on the seafloor were spotted off the Tamil Nadu coast, which might act as precursors to future landslides. This comprehensive mapping initiative plays a vital role in safeguarding India's economic prosperity, conserving marine ecosystems, and ensuring the sustainable development of its maritime territory.

## **Speaker's Profile**

V Sunil is Scientist D and Scientist-In-Charge–Deep Sea Surveys and Mapping, National Centre for Polar and Ocean Research, Goa. He is a marine geophysicist with a PhD (2014) in geophysics from UiT The Arctic University of Norway, Tromsø, Norway. He is an expert in numerical modelling of the dynamics of gas hydrates in glaciated margins. He has over 13 years of experience in collecting and analysing marine geophysical and geological data, broad research experience in the field of natural gas hydrates and methane seepage in marine sediments and geohazards, focusing on its impact on the environment and climate, and an extensive field experience with over 400 days of ship time in the North Atlantic Ocean, Indian Ocean, and Arctic Ocean. His current research focuses on geohazards in the Indian EEZ, hydrothermal systems in mid-oceanic ridges, and exploration of hydrothermal minerals.



# ABSTRACTS OF LECTURES

**4 November 2023: 1400–1540**

## **Session 2C – Lectures by Fellows and Associates**

**Chairperson: Somdatta Sinha, IISER, Mohali**

**4 November 2023: 1400–1420**



**Rajiv Sinha**  
IIT, Kanpur

### **Riverscape dynamics in the northwestern Himalaya and its non-contemporaneity to the Harappan civilization**

A large perennial river system (Ghaggar-Hakra), comprising paleo-Sutlej and paleo-Yamuna Rivers, has been argued to have sustained the Bronze Age Harappan urban settlements (~4.6–3.9 thousand years before present, ka) in the northwestern Indian plains. Based on comprehensive chronostratigraphic, sedimentological and sediment provenance data, our work has shown that the palaeo-Sutlej was already defunct in this region by ~8 ka. The Harappan urban settlements thus developed along an abandoned river valley rather than an active Himalayan River. Further, the paleo-Yamuna also acted as an important feeder to the Ghaggar-Hakra system, which impacted the local hydrological conditions, although its role in the growth and eventual demise of the Harappan settlements has been debated. Our new data on high-resolution chrono-stratigraphy from six sediment cores (~50 m deep) across the palaeochannels of the Yamuna document multistoried sand bodies deposited by a mobile channel belt in a large fluvial fan system. Based on extensive luminescence dating, we infer a major drainage reorganization of the palaeo-Yamuna River at ~18 ka, at least 10 ka before the westward switch of the paleo-Sutlej River. This means that the Ghaggar-Hakra system was already flowing with a much-reduced discharge during the Early Holocene and was completely defunct by ~8 ka, much before the decline of the Harappan Civilization started.

### **Speaker's Profile**

Rajiv Sinha is a Professor of Earth Sciences at IIT Kanpur. He holds a PhD in sedimentology from the University of Cambridge (1992) and has worked on various aspects of river science during his career. Apart from his early work on proposing a new source area classification of Gangetic river systems, one of his most significant contributions has been characterising geomorphic diversity and landscape evolution across the Gangetic plains as a function of the balance between stream power and sediment flux. His recent research on palaeochannels in northwest India has suggested that no large river was contemporaneous with the Harappan civilisation in this region. He has published over 200 papers with over 9000 citations (h-index 57). He is a recipient of the Alexander von Humboldt Fellowship (2000), National Mineral Award (2002), and S S Merh Award (2006). He is an elected Fellow of the Indian Academy of Sciences (2021) and the National Academy of Sciences (India).



# ABSTRACTS OF LECTURES

4 November 2023: 1425–1445



**Bibin G Anand**

SRM Institute of Science and Technology, Kattankulathur

## **Understanding the molecular mechanism underlying protein and metabolite cross-catalysis and coalescence using bio-physical approaches**

