Anniversary General Meeting

INDIAN NATIONAL SCIENCE ACADEMY

26-28 December 2018

Hosted by

PHYSICAL RESEARCH LABORATORY (PRL), AHMEDABAD

INSTITUTE FOR PLASMA RESEARCH (IPR), BHAT

INDIAN INSTITUTE OF TECHNOLOGY (IIT-GN), GANDHINAGAR

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ABSTRACTS

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PROGRAMME

WEDNESDAY, 26 DECEMBER 2018

K.R. Ramanathan Auditorium
Physical Research Laboratory (PRL)

08:15	**Departure from Hotels**
09:00 – 09:45	**INAUGURATION**
09:45 – 10:30	**PRESIDENTIAL ADDRESS** **Prof. A.K. Sood,** President, INSA and IISc, Bengaluru ***Nano Heat Engines***
10:30 – 10:45	**GROUP PHOTO** **PRL Administration Building Lawns**
10:45 – 11:15	**TEA**
11:15 – 13:30	**SESSION-1** **CHAIR: Prof. A.K. Sood**
11:15 – 11:45	**Prof A. Bhardwaj,** Director, PRL, Ahmedabad ***Science at PRL***
11:45 – 13:30	**SYMPOSIUM 1** **Vikram Sarabhai Space Science Symposium (Vs⁴): Innovations from Space Program** **CONVENERS: Dr. B.N. Suresh** and **Prof. A. Bhardwaj**
11:45 – 12:05	**Dr. K. Sivan,** Chairman, ISRO & Secretary, Dept. of Space, Bengaluru ***ISRO Programs, Present and Future Directions and Their Contribution in Nation Building***
12:05 – 12:25	**Dr. S. Somanath,** Director, VSSC, Thiruvananthapuram ***Launch Vehicles, Innovations and Future Perceptive***
12:25 – 12:50	**Sri. P. Kunhikrishnan,** Director, URSC, Bengaluru ***Satellites, Interplanetary Missions, Technologies and Future Trends***
12:50 – 13:10	**Dr. P. Diwakar,** Earth Science Program, ISRO HQ, Bengaluru ***Space Application Programme: Societal Applications and Their Benefits***
13:10 – 13:30	**Discussion**
13:30 – 14:30	**LUNCH**

14:30 – 16:00	**SESSION-2** **CHAIR: Prof. A.K. Sood**
14:30 – 15:15	**MEGHNAD SAHA MEDAL LECTURE - 2018** **Prof. Ashutosh Sharma,** Secretary, Dept. of Science & Technology ***Navigating Complexity by Common Sense***
15:15 – 16:00	**ARYABHATTA MEDAL LECTURE (2018)** **Prof. S.C. Lakhotia,** Banaras Hindu University, Varanasi ***Need for Integration of Ayurveda with Modern Biology and Medicine***
16:00 – 16:30	**TEA**
16:30 – 18:30	**SESSION-3** **CHAIR: Prof. K. Veluthambi** **SYMPOSIUM 2** **Food Security and Genomics** **CONVENERS: Dr. Deepak Pental, Dr. R.K. Varshney, Dr. I.P. Abrol**
16:30 – 16:50	**Prof. Deepak Pental,** Delhi University, New Delhi ***Transgenic Technologies for Low-input, High-output Agriculture***
16:50 – 17:10	**Dr. R.K. Varshney,** ICRISAT, Patancheru, Hyderabad ***Translational Genomics for Agriculture***
17:10 – 17:30	**Dr. T.R. Sharma,** NABI, Mohali ***Plant Pathogen Interaction-Developing Disease Resistant Plants***
17:30 – 17:50	**Sri M.L. Jat,** International Maize and Wheat Improvement Center, Delhi ***Conservation Agriculture***
17:50 – 18:10	**Dr. I.P. Abrol,** CASA, New Delhi ***Future Agriculture***
18:10 – 18:30	**Discussion**
18:30 – 19:00	**TEA**
	SESSION-4 **CHAIR: Prof. A. Bhardwaj** **PUBLIC LECTURE**
19:00 – 20:00	**Prof. A.V. Ramarao,** A.V.R.M. Industries, Hyderabad ***Reflections from a Personal Journey as Scientist, Technologist and Entrepreneur: Academia and Industry Interactions***
20:00 onwards	**DINNER**

PARALLEL MEETINGS

21:00 – 22:00	**Prof. S.C. Lakhotia** ***Meeting of Editorial Board of PINSA*** Computer Centre Committee Room, PRL
21:00 – 22:00	**Dr. Mahesh Kumar** ***Meeting of INYAS Core Committee*** Video Conference Room PRL

