86th ANNUAL MEETING OF THE INDIAN ACADEMY OF SCIENCES

6–8 November 2020

ABSTRACT BOOK

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organized by Sudha Bhattacharya

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1225–1250 **Krishna M. Ella,** Bharat Biotech Limited, Hyderabad
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1425–1445 **Purvi Gupta,** Indian Institute of Science, Bengaluru
The role of topology in certain analytic problems

1450–1510 **Ruta P. Kale,** National Centre for Radio Astrophysics, Pune
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1515–1535 **Manjula Reddy,** Centre for Cellular and Molecular Biology, Hyderabad
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1540–1710 Business Meeting of Fellows

1710–1730 Virtual Group Photograph Session for Fellows

Session 2E: Public Lecture

1800–1900 **Jairam Ramesh,** Member of Parliament, Chairman of the Parliament's Standing Committee on S&T, Environment, Forests and Climate Change & former Union Minister
Science & technology in post-covid19 world

8 November 2020 (Sunday)

Session 3A: Lectures by Fellows/Associates

0900–0920 **Yogita K. Adlaka, T**ranslational Health Science And Technology Institute, Faridabad
Understanding post transcriptional mechanisms in neural development: Implications of induced pluripotent stem cells and organoids

0925–0945 **Debashree Chakraborty,** National Institutes of Technology, Suratkal
Structural and dynamical properties of water near surfactant like peptide nanotubes

0950–1010 **Arnab Bhattacherjee,** Jawaharlal Nehru University, New Delhi
Understanding protein transport on DNA track

1015–1030 Short break

Session 3B: Special Lecture

1030–1110 **C. Jagadish,** Australian National University, Canberra, Australia
Semiconductor nanowires for optoelectronics, energy and neuroscience applications

6 November 2020

1000–1100

SESSION 1A: Presidential Address

PARTHA P. MAJUMDER

National Institute of Biomedical Genomics, Kalyani

Selective sweep of a SARS-CoV-2 mutant, with some hiccups

SARS-CoV-2 originated in China and rapidly evolved to 10 additional subtypes. Two evolved subtypes (A2 and A2a) carry a non-synonymous Spike protein mutation (D614G). The speaker and his team conducted a phylodynamic analysis of over 70,000 SARS-CoV-2 coronaviruses worldwide, sequenced until July 2020, and found that the mutant subtype (614G) outcompeted the pre-existing type (614D). The selective sweep of this mutant was significantly faster in Europe and North America than in East Asia. Bioinformatically and computationally, they identified a novel neutrophil elastase (ELANE) cleavage site introduced in the G mutant, near the S1–S2 junction of the Spike protein. They hypothesised that elevation of neutrophil elastase level at the site of infection will enhance the activation of Spike protein thus facilitating host cell entry for 614G, but not the 614D, subtype. The level of neutrophil elastase in the lung is modulated by its inhibitor α1-antitrypsin (AAT). AAT prevents lung tissue damage by elastase. However, many individuals exhibit genotype-dependent deficiency of AAT. AAT deficiency eases host-cell entry of the 614G virus, by retarding inhibition of neutrophil elastase and consequently enhancing activation of the Spike protein. AAT deficiency is

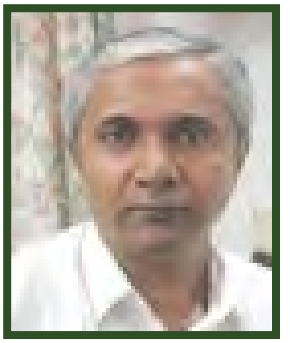
highly prevalent in European and North American populations, but much less so in East Asia. Therefore, the 614G subtype can infect and spread more easily in populations of the former regions than in the latter region. Their analyses provide a molecular biological and evolutionary model for the higher observed virulence of the 614G subtype, in terms of causing higher morbidity in the host (higher infectivity and higher viral load), than the non-mutant 614D subtype.

The study was undertaken jointly with Nidhan K. Biswas, Arnab Ghosh, Chandrika Bhattacharyya, Chitrarpita Das, Analabha Basu, Souvik Mukherjee, and Animesh K. Singh.