Conversion of proteins from their native form into aggregates can lead to the formation of highly stable structures known as amyloid fibrils characterized by cross  $\beta$  structures. Proteins and peptides with persistent folds and well-defined structures are prone to amyloid formation under different conditions, such as mutations, post-translational modification, impaired cellular mechanisms, and disrupted homeostasis. Approximately 50 proteins and peptides are known to form toxic amyloid entities, contributing to various pathological complications, including non-cerebral amyloidosis (systemic or localized) and neurodegenerative disorders. Even metabolites like phenylalanine, tyrosine, etc., tend to form a beta sheet-like structure with biophysical and biochemical properties like amyloids. However, due to the structural polymorphism displayed by amyloid fibrils, the precise molecular mechanisms behind these debilitating diseases remain a topic of ongoing debate. Our research tries to emphasize the significance of primary nucleation and secondary nucleation in the context of protein and metabolite aggregation, as well as their coalescence and cross-catalytic interactions. The results highlight the critical role of optimized intermolecular arrangements driven by aromatic interactions in facilitating coalescence and cross-catalysis events. These insights offer valuable clues for a fundamental and mechanistic understanding of the diverse pathological complications associated with neurodegenerative diseases. Furthermore, they shed light on the complicated nature of disease mechanisms and their direct association with amyloid formation in relevant proteins and metabolites.

### **Speaker's Profile**

Bibin G Anand is a Research Assistant Professor from the Department of Biotechnology at SRM Institute of Science and Technology. He earned his PhD from IIT Jodhpur, specializing in designing nanomaterials to tackle protein aggregation. After his PhD, he moved to the University of Alberta in Canada, where he worked on engineered nano-shells to target Alzheimer's disease *in vitro* and *in vivo*. He has also successfully secured funding from SynAD to study the role of functional nanoparticles on AD progression. Subsequently, he joined Boston University, where he explored eukaryotic transcription initiation factors and their role in triggering integrated stress responses in neurodegenerative diseases. He has published ~ 37 research articles to date. He works in the fields of amyloid biology, neurodegeneration, and molecular self-assembly and believes that the most significant impact can be achieved through a blend of fundamental and translational research approaches. Selected as Associate in 2023.

# ABSTRACTS OF LECTURES

4 November 2023: 1450–1510



**Sanghamitra Bandyopadhyay**  
ISI, Kolkata

## On some machine learning applications in biomedical research

Over the past few decades, the usage of machine learning (ML) methods in biomedical research has gained immense importance. An overview of some ML techniques and molecular biology will be provided first in this talk. Brief presentations of some classical as well as recent applications of ML methods to a few problems in computational biology will follow.

## Speaker's Profile

Sanghamitra Bandyopadhyay is presently serving her second tenure as the Director of the Indian Statistical Institute. She joined the institute as a faculty member and became the Director in 2015. Her research interests include computational biology, soft and evolutionary computation, artificial intelligence, and machine learning. She is the recipient of several awards including the Shanti Swarup Bhatnagar Prize in Engineering Science, TWAS Prize, Infosys Prize, J C Bose Fellowship, Swarnajayanti Fellowship, INAE Silver Jubilee award, INAE Woman Engineer of the Year award (academia), IIT Kharagpur Distinguished Alumni Award, Humboldt Fellowship from Germany, Senior Associateship of ICTP, Italy, Young Engineer/Scientist Awards from INSA, INAE and ISCA, and Dr Shanker Dayal Sharma Gold Medal and Institute Silver from IIT, Kharagpur, India. She is a Fellow of the four Science and Engineering Academies in India, as well as of IEEE, TWAS, International Association for Pattern Recognition (IAPR) and West Bengal Academy of Science and Technology. She serves as a member of the Science, Technology, and Innovation Advisory Council of the Prime Minister of India (PM-STIAC). In 2022, she was conferred the Padma Shri Award by the Government of India. Elected as Fellow in 2023.

# ABSTRACTS OF LECTURES

4 November 2023: 1515–1535



**Amiya Kumar Samal**  
BHU, Varanasi

## Large igneous provinces of the Indian shield: Insights and perspectives

Large igneous provinces (LIPs) are a fascinating geological phenomenon that refers to massive outpourings of mantle melts (magma) over a relatively short geological time ( $< 5$  million years) on a continental scale, occurring away from the plate boundaries. Apart from the ca. 66–65 Ma Deccan Volcanic Province, the Indian Shield hosts several remarkable Precambrian LIPs distributed over its Archean cratons. A total of 16 (3 Archean and 13 Proterozoic) distinct LIPs are identified in the Indian Shield. The identification of most of these LIPs relies on precisely dated mafic dyke swarms (mostly by the U–Pb baddeleyite ID-TIMS method), their mineralogical–chemical compositions, trends, and cross-cutting relationships with each other and country rocks. These Precambrian LIPs offer valuable insights into the geological history of the Indian Shield and its long and complex evolution. They are crucial for understanding the tectonic and magmatic processes that have shaped the Indian subcontinent over billions of years. Many of these Precambrian LIPs belong to the DHABASI megacraton (a newly identified large landmass in the Indian Shield) and are linked to different mineral systems. Many of these mafic–ultramafic units of LIPs are supposed to be potential targets for mineralization of the Cu–Ni–Co–platinum group elements, Fe–Ti–V and Cr—both as oxides and sulphides. The identified LIP events of the Indian Shield are supposed to be an integral part of most of the known supercontinents, such as Kenorland/Superia, Columbia/Nuna, Rodinia, Gondwana/Pannotia, and Pangea, in Earth’s evolution.

