

Indian Academy of Sciences, Bengaluru – 86th annual meeting*

The 86th annual meeting of the Indian Academy of Sciences, Bengaluru was held virtually between 6 and 8 November 2020. The three-day meeting comprised of several talks in the form of inaugural lectures by fellows/associates, special lectures, public lectures and symposiums.

The annual meeting began with an opening address by Partha Majumder (President of the Academy). He spoke about his current research work on a SARS-CoV-2 mutant and its selective sweep in the population. Majumder started by detailing the timeline of the outbreak, from 30 December to now and further explained the genetic and molecular structure of the virus. He further explained how his research team used two databases – GISAID and NextStrain – for the evolutionary and epidemiological analyses of the virus. He also spoke about his recently published paper in which his team had analysed RNA sequences of 3636 SARS-CoV-2 samples collected from 55 countries to understand the selective advantage of one SARS-CoV-2 type.

The presidential address was followed by lectures by fellows/associates. Vikram Mathews (CMC, Vellore) gave a talk on his research in the area of acute leukaemia, a condition that is difficult to manage owing to the high recurrence rate, especially in adults and the elderly, and specific challenges in the delivery of cost-effective care. The talk focused on studies conducted in an area of special interest to the group, i.e. the role played by the micro-environment in the bone marrow in which the malignant cells reside, in inducing resistance to therapy and mechanisms to overcome this resistance.

Sushmee Badhulika (IIT, Hyderabad) a researcher in the area of conformable electronics, discussed the development and applications of nanomaterials-based flexible and portable devices for point-of-care (POC) diagnostics. She emphasized that to meet the rising demands of POC diagnostics, the need of the hour is to come up with low-cost engineering

solutions in POC diagnostics devices and integrate the same with the right interface to transform them into self-usable, versatile, smart healthcare units.

Ravi S. Nanjundiah (IITM, Pune) presented a talk on the possible cause for change in the Indian Summer Monsoon (ISM) and El-Niño relationship. The connection of El-Niño over the Central Equatorial Pacific (EnSO) with the ISM and West African Monsoon (WAM) was studied on a multidecadal timescale (pre- and post-1980s). It was found that the relationship of WAM–EnSO and ISM–EnSO appeared to be out of phase. It was also found that EnSO affects both ISM and WAM through upper tropospheric temperature anomalies. The relationship between EnSO and Atlantic Niño also changed post-1980s. The evidence thus presented supports the changing nature of EnSO and ISM relationship.

A talk on entanglement entropy, its evaluation and application in the study of quantum-field theories was delivered by Justin R. David (IISc, Bengaluru). He highlighted that entanglement entropy is emerging as a useful observable to characterize quantum systems and has been a driving factor in obtaining universal results in conformal field theories. Entanglement entropy has also played an important role in understanding quantum gravity through holography.

A talk on strategies for combating carbapenem-resistant *Acinetobacter baumannii* was delivered by Vishvanath Tiwari (Central University of Rajasthan, Ajmer). *A. baumannii* causes pneumonia, respiratory infections and urinary-tract infections in humans, and accounts for 10–20% of bacterial nosocomial infections worldwide. Emergence of resistance against carbapenems is a significant health problem which is associated with high morbidity and mortality. Tiwari mentioned different strategies being developed in his laboratory for combating resistant *A. baumannii* and elaborated upon two approaches that combat resistance, i.e. using nano-herbal hybrid composition and suitable disinfectants for hospitals.

Amritanshu Prasad (IMSc, Chennai) gave a talk on polynomials as characters. A polynomial in variables x_1, x_2, \dots can be interpreted as a sequence of charac-

ters, one for each symmetric group. Using such polynomials, Prasad along with his collaborators has attempted to understand the Kronecker coefficients and restriction coefficients, two elusive families of numbers that arise in representation theory.