THURSDAY, 27 DECEMBER 2018

Forenoon: Institute of Plasma Research, Bhat
Afternoon: I.I.T. Gandhinagar

08:30	**Departure from the Hotels to IPR, Gandhinagar**

SESSION-5
CHAIR: Prof. Shobhona Sharma

Venue: Magnet Laboratory, IPR

10:00 – 10:30	**Prof. Shashank Chaturvedi,** Director, IPR, Ahmedabad ***Welcome and an Introduction to the Institute of Plasma Resarch***
10:30 – 11:00	**TEA**

11:00 – 13:00

SESSION-6
CHAIR: Dr. Shashank Chaturvedi

SYMPOSIUM 3
Scaling Up Artificial Intelligence in India

CONVENER: Prof. Y. Narahari

11:00 – 11:20	**Prof. Y. Narahari,** I.I.Sc., Bengaluru ***The AI Tsunami***
11:20 – 11:40	**Prof. S. Bandyopadyay,** I.S.I., Kolkata ***Artificial Intelligence Methods for Biological Data Analysis***
11:40 – 12:00	**Prof. Vijay Chandru,** Stand Life Sciences, Bengaluru ***The Unreasonable Effectiveness of Machine Learning in the Sciences of the Artificial***
12:00 – 12:20	**Prof. P.P. Mujumdar,** I.I.Sc., Bengaluru ***AI in Hydrology and Water Resources***

PANEL DISCUSSION
Strengthening AI Research & Education in India

12:20 – 12:50	**PANELLISTS:** **Prof. Balaraman Ravindran,** I.I.T., Chennai **Prof. Chiranjib Bhattacharyya,** I.I.Sc., Bengaluru **Prof. Vijay Chandru,** Strand Life Sciences, Bengaluru
12:50 – 13:00	**Discussion**
13:00 – 13:45	**LUNCH**
13:45 – 15:00	**Departure to I.I.T., Gandhinagar**

SESSION: 7
CHAIR: Dr. Chandrima Shaha

Venue: Academic Block 1 (AB 1/ 300 Audi)

15:00 – 15:30	**Prof Sudhir K. Jain,** Director, IIT, Gandhinagar ***Welcome and an Introduction to IIT Gandhinagar***
15:30 – 17:00	**SYMPOSIUM 4** **Water Futures**

CHAIR: Prof. R.N. Singh, I.I.T., Gandhinagar

CONVENERS: Prof. P.P. Mujumdar and Prof. V.M. Tiwari

15:30 – 15:45	**Prof. P.P. Mujumdar,** I.I.Sc. Bengaluru ***Introduction***
15:45 – 16:00	**Prof. Veena Srinivasan,** ATREE, Bengaluru ***Human Alterations of Catchment Processes: Understanding the Cauvery Conflict***
16:00 – 16:15	**Prof. M. Sekhar,** I.I.Sc, Bengaluru ***Adaptation of Irrigated Agriculture under Global Change***
16:15 – 16:30	**Prof. Subimal Ghosh,** I.I.T, Mumbai ***Hydrologic Simulations of Human-Natural System: Simple vs Complex Models***
16:30 – 16:45	**Dr. V.M. Tiwari,** NGRI, Hyderabad ***Concluding Remarks***
16:45 – 17:00	**Discussion**

15:30 – 17:00	**PARALLEL MEETING** **CHAIR: Prof. A.K. Sood** **Venue: Room - AB 6/20, I.I.T., Gn** ***INSPIRE APEX Committee Meeting* - Members only**
17:00 – 17:30	**TEA**
	SESSION: 8 **CHAIR: Prof. J.P. Mittal, BARC, Mumbai**
17:30 – 19:30	**SYMPOSIUM 5** **Ethics in Science Research and Education** **CONVENERS: Prof. Amit Ghosh and Prof. K. Muralidhar**
17:30 – 17:40	**Dr. Amit Ghosh,** N.I.C.E.D., Kolkata ***Introductory Remarks***
17:40 – 18:00	**Prof. K. Muralidhar,** University of Hyderabad, Hyderabad ***Ethics: Issues and Dimensions***
18:00 – 18:15	**Dr. Praveen Chaddha,** Gurugram ***Ethics in Publications***
18:15 – 18:30	**Dr. Sunil Mukhi,** IISER, Pune ***Ethics in Work Places***
18:30 – 18:45	**Dr. Shobhana Sharma,** TIFR, Mumbai ***Gender Issues/Equal Opportunity***
19:00 – 19:20	**Sri Pallav Bagla,** NDTV ***Ethics in Science Journalism***
19:00 – 19:30	**Discussion**
19:30 – 20:30	**DINNER**
20:00 – 23:00	**CHAIR: Prof. A.K. Sood** **MEETING of the Council INSA** **Venue: Room AB-6, I.I.T., Gn**
20:30	**Return to Hotels for other delegates**