6 November 2020

1130–1150

SESSION 1B: Lectures by Fellows/Associates



VIKRAM MATHEWS

Christian Medical College, Vellore

Elected Fellow IASc: 2018 (Medicine)

Acute promyelocytic leukemia: A bench to bedside journey

There remain significant challenges in diagnosis, accurate prognostication, and management of acute leukaemia. Additionally, there are specific challenges in delivery of cost-effective care in India and many parts of the developing world. A major problem in the management of acute leukaemia is the high recurrence rate, especially in adults and the elderly. While there has been a significant increase in the understanding of the biology of these malignancies the reasons for recurrence despite conventional therapy is not clear in most cases. More research is required to address these reasons and to accurately predict relapse of acute leukaemia. One area of special interest to the speaker's group is the role played by the micro-environment in the bone marrow, in which these malignant cells reside, in inducing resistance to therapy. Preliminary work by their group and others suggest that there is significant survival advantage and drug resistance to conventional therapy mediated by cells in the bone marrow microenvironment. Their preliminary data suggests that this phenomenon is seen in all types of leukaemia though it would appear that the major mediators and pathways are different in different in subtypes of leukaemia. They have made significant progress in understanding the

mechanism of microenvironment-mediated drug resistance to arsenic trioxide in acute promyelocytic leukaemia. In a recent publication from their group, they have suggested a strategy in APL to overcome such resistance, which they went onto translate into a clinical trial. The speaker hopes that they will be able to identify similar strategies to overcome microenvironment mediated drug resistance to chemotherapeutic agents in other subtypes of acute leukaemia. They feel this information along with additional work that they do in evaluating mechanisms of drug resistance will help direct their research on the use of novel agents and novel combinations of therapy to overcome such drug resistance in leukaemia.

6 November 2020

1155–1215

SESSION 1B: Lectures by Fellows/Associates

SUSHMEE BADHULIKA

Indian Institute of Technology Hyderabad

IASc Associate: 2017 (Engineering and Technology)

Nanomaterials based low cost, flexible devices for point of care diagnostics

Most modern-day electronic devices are developed on rigid substrates and thus cannot be integrated onto soft, flexible and curvilinear surfaces. This severely limits their applications in wearable electronics, bio-implantable devices and microfluidic devices. Conformable electronics, a rapidly evolving parallel field of research, aims to address this issue by integrating the property of flexibility and stretchability of substrates to develop human friendly devices. Nanomaterials exhibit extraordinary mechanical, thermal, and electronic properties, which makes them ideal candidates for applications in field-effect transistors, batteries, super capacitors sensors, etc. In this talk, the development of such nanomaterials based flexible and portable devices for point of care diagnostics will be discussed. This would include key insights into designing subtle yet high performance nanoarchitectures, flexible substrate engineering, smart and wearable personal healthcare monitoring systems using multifunctional nanosensors, etc.

6 November 2020

1220–1240

SESSION 1B: Lectures by Fellows/Associates

RAVI S. NANJUNDIAH

Indian Institute of Tropical Meteorology, Pune

Elected Fellow IASc: 2019 (Earth & Planetary Sciences)

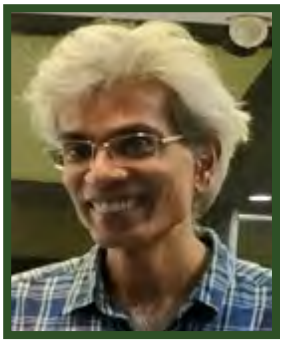
A possible cause for change in Indian monsoon & El-Nino relationship

The Indian Summer Monsoon (ISM) governs the pulse of our nation. The monsoon varies from year to year. There are various phenomena associated with the variability of ISM, the major ones being the El-Nino over the Central Equatorial Pacific (EnSO), and fluctuations of rainfall over the eastern and western parts of Indian Ocean. Studies have shown that the strength of association between ISM and EnSO varies with time. It is found that fluctuation of West African Monsoon (WAM) is also associated with EnSO and the relationship of WAM-EnSO and ISM-EnSO seem to be out of phase. It is noticed that during the period prior to 1980, the relationship between WAM and EnSO was weak and strengthened in the post-80s. EnSO-ISM relationship weakened in the post-80s period. It is found that EnSO affects both ISM and WAM through upper tropospheric temperature anomalies. This anomaly was quite strong and located to the northwest of India during the pre-80s period. In the post-80s, a westward shift of this anomaly is observed and it is also more diffuse. The relationship between EnSO and Atlantic Nino also changed in the post-80s... The effect of all these on the changing nature of EnSO relationship with ISM and WAM will be discussed.

6 November 2020

1245–1305

SESSION 1B: Lectures by Fellows/Associates



JUSTIN R. DAVID

Indian Institute of Science, Bengaluru

Elected Fellow IASc: 2019 (Physics)

Entanglement entropy and holography

Entanglement entropy is emerging as a useful observable to characterize quantum systems. In this talk, the definition of entanglement entropy, its evaluation and application in the study of quantum field theories are reviewed. Then, the talk will focus on two-dimensional field theories, which are scale invariant and show how entanglement entropy has played an important role in understanding quantum gravity through holography.

