Indian Academy of Sciences

Bengaluru 560 080

87th Annual Meeting

12-14 November 2021

Via Virtual Room of CISCO WebEx

Programme and ABSTRACTS

PROGRAMME

12 November 2021 (Friday)

Session 1A

1000-1100 **Presidential Address**
Partha P. Majumder, NIBMG, Kalyani
Genes as a guide to human history and culture

1100-1130 **Short break**

Session 1B

1130-1305 **Lectures by Fellows/Associates**
(Chair: Umesh Waghmare, JNCASR, Bengaluru)

1130-1150 **Neena Gupta, ISI, Kolkata**
On separable A2 and A3 – forms

1155-1215 **Kalachand Sain, WIHG, Dehradun**
Machine learning for automatic interpretation of subsurface geologic features from 3D surface seismic data

1220-1240 **Ajaya K Nayak, NISER, Bhubaneswar**
Room temperature magnetic skyrmion bubbles in centrosymmetric magnets

1245-1305 **Mohit K Jolly, IISc, Bengaluru**
Computational systems biology of reversible cell-state switching during cancer metastasis

1305-1400 **Lunch Break**

Session 1C

1400-1510 **Lectures by Fellows/Associates**
(Chair: Renee M. Borges, IISc, Bengaluru)

1400-1420 **R Chandrasekar, University of Hyderabad, Hyderabad**
Mechanophotonics - An approach towards all-organic photonic integrated circuits

1425-1445 **Arvind Sahu, NCCS, Pune**
Viruses strike back against the complement system

1450-1510 **Neeldhara Misra, IIT, Gandhinagar**
Algorithmic aspects of the firefighting problem

1515-1530 **Short break**

Session 1D

1530-1730 **Symposium: "Some applications of probability and statistics"**
Organizers: Arup Bose (ISI, Kolkata) & Kapil H Paranjape (IISER, Mohali)

1530-1610 **Mustansir Barma, TIFR, Hyderabad**
Dynamics of extremes

1610-1650 **Rajesh Sundaresan, IISc, Bengaluru**
Statistical principles in the design of serosurveys

1650-1730 **Rahul Roy, ISI, Delhi,**
Walking randomly for 100 years

1730-1800 **Short break**

Session 1E

1800-1900 **Public lecture**
Thomas Pradeu, University of Bordeaux, France
Why science needs philosophy

1915-2030 **Panel Discussion: "Why do we need data science and statistics to count deaths during a pandemic?"**

Organizers: LS Shashidhara (Ashoka University, Sonepat) and Satyajit Mayor (NCBS, Bengaluru)

Opening Remarks (5 min): (LS Shashidhara/Satyajit Mayor)

Speakers (8 min each):
Arvind Subramanian, Brown University, USA

Prabhat Jha, Centre for Global Health Research, University of Toronto, Canada

S Rukmini, Independent Journalist, Chennai

Panelists:
Madhuchhanda Bhattacharjee, School of Mathematics and Statistics, University of Hyderabad.

Murad Banaji, Mathematics, Middlesex University, UK

Manindra Agrawal, IIT, Kanpur

Moderators:
Mukund Thattai, NCBS, Bengaluru

Gautam Menon, Ashoka University, Sonepat

13 November 2021 (Saturday)

Session 2A

0900-0940 **Special Lecture**
Spenta Wadia, ICTS-TIFR, Bengaluru
Black holes, information paradox and quantum entanglement

Session 2B

0940-1030 **Lectures by Fellows/Associates**
(Chair: Umesh Waghmare, JNCASR, Bengaluru)

0940-1000 **Dipshikha Chakravortty, IISc, Bengaluru**
Life in a vacuole: Why Salmonella prefers to stay in a vacuole

1005-1025 **Vamsi Pingali, IISc, Bengaluru**
Two stories of PDE arising from differential geometry and physics

1030-1100 **Short break**

Session 2C

1100-1300 **Symposium: "Electrochemical Energy Storage and Sustainability"**

Organizers: S Sampath (IISc, Bengaluru) and
K Vijayamohanan Pillai (IISER, Tirupati)

1100-1110 **Introduction**

1110-1135 **Ashish Lele, CSIR-NCL, Pune**
Green hydrogen for Indian's green future

1135-1200 **SA Ilangovan, VSSC, Thiruvananthapuram**
Supercapacitor(-battery) to supercabattery: An innovative energy **storage** system

1200-1225 **Amartya Mukhopadhyay, IIT, Mumbai**
Stress-induced degradation of electrode materials in alkali metal-ion batteries

1225-1250 **N Kalaiselvi, CSIR-CECRI, Karaikudi**
Various aspects of lithium batteries