FRIDAY, 28 DECEMBER 2018

K.R. Ramanathan Auditorium, Physical Research Laboratory

08:30	**Departure from Hotels**
	SESSION: 9 **CHAIR: Dr. S. Sinha**
09:30 – 11:00	**SYMPOSIUM 6**
	New Drug Discovery and Development: The Indian Narrative
	CONVENERS: Dr. Madhu Dikshit and Dr. B.K. Thelma
09:30 – 09:40	**Dr. Madhu Dixit,** THSTI, Faridabad ***Introduction***
09:40– 10:05	**Dr. Deepa Joshi,** Torrent Pharma, Ahmedabad ***Drug Discovery and Development in India: An Industry Perspective***
10:05 – 10:30	**Dr. Parimal Misra,** University of Hyderabad , Hyderabad ***Discovery of a Potent Activator of AMPK: A Collective Effort of Industry and Academia***
10:30 – 10:45	**Dr. Praveen Kumar Vemula,** InSTEM, Bengaluru ***Translating Technologies in India: A Scientist's Perspective***
10.45 – 11:00	**Dr. B.K. Thelma,** Delhi University, Delhi ***Summing Up and Overview***
10:45 – 11:00	**Discussion**
11:00 – 11:30	**TEA**

SESSION: 10
CHAIR: Dr. Saurav Pal

11:30 – 13:00

SYMPOSIUM 7
Sustainable Energy and Chemical Engineering Platforms

CONVENER: Dr. A. Nangia

11:30 – 11:45	**Dr. Ashwini Nangia,** N.C.L., Pune ***Overview***
11:45 – 12:00	**Dr. Amol Kulkarni,** N.C.L., Pune ***Continuous Manufacturing Platforms for Fine and Specialty Chemicals Industry: Relevance Toward Sustainability***
12:00 – 12:15	**Dr. Paresh Dhepe,** N.C.L., Pune ***Sustainable Catalytic Transformations of Renewables into Chemicals and Fuels***
12:15 – 12:30	**Prof. Sanjay Mahajani,** I.I.T., Mumbai ***Process Intensification through Multi-functional Reactors***
12:30 – 12:45	**Dr. Ramesh Bhujade,** R.I.L., Jamnagar ***Catalytic Hydrothermal Liquefaction – Sustainable Technology for Biomass Conversion to Drop-in Liquid Fuel***
12:45 – 13:00	**Discussion**
13:00 – 14:00	**LUNCH**

SESSION 11
CHAIR: Prof. A.K. Sood

14:00 – 15:00	**Anniversary General Meeting** Induction of New Fellows Felicitations of Awardees of INSA Medal for Young Scientists INSA Teachers Award Felicitation of outgoing Council Members INYAS Activities Presentations Conclusion
15:00 – 15:15	**TEA**
15:15 – 17:00	**General Body Meeting** (Fellows only)
17:00	**TEA / DEPARTURE**

PHYSICAL RESEARCH LABORATORY

Physical Research Laboratory (PRL), founded in 1947 by Dr. Vikram A. Sarabhai, is a premierscientificinstitutionunderthe Department of Space, Government of India. The laboratory started with its focus on research areas of Astronomy and Cosmic Rays. In course of time several new disciplines were added to its research theme. The current research activities of PRL are truly of multi-disciplinary nature at the cutting edge of science. These include Astronomy and Astrophysics, Space and Atmospheric Sciences, Solar Physics, Geosciences, Planetary Science, Atomic, Molecular & Optical Physics, Theoretical Physics & Cosmology.

PRL currently has four campuses: the main campus at Navrangpura, Ahmedabad, with several world-class experimental and computing facilities; many leading laboratories in Thaltej campus, Ahmedabad; Infrared Observatory at Mount Abu, and Udaipur Solar Observatory at Udaipur.

The research work done at PRL has been recognized by peers at both national and international levels. This is also reflected in International and National awards and honours received by PRL scientists over the years.

The laboratory has a very strong human resource development component with doctoral (Ph.D.), post-doctoral & visiting scientist programs, summer internship program for B.Sc./M.Sc. students and college teachers, project training for graduate and post-graduate students in science, engineering and computer applications. PRL also conducts biennial PG Course in Space & Atmospheric Science since 1998 for the Center for Space Science and Technology Education in Asia and the Pacific (CSSTEAP) established in Dehradun which is affiliated to the United Nations.

INSTITUTE FOR PLASMA RESEARCH

The Institute for Plasma Research (IPR) is located in on the banks of the river Sabarmati, near Indira Bridge, Gandhinagar, Gujarat. It was established in 1986 as an autonomous institute under the Department of Science and Technology (DST). The institute grew rapidly and came under the administrative umbrella of the Department of Atomic Energy (DAE) in 1995.