## Speaker’s Profile

Amiya Kumar Samal has been an Assistant Professor in the Department of Geology at Banaras Hindu University since 2017. He specializes in the fields of igneous petrology and geochemistry. He has carried out research towards understanding the subcontinental lithospheric mantle below different Archean cratons of the Indian Shield, particularly the Dharwar craton, during the Precambrian through systematic studies on distinct generations of Paleoproterozoic mafic dyke swarms. His research is focused on identifying Precambrian large igneous provinces through geochemical and isotopic characterization together with U–Pb geochronology of mafic dyke swarms. Additionally, he conducts geochemical studies on the rare earth element potential of the Ambadungar alkaline carbonatite complex in Gujarat, India. He has authored 30 research papers and has received the Young Scientist Award from NASI and the National Young Geoscientist Award from the Ministry of Mines, Govt of India in 2022. Selected as Associate in 2022.

# ABSTRACTS OF LECTURES

**4 November 2023: 1800–1900**

## **Session 2D–Public Lecture**

**Chairperson: Umesh V Waghmare, JNCASR, Bengaluru**



**Gurmeet Kaur**  
Panjab University, Chandigarh

### **The saga of laterite**

The saga of laterite is a tale that recounts the enduring significance of this intriguing stone in understanding the culture and history of the Western Ghats. The story begins with the geological formation of laterite. Centuries ago, people thriving in the Western Ghats and vicinity discovered the remarkable qualities of laterite. The presence of extensive laterite deposits in this region shaped its cultural landscape. Laterite structures not only served as architectural wonders but also held perceptive cultural significance. They became centres of worship and repositories of history. In recognition of the importance of laterite-built structures and sites, UNESCO designated some of them as World Heritage Sites. Today, the saga of laterite continues as these sites and structures continue to inspire awe and wonder. They remind us of the enduring legacy of human ingenuity etched in stone.

### **Speaker's Profile**

Gurmeet Kaur is an Associate Professor (2019–present) at the Centre of Advanced Study in Geology, Panjab University. She specialises in petrology, mineralogy, and geochemistry. She has been involved in international projects such as the IUGS and UNESCO-sponsored 'Heritage stones recognition: A step forward' (2020–2024) and IGCP 637 Heritage stone designation (2015–2019). She has been the Chair of the IUGS Subcommission on Heritage Stones (November 2020 onwards), IUGS Publications Committee Member (August 2018 onwards), visiting faculty at Laurentian University, Canada, and visiting scholar at the Department of Geology, Lakehead University, Canada. She has mentored senior school students at the Department of Science and Technology-INSPIRE camp organised at Panjab University (2016–2018). She was elected a Fellow of the Geological Society of India in 2004.

# ABSTRACTS OF LECTURES

5 November 2023: 0900–1015

## Session 3A – Lectures by Fellows and Associates

Chairperson: E Krishnakumar, RRI, Bengaluru

5 November 2023: 0900–0920



**B Senthilkumar**

University of Hyderabad, Hyderabad

### ‘Brain sex differentiation’ in bony fishes

The mammalian brain depicts structural and functional changes during brain sex differentiation wherein responses of a fetal brain to sex steroid hormones impart diverse variations as specified by gonadal sex, leading to a gender-centric pattern. Later, the influence of sex steroids sensitizes the brain through a steroid-mediated feedback mechanism. Consequentially, gender-based brain differences are evident, driven by various molecules with structure-based differences. On the other hand, the ‘brain sex differentiation’ mediated impact on gonads seems intriguing in lower vertebrates. Such a mechanism seems consequential rather than causative, yet distinguished gender-based mechanisms have been recognized. Bony fishes exhibit sexual plasticity during gonadal development. Incidentally, our research on this line identified novel brain-specific biomarkers concerning brain–gonadal interaction during sexual development in fish. Sex-specific differences in a variety of transcripts or molecules ranging from tryptophan hydroxylase, tyrosine hydroxylase, cyp19a1, serotonin, catecholamines, glial cell-line derived neurotrophic factor, and its receptor, gfra-1 are evident in the fish brain during early gonadal development. Incidentally, gonadotropin-releasing hormone but not gonadotropins showed a brief phase of sexual dimorphism. In line with this, the controlled release of sex steroids via an osmotic pump imparted hormone-mediated influence on several brain biomarkers, indicating a contributory gonadal influence. In general, the brain serotonergic system explicitly directs male sex development, while the catecholaminergic system shows higher activity during female sex development. Overall, our study warrants the existence of brain sex differentiation in fish, leading to the identification of the most reliable novel gene biomarkers from the brain to detect reproductive well-being or endocrine disruption.