6 November 2020

1400–1420

SESSION 1C: Lectures by Fellows/Associates

VISHVANATH TIWARI

Central University of Rajasthan, Ajmer

IASc Associate: 2019 (Medicine)

Strategies for combating carbapenem resistant *Acinetobacter baumannii*

Acinetobacter baumannii causes pneumonia, respiratory infections, and urinary tract infections in humans. Phenotyping and genotyping, as well as clinical quantitative proteomics studies, concluded the overproduction of different carbapenem hydrolyzing β-lactamase, efflux pumps, and siderophore receptors in carbapenem-resistant strain. Further, the bacterium also downregulates putative OmpW as well as transporters that decreases the uptake of carbapenem. The differentially expressed proteins were cloned and purified. It is found that the conformational stability of the recombinant protein (like OXA-51) plays a vital role in retaining the function of β-lactamase even under stress conditions. Experimental and bioinformatics studies showed that carbapenem is effectively hydrolyzed by OXA-51. To combat this carbapenem-resistant *Acinetobacter baumannii* different strategies were used. In first strategy, it was reported that PVP-capped AgNPs inhibits the infection of *A. baumannii* in the human pulmonary epithelial cell, and secondary metabolites of Actinidia deliciosa and Phyllanthus emblica inhibit biofilm and reduces its extra-cellular matrix components in *A. baumannii*. Hence, this secondary metabolite has been capped on PVP-AgNPs and a nano-herbal molecule was synthesized,

i.e., gallate-polyvinylpyrrolidone capped hybrid silver nanoparticles (G-PVP-AgNPs) that showed good antimicrobial activity against the carbapenem-resistant strain of *A. baumannii* and involved ROS dependent killing mechanism. In another strategy, In-silico screening, molecular mechanics, molecular dynamics simulation, and experimental validation studies identified ZINC00039089 as an inhibitor for Bap, a biofilm-associated protein, ZINC01155930 as an inhibitor of AdeABC efflux pump, and ZINC01530654 as an inhibitor for RecA protein of *A. baumannii*. RecA inhibitor is useful to enhance the efficacy of current antibiotics or disinfectants. Therefore, different strategies can be used in combination for combating carbapenem resistant *Acinetobacter baumannii.*

6 November 2020

1425–1445

SESSION 1C: Lectures by Fellows/Associates

AMRITANSHU PRASAD

The Institute of Mathematical Sciences, Chennai

Elected Fellow IASc: 2020 (Mathematics)

Polynomials as characters

A polynomial in variables x1, x2, ... can be interpreted as a sequence of characters, one for each symmetric group. Using such polynomials, the speaker has tried to understand Kronecker coefficients and restriction coefficients, two elusive families of numbers that arise in representation theory. This talk is based on ongoing collaboration with Digjoy Paul (TIFR), Shraddha Srivastava (Uppsala) and Sridhar Narayanan (IMSc).

6 November 2020

1450–1510

SESSION 1C: Lectures by Fellows/Associates

A. SUNDARESAN

Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru

Elected Fellow IASc: 2020 (Chemistry)

Magnetoelectrics and Multiferroics

The speaker's primary research interest is on solid-state chemistry, which involves studying the synthesis, structure, and, more importantly, the solid's physical properties such as superconductivity, magnetism, and magnetoelectricity. This study enables him to establish a structure-property relationship and hence design materials of interest. His research currently focuses on understanding various mechanisms of linear magnetoelectricity and multiferroicity towards finding new magnetoelectric materials with large magnetoelectric coupling at room temperature. In his talk, first, he will provide an overview of my research and then focus on current research strategies.

6 November 2020

1530–1600

SESSION 1D: Symposium Quantum Technology

organized by Urbasi Sinha (RRI) and Vibhor Singh (IISc)

KAVITA DORAI

Indian Institutes of Science Education and Research, Mohali

Nuclear magnetic resonance as a testbed quantum processor

Nuclear magnetic resonance (NMR) is a robust quantum technology and has been used to successfully implement several important quantum information processing protocols. NMR has been utilized to explore foundational aspects of quantum information, such as the characterization and detection of uniquely quantum features like entanglement and contextuality and their role in the speedup of quantum computational processes. The speaker will present recent results from his laboratory on generation, characterization and detection of quantum entanglement and contextual quantum correlations on an NMR quantum processor.