The Institute is engaged in basic and applied research in Plasma Sciences and Technologies with a mandate to develop expertise and technologies for Nuclear Fusion as a source of Energy. The Institute has a vibrant research programme that includes many small experiments, two major Tokamak experiments and theoretical and computational studies in many areas of plasma physics. The Tokamak experiments include India's first Tokamak, Aditya, which has been in operation since 1990. The second is the Steady-State Superconducting Tokamak (SST-1). IPR is the Indian nodal agency for its participation in the international fusion mega-project called ITER being built in France. Accordingly, the Institute has initiated a major programme in Fusion Technology development.

Apart from the focus area of Fusion science & technology, the Institute is actively engaged in developing plasma-based technologies for industrial and societal applications. It set up the Facilitation Center for Industrial Plasma Technologies (FCIPT), in 1999 at Gandhinagar, which is engaged in plasma based projects of interest to Indian industries. FCIPT has successfully completed a large number of externally-funded projects, with several indigenously-developed technologies transferred to industry. These include plasma applications in waste disposal, textile technology, medical, defence, space, agriculture, etc.

Over the years IPR has developed competence in advanced fields like theoretical plasma physics, computer modeling and simulation, Superconducting magnets and Cryogenics, Ultra high vacuum technologies, sophisticated plasma diagnostic systems, RF and Neutral beam heating systems, High voltage engineering systems, Pulsed power systems, Computer based Data Acquisition and Control systems besides, industrial, environmental and strategic plasma applications. A multi-disciplinary team of around 400 scientists and technologists carries out these tasks. IPR is now internationally recognized for its contributions to fundamental and applied research in plasma physics and associated technologies.

INDIAN INSTITUTE OF TECHNOLOGY GANDHINAGAR

It currently offers degree programs (BTech/MSc/MA/MTech/PhD) in 13 disciplines spanning engineering, sciences, humanities and social sciences, and two interdisciplinary courses in 'Cognitive Science' and 'Society and Culture'. The Institute has interdisciplinary research ecosystem with state-of-the-art research facilities cutting across traditional discipline boundaries. Six Centers of Excellence, Archeological Sciences, Biomedical Engineering, Cognitive Science, Design and Innovation, Safety Engineering, Sustainable Development, further encourage interdisciplinary scholarly pursuits.

Given the need for providing hands-on, experiential education at the school level, a unique Centre, the Centre for Creative Learning (CCL), has been created at IIT Gandhinagar. It provides a space and environment where learning can be joyous and lead to conceptual understanding, with the goal of bringing back a sense of wonder and curiosity. CCL has conducted more than twenty five workshops working with more than 3000 Government School teachers and received overwhelming feedback.

Recruitment and evaluation of faculty, students' admission, curricula development, research agenda and infrastructure, global collaborations, are all driven by the pursuits of excellence. With globalization as one of the core pillars, ~ 40% of UG students get international exposure in top-notch universities abroad through summer fellowships/exchange programs. Excellence in faculty is reflected by the fact that more than 75% faculty members, having high academic credentials, have received their education/ research training at some of the most prestigious institutions around the world. Institute has developed several strategic partnerships with leading universities, R&D organizations and industries abroad for student and faculty exchanges and research collaborations. Large numbers of visiting faculty from renowned institutions repeatedly visit the institute to participate in teaching. Fully residential campus

with world class facilities/ amenities for students has won laurels for its eco-friendly design and practices.

With social responsibility as the guiding principle of its ethos, the traditional BTech and MTech education at IITGN is more societal problems-centric. Institute's two unique fellowships - Explorer and Gram fellowships - allow students to appreciate societal diversity and pluralism of India through direct interactions with the communities in rural India. Our various in-house initiatives work tirelessly to empower the underprivileged sections of society both within the IITGN fraternity and nearby localities. The Nurture & Empower Entrepreneurial Ventures (NEEV) - our community outreach program - organizes regular workshops on entrepreneurship and vocational skills training program for young men and women from nearby villages.

Engaging with external stakeholders has been a keystone of our vision and numerous well-wishers contribute to the Institute in numerous ways, including financial support and academic opportunities.

A Research Park, housing industry R&D setups within the Institute, is established to create strong industry-academia interaction. Institute also provides support system for nurturing/ incubating new ideas through its Incubation Centre.