### Speaker’s Profile

B Senthilkumar is a Professor, DBT-TATA Innovation Fellow, and faculty in the Department of Animal Biology, School of Life Sciences, University of Hyderabad. He works in the area of fish reproductive biology and molecular endocrinology research. His group is known for identifying the shift in steroidogenesis during meiotic maturation and unravelling the molecular mechanisms underlying sexual development and gamete maturation in fishes. His group has also identified sexually dimorphic transcripts and proteins from the gonads and brain to define sex differentiation that leads to identifying biomarkers of gamete maturation and brain sex differentiation in fishes. He is a recipient of the DBT-TATA Innovation Fellowship (2014–2019) from DBT India, visiting STA and JSPS fellowships from the Government of Japan, Global Ambassador Fellowship, University of Saskatchewan, Canada (2021–2022) and J C Bose Fellowship (2023) from SERB, India. He is a Fellow of the National Academy of Agricultural Sciences (2022) and an elected Fellow of all three major science academies in India. Elected as Fellow in 2020.

# ABSTRACTS OF LECTURES

5 November 2023: 0925–0945



**Vikash Kumar**  
NCPOR, Goa

## **Polar climate reconstructions and Indian monsoon teleconnections**

Earth's climate is a dynamic system that varies over a wide range of timescales. Across the globe, large-scale atmospheric and oceanic circulation patterns connect distinct sub-systems that are dominant over different locations. As a result, the climate variability over different regions on the planet is inextricably linked to each other. Here, we explore past linkages between high-latitude climate variability and tropical climate sub-systems, focusing on paleoclimate reconstructions in the Arctic and Southern Ocean and their impact on the Indian monsoon. In the Southern Ocean, a sediment core analysis from the Indian sector during the last glacial period provided rare quantitative data on climate variability in this data-sparse region. The work highlights an inter-hemispheric linkage between the Indian monsoon and surface conditions in the Indian sector of the Southern Ocean in the millennial time frame. In the Arctic, western Svalbard fjords are ideal for investigating paleoenvironmental changes due to their unique glacial marine contrast, proximity to vital current systems, strong biophysical coupling, and high sedimentation rates. Our work on surface and core sediment samples from one such fjord demonstrates a high climate sensitivity and provides a high-resolution record of paleoenvironmental changes during the last millennium. Moreover, the reconstructed Arctic record forms a highly coherent pattern with the Indian monsoon variability during the last millennium, likely modulated by meridional thermal gradients over the Indian monsoon domain.

## **Speaker's Profile**

Vikash Kumar is a Scientist at the National Centre for Polar and Ocean Research, Goa, India, specializing in past climate and ocean studies. He holds a BS-MS dual degree with a major in Earth Sciences from the Indian Institute of Science Education and Research, Kolkata (2012). Thereafter, he joined the Indian Institute of Tropical Meteorology Pune (IITM) as a trainee scientist at the Centre for Advanced Training (CAT). He joined the National Centre for Polar and Ocean Research as a scientist in 2016 upon completion of his training at IITM Pune. Working in the Paleoceanography division at NCPOR, he obtained a PhD in marine sciences from Goa University with a thesis examining the teleconnections between past high and mid-latitude climate and Indian Monsoon variability. His research focuses on polar climate reconstructions while also delving into their global teleconnections. A significant aspect of his work investigates how northern and southern high-latitude climate change impacts the Indian climate system in different time frames. Selected as Associate in 2023.