1250-1300 **Conclusion**

1300-1400 **Lunch Break**

Session 2D

1400-1540 Lectures by Fellows/Associates
(Chair: Renee M. Borges, IISc, Bengaluru)

1400-1420 Sanjeev Khosla, CDFD, Hyderabad
Epigenetic Inheritance

1425-1445 Sadiqali A Rangwala, RRI, Bengaluru
Understanding inter-particle interactions with hybrid traps

1450-1510 Shreya Karmakar, Jadavpur University, Kolkata
Origin of ruby in chromiferous anorthosites, from the Sittampundi Layered Complex, South India

1515-1535 Anirban Basu, NBRC, Manesar
Drug repositioning/repurposing: Promising strategy to develop therapy against viral infections

1540-1710 Business Meeting of Fellows

1710-1730 Virtual Group Photograph Session for Fellows

Session 2E

1800-1900 Public Lecture
Arunabha Ghosh, Council on Energy, Environment and Water (CEEW), New Delhi
From energy transition to energy revolution: India's journey to energy security

14 November 2021 (Sunday)

Session 3A

0900-1015 Lectures by Fellows/Associates
(Chair: VA Raghunathan, RRI, Bengaluru)

0900-0920 Vivek Agarwal, IIT, Mumbai
My contributions to research on solar PV technology

0925-0945 Ritu Gupta, IIT, Jodhpur
Fluorinated nanomaterials for energy and healthcare applications

0950-1010 Anjan K Banerjee, IISER, Pune
Induction of aerial and belowground tubers in potato: A classic example of developmental plasticity and modulation of plant architecture

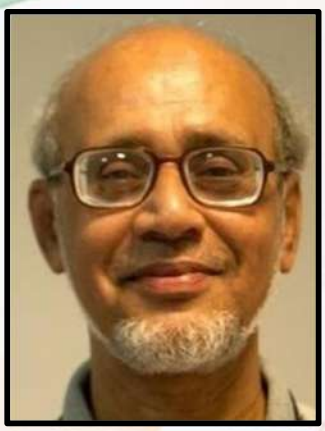
1015-1030 Short break

Session 3B

1030-1110 Special Lecture
Ashok Sahni, Panjab University, Chandigarh
greenhouse explosion of biodiversity

Session 1A

1130-1150
12 November 2021 (Friday)



Presidential Address

Partha P. Majumder
NIBMG, Kalyani

Genes as a guide to human history and culture

12 November 2021
1130-1150
SESSION 1B: Lectures by Fellows /Associates

NEENA GUPTA
ISI, Kolkata

Elected Fellow IASc: 2020 (Mathematics)

On Separable A^2 and A^3-form

Abstract:

Let k be a field and F be its algebraic closure. A k-algebra B is said to be an A^n-form over k if $B \otimes_k F$ is isomorphic to the polynomial ring $F[Y,.....,Y_n]$.

It is well-known that separable A^1-forms over k are isomorphic to the polynomial ring $k[Y]$ and that there exist non-trivial purely inseparable A^1-forms over fields of positive characteristic. A nontrivial result of T. Kambayashi establishes that separable A^2-forms over k are also isomorphic to the polynomial ring $k[Y_1;Y_2]$. However, for $n > 2$, it is not known whether every separable A^n-form is necessarily isomorphic to the polynomial ring $k[Y_1,.....,Y_n]$.

In this talk, we shall discuss a partial solution to this problem for the case $n = 3$. We shall also discuss A^2-forms over commutative rings.

12 November 2021
1155-1215
SESSION 1B: Lectures by Fellows /Associates

Kalachand Sain

Wadia Institute of Himalayan Geology, Dehradun

Elected Fellow IASc: 2021 (Earth & Planetary Sciences)

Machine learning for automatic interpretation of subsurface geologic features from 3D surface seismic data

Abstract: Seismic method is one of the most suited geophysical methods, which provides quite accurate information on subsurface structures and properties from surface measurement. This has been widely used for exploration of hydrocarbons and coal seams, identification of mineralized prospects, understanding geo-tectonics, comprehending earthquake processes, and assessment of ground water contamination. A phenomenal growth of processing/modeling of voluminous data has been possible due to availability of high performance computing system to generate improved images of subsurface. However, human analysts struggle in interpreting such volume of data, when the subsurface is geologically complex. Is it possible to automate the process of interpretation? To find the answer, we have adopted the concept of AI/ML, which is being employed in almost all fields of Science, Technology and Medicines for quick analysis and decision making. We have computed a new attribute, called meta-attribute, by fusing a number of other seismic attributes that are associated with a specific geologic feature. We shall demonstrate the application for automatic delimitation of subsurface geologic features such as fault network, gas plumes, intrusive, magmatic sills & plumbing, fluid migration, mass transport deposit etc. for quick and advanced interpretation of 3D seismic data with much reduced intervention by a human analyst.