Special Lectures

A.K. SOOD
President, INSA &
Department of Physics, Indian Institute of Science, Bengaluru

Nano Heat Engines: Extracting Work from Bacterial Baths

Artificial microscale heat engines are prototypical models to explore the mechanisms of energy transduction in a fluctuation dominated regime. This talk will first discuss our experiments to realize a micrometer sized active Sterling heat engine operating between two nonequilibrium reservoirs with different activities of the bacteria. At high activities of bacteria, the efficiency of our heat engines surpasses the equilibrium saturation limit of Sterling efficiency.(1)

A key requirement to achieve performance of macroscopic non-Equilibrium engines, all lifeforms, is to build collections of heat engines that perform in unison. Here, in our recent work ,we demonstrate that the act of building a pair of heat engines with optical traps in close proximity, increases their performance even in the absence of bacterial reservoirs. We show that the synergistic action between two microspheres, optically trapped in close vicinity, amplifies the non-conservative probability flows, Brownian vortexes, that transduce optical energy to thermal energy. Our work highlights a future pathway for the construction of macroscopic non-equilibrium engines.(2)

(1) S. Krishnamurthy, S. Ghosh, D. Chatterji, R. Ganapathy and A.K. Sood, Nature Physics 12, 1134 (2016)

(2) S. Krishnamurthy, R. Ganapathy and A.K. Sood (2018)

Speaker Profile

Prof. A.K. Sood, FRS is an Honorary Professor in Department of Physics at Indian Institute of Science, Bengaluru. He is currently the President of the Indian National Science Academy and the Secretary General of The World Academy of Sciences (TWAS). He was the President of the Indian Academy of Sciences from 2010 to 2012. Currently, he is a member of the Science, Technology and Innovation Advisory Council of the Prime Minister of India. Prof. Sood's research interests include Physics of Nano systems such as grapheme and other 2D materials and soft condensed matter, with a strong focus on innovative experiments. The latter includes the flow behaviour such as rheochaos, nonequilibrium phase transitions, deconstruction of glass physics using colloid experiments, active matter and stochastic thermodynamics. The experimental probes used for exploring physics at nanoscale are Raman spectroscopy, Ultrafast time resolved spectroscopies including terahertz spectroscopy, transport measurements and x-ray diffractions. He has published close to 400 papers in refered international journals and holds a few national and International patents. His work has been recognized by way of many honors and awards .These include the Fellowship of the Royal Society (FRS) , all the three science academies of India and TWAS; the civilian honor, Padma Shri by Government of India, S.S. Bhatnagar Prize, G.D. Birla Award, TWAS Prize in Physics, FICCI Prize, Goyal Prize, M.N. Saha Award and Millennium Gold Medal of Indian Science Congress, Sir C.V. Raman Award of UGC, Homi Bhabha Medal of Indian National Science Academy, DAE Raja Ramanna Award of JNCASR, National Award in Nanoscience and Nanotechnology by Government of India, Nano Award by Government of Karnataka, G.M. Modi Award of Science and R.D. Birla Award for Excellence in Physics by Indian Physics Association. He is Associate Editor of ACS Nano and Executive Editor of Solid State Communications.

ASHUTOSH SHARMA
Department of Science and Technology, Government of India; Indian Institute of Technology Kanpur

Navigating Complexity by Common Sense

The talk will be focus on the central role of ideas and scientific common sense even in the cutting-edge science, rather than an exclusive reliance on the state-of-art infrastructure alone. Examples will be from some of our work on self-assembly and self-organization in soft materials by control of instabilities. The basic principles will be illustrated by some select examples of self-organization in highly confined systems, e.g., in thin (5 nm-100 nm) films, electrospinning, nature-inspired science and others.

The talk will also interweave some oncoming challenges, opportunities and directions in S&T research and a few selected new DST programs that address the gaps in our S&T and innovation ecosystems. This part may also briefly introduce an assortment of emerging concepts such as Academic Social Responsibility, Grass-roots Innovations, Convergence and Co-arising of Technologies, Gender and Diversity in Science, Rise of Machines in Industry 4.0 and maybe even that eternal debate on 'basic' vs 'applied'! The idea is not to arrive at a final view on any of these multi-faceted notions, but to encourage awareness and debate.

Speaker Profile

Ashutosh Sharma is Secretary to the Government of India since January 2015, heading the Department of Science and Technology, and an Institute Chair Professor in Chemical Engineering at the Indian Institute of Technology at Kanpur. Ashutosh received his PhD from the State University of New York at Buffalo (1988), MS from the Pennsylvania State University (1984) and B.Tech. from IIT Kanpur (1982). Ashutosh has worked in nanotechnology; thin polymer films; nanocomposites and devices in energy, health and environment; functional interfaces; micro/nano-mechanics of soft matter; nano-patterning and nanofabrication; colloid and interfacial engineering; biomaterials and biosurfaces; wetting and adhesion. He has published over 350 peer reviewed papers and filed over 15 patents in these areas. Ashutosh is a recipient of several honors and awards including the inaugural Infosys Prize in Engineering and Computer Science, TWAS Science Prize of the World Academy of Sciences, Bessel Research Award of the Humboldt Foundation, Distinguished Alumni Awards of IIT Kanpur and SUNY Buffalo, UNESCO Medal in Nanosciences, Firodia Award, Syed Husain Zaheer Medal of INSA and many others. Ashutosh is an elected Fellow of The Indian National Science Academy, Indian National Academy of Engineering and The World Academy of Sciences (TWAS). He is an associate editor of ACS Applied Materials and Interfaces since 2014. His other interests are in ancient history and philosophy, poetry and visual arts.