6 November 2020

1600–1630

SESSION 1D: Symposium Quantum Technology

organized by Urbasi Sinha (RRI) and Vibhor Singh (IISc)

MADHU THALAKULAM

Indian Institutes of Science Education and Research, Thiruvananthapuram

Charge amplification approaching the quantum limit

An in-depth understanding of the electrical properties of mesoscopic systems requires direct insight into various quantum phenomena such as electron-electron correlations, dephasing and decoherence, quantum oscillations, single-electron charging, excitation, and de-excitation process. Most of these phenomena are short-time-scaled, fragile and, sensitive to environmental decoherence. Conventional transport studies have limited reach in these studies as it probes only the average behaviour of the system, whereas a complete understanding of these phenomena requires temporal and spatial information of individual electrons in the system. Quantum point contact (QPC) and the superconducting single electron transistor (S-SET) based charge amplifiers are exploited for many of these studies. QPC based amplifiers are also considered as the readout devices for solid-state spin qubits. In this talk, an overview of charge sensing techniques using QPC charge amplifiers will be presented. In addition, ongoing works on attaining nanosecond time-scale charge amplification by coupling QPC amplifiers to superconducting planar microwave resonators also will be discussed. The speaker will also discuss noise properties and backaction of these devices on to the measurement system.

6 November 2020

1630–1700

SESSION 1D: Symposium Quantum Technology

organized by Urbasi Sinha (RRI) and Vibhor Singh (IISc)

VIBHOR SINGH

Indian Institute of Science, Bengaluru

Electromechanical device with a transmon qubit

Control over the quantum states of a massive oscillator is important for several technological applications and to test the fundamental limits of quantum mechanics. Recently, hybrid electromechanical systems using superconducting qubits, based on electric-charge mediated coupling, have been quite successful in this regard.

In this talk, the speaker will introduce a hybrid device, consisting of a superconducting transmon qubit and a mechanical resonator coupled using the magnetic-flux. Such coupling stems from the quantum-interference of the superconducting phase across the tunnel junctions. Consequently, we detect thermomechanical motion using drive corresponding to average occupancy of less than one photon.

In addition, the large coupling between qubit and mechanical resonator is manifested in the observation of the Landau–Zener–Stückelberg effect.

6 November 2020

1700–1730

SESSION 1D: Symposium Quantum Technology

organized by Urbasi Sinha (RRI) and Vibhor Singh (IISc)

URBASI SINHA

Raman Research Institute, Bengaluru

Photonic quantum science and technologies

The Quantum Information and Computing lab at the Raman Research Institute in Bangalore, India has been performing cutting edge research in quantum information processing towards quantum computation, quantum communication as well as fundamental tests of quantum mechanics itself using single and entangled photons. In this talk, the speaker will present some of his recent results in the domain of experimental quantum information processing as well as quantum communications. In the first part of the talk, he will discuss a novel means of quantum state estimation that they have recently developed and experimentally demonstrated. While Quantum State Tomography has been the traditional method for characterization of an unknown quantum state, he presents an interferometric method, in which any qubit state, whether mixed or pure, can be inferred from the visibility, phase shift, and average intensity of an interference pattern using a single-shot measurement—hence, they call it quantum state interferography. They then go on to show that QSI is more resource efficient than QST for quantification of entanglement in pure bipartite qubits. An extension of the scheme to pure states involving d–1 interferograms for d-dimensional systems (qudits) is also presented. Thus, the scaling gain is even more dramatic in the qudit scenario for

our method, where, in contrast, standard QST, without any assumptions, scales roughly as d2.

In the second part of the talk, the speaker will discuss her recent free space quantum key distribution experiment in the domain of secure quantum communications, which is a part of his ongoing satellite QKD project “Quantum Experiments with Satellite Technology”.

6 November 2020

1800–1900

SESSION 1E: Public lecture

LORD MARTIN REES

University of Cambridge, UK

Elected Honorary Fellow IASc: 1991

The world in 2050 and beyond

7 November 2020

0900–0940

SESSION 2A: Special lecture

M RAJEEVAN

Ministry of Earth Sciences, New Delhi

Elected Fellow IASc: 2012 (Earth and Planetary Sciences)

Recent advances in weather and climate prediction in India

The Ministry of Earth Sciences (MoES) has the mandate of providing weather and climate services for the country, which include weather forecasts, warnings, alerts, and advisories. Over the past 8–10 years, the ministry has invested in development of suitable forecasting systems based on dynamical models, improvement in observational network, capacity building and also in developing suitable applications. All these efforts have resulted in substantial improvement in forecast skill over the recent years.

In this presentation, the speaker will be discussing on all these efforts, especially on research and developmental efforts. He will illustrate the improvement of forecast skill for some specific cases like tropical cyclones, heavy rainfall spells, active and break spells etc. In the end, he will also discuss what we are planning for next few years in further improving the skill of weather and climate forecasts and warnings in the country. The ministry plans to develop our nation into a weather ready and climate resilient nation.

