MEETING REPORT

Indian Academy of Sciences, Bengaluru – 33rd Mid-Year Meeting

The 33rd Mid-Year Meeting of the Indian Academy of Sciences, Bengaluru was held at the New Biological Sciences Auditorium, Indian Institute of Science (IISc), Bengaluru, 8 and 9 July 2022. The two-day event comprised of talks by the elected Fellows and Associates, a special lecture, a public lecture and a symposium.

The Meeting began with a special lecture by Dipankar Banerjee (IISc, Bengaluru) that was targeted toward the materials science and engineering audience. He explained the concept of shear and shuffle in martensitic transformations, where shear changes the parent to the production phase in the alloy and subsequently, the shuffle provides the symmetry. He also described other pathways where the shuffle occurs first followed by the shear. The broad application of the concept described is primarily in biomaterials, where there is a need for high strength combined with modulus mismatch with the bone and lack of toxicity in the human body. When appropriately alloyed and tuned for martensitic transformation, titanium can increase the modulus mismatch with the bone to avoid the stress shielding effect when stress is applied.

The next talk by V. B. Shenoy (IISc, Bengaluru) discussed a new class of quantum matter called fractonic phase, which involves emergent quasiparticles with constrained mobility. He explained how fractonic physics could provide new perspectives on various problems, from day-to-day phenomena like paper folding to developing new platforms for quantum memories.

Apoorva Khare (IISc, Bengaluru) spoke about Polymath-14, a crowd-sourced, computer-aided analysis theorem of abelian groups. The topic covers algebra, analysis, geometry, probability and combinatorics. It also provides a non-standard, modern model for mathematics collaboration in today's fast-evolving world using both technology and crowd-sourcing.

R. I. Sujith (IIT, Chennai) spoke about the commonality between COVID-19 and flame blowouts in jet engines. He highlighted that extreme COVID-19 waves exhibit hyper-exponential growth and log-periodicity close to a critical point. Also, a flame blowout is preceded by hyper-exponentially growing, low-amplitude oscillations with log periodicity, and the log-periodic power law model can be used to predict the critical points.

Jyotirmayee Dash (IACS, Kolkata) spoke about how nucleic acids can synthesize their own ligands and show promising therapeutic applications. She mentioned that due to the continuous threats of infectious disease outbreaks, it is important to expand the scope of chemical toolsets to assist conventional drug discovery strategies in order to easily identify and optimize therapeutically relevant drug candidates.

N. G. Prasad (IISER, Mohali) discussed exploring intersexual genomic conflict using *Drosophila melanogaster*. He highlighted that altering levels of intersexual competition can drive changes in traits related to life history, immunity, behaviour and cognition. He further added that evidence of incipient speciation was found because of such antagonistic coevolution.

Samir K. Maji (IIT, Mumbai) discussed how liquid–liquid phase separation (LLPS) is a generic property of proteins and polypeptides under high crowding or conditions favouring high intermolecular interactions. He further elaborated that an exposed hydrophobic surface or charge-based interaction and hydrogen bonding drive both single and multicomponent protein/polypeptide LLPS.

The symposium on the 'International Year of Basic Sciences for Sustainable Development' was organized to align with the objective of the United Nations to increase awareness on the importance of basic sciences for sustainable development in accordance with national priorities. Gagandeep Kang (CMC, Vellore), spoke on measuring what matters in public health. She began her talk by emphasizing that when human beings and the environment, which are both heterogenous, are involved, measurements need to be accurate. She provided case studies of common measurement errors in areas such as structure, process and outcome indicators, the right kind of measurement, standardization, overlap and interpretation, and trajectories and impact assessment. Kang concluded her talk by laying down seven principles of measurement in public health – measure for the outcome and not the process, measure for and with the people, value the things that matter most, be responsive, avoid over-claiming, measure strengths, risks and weaknesses, and measure with transparency and honesty.

T. Pradeep (IIT, Chennai) gave a talk on 'Water: gaps and opportunities'. When it comes to sustainability, the sustainable development goals (SGDs) are, in one way or another, related to water. The 3Ss, i.e. store–sensitive–smart are needed for water and its benefits to reach all. Highlighting the technologies required for water security, Pradeep provided case studies of biopolymer-reinforced, synthetic, granular nanocomposites for affordable point-of-use water purification. He also discussed the hydro-informatics platform in India and the opportunities arising from water becoming data. Pradeep emphasized the utilization of traditional water purification technologies as well as new materials and technology, which necessitate improved water literacy.

M. Rajeevan (MoES, GoI) gave a talk on basic sciences for environmental sustainability. He focused on air pollution and heatwaves, which pertain to SDG 11 and SDG 13 respectively. Rajeevan discussed the sources of air pollution, its impact on climate change, the natural mitigation effort during the COVID-19 lockdown, and its health impact. Next Rajeevan focused on climate modelling studies which suggest that heatwaves could be part of increasing global warming caused by human activities. With heatwaves showing an increasing trend during 1961–2017 and likely to continue in the coming years, he discussed a new tool developed by India Meteorological Department to predict heatwaves with and without humidity.