The next talk on magnetoelectrics and multiferroics was delivered by A Sundaresan (JNCASR, Bengaluru). He gave an overview of his research on understanding various mechanisms of linear magnetoelectricity and multiferroicity towards finding new magnetoelectric materials with large magnetoelectric coupling at room temperature.

After this session, a symposium on quantum technology was arranged by Urbasi Sinha (Raman Research Institute, Bengaluru) and Vibhor Singh (IISc, Bengaluru). Over the course of two hours, four experts in the field spoke about their work in different domains of quantum technology. The first speaker, Kavita Dorai (IISER Mohali) spoke about her work in building a nuclear magnetic resonance quantum computer, the several elements in it, and shared potential applications of the technology. The next speaker, Madhu Thalakulam (IISER, Thiruvananthapuram) spoke about his work in detecting quantum-level charges using amplifiers. His group employs a technique of measuring reflectivity at the quantum scale and then determining charge from that measurement. Following this talk, Vibhor Singh explained his team's experiments on coupling an electromechanical device with a transmon qubit. The final speaker in the symposium, Urbasi Sinha talked about photonic quantum science and the technologies that are being developed in the field. She spoke about her studies on entanglement dynamics and then elaborated on the practical applications of the technology in cryptography and communication.

Following all the technical talks from the day, Martin Rees (University of Cambridge, UK) delivered a public lecture about our world in 2050 and beyond. His talk was drawn from his recently authored book titled *On the Future: Prospects for Humanity*. He started by talking about population growth and how

*A report on 86th Annual meeting of Indian Academy of Sciences, Bengaluru which was held virtually.

it will balloon up across the globe. He further spoke about several important topics, now and in the future. He spoke on the topic of climate change, on rising global temperatures and carbon concentration, and emphasized on the need for immediate solutions by moving towards renewable energy. He also spoke about rising and powerful technologies in biotechnology, in robotics and artificial intelligence, and acknowledged the outsized roles these technologies are going to play in future lives. He focused a part of his talk on space exploration and our quest for finding life in the Universe. He concluded his lecture with the following message: 'We need to focus on the problems we are ourselves causing, and think on a timescale of a century – an instant in cosmic perspective, but an eternity for politicians!'

The day's programme was concluded with a music performance by Gaash, a Kashmiri youth band, who played their original songs that speak of hope, forgiveness and peace.

The second day of the annual meeting began with a special lecture by M. Rajeevan (Secretary, Ministry of Earth Sciences (MoES), Government of India (GoI)). He began by talking about the atmospheric phenomenon and what goes into weather prediction at different scales from now casting to short range to long-range predictions. He delineated the process of how weather predictions are made by explaining the various physical processes in a climate system and how MoES, GoI uses its several weather and climate modelling systems for predictions. Further, he spoke about the future of climate prediction and the move towards an integrated earth observing system, which can use data from multiple sources, like crowd-sourced data from ground-based traffic, low-cost air-pollution sensors, mobile towers measuring precipitation, etc. to make an accurate prediction.

Following the special lectures, Riddhi Singh (IIT Mumbai) spoke about her work on using hydrological models to estimate future surface-water availability. She also explained the challenges and uncertainties that arise in using hydrological models for such estimations. Alope Paul (IISc, Bengaluru) spoke about his work on solving the issues of multicomponent diffusion.