12 November 2021

1220-1240

SESSION 1B: Lectures by Fellows /Associates

Ajaya K. Nayak

School of Physical Sciences, (NISER), Bhubaneswar

IASc Associate: 2019 (Physics)

Room temperature magnetic skyrmion bubbles in centrosymmetric magnet

Abstract: Magnetic skyrmions/antiskyrmions are topologically nontrivial chiral spin textures, whose topological protection helps them to move in lower cut-off current by avoiding defects, hence considered as potential candidates for high density racetrack memory devices. In general, the competing Heisenberg exchange and the Dzyaloshinskii-Moriya interaction (DMI) in noncentrosymmetric systems gives rise to the formation of skyrmions/antiskyrmions [1,2]. Recently skyrmion like spin textures have also been found in centrosymmetric magnets with uniaxial magnetocrystalline anisotropy (UMA) [3-5]. Competing dipolar interaction and UMA is the fundamental mechanism for the stabilization of skyrmions in these materials. Here, we explore room temperature hexagonal skyrmion lattice in a new centrosymmetric kagome ferromagnet using Lorentz transmission electron microscopy (LTEM). The stripe domain like magnetic ground state transforms into skyrmion lattice with increasing magnetic field applied along the *c*- axis over a wide range of temperature. Existence of skyrmions with opposite helicities are observed due to the degenerate energy state of both skyrmions in the centrosymmetric magnets. A switching mechanism of chiral skyrmion (topological number ± 1) to non-chiral type II bubble (topological number 0) is also demonstrated by applying a nonzero in plane magnetic field excitation.

12 November 2021

1245-1305

SESSION 1B: Lectures by Fellows /Associates

Mohit Kumar Jolly
Indian Institute of Science, Bengaluru

IASc Associate: 2021 (Life Sciences)

Computational systems biology of reversible cell-state switching during cancer metastasis

Abstract: Cancer metastasis causes over 90% of cancer-related deaths and is clinically insuperable. Despite extensive ongoing efforts, no unique genomic or mutational signature has emerged for metastasis. Instead, the ability of genetically identical cells to adapt reversibly by exhibiting multiple phenotypes and switching reversibly among them - phenotypic plasticity - is proposed as a hallmark of metastasis. This talk will highlight how mathematical modeling approaches, in an iterative interaction with experimental and clinical data, can better understand how metastasizing cells switch back and forth among multiple phenotypes to maintain their 'fitness' and how such interdisciplinary platforms can help identify accelerators of metastasis that can be clinically targeted.

12 November 2021

1400-1420

SESSION 1C: Lectures by Fellows /Associates

Rajadurai Chandrasekar

Advanced Organic Photonic Materials & Technology Laboratory, School of Chemistry,
University of Hyderabad, Hyderabad

Elected Fellow IASc: 2021 (Chemistry)

Mechanophotonics - An approach toward all-organic photonic integrated circuits

Abstract: Nano-/micro-organic solids have emerged as promising non-silicon-based alternative materials for fabricating miniaturized organic photonic components, such as optical waveguides (active/passive), lasers, resonators, filters, and modulators suitable for constructing all-organic photonic integrated circuits (OPICs).[1-4] Miniature crystal (rigid/flexible) optical waveguides are useful for controlling and manipulating light propagation down to microscale. In optical resonators, their mirror-like geometry allows them to trap the photons tightly by repeated total internal reflection at the air-matter interface and produce multimodal optical emissions. Low-optical-loss resonators are good optical gain media, therefore potential elements for microlasers. The guided light-intensity and- speed can be modulated using light-driven refractive index changes in photochromic crystal waveguides.

Atomic force microscopy is an effective technique to mechanically micromanipulate miniature organic photonic components towards OPICs - an approach developed in our group, known as *Mechanophotonics*.[1] These OPICs employ active, passive, and energy-transfer mechanisms for their operations. The OPICs switch, split, direct, and filter optical signals useful for signal enhancement, sensing, information processing and switchable photonic device applications.