SUBHASH C. LAKHOTIA
Cytogenetics Laboratory, Department of Zoology, Banaras Hindu University, Varanasi

Need for Integration of Ayurveda with Modern Biology and Medicine

Concern for health since the beginning of civilization led each community to develop its own health/medical care system. Ayurveda, the oldest and well-documented Indian health-care system, is practiced for several thousand years. This experience-based system would have had its evidence-based origin. However, in the current perspective and practices, it is largely experience-based system with myths, fallacies and inappropriate commercial practices having made inroads in its integrative health-care practices and philosophies. Historically, the so-called 'modern medicine' practices and formulations had their origins in traditional health-care systems, especially Indian and Chinese. However, today the traditional and the modern medicine systems are competitive and mutually exclusive. Remarkable developments in all disciplines of natural sciences, including biology and understanding of human body and its systems, requires re-examination of Ayurvedic practices and formulations, not only for their claimed effectiveness but also for the physiological, cellular and molecular bases of their actions. Some of our results would be presented to illustrate advantages of Ayurvedic Biology. More such studies would generate the much needed evidence-based practices, and also provide simple quality-control systems for Ayurvedic formulations. This would finally lead to emergence of integrative health-care incorporating the best practices of traditional and modern medical system.

Speaker Profile

Following his education at Calcutta University and a short post-doctoral work at Delhi University, Prof. Lakhotia served Burdwan and Gujarat Universities before moving to Banaras Hindu University in 1976. Following superannuation, he continues as a Distinguished Professor and INSA Senior Scientist (2016-18) at BHU. His current research interests using Drosophila include i) roles of hsr-omega long non-coding RNAs in normal and stressed cells, ii) stress-induced genes and tumourigenesis, and iii) Ayurvedic Biology. Prof. Lakhotia actively discusses policies relating to higher education, research publications and assessment in India. He has published more than 160 research and ~80 other articles. He is member of Editorial Boards of Journal of Biosciences, Annals of Neuroscience, RNA Biology, Cell Stress & Chaperones, and editor-in-chief of the Proceedings of the Indian National Science Academy. He has received INSA YS Medal (1975), UGC National Lecturership, UGC Career Award, Bhatnagar Prize (Biological Sciences, 1989), UGC J.C. Bose Award (Life Sciences, 1998), INSA Sunder Lal Hora Medal (2002), Prof. C.N.R. Rao Education Foundation Award for Excellence in Research at BHU (2007), DST Ramanna Fellowship (2009), DAE Raja Ramanna Fellowship (2011). He is a fellow of the Indian National Science Academy, Indian Academy of Sciences, National Academy of Sciences India and a Senior Fellow of Cell Stress Society International.

Public Lecture
Chair: A. Bhardwaj, PRL, Ahmedabad

DR. A.V. RAMARAO
A.V.R.M. Industries, Hyderabad

Reflections from a Personal Journey as Scientist, Technologist and Entrepreneur (Academia and Industry Interactions)

The speaker has the distinction of being one of the first Indian scientists to take a lead in nurturing and fostering integration in basic science, technology development and engineering design to provide complete package for commercial exploitations. He pioneered the concept of Institution and Industry interaction with several leading Indian pharmaceutical industries such as Cipla, Lupin, Cadila, Dr. Reddy's, FDC, etc. He is the first scientist to develop alternative affordable technologies for several essential generic drugs including anti-HIV drugs which enabled the Indian Pharmaceutical Industry to introduce them in the market at a fraction (1/5 to 1/10) of the prevailing international prices.

He is the first academic to realize the potential and commercial opportunity in providing chemical research services (CRAMS) to various National and International Pharmaceutical companies by starting such programs more than 3 decades ago. He showed that there was a viable business model in translating science to service and wealth. In fact he showed the potential of this business model by taking the plunge himself. He founded Avra Laboratories in 1995 after retiring as the Director of the Indian Institute of Chemical Technology (IICT). It is amongst the first companies in India to focus on high-end contract research, custom synthesis of complex chemicals and difficult to manufacture intermediates and APIs.

One example of the innovative technologies developed by Avra is the total synthesis of Irinotecan. This drug is a semi-synthetic derivative of the natural product Camptothecin and used to treat colorectal cancer. Using a 20 step synthesis, Avra has developed a commercially viable process to produce irinotecan and its intermediates with a higher purity at a lower cost. Avra is the first chemical / Pharmaceutical company to receive CSIR Diamond Jubilee Technology Award – 2014 (cash award Rs.10 lakhs) for the process.