7 November 2020

0940–1000

SESSION 2B: Lectures by Fellows/Associates

RIDDHI SINGH

Indian Institutes of Technology, Mumbai

IASc Associate: 2018 (Engineering and Technology)

On the use of hydrological models to estimate future surface water availability

Water resources support crucial activities of the coupled human-natural system ranging from habitat maintenance to food production. The complex nature of hydrological processes and our inability to measure all relevant fluxes across space and time necessitates the use of models that combine our conceptual understanding of the system with observed data. Hydrological models enable water resources planning as well as testing hypotheses concerning the functioning of river basins. They are ubiquitous in water-related decision making, especially when decision-makers need to quantify future water availability under a changing climate. Broadly two issues arise when using hydrologic models to quantify future water availability. First, there are considerable uncertainties regarding climate change, which translate to high uncertainties in future estimates of water resources. Second, climate change may alter the hydrologic response characteristics of river basins that are typically assumed static in models. Here, the speaker will present modelling frameworks that address these concerns related to large uncertainties and model representativeness in a changing climate.

7 November 2020

1005–1025

SESSION 2B: Lectures by Fellows/Associates

ALOKE PAUL

Indian Institute of Science, Bengaluru

Elected Fellow IASc: 2020 (Engineering and Technology)

Solving the issues of multicomponent diffusion

The diffusion community faced an unsolved challenge for several decades after the relations for the estimation of the diffusion coefficients in inhomogeneous multicomponent material systems were established based on the Onsager formalism. These could not be estimated experimentally in a system with more than three components fulfilling the mathematical complications and associated stringent experimental requirements. This led to an unbridgeable gap between the fundamental studies conducted in simpler systems and the need for understanding the diffusion phenomenon in various multicomponent systems in applications. We have now solved these issues by developing the concept of pseudo-binary and pseudo-ternary diffusion couple methods. These reduce the complications significantly for estimation of both main and cross interdiffusion coefficients. These are further extended for the estimation of the tracer and intrinsic diffusion coefficients from multicomponent diffusion profiles by developing new equations, which were considered impossible until now. The usefulness of these methods is demonstrated by explaining the diffusion-controlled microstructural evolution between single crystal superalloy and bond coat in jet engine.

7 November 2020

1110–1135

SESSION 2C: Symposium Rare Genetic Disorders

organized by Sudha Bhattacharya, Ashoka University, Sonepat

VISHWA MOHAN KATOCH

Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry

Rare Genetic Diseases in India: Unmet Needs, Challenges and Opportunities

During the recent years, the debate on rare diseases has gained momentum in India and other parts of world. However, in a scenario of competing health priorities, these disorders have not received due attention. We do not even know how many really affect the Indian population. Efforts are being made to establish registries, which will be certainly very helpful for research and interventions in future. It is accepted that a national policy for rare diseases is required because such diseases have different needs compared with other common medical conditions. As of now most of them are incurable and can be quite debilitating. While the genetic basis of some of them is partially understood, in most cases, the scene is hazy. Under these circumstances, rational drug development is very difficult. Further, investments in the development of therapeutics for these disorders are extremely low due to poor expected return. Also, adequate numbers for clinical trials are not easily available. Because of such factors, rare diseases have been accorded special policy preference in many countries through the enactment of laws like the Orphan Drug Act of USA. There is a need for a comprehensive policy that incorporates special provisions for supporting diagnosis and development/ availability of therapeutics

at a rapid scale using expertise from both public and private sector. Scientific and social activists, institutions, science academies, science agencies, the Central Drugs Standard Control Organization, the Ministry of Health & family Welfare, other Ministries, State Governments, etc. have taken various initiatives on rare diseases. Court interventions have helped in several instances. Different stakeholders including patients, clinicians, researchers, social scientists, government officials and political leaders are also contributing to the process. Development of cost-effective therapies is considered a top priority. Repurposed drugs as well as alternative systems of medicine/ health care deserve priority for finding out possible treatment/ prevention options. In scientific and social debates, various pathways have been suggested for research cum interventions, both, for rare diseases for which currently there is no cure, as well as also for those conditions for which some products are available but currently unaffordable. As both the situations have ethical issues, these are being addressed at societal as well as at governmental level. In-depth understanding of globally tried best practices and their adaptation to Indian socio-economic milieu will provide many options to consider adopting, adapting and also innovating according to our own requirements. This presentation attempts to address the gaps, unmet needs, progress, barriers and opportunities to accelerate the research cum intervention work on these conditions in India.

7 November 2020

1135–1200

SESSION 2C: Symposium Rare Genetic Disorders

organized by Sudha Bhattacharya, Ashoka University, Sonepat

MEENAKSHI BHAT

Centre for Human Genetics, Bengaluru

Rare Genetic Diseases in India: an overview and experiences from one centre

There are over 6000 rare or orphan diseases. Nearly 80% of them have an underlying genetic basis. Roughly half first manifest at birth or in early childhood. Most are chronic, disabling disorders, limiting life expectancy and the possibility of a normal life. Fewer than 5% have a definitive treatment. Where treatment is available, it is usually very expensive and needed life-long. Families often feel completely bewildered when a genetic disorder is diagnosed in their family, leaving them without their usual support systems or sense of security.