# ABSTRACTS OF LECTURES

5 November 2023: 0950–1010



**Ishwariya Venkatesh**  
CCMB, Hyderabad

## **Decoding the molecular blueprint of regeneration in mammalian CNS neurons: Peeling back the regulatory layers**

Our research delves into the molecular regulation of axon growth during development and regeneration in mammals. Axons are crucial for efficient nervous system communication, and their preservation is essential for proper neuronal function. While young neurons exhibit remarkable regenerative abilities, adult neurons lose this capacity, resulting in irreversible damage. Unravelling the molecular pathways that drive the decline in regenerative capacity throughout development is the aim of our research. We explore the intricate interplay between transcription factor regulatory networks, epigenetic landscape, and 3D genome topology, which collectively govern axon growth and regeneration. Using bioinformatic modelling and cutting-edge functional genomics techniques, including single-cell RNA-Seq and ChIP-Seq, they aim to decipher the underlying regulatory mechanisms that enable successful regeneration. *In vivo* mouse models of injury to assess axonal growth and regeneration are used. Ultimately, our research is expected to clarify fundamental molecular mechanisms that govern successful regeneration and, in the future, may contribute to the development of therapeutic interventions aimed at promoting regeneration and repair in the adult nervous system.

### **Speaker's Profile**

Ishwariya Venkatesh has been serving as a Senior Scientist at CSIR CCMB, since December 2022, following her role as a SERB Ramanujan Fellow at CCMB from April to December 2022. She holds a PhD in molecular neuroscience from the University of Wisconsin-Milwaukee. She has pursued a postdoctoral position at Marquette University, working on understanding the molecular underpinnings of regenerative capacity across mammalian development, using the mouse as a model system. Following her postdoctoral work, she established and led an independent lab at Marquette University as a Research Assistant Professor. She currently leads a dedicated team at CCMB, whose research is centred on addressing the fundamental question of what molecular mechanisms drive regenerative capacity in central nervous system (CNS) neurons, with a specific and crucial emphasis on spinal injuries. Her work holds significant promise for advancing our understanding of neural regeneration and its potential applications in treating CNS injuries. Selected as Associate in 2023.



# ABSTRACTS OF LECTURES

5 November 2023: 1045–1200

## Session 3B – Lectures by Fellows and Associates

Chairperson: Praveen Chaddah, Gurugram

5 November 2023: 1045–1105



**I N N Namboothiri**

IIT, Mumbai

### Functionalized polycyclic cage compounds as prospective high energy density materials

Highly strained polycyclic cage compounds have attracted the imagination of theoretical, synthetic and medicinal chemists as well as materials scientists. The enormously rigid and compact, yet thermally stable, cage-like structures are potential powerhouses in a volume-limited environment. Besides the rigid polycyclic skeleton, functional groups such as nitro, azido, nitrito, and polynitrogen-containing heterocycles enhance the energetic properties of such compounds. Preliminary theoretical evaluation of the molecular geometry, enthalpy of formation and a specific impulse of model systems encouraged us to synthesize several functionalized cage compounds possessing bis-homocubyl, homocubyl and cubyl skeletons starting from readily available dicyclopentadiene or cyclopentanone in a minimum number of steps. Details of synthesis, characterization and possible applications as energetic materials will be presented.

### Speaker's Profile

I N N Namboothiri is currently a Senior Professor at the Department of Chemistry, IIT Bombay. He received his MSc from Mangalore University and PhD from the Indian Institute of Science, Bengaluru. He carried out postdoctoral research at Bar-Ilan University, Israel, the University of North Texas and Columbia University, NY, before joining IIT Bombay in 2001. His research interests include organic synthesis, development of new synthetic methodologies, asymmetric catalysis, mechanistic studies, and materials chemistry. He is a recipient of the Jean D'Alembert Senior Fellowship, Paris-Saclay University, France, the Chemical Research Society of India Medal, and the Departmental Excellence in Teaching Award at IIT Bombay. He has supervised 26 PhDs and co-authored over 190 publications (h-index 47), including four chapters and two books and is also jointly involved in 6 patents. He is an elected Fellow of the Indian Academy of Sciences (2020) and National Academy of Sciences (India).

# ABSTRACTS OF LECTURES

5 November 2023: 1110–1130



**Haripada Sau**  
IISER, Pune

## A constrained Ando dilation problem

Ando's inequality and its remarkable improvements, first for certain matrices and then for certain operators, motivate us to ask a question that can be seen as a constrained Ando dilation problem. The statement involves a class of two-variable polynomials with a geometric condition on its zero sets, called the toral polynomials. If a pair of commuting operators is annihilated by a toral polynomial, then the pair is called a toral pair. "Does every toral pair of commuting contractions dilate to a toral pair of commuting isometries?" We shall see why one may want to find an answer to this question in this talk.