Speaker Profile

Rama Rao has trained 112 Ph.D. students. He published more than 260 papers in international scientific journals, developed over 30 process technologies for making life saving drugs more affordable and finally after retiring as Director of Indian Institute of Chemical Technology, built a multi-million dollar pharmaceutical company (Avra Laboratories) with 750 employees. At NCL, Rama Rao worked on the isolation and structural elucidation of plant and insect pigments, and on synthetic dyes. His subesquent work provided amazing achievements in the synthesis of biologically active natural products such as antitumor antibiotics, macrolide, immunosuppressants, cyclic peptides, etc. including Vancomycin representing complexity, diversity and aesthetics of modern asymmetric synthesis.

Rama Rao pioneered the concept of Institution and Industry interaction. He is the first scientist to develop affordable technologies for several essential generic drugs including anti-HIV drugs which enabled the Indian Pharmaceutical Industry to introduce them in the market at one-fifth to one-tenth of the prevailing international prices. Avra Laboratories are located in 4 sites based in Hyderabad and Visakhapatnam. It is amongst the first companies in India to focus on high-end contract research, custom synthesis of complex chemicals and difficult to manufacture intermediates and APIs. Rama Rao has received over 45 awards and honours including "Padma Shri" in 1991 and "Padma Bhushan".

Symposia

K. SIVAN
Chairman, ISRO & Secretary, Dept. of Space, Bengaluru

ISRO Programs, Present and Future Directions and Their Contribution in Nation Building

India's space endeavour is now more than 60 years old. From simple rocket borne scientific instruments flown from the Thumba Equatorial Rocket Launching Station (TERLS), located over geomagnetic equator, the program has grown in several dimensions covering the four verticals encompassing launch vehicles, satellites, applications & space science and capacity building; besides vibrant international cooperation, industrial interface as well as setting up innovative organisational structures. The emphasis on the socio-economic aspects of the Indian space efforts gives it a unique character the likes of which we do not see in the space programs of other countries. Indian Space Program over the years has evolved keeping in line with the vision of Dr. Vikram Sarabhai in ensuring safety, security and enhancing the quality of life people of India. Indian Space Program is structured not only to meet the current national requirements but also to enable India in leapfrogging to next generation space technology. Chandrayaan-2 mission slated for launch in January 2019 and Indian Human Space Flight Programme "Gaganyaan" are the kind of missions which are going to push the envelope of knowledge for future generations. The lecture proposes to cover the state of the art of the above components of India's space program and also provide a glimpse of the futuristic direction in the related activities.

Speaker Profile

Born on April 14, 1957 in Sarakkalvilai, Nagercoil in Kanyakumari district, Tamil Nadu and hailing from a humble family background, Dr. K. Sivan is the Secretary, Department of Space. Besides, he holds the office of Chairman, Space Commission and Chairman, Indian Space Research Organization.

After obtaining Mathematics Honours degree from Hindu College, Nagercoil, Dr. K Sivan graduated from Madras Institute of Technology in Aeronautical engineering in 1980. He took his ME in Aerospace engineering from IISc, Bengaluru in 1982. Subsequently, he completed his PhD in Aerospace engineering from IIT, Bombay in 2006.

He joined ISRO in the year 1982 and since then has contributed immensely in the launch vehicle programs especially during the formative phase of PSLV Project and Development phase of GSLV and GSLV Mk-III. He played instrumental role in flight demonstration of Re-usable launch vehicle technology demonstrator (RLV-TD) and testing of scramjet engines.

He is a Fellow of Indian National Academy of Engineering (INAE), Aeronautical Society of India (AeSI), Systems Society of India (SSI) and Indian Systems Society for Science and Engineering (ISSE). He has received numerous awards – to name a few Tilak memorial award, Dr. Vikram Sarabhai Research award, ISRO Merit award and Dr. Biren Roy Space science award.

He has numerous research publications in reputed national and international journals and co-authored a book "Integrated Design for Space Transportation System" published by Springer.

S. SOMANATH
Director, Vikram Sarabhai Space Centre, ISRO, Thiruvananthapuram

An Outline of the Launch Vehicles Development Plans in ISRO

The core strength of ISRO is the end-to-end capability to envision the space applications requirements for the nation, develop suitable payload and application technologies, integrate and realise appropriate spacecrafts and accomplish the missions using indigenous launch vehicles. Launch vehicles being one of the high technology areas that have grown to the level of mastery in the last four decades. The PSLV, GSLV and GSLV Mk-III launch vehicles provide the strategic capability to launch any types of spacecrafts including remote sensing, communication, navigation, science and exploratory missions. Progressively, the capability has been enhanced in mass of spacecraft, mission accuracy, availability and technology content.