There is a world-wide shortage of experts to diagnose, counsel and treat rare disorders. Training of clinical geneticists, genetic counsellors and diagnostic laboratory personnel is now a priority the world over. In India, over the past decade, there has been a notable increase in public awareness, number of disease support groups, laboratories offering next generation DNA sequencing and trained specialists. Government policies, programmes and funding have improved management of some rare disorders. There are fledgling attempts in the horizon at developing low-cost indigenous therapies. There are

new policy initiatives to promote partnerships between science and industry. However, universal new-born screening, state funding for diagnosis and therapy, wider availability of genetic tests and disease registries are still awaited. The draft National Rare Diseases Policy, 2020, which aims at equitable and more inclusive management of rare disorders is also waiting to be approved.

The speaker will conclude this presentation with an account of her experience over the past fifteen years as a clinical geneticist at the Centre for Human Genetics. Their initiatives include training of personnel, outreach clinics, public engagement, developing low-cost medical diets for inborn metabolic disorders, setting up a centre of excellence for rare disease therapy, developing an interactive online database for patient records and their successful experience in conducting telegenetic clinics during the Covid-19 pandemic.

7 November 2020

1200–1225

SESSION 2C: Symposium Rare Genetic Disorders

organized by Sudha Bhattacharya, Ashoka University, Sonepat

SOUVIK MAITI

Institute of Genomics and Integrative Biology, Delhi

FELUDA^{SCD} : FnCas9 Editor Linked Uniform Detection Assay for Sickle Cell Disease

Sickle cell disease (SCD) is a rare blood disorder that is inherited in an autosomal recessive manner. This is a life-threatening genetic disorder that is best managed when diagnosed early by new-born screening. However, SCD is most prevalent in low-resource regions of the world where new-born screening is rare and diagnosis at the point-of-care is challenging. This presentation will describe a method for using a bacterial CRISPR Cas Ribonucleoprotein complex for detecting single nucleotide variants in SCD, without the need for sequencing. The principle of discrimination is derived from the natural property of the enzyme being used for the invention, *Francisella novicida* Cas9 (FnCas9), which shows very low binding affinity to mismatched substrates. DNA is isolated either from blood or saliva. The DNA is subjected to polymerase chain reaction, amplified using specific primers and then tagging the amplified DNA products with a ligand of choice. The detection mix consists of labelled PCR products, sgRNA-fnCAS9 complex. The detection complex can be visualized using a wide array of technologies like lateral flow, gel-based cleavage assay, fluorescence-based detection, in both low, medium or plate-based high-throughput format. The most important advantage of the present invention

as a detection tool over the closest prior art is the combination of speed, reliability, robustness and universal applicability for all DNA and RNA variations.

7 November 2020

1225–1250

SESSION 2C: Symposium Rare Genetic Disorders

organized by Sudha Bhattacharya, Ashoka University, Sonepat

KRISHNA M. ELLA

Bharat Biotech Limited, Hyderabad

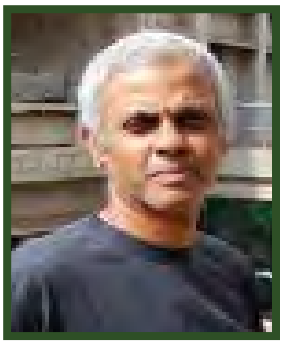
Translational and manufacturing of viral vectors for gene therapy to correct genetic disorders

Rare genetic disorders was a neglected field due to lack of market potential. Gene therapy has given some hope to correct some rare genetic disorders. Safety and regulatory issues have hindered the progress of gene therapy during the last two decades. Of late, more than twenty products have been licensed for use as therapy for genetic disorders. Several of the products use different viral vectors. The vectors have to be manufactured in cGMP manufacturing facility and strict quality control and quality assurance have to be established. India needs to gear up in translational research and manufacturing of viral vectors. Manufacturing, quality control, quality assurance and regulatory issues will be discussed briefly for viral vectors that are required for Gene therapy for correcting genetic disorders.

7 November 2020

1400–1420

SESSION 2D: Lectures by Fellows/Associates



MAHESH SANKARAN

National Center For Biological Sciences, Bengaluru

Elected Fellow IASc: 2020 (Plant Sciences)

The paradox of forest-grassland mosaics: Revisiting the 'one climate-one biome' paradigm

The 'one climate-one biome' paradigm – the idea that each biome occupies a unique area of climate space such that the dominant or 'climax' vegetation of a region can be predicted based on local climate alone – has been a cornerstone of traditional ecological thought. However, many ecosystems display 'bi-stability', where two different biomes occur under the same climatic conditions. Forest-grassland mosaics, such as the shola-grassland complexes of the Western Ghats, are a classic example of this phenomenon, wherein both forest and grassland patches, with abrupt boundaries between the two, co-occur in the landscape. Here, the speaker will leverage recent experiments carried out in the montane shola-grassland mosaics of the Nilgiris in the Western Ghats to assess the role of different biotic and abiotic drivers in maintaining these mosaics, and discuss the potential impacts of future climatic changes on the ecological integrity of these unique ecosystems.