T. Ramasami (Anna University, Chennai) talked about talent supply chain management for basic sciences and SDG goals. He stated that investing in basic sciences means investing in the right people. His talk focused on India's efforts in talent supply chain management for basic sciences through programmes such as KVPY, INSPIRE, fellowships and early career opportunities. He elaborated on the INSPIRE scheme covering SEATS (Scheme for Early Attraction of Talents for Science), SHE (Scholarship for Higher Education) and AORC (Assured Opportunity for Research

Career) for different age groups. Ramasami also indicated that in the absence of INSPIRE, the talent attraction scale might have been missed, and concluded that a holistic approach for promoting basic sciences and research in India might be the next best action.

Rohini Godbole (IISc, Bengaluru) addressed gender (in)equity in science – the reasons and possible actions. She highlighted that while SDG 5 pertains to gender equality, it also positively impacts achieving several other SDGs. Taking up the case of women in science in India, Godbole mentioned that the number of women practicing science is not commensurate with the number of women studying or teaching science. She also indicated that the fraction of women professors, directors, deans and vice chancellors is not commensurate with the small fraction present in research. She emphasized that, like any creative activity, diversity can only be good for science. While lack of numerical representation is a symptom, she mentioned that the root causes of inequity, such as the ticking of biological clocks, negotiating career and family balance, etc. need to be addressed. Godbole also discussed invisible and unconscious biases that impact the number of women that stay in Science and Technology. With such biases arising due to the lack of importance attached to women's participation in science in the eyes of society and scientists, she appealed to the forum to think about how such biases can be overcome.

The symposium was followed by a public lecture delivered by G. N. Devy (The People's Linguistic Survey of India, Gujarat) on language, memory and aphasia. It focused on the idea of language, its emergence, future and how memory has impacted the recent course of the existence of languages. Devy predicted that while nearly 7000 languages exist in the world as of now, around 4000 will disappear in the next 30 years. A succinct excerpt from his broader talk is as follows: 'Knowledge that comes to an individual through sensory perception becomes cognition and is shared for verification. Subsequently, it acquires an independent existence outside as a collected memory. When the knowledge load becomes more complex, classification of the same also becomes difficult. This leads to classifications of collected memory being abstracted at a higher level, thus facilitating the creation of artificial memory, which has in turn affected language. Human memory is founded on the human sense of time, which is in turn founded on language. If artificial memory comes into play, human memory is sidelined, leading to human language also being sidelined.'

The second day of the Meeting began with a special lecture by Sanjay P. Sane (NCBS, Bengaluru) on the biomechanics of insect flight. He presented some recent work in his laboratory on how wing movement is coordinated relative to the body to ensure fine control of flight, with the common housefly as an example. A common housefly can flap its wings more than 200 times per second and execute complex decisions with the duration of a proverbial eye-blink. Sane mentioned that the need for rapid air movements puts extreme demands on insect physiology and the nervous system, which also reveals that flight-related adaptations are some of the most compelling examples of evolution. Equally important has been the study of the mechanics and control of flight, which ensures that the flapping wings generate sufficient aerodynamic forces to fly, while also making subtle changes in the wing attitude for finely controlled manoeuvres.

Vijayalakshmi Trivedi (TIFR, Mumbai) discussed the compactly supported continuous function called the Hilbert–Kunz function and applications to study the well-known positive characteristic invariants of rings.

Vandana Prasad (BSIP, Lucknow) discussed the evolution of angiosperms in the context of geological history of the Indian Plate. Angiosperms are the most species-rich and ecologically diverse in the plant ecosystem. While the latitudinal diversity pattern of the angiosperms in deep geological time was very different, the plate tectonic movement aided in the dispersion and distribution of angiosperms. Prasad discussed the movement of the Indian Plate and how it has acted as an evolutionary cradle and evolutionary cradle for tropical biodiversity, and has mainly driven the emergence of tropical rainforests in Southeast Asia.

Maddika Subba Reddy (CDFD, Hyderabad) spoke about the mapping interaction network of human phosphatases. The take-home points of this talk were that phosphatases have diverse unidentified cellular functions; they may not necessarily require catalytic activity for all their functions, and they assemble multimeric complexes for substrate and functional diversity.

Chiranjib Bhattacharyya (IISc, Bengaluru) discussed the foundations of unsupervised learning, where many fundamental challenges remain. He presented several recent results derived from the ideas drawn from the disciplines of computational geometry and statistical mechanics, which further the theory behind several unsupervised learning models.

K. Subrahmanyam (NARL, Hyderabad) discussed the three-dimensional structure of cloud-type distribution over the Indian summer monsoon region using space-based W-band radar observations. Its significance lies in establishing the vertical distribution of various types of clouds, and including vertically resolved multi-layer clouds and their associated dynamics. According to Subrahmanyam, this will aid in estimating cloud radiative models and studying their role in modifying the large-scale atmospheric circulation.

The last speaker of the day, Bushra Ateeq (IIT, Kanpur) talked about mechanistic underpinnings and therapeutic interventions for major prostate cancer subtypes. She highlighted that anti-androgen drugs commonly used for treating advanced-stage cancer patients are counterproductive in the long term. Ateeq also explained the utility of DLX1 as a prognostic marker and a drug target, which is highly expressed in 60% of the organ-confined or metastatic CRPC patients.

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