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12 November 2021

1425-1445

SESSION 1C: Lectures by Fellows /Associates

Arvind Sahu

National Centre for Cell Science, Pune

Elected Fellow IASc: 2019 (General Biology)

Viruses strike back against the complement system

Abstract: Viruses require a host for replication and survival and hence are subjected to host immunological pressures. The complement system, a crucial first response of the host immune system, effectively targets viruses and virus-infected cells and boosts the antiviral innate and acquired immune responses. Thus, the system imposes a strong selection pressure on viruses. Consequently, viruses have evolved multiple countermeasures against the host complement. A major mechanism employed by viruses to subvert the complement system is molecular mimicry of the host complement regulators — the structure, function, and mechanism of complement evasion of these proteins will be discussed in the meeting. Additionally, data will also be presented on the complement-mediated immunological control of viruses.

12 November 2021

1450-1510

SESSION 1C: Lectures by Fellows /Associates

Neeldhara Misra

IIT, Gandhinagar

IASc Associate: 2021 (Engineering & Technology)

Algorithmic aspects of the firefighting problem

Abstract: This talk will present some results about specific types of games on graphs, which are a powerful tool to model various real-world applications. Our focus will be mostly on the algorithmic aspects of the firefighter game, which is a turn-based game played on a graph, where the fire spreads to vertices in a breadth-first manner from a source, and firefighters can be placed on yet unburnt vertices on alternate rounds to block the fire. The Firefighter problem was introduced in 1995 and intended to capture also important applications, like understanding the spread of news on a social network, or developing a strategy for immunizing a population against a virus. The goal here is to come up with a strategy for placing firefighters on nodes in order to intercept the spread of the fire. The most natural algorithmic question associated with this game is to find a strategy that optimizes some desirable criteria, for instance, maximizing the number of saved vertices, minimizing the number of rounds, the number of firefighters per round, or the number of burned vertices, and so on. These questions are well-studied in the literature, and while most variants are NP-hard, approximation and parameterized algorithms have been proposed for various scenarios. In this talk, we will survey some of the known results and techniques for solving the firefighting problem, with a special focus on the variant where the goal is to save a critical subset of nodes. In this context, we will draw connections with notions of important separators and tight separator sequences. We will also contemplate on possible relationships that this problem has with other models of information spread on networks.

12 November 2021

1530-1610

Session 1D: Symposium - Some Applications of Probability and Statistics

Organizers: Arup Bose (ISI, Kolkata) & Kapil H. Paranjape (IISER, Mohali)

Mustansir Barma

Tata Institute of Fundamental Research, Hyderabad.

Dynamics of extremes

Abstract: The statistics of the extreme value of a set of uncorrelated variables is well studied, and has many applications. The results fall into three universality classes, described by the Gumbel, Frechet and Weibull distributions. We will discuss how these results can change when there are correlations between variables, as in some interacting particle systems such as the zero-range process and the coarse-grained depth model of a fluctuating interface. Especially interesting is the dynamics of extremes, following the time evolution of the distribution during the process of coarsening, starting from a totally disordered, uncorrelated state, and ending with an ordered, correlated state.

12 November 2021

1610-1650

Session 1D: Symposium - Some Applications of Probability and Statistics

Organizers: Arup Bose (ISI, Kolkata) and Kapil H. Paranjape (IISER, Mohali)

Rajesh Sundaresan

Indian Institute of Science, Bengaluru

Statistical principles in the design of serosurveys

Abstract: Infections were near a peak in Karnataka during September 2020 when a state wide COVID-19 serosurvey was conducted. For accurate total disease-burden estimation during such periods, both the active infection and the seroprevalence of antibodies to the virus must be estimated. This requires the use of multiple tests, e.g., antigen and RT-PCR tests for active infection estimation, and serology for antibody prevalence estimation. We will discuss the challenges in combining data from multiple tests, the science of optimal design, what ought to have been the design, and how this optimal design was used in the second survey in January-February 2021.

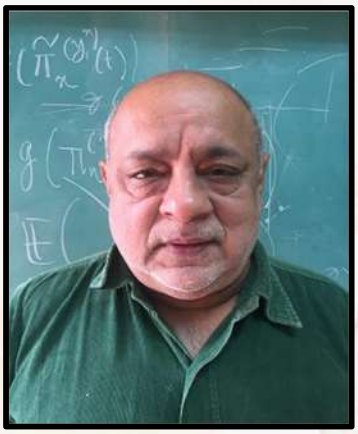
The talk will be based on joint work with collaborators from the Indian Institute of Public Health, Indian Statistical Institute, Strand Life Sciences, and the Indian Institute of Science.

12 November 2021

1650-1730

Session1D: Symposium - Some Applications of Probability and Statistics

Organizers: Arup Bose (ISI, Kolkata) and Kapil H. Paranjape (IISER, Mohali)



Rahul Roy

Indian Statistical Institute, New Delhi

Walking randomly for 100 years.