7 November 2020

1425–1445

SESSION 2D: Lectures by Fellows/Associates

PURVI GUPTA

Indian Institute of Science, Bengaluru

IASc Associate: 2020 (Mathematics)

The role of topology in certain analytic problems

There are several analytic phenomena that set apart the multivariate theory of complex-analytic functions from its univariate counterpart. Some of these give rise to notions of convexity, which form the subject of many open problems in several complex variables. In this talk, an overview of this subject in the special, but natural, setting of real submanifolds in complex Euclidean spaces will be given. Here, some relevant factors are the topology of the submanifold, the (partial) complex structure inherited by the submanifold from the ambient space and the nature of the singularities of this inherited structure. Questions of convexity (and of the associated hulls) can be considered, both, when all these factors are rigid or when the embedding of the submanifold is allowed some flexibility. Some recent results in both these flavours will be discussed, while emphasizing the modern aspects of this theory.

7 November 2020

1450–1510

SESSION 2D: Lectures by Fellows/Associates

RUTA P. KALE

National Centre for Radio Astrophysics, Pune

IASc Associate: 2020 (Physics)

Plasma laboratories on megaparsec-scales

Our Universe on large scales is like a 'web' in which the nodes are the most massive gravitationally systems (about 10^15 solar masses) called the galaxy clusters. Clusters of galaxies hold large reservoirs of baryons in the form of diffuse gas called the intra-cluster medium (ICM). The ICM is a blob of plasma on megaparsec (~3 million light years) scales whose properties are poorly known. It contains mainly thermal gas of temperature about ten million Kelvin and is weakly magnetised with field strength of about a micro Gauss. The cosmic rays and magnetic fields, referred to as the non-thermal components, elude detection in most spectral bands and thus have remained the least understood components of the ICM. The relativistic electrons in the ICM manifest the non-thermal components at low radio frequencies (<= GHz) via synchrotron radiation providing a direct probe of their life cycle. The speaker will describe his work towards characterising the cosmic rays and magnetic fields in the ICM with the Giant Metrewave Radio Telescope and the prospects with the next generation radio telescopes.

7 November 2020

1515–1535

SESSION 2D: Lectures by Fellows/Associates

MANJULA REDDY

Centre for Cellular and Molecular Biology, Hyderabad

Elected Fellow IASc: 2020 (General Biology)

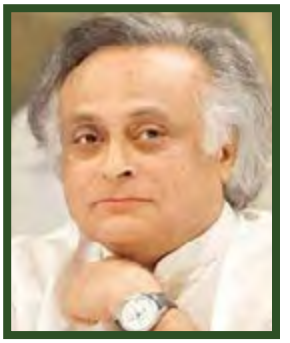
Break before make - how do bacteria make their cell walls

Bacteria are a large group of ubiquitous unicellular microorganisms. To protect themselves against both extracellular stress and intracellular osmotic pressure, most bacteria are surrounded by a cell wall that consists of an elastic, mesh-like polymer called peptidoglycan (PG) sacculus. PG is a single large macromolecule made up of multiple overlapping glycan strands interlinked by short peptide chains and forms a net-like structure around the bacterial cytoplasmic membrane. Since, PG completely encases the cytoplasmic membrane, cleavage of peptide cross-links is a prerequisite to open the mesh and make space to incorporate nascent glycan strands for its successful expansion during growth of a cell. Using a Gram-negative rod-shaped bacterium, Escherichia coli as a model system, the speaker's lab has shown that the step of cross-link cleavage mediated by specialized endopeptidases is essential for the expansion of PG sacculus and hence for bacterial growth. Overall, their study signifies the role of PG hydrolysis in bacterial cell wall synthesis thereby rendering it an alternative drug target for development of novel antimicrobial agents.