While operational launchers were introduced, technology developments were taking place in demonstration levels which include air breathing scramjet engines, winged re-usable vehicles, re-entry and recovery capsules and new propulsion engines and stages. These new technologies enable ISRO to plan for future new exploratory missions, low cost access to space, re-usability and introduction of green propulsion concepts. The proposal for develop a human rated launch vehicle for 'Gaganyaan' is one such new venture, where the complexity increases in multi-fold and reliability requirements demands new approaches. The application of the new technologies enables ISRO to develop very high thrust semi-cryo and cryo engines, clustering of engines to develop liquid stage boosters, orbital launching and runway landing of winged re-usable vehicles, air breathing and accelerating engines in sustained flights and vertical landing liquid stags with retro propulsion. In the scenarios of high demand for launches from various sectors, the production and launch rates are being enhanced. Low cost quick turnaround launch for small satellites is targeted through SSLV.

Advancements in computational and testing capabilities, materials and manufacturing technologies, miniaturised avionics, redundant high reliable control systems, health management and intelligent algorithms leading to faster engineering solutions and production enhancement from industries for operational and new missions is the present hallmark.

Speaker Profile

Sri S. Somanath is Director VSSC; Director of Liquid Propulsion Systems Centre (LPSC); the Project Director of GSLV Mk-III Launch vehicle, the first Experimental flight of LVM3-X/CARE mission. He joined VSSC in 1985 and was a team leader for Integration of PSLV during its development. As Project Manager of PSLV he handled areas of mechanisms, pyro-technique systems, integration and satellite launch service management. He conceived and executed the first time launches of commercial mini satellites and developed small satellite mounting and separation systems which have since been successfully deployed commercially. Sri Somanath is an expert in system engineering of Launch vehicles. He has been the Deputy Director of the 'Structures' Entity in VSSC and of 'Propulsion and Space Ordnance Entity' in VSSC.

Sri Somanath took his B. Tech from TKM College of Engineering, Kollam and Masters from I.I.Sc., Bengaluru. He is the recipient of the 'Space Gold Medal' from AeSI, the 'Merit Award" and 'Performance Excellence Award' and a 'Team Excellence Award' from ISRO. He is a Fellow of INAE, AeSI, ASI and a member of International Academy of Astronautics (IAA). He is the Vice-President of IAF and AeSI.

P. KUNHIKRISHNAN
Director, URSC, Bengaluru

Satellites, Interplanetary Missions, Technologies and Future Trends

Eversince the concept of artificial satellites coined by Sir Arthur C Clarke was demonstrated, satellites of various sizes in different orbits have established theireffectiveness as a catalyst for development. Satellites have also opened up new vistas of space explorations and have expanded our knowledge about Space and Universe through a number of fascinating interplanetary missions. This has been possible through advances in satellite technology over the years.

Indian Space Programme envisioned by Dr. Vikram A Sarabhai with its modest beginning in the early 1960s laid the strong foundation for building a robust space based infrastructure in the country. More than 100 Indian satelliteslaunched till date is an index to the growth and evolution of Indian Satellite Programme. A host of technologies were developed over the years to build state of the art satellites to meet national requirements.

ISRO'sforay into interplanetary missions started with the launch of Chandrayan-1, followed by the Mars Orbiter Mission (MOM). Chandrayan-2 mission with orbiter, lander and a rover is on course for a launch. Science missions such as Xposat, Aditya etc are also taken up ISRO.

Critical technologies were adopted in the existing in-orbit satellitesand newer technologies are inducted in the recently launched satellites. Innovative technologies are underway in ISRO to realizeHigh Throughput Satellites, satellite constellation with sub-meter imaging capabilities, data relay satellites, human rated orbital capsule, inter-planetary missions etc.

Speaker Profile

Shri P. Kunhikrishnan, is a Distinguished Scientist of Indian Space Research Organization (ISRO) and currently Director, U.R. Rao Satellite Centre (URSC), Bangalore, the lead Centre for the design, development and realisation of all the satellites of Indian Space Programme. Before assuming charge as Director, URSC, he was the Director of Satish Dhawan Space Centre SHAR, Sriharikota, the Spaceport of India, from 1st June, 2015 to 31s t July, 2018. Prior to his taking over as the Director of SDSC, SHAR, he had played significant role as the Project Director of Polar Satellite Launch Vehicle (PSLV Project) from 1st June 2010 to 31st March 2015. During his tenure as Mission Director, 13 consecutive successful PSLV missions were accomplished, adding each of these to ISRO's cherished successes. These include the launch of India's prestigious Mars Orbiter by PSLV-C25. Shri P. Kunhikrishnan joined ISRO in the Systems Reliability Entity of Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram in 1986 after completion of B.Tech in Electronics & Communication from College of Engineering, Trivandrum (CET). Shri P. Kunhikrishnan is the recipient of ISRO Individual Merit Award for the year 2010, Astronautical