A symposium titled 'Rare Genetic Disorders' was organized by Sudha

Bhattacharya (JNU, New Delhi). Her introductory remarks provided the definition and complexities of genetic diseases and the work carried out in the field that has contributed to basic science. V. M. Katoch (JIPMER, Puducherry) focused on the unmet needs, challenges and opportunities in the area of rare genetic disease in India. He also mentioned efforts of the global and Indian civil society and of key stakeholders in this area, and touched upon the legislative approaches for improving the affordability of drugs for rare diseases. Meenakshi Bhat (Centre for Human Genetics, Bengaluru) in an overview on the type of clinical work carried out at her Centre, highlighted the initiatives taken such as 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 successful experience in conducting telegenetic clinics during the COVID-19 pandemic. Souvik Maiti (Institute of Genomics and Integrative Biology, Delhi) described a method for using a bacterial CRISPR Cas ribonucleoprotein complex for detecting single-nucleotide variants of sickle cell disease, without the need for sequencing. The most important advantage of the invention as a detection tool is the combination of speed, reliability, robustness and universal applicability for all DNA and RNA variations. With gene therapy having given some hope to correct some rare genetic disorders, Krishna M. Ella (Bharat Biotech Limited, Hyderabad) emphasized the need for India to gear up in translational research and manufacturing of viral vectors for gene therapy. He also touched upon manufacturing opportunities of viral vectors, challenges in clinical trials and other issues related to gene therapy.

Following the symposium, a lecture by fellows and associates was organized. Mahesh Sankaran (NCBS, Bengaluru) spoke about his work in the Shola grasslands of the Nilgiris, Tamil Nadu. He explained forest–grassland mosaics and how his experiments challenge the 'one climate–one biome' paradigm in ecology.

Purvi Gupta (IISc, Bengaluru) spoke about her work in complex analysis and the role of topology in certain analytical problems. Ruta P. Kale (NCRA, Pune) spoke about her work on making low

radio-frequency observations of distant galaxy clusters and future work using The Square Kilometre Array. Manjula Reddy (CCMB, Hyderabad) spoke about the bacterial cell wall and explained how bacteria make their cell walls.

The second day ended with a public lecture by Jairam Ramesh (MP, Chairman of the Parliament's Standing Committee on S&T, Environment, Forests and Climate Change, GoI). Initially focusing on the COVID-19 crisis, he highlighted that fundamentally this pandemic reflects an ecological disequilibrium and that understanding the three Es – Ecology, Evolution and Environment will be key to identifying potential pandemics. In the next part of the talk that focused on aspects of climate change, he lauded a recent report of the MoES, GoI on the assessment of climate change over the Indian region as an excellent and up-to-date analysis that deserves wider debate and discussion. He also touched upon aspects of treating the boundaries identified by the Stockholm Resilience Centre as interconnected systems, so that savings in one boundary are not achieved at the cost of another. Focusing on aspects of carbon neutrality, Ramesh emphasized that it is a bold and worthwhile goal, the attainment of which has to be consciously engineered. Drawing to a conclusion, he stated that in the post-COVID-19 world, there is an opportunity to switch gears and make a radical departure from the past in order to make economic growth ecologically sustainable with every effort fuelled by Science and Technology to ensure that the 'G' in GDP represents 'green'. He emphasized that India can and should show to the world how the measurement of economic growth can take place taking into account ecological pluses and minuses, and how a fuller understanding of the ecology–health interface and interaction calls for renewed scientific endeavours that in turn call for intensive collaboration across disciplines, both within the country and internationally.

The last day of the annual meeting began with a talk by Yogita K. Adlaka, (THSTI, Faridabad). Her study has unlocked the regulatory role of miR-137 (a brain-enriched miRNA) in neural development. The study provides first evidence in human neural stem cells (NSCs) derived from induced pluripotent stem cells, that miR-137 inhibits proliferation and enhances neuronal differentiation

and migration of NSCs. Thus NSCs derived from induced pluripotent stem cells serve as a model to study neurological diseases.

Surfactant-like peptide (SLP) nanotubes can be considered as a class of biocompatible and biodegradable materials used for biomedical applications. Debashree Chakraborty (NIT, Suratkal) discussed the structural and dynamical properties of water near SLP nanotubes. She discussed the outcomes of an atomistic molecular dynamics simulations study of water molecules near nanotube-like structures, where glycine and lysine were taken as the constituents for the composition of SLPs.

DNA metabolic processes such as transcription, repression, replication and DNA damage repair elicit movement of proteins from one subnuclear location to another. Arnab Bhattacharjee (JNU) discussed the molecular features of proteins

and nucleic acids that allow fast dynamics and high-affinity binding on both single- and double-stranded DNA.