Abstract: Random walks on lattices and graphs have been studied for more than a 100 years by mathematicians, statisticians and others. We elucidate the formal mathematical structure of the model and indicate some of the interesting results in this area. We also discuss how this theory helps us to understand the geometry of such complex networks as the World Wide Web and the small world network.

13 November 2021

0900-0940

Session 2A: Special Lecture

Spenta Wadia
ICTS, TIFR, Bengaluru

Black holes, information paradox and quantum entanglement

13 November 2021

0940-1000

SESSION 2B: Lectures by Fellows /Associates

Dipshikha Chakravortty

Indian Institute of Science, Bengaluru

Elected Fellow IASc: 2021 (Medicine)

Life in a vacuole- Why Salmonella prefers to stay in a vacuole

Abstract: Intracellular niche of bacteria is a determining factor in establishing pathogenesis. The chosen niche by a bacterial, either vacuolar or cytosolic is determined by intricate network of virulence factors. On one hand where cytosolic bacteria can be taken care by the host defense system, the vacuolar bacteria are difficult to tackle. The talk will focus on few fascinating strategies of intavacoular bacterial pathogenesis

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13 November 2021

1005-1025

SESSION 2B: Lectures by Fellows /Associates

Vamsi Pritham Pingali

Indian Institute of Science, Bengaluru

IASc Associate: 2021 (Mathematics)

Two stories of PDE arising from differential geometry and physics

Abstract: My research focuses on PDE arising from geometry (and connected vaguely to physics). I shall describe some of my results in the context of two such PDE - the gravitating vortex equation and the vortex Monge-Ampere equation. Along with collaborators, I proved that these equations have solutions if and only if some "easy-to-check" algebra-geometric conditions are met. These equations are actually special cases of more complicated equations, namely, the Kahler-Yang-Mills equations and the vector bundle Monge-Ampere equation. If time permits, I hope to convey why one must care about these more general equations too.

13 November 2021

1110-1135

Session 2C: Symposium " Electrochemical Energy Storage and Sustainability"

Organizers: S Sampath (IISc, Bengaluru & K Vijayamohanan Pillai (IISER, Tirupati)

Ashish Lele
CSIR-NCL, Pune

Green hydrogen for India's green future

Abstract: India has set the tone of the COP26 conference by declaring the Panchamrut action plan for climate action. This includes the ambitious target of achieving net zero emissions by 2070. It also set a new target of 500 GW renewable electricity generation, which would take renewable contributions to 50% of India's energy mix by 2050. I believe that low carbon hydrogen is likely to play a pivotal role in achieving these targets. The recent "Hydrogen for Net Zero" report of the Hydrogen Council emphasizes this fact at global scale. In this talk, I will give an overview of the potential of low-carbon hydrogen in India and propose the role of R&D institutions in building hydrogen economy for India.

13 November 2021

1135-1200

Session 2C: Symposium " Electrochemical Energy Storage and Sustainability"

Organizers: S Sampath (IISc, Bengaluru & K Vijayamohanan Pillai (IISER, Tirupati)

SA Ilangovan

VSSC, Thiruvananthapuram

Supercapacitor(-Battery) to Supercabattery: An innovative energy storage system

ABSTRACT: Progressive depletion of non-renewable fossil fuels has resulted in distressing effects of greenhouse gas emission causing global warming and energy security. These facts have reformed the perception of world community on sustainable and environment friendly energy storage system. To envisage features viz., fast discharge and charge capability, enhanced recharge durability with high energy density into the energy storage system are essential to achieve transformation and viability. Although the competing battery technology is significantly advanced, the systems do not entirely meet the energy demands of applications especially for rapid power profiles and the challenges due to safety, size, cost, and overall management issues. To meet the concurrent objective of achieving high-energy and high-power demands, hybridization concepts combining Batteries (energy) and Supercapacitors (power) become promising as power sources improved life and cost effectiveness. Traditionally, hybrid power systems invoke external paralleling of Battery and Supercapacitor banks as individual strings. But the architecture lacks simple management for practical application due to different charge and discharge characteristics of Lithium ion cells (4V, Faradaic) and Supercapacitors (2.5V, Non Faradaic). Also, the issues related to inherent lower voltage and

self-discharge in Supercapacitors call for a stringent cell balancing in the present external hybridization concepts. To overcome these present technical issues, Supercabattery (Supercapacitor + Battery) is a recent innovation in the area of electrochemical energy storage system that efficiently facilitates high rate discharge while retaining the higher energy density. The novel internal hybridization configuration exhibits improved performance attributes of high power rate and energy with cell operating voltage of batteries (> 4.0 V, as the chosen Lithium systems). VSSC/ISRO has designed, developed and qualified Supercabattery devices (0.5 Ah to 3.0 Ah capacity values) with minimal self-discharge and improved cell performance characteristics demonstrated for space applications. Features of higher cell voltage, higher power and energy density and ability to fast discharge will possibly make it as a promising energy storage device suitable for powering electric vehicles with significant performance advantages sorting out the present issues associated with the conventional hybrid systems of Battery and Supercapacitor connected externally.