7 November 2020

1800-1900

SESSION 2E: Public Lecture



JAIRAM RAMESH

Member of Parliament, Chairman of the Parliament's Standing Committee on S&T, Environment, Forests and Climate Change & former Union Minister

Science & Technology in Post-Covid19 World

8 November 2020

0900–0920

SESSION 3A: Lectures by Fellows/Associates

YOGITA K. ADLAKA

Translational Health Science and Technology Institute, Faridabad

IASc Associate: 2020 (Medicine)

Understanding post transcriptional mechanisms in neural development: Implications of induced pluripotent stem cells and organoids

Human central nervous system (CNS) development requires complex and precisely coordinated control of gene expression and intercellular interactions that result in the generation of a variety of cell types having distinct morphology and functions. A vast amount of knowledge of the fundamental molecular events underlying human neural development has been derived from model organisms. Despite studies using foetal tissues, the complexities of human brain development are poorly understood. However, recent advancement in the generation of human induced pluripotent stem cells (iPSCs) has transformed the studies of human brain development. MicroRNAs being the small non-coding RNAs, act as post-transcriptional regulators of gene expression. The speaker has unlocked the regulatory role of miR-137 (a brain enriched miRNA) in neural development. This miRNA is dysregulated in several neurodevelopmental disorders including autism and intellectual disability. Her study provides first evidence in human neural stem cells (NSCs) derived from iPSCs that miR-137 inhibits proliferation while enhancing neuronal differentiation and migration of NSCs. MiR-137 affects mitochondrial dynamics such as mitochondrial fission and fusion to achieve neuronal fate. A small part of the talk

will be about retina, which is a part of CNS involved in visual function. An excellent model to study retinal degenerative diseases is retinal organoids generated from human pluripotent stem cells. Molecular staging of retinal organoids revealed their competence with gene profiles of human foetus and adult retina using comparative transcriptomics.

8 November 2020

0925-0945

SESSION 3A: Lectures by Fellows/Associates

DEBASHREE CHAKRABORTY

National Institute of Technology, Suratkal

IASc Associate: 2020 (Chemistry)

Structural and dynamical properties of water near Surfactant like peptide nanotubes.

Surfactant like peptides (SLPs) nanotubes can be thought of as a class of biocompatible and biodegradable materials, which can be used for biomedical applications. The structural and dynamical properties of the water molecules around these self-assembled surfactant-like peptides (SLPs) will be very much different from the bulk water. In view of this, the speaker carried out atomistic molecular dynamics simulations of water molecules near nanotube-like structures where glycine and lysine are taken as the constituents (G6K) for the composition of SLPs. The nanotubes considered were of different dimensions; such as 18x15 (number of peptides on the circumference x number of peptides layers), 18x12 and 16x12 for both charged and neutral analogues. The charged composition consists of protonated nitrogen in lysine subunit and chlorine/bromine as counter ions. It was found that neutral SLPs have less hydrated inner pore consisting of more tetrahedral water compared to their charged analogues. The hydrogen bond lifetime of water–water and water–peptide molecules increases in the inner pore and found to be maximum for charged 16x12 system. Outside the pore, charged analogue of 18x15 have more water–water hydrogen bond lifetime compared to all other systems. However, the protein–water hydrogen bond lifetime was found to be more for neutral analogues outside the pore due to more probable interactions of the SLPs with the water molecules.

8 November 2020

0950–1010

SESSION 3A: Lectures by Fellows/Associates

ARNAB BHATTACHARJEE

Jawaharlal Nehru University, New Delhi

IASc Associate: 2020 (Life Sciences)

Understanding Protein Transport on DNA Track

DNA metabolic processes, such as transcription, repression, replication, and DNA damage repair elicit movement of proteins from one subnuclear location to another. Transport of these DNA binding proteins (DBPs) is amazingly fast and their specific binding to short DNA target sequences in an enormous genomic background containing many alternative sites of similar sequences to that of the specific target site is extremely accurate. The fast association between proteins and DNA is governed by nonspecific interactions that allow protein transport (sliding) on DNA track, where the protein binds to DNA nonspecifically and performs a helical motion along the DNA major groove. The speaker has explored, using various computational approaches how the molecular characteristics of the interacting molecules and the in-vivo conditions (for example, crowding in the cell or coverage of DNA by nucleosomes) affect the transport efficiency of proteins on DNA. In this presentation, the molecular features of proteins and of the nucleic acids that allow fast dynamics and high-affinity binding on both single- and double-stranded DNA will be discussed.

8 November 2020

1030–1110

SESSION 3B: Special Lecture

C. JAGADISH

Australian National University, Canberra, Australia

Elected Honorary Fellow IASc: 2017

Semiconductor nanowires for optoelectronics, energy and neuroscience applications

Semiconductors have played an important role in the development of information and communications technology, solar cells, solid state lighting, etc. Nanowires are considered as building blocks for the next generation electronics and optoelectronics. In this talk, the speaker will introduce the importance of nanowires and their potential applications and discuss about how these nanowires can be synthesized and how the shape, size and composition of the nanowires influence their structural and optical properties. The speaker will present results on axial and radial heterostructures and how one can engineer the optical properties to obtain high performance lasers, LEDs, solar cells and to engineer neuronal networks. Future prospects of the semiconductor nanowires will be discussed.