The last day of the annual meeting came to a close with a special lecture by C. Jagadish (Australian National University) on the topic of semiconductor nanowires for optoelectronics, energy and neuroscience applications. Jagadish began his talk highlighting that we are now in the fourth industrial revolution that merges the digital and biological worlds using light to sense and interface humans and machines. With the World Economic Forum identifying holographic displays, wearable optical sensors, light navigation and communication, 3D vision and gesture recognition, enhanced machine vision and augmented reality as technologies of the future, such aspirational technologies require fundamentally new approaches for smart and miniaturized optical systems. Nanowires are

considered as building blocks for the next-generation electronics and optoelectronics. Jagadish discussed how nanowires are synthesized and how the shape, size and composition of the nanowires influence their structural and optical properties. He also discussed how nanowires open up opportunities for manipulation of light-matter interaction at the nanoscale and help in developing a new class of lasers, THz detectors and modulators, solar cells and photoelectrochemical water-splitting, integrating optoelectronic devices on various platforms and engineering the growth of neuronal networks.

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MEETING REPORT

The Upper Indus Basin Network*

The Upper Indus Basin (UIB) stretches across the regions of Pakistan, India, China and Afghanistan. The Upper Indus Basin Network-India Chapter (UIBN-IC) coordinates the research with six thematic working groups (TWGs). It acts as a platform to share research outcomes, discuss the progress and the challenges of the TWGs. This collaborative platform co-organized by the International Centre for Integrated Mountain Development (ICIMOD), Kathmandu, Nepal, and Jawaharlal Nehru University (JNU), New Delhi, India provides cross-cutting understanding on the areas of climate, cryosphere, water, hazards, and vulnerability, etc. within these TWGs.

The first workshop of UIBN-IC on ‘Bridging and strengthening science-socio-economic understanding’ was held on 19 April 2019 in New Delhi. The event was attended by representatives from the Government and research organizations in a day-long discussion. It focused on largely identifying key re-

search areas such as modelling of climate extremes, glacier monitoring and pollution stress faced by water bodies for each of the six TWGs in the first half of the discussion. During the second half, the deliberation was on future structure plans to integrate research activities among the TWGs.

To assess the progress made while taking these discussions forward, a second workshop on ‘Bridging and strengthening science-socio-economic understanding’ was organized on 13 December 2019 at JNU. Again, this was attended by various stakeholders from academia, institutions and the Government.

The third workshop on ‘Understanding key drivers of change for science-socio-economic understanding’ was held through the Web platform on 21 June 2020 during the COVID-19 pandemic, with the objective to assess and analyse discourses surfaced during the course and discuss the recent researches proposed within the TWGs. It emphasized the need to link all these TWGs to interdisciplinary dimensions further for progress. It discussed flagship studies by various researchers, and the need to ad-

dress and bridge the data gaps that currently exist in research in the UIB.

A. P. Dimri (JNU) mentioned the objectives of the workshop focusing on integration and perspectives followed by an overview on UIBN by A. Shrestha (ICIMOD). Anil Kulkarni (IISc, Bengaluru) in his keynote address on ‘Advanced Land Observing Satellite 2 with Phased Array Type L-band Synthetic Radar (PALSAR-2)’ discussed about monitoring the glaciers using differential interferometric pair. He presented the formation of ponds on the glacier surface, debris cover, bottom topography, glacier lake near the terminus, and melt water from tributary glaciers to be possible causes for mass wastage of glaciers. He concluded by stating that the communities near the mountains are vulnerable.

TWG1 deals with the ‘Framework of data collection, quality, and standardization’. G. Jeelani (University of Kashmir, Srinagar) deliberated upon ‘Evaluating the groundwater resources of Upper Indus Basin (UIB), Ladakh’. Water stress and availability remain an issue in the UIB.

*A report on Upper Indus Basin Network-Indian Chapter was held on 19 April 2019 in New Delhi.