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13 November 2021

1400-1420

SESSION 2D: Lectures by Fellows/Associates

Sanjeev Khosla

CSIR-IMTECH, Chandigarh

Elected Fellow IASc: 2020 (General Biology)

Epigenetic inheritance

Abstract: Transfer of genetic information, in the form of DNA, from one generation to another forms the basic tenant of inheritance. The inheritance of non-genetic information has been enigmatic but in the past few decades several examples of it have been documented. The DNA methyltransferase 3-Like (DNMT3L) protein is a catalytically inactive member of the de novo DNA methyltransferases family that also includes DNMT3A and DNMT3B. However, it provides specificity to the action of de novo methyltransferases, DNMT3A and DNMT3B and interacts with Histone H3. DNMT3L has been invoked as the molecule that can read the histone code and translate it into DNA methylation. The presentation would discuss the role of DNMT3L in nuclear reprogramming in the light of our observation that ectopic expression of DNMT3L in Drosophila results in inheritance of epimutations across several generations. Our results, we believe, provides a reason to reevaluate the theories that discuss the need for epigenetic inheritance.

13 November 2021

1425-1445

SESSION 2D: Lectures by Fellows/Associates

S. A. Rangwala
Raman Research Institute, Bengaluru

Elected Fellow IASc: 2021 (Physics)

Understanding inter-particle interactions with hybrid traps

Abstract: At room temperature, interactions between gas molecules are dominated by their kinetic energy, as is evident by the success of the classical theory of gases since Maxwell and Boltzmann's formalization of the microscopic theory, and the advances that followed. The quantum theory of gases was developed by legends of physics, including Einstein, who built on the work of Bose on the counting of indistinguishable particles. Since then, multiple advances have followed providing a very clear understanding of the theory of dilute gases, both in the classical and quantum domains, with idealized interactions. At every step of these developments, ingenious experiments have been the arbiter of what holds and what needs to be revised. The most important goal, towards a better understanding of physics is the determination of the interaction between the constituents of the gas, be it atoms, molecules, ions or mixtures of these.

Cooling and trapping of dilute gas atoms creates small ensembles of gases, which can be controlled and measured with unprecedented precision. When a dilute gas cools, its kinetic energy drops and the interactions are dominated by the inter-particle potentials. Such cooling along with trapping enables the detailed study of the inter-particle interactions. In the early years, single species experiment dominated. More recently, mixtures of gases of the same type have been studied. Our experiments at the Raman Research Institute innovated to develop hybrid traps, so that ions-atoms-molecules and light can be simultaneously trapped and interactions between these can be studied. Hybrid traps combine the technologies to confine individual species, so that simultaneous trapping of different classes of particles is made possible, in order to study diverse interactions in detail. In this talk, I shall present the new cooling mechanisms which we have discovered in our experiments, discuss the role of symmetries in the system and some pathways forward for the study of ion transport in a gas of atoms.

13 November 2021

1450-1510

Session 2D: Lectures by Fellows/Associates

SHREYA KARMAKAR
DEPARTMENT OF GEOLOGICAL SCIENCES, JADAVPUR UNIVERSITY,
KOLKATA-700 032, INDIA
IASc Associate: 2021 (Earth & Planetary Sciences)

Origin of ruby in chromiferous anorthosites, from the Sittampundi layered complex, South India

Abstract: The origin of colourless and pink corundum (ruby) is a subject of significant interest to petrologists and gemologists. Studies have shown that economically viable ruby is associated with alluvial deposits and hence genesis of this gem mineral remains the subject of considerable debate. Corundum / ruby is rarely found in basic-ultrabasic / anorthositic rocks. A number of diverse petrogenetic models have been proposed to explain the formation of corundum in basic-ultrabasic rocks and anorthosites (extremely rare). These are (1) as a liquidus phase during magmatic crystallization; (2) as a product of high- to ultra-high pressure metamorphism; (3) through anatexis (melting) of anorthositic rocks; (4) as a result of metasomatism i.e. by desilification of rocks. The ~2.9 Ga old metamorphosed layered anorthosite complex of Sittampundi (SLC) developed ruby (with up to 2.2 wt% Cr_2O_3) in the anorthosite rocks (with unusually Ca-Al-rich feldspars, with >96 mole % anorthite end-member), proximal to chromitite layers. Textural features and numerically computed phase diagrams in the systems NCASH (Na_2O-CaO-Al_2O_3-SiO_2-H_2O) and CASH suggest that incongruent melting of the Ca-Al-rich feldspars in the anorthosite rocks requires metamorphic temperature in excess of 1000°C at 9 kbar, due to the presence of Na (albite content in feldspar) and H_2O. Integrating all the geological features it is proposed that vapour (H_2O) assisted partial melting of the anorthosite rocks of the SLC at >1000°C and at ~9 kbar, formed the ruby and corundum. The Cr_2O_3 that renders the pink color of the ruby was presumably derived from the adjoining chromite band during partial melting. This study offers a new petrogenetic model for the origin of ruby in nature.