## Speaker's Profile

Haripada Sau is currently an Assistant Professor at IISER Pune and works in Hilbert space operator theory. His expertise revolves around the rational dilation problem, which originated from the pioneering works of Sz.-Nagy, Ando, and Arveson around the mid-20th century. His current research focuses on a variant of the rational dilation problem constrained to certain affine varieties. He holds a PhD from the Indian Institute of Science under the supervision of Prof. Tirthankar Bhattacharyya. He has done postdoctoral research at IIT Bombay, Virginia Tech, IIT Guwahati, and the TIFR Centre for Applicable Mathematics. Selected as Associate in 2023.

# ABSTRACTS OF LECTURES

5 November 2023: 1135–1155



**B Eswar Reddy**

IIA, Bengaluru

## **Evolution of the element lithium in the universe – A case of anomalously high lithium in red giant stars**

Lithium (Li) is a light element with atomic number  $Z=3$ , known to have a primordial origin along with two other elements – H and He. The present Big Bang nucleosynthesis models with measured cosmological parameters predict Li abundance of  $A(\text{Li}) = \log N(\text{Li})/N(\text{H}) + 12 = 2.7 \sim \text{dex}$ . The predicted primordial value is a factor of 4 less than the Li abundance measured in the interstellar medium and very young stars ( $A(\text{Li}) = 3.3 \sim \text{dex}$ ), implying Li enrichment over the cosmic time scale. Studies have identified a few sources: cosmic ray spallation, stellar explosions, nucleosynthesis, and star mass loss. Our focus is on Li in stars. Stars are known to be sinks of Li rather than producers, validated by both theory and general observations. The finding of a surprisingly large amount of Li in a few red giants has challenged the general understanding of Li evolution in stars. Sometimes, the value exceeds an order of magnitude more than the current ISM value and three to four orders more than the model predictions. The high amount of Li in red giants has been a puzzle for over four decades since its discovery in the early 1980s. Our recent efforts will be described in the talk while providing multiple pieces of evidence that lithium enhancement takes place during the helium flash, and Li-rich giants are common among He-core burning stars.

### **Speaker's Profile**

B Eswar Reddy is a Senior Professor and Dean of the Faculty of Sciences at the Indian Institute of Astrophysics, Bengaluru. He received his PhD in 1997 from IIA, and after six years of post-doctoral stints in the USA (the University of Texas Austin and Valparaiso University), he moved back to IIA, Bengaluru, as faculty. His research interests mainly revolve around the chemical tagging of stars to understand star evolution, nucleosynthesis aspects and the evolution of the galaxies. His work on the Milky Way Galaxy is well known for its chemical decomposition of the Galactic Disk into thin and thick disks and for discovering the He-flash as the source of high Li abundance among giants. He is also spearheading India's participation in the Thirty Meter Telescope International Observatory or TIO as the Programme Director of the India TMT centre. Elected as Fellow in 2023.

# ABSTRACTS OF LECTURES

**5 November 2023: 1200–1240**

## **Session 3C – Special Lecture**

**Chairperson: P C Pandey, IIT, Gandhinagar**



**D Shankar**  
NIO, Goa

### **Evolution of our understanding of the dynamics of the North Indian Ocean**

Our understanding of the dynamics of the North Indian Ocean is the subject of this talk. The presentation is restricted to wind-forced circulation and discusses the theoretical framework that underpins its dynamics. This talk has four modules. Module 1 has two sections. The talk will start with the background, covering the global ocean circulation and the theories that explain the observations. The observed seasonal cycle of the circulation of the North Indian Ocean will be covered in the second section. The largely linear theoretical framework used to explain this observed seasonal cycle (discussed in Module 1) will be dealt with in Module 2. Considering the North Indian Ocean as a complex physical system, the effects of nonlinearity will be dealt with in Module 3. The nonlinear effects with the linear processes discussed in Module 2 will be contrasted in this module. The implications of complexity and linearity for prediction and insight will be dealt with in Module 4.

### **Speaker's Profile**

Shankar Doraiswamy is Chief Scientist at the CSIR-National Institute of Oceanography, Goa. He specialises in large-scale ocean processes, circulation, and air–sea interaction. He is a Fellow of the National Academy of Sciences, India. He was the Chief Editor of the Academy's *Journal of Earth System Science* during 2012–2016. Elected as Fellow in 2011.

*NOTES:*

[illegible]

*NOTES:*

[illegible]







**Indian Academy of Sciences**  
Bengaluru 560 080