13 November 2021

1515-1535

Session 2D: Lectures by Fellows/Associates

Anirban Basu

National Brain Research Centre, Manesar

Elected Fellow IASc: 2018 (Medicine)

Drug repositioning/repurposing: Promising strategy to develop therapy against viral infections

Abstract: Development of a new drug being a high-risk, time consuming and very laborious process, repositioning/repurposing of drugs has been the focus of many groups working in the field of drug discovery. Drug repositioning (DR) aims to find new uses of existing safe drugs in different disease settings. Not only in the developed nations has this approach revolutionized drug discovery, many developing countries are also currently focusing on the same strategy thus seeking for an alternative to high costs and failure rates associated with the drug discovery pipeline. Absence of safe, efficient as well as cost effective vaccine and anti-viral drug prompts us to explore the potential of known drug as a therapeutic strategy for Japanese Encephalitis Virus (JEV) infection. By exploring the pathways which are involved in inflammation, we have identified Minocycline, which is an approved drug with a long standing record of acceptable safety and has a similar spectrum to Doxycycline, as a potential therapeutic candidate against JEV infection. Based upon pre-clinical study undertaken in our laboratory at National Brain Research Centre, a Phase II clinical trial has been completed at King George Medical University (KGMU), Lucknow, where minocycline has been used as a therapy for JE patients and the patients with Acute Encephalitis Syndrome (AES). Results of the trial indicates a potential benefit that Minocycline confers upon patients, especially in those who survive the initial days in hospital. These findings could form the basis for planning a larger study and possibly including minocycline in the management of AES and JE. More recently, we have shown the therapeutic potential of AMG487, an antagonist of CXCR3, in Dengue virus (DV) as well as in JEV infection.

14 November 2021

0900-0920

Session 3A: Lectures by Fellows/Associates

Vivek Agarwal
IIT, Mumbai

Elected Fellow IASc: 2020 (Engineering)

My contributions to research on solar PV technology

Abstract: Solar PV Technology has emerged as the front runner in mankind's search for a non-polluting and abundant source of energy to replace the conventional fossil fuels. However, the use of solar PV poses sevral challenges, which include the highly non-linear electrical characteristics of the solar PV source and the intermittent nature of solar radiation. The latter gets further complicated due to non-uniform insolation and mis-matched characteristics of the PV modules constituting the solar PV source.

The talk will focus on the power electronic solutions to these challenges, where the speaker will highlight some representative circuit topologies and control schemes that he has been working on.

14 November 2021

0925-0945

Session 3A: Lectures by Fellows/Associates

Ritu Gupta

Associate Professor, Department of Chemistry, IIT Jodhpur, Rajasthan

IASc Associate: 2021 (Chemistry)

Fluorinated nanomaterials for energy and healthcare applications

Abstract: Fluorine chemistry has gained tremendous attention in energy and sensing devices such as energy storage devices, hydrogen generation, solar cells, and gas sensors. Fluorination of nanomaterials (metal oxide nanoparticles and carbon-based nanomaterials) can significantly change their physical, chemical, and electrochemical properties. The conventional methods known for fluorination are not easily adaptable to various synthetic methods due to safety issues associated with the precursors. With the advent of commercially available electrophilic fluorinating precursors such as Selectfluor™ (F-TEDA), it is interesting to synthesize fluorine functionalized nanomaterials by using them as a direct source of fluorine in solution. Many nanostructured materials such as Fe_2O_3,[1,2] SnO_2,[3-5,] and nanocarbon[6] are fluorinated for application as electrodes in supercapacitors, photoelectrochemical cells, and chemical sensors for enhanced charge transport and high performance of these devices, which will be presented briefly.

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2. Janu, V. C.; Bahuguna, G.; Laishram, D.; Shejale, K. P.; Kumar, N.; Sharma, R. K*.; **Gupta, R***. Surface Fluorination of α-Fe_2O_3 using Selectfluor for Enhancement in Photoelectrochemical Properties. *Sol. Energy Mater. Sol. Cells* **2018**, *174*, 240–247.

3. Bahuguna, G.; Mondal, I.; Verma, M..; Kumar, M.; Bhattacharya, S.; **Gupta, R***.; Kulkarni, G.U. Innovative Approach to Photo-Chemiresistive Sensing Technology: Surface-Fluorinated SnO_2 for VOC Detection. *ACS Appl. Mater. Interfaces,* **2020**. 12, 33.
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5. Bahuguna, G.; Chaudhary, S.; Sharma, R. K.; **Gupta, R***. Electrophilic Fluorination of Graphitic Carbon for Enhancement in Electric Double Layer Capacitance. *Energy Technol.*, **2019**, 19000667.
6. Bahuguna, G.; Adhikary, V.; Sharma, R. K.; **Gupta, R***. Ultrasensitive Organic Humidity Sensor with High Specificity for Healthcare Applications. *Electroanalysis*, **2020**, 32, 76.

14 November 2021

0950-1010

Session 3A: Lectures by Fellows/Associates

Anjan K. Banerjee

Biology Division, Indian Institute of Science Education and Research (IISER), Pune

Elected Fellow IASc: 2020 (Plant Sciences)

Induction of aerial and belowground tubers in potato: A classic example of developmental plasticity and modulation of plant architecture.

Abstract: Plants, being sessile, exhibit diverse developmental plasticity and modulate their growth in response to various environmental conditions. Potato is an important food crop after cereals and serves as a significant portion of the world's subsistence food supply. In last two decades, crucial molecular signals (Mobile RNAs, proteins etc.) have been identified that govern potato development (tuberization). Remarkably, overexpression of microRNA156 provided the first evidence for induction of profuse aerial tubers from axillary-nodes under short-day photoperiod. Similar phenotype was noticed for overexpression of epigenetic modifiers - *StMSI1* or *StE(z)2*, and knockdown of *StBMI1*. This striking phenotype prompted us to investigate its mechanistic basis. We showed that polycomb group proteins control microRNA156, phytohormone metabolism/transport/signalling, and key tuberization genes through histone modifications and regulate this phenotype. Tuberization (stolon-to-tuber transition) appears to be a dynamic process, and plethora of small RNAs and their targets coordinate this, besides tuberization genes, phytohormones and environmental factors. Presence of histone marks on key tuberization genes is evident in stolons under short-day photoperiod. More than 1000 common genes are associated with aerial and belowground tuber development, indicative of a common gene-regulatory network. We demonstrate that photoperiods and epigenetic mechanisms play a crucial role in controlling this phenotype in potato.

14 November 2021

1515-1535

SESSION 3B: Special Lecture

Ashok Sahni
Centre of Advanced Study in Geology, Panjab University, Chandigarh.

A greenhouse explosion of biodiversity

Abstract: In the last three hundred million years (mys), the climate of the earth has changed dramatically as has the life on it. This talk deals with a special time in earth history around 56-52 mys, when the global climate was the hottest it ever has been, about 5-8^{o}C warmer than the present mean global annual temperature of about 15^{o}C. Research in India during the last 15 years from the open-cast lignite (brown coal) mines of Gujarat, has shown that an equatorial, drifting island India was teeming with diverse forms of life signifying a biotic radiation of species including mammals and other vertebrates, diverse plants and aquatic life in this super greenhouse. On the basis of the sediment screening technique and after processing well over 50 tons of rock material, it has been possible to reconstruct one of the earliest broadleaf mixed angiosperm forests dominated by *Shorea* (Dipterocarpaceae) trees commonly known as the *sal* in this country. Some of the earliest representatives of ancestral horses, earliest artiodactyls, primates, rabbits, bats, and the carnivore hyaenodont, including a parrot-ancestor (Psittaciformes), have been recognized. The Eocene greenhouse not only triggered an explosion of biodiversity but also facilitated the global migration of some mammal taxa found also in North America and Europe. This was seemingly possible because of the evenness of temperature across a large range of latitude. Along with the reconstruction of the macroenvironment, it has been possible to build a picture of the forest microenvironment, using the prolific abundance of amber nodules and their contained inclusions. Amber is a polymerized resin that encapsulated a variety of smaller life forms which are not usually preserved in rocks. It has been biochemically analyzed to represent dammar 2 resin found in *sal* trees. The nodules include testate amoeba, pollen, mosses, fungi, ectomycorrhiza, a variety of insects, spiders and their webs, and ostracod crustaceans. The biodiversity documented from this “fossil” forest is exceptional and attests to the resilience of life even in the most adverse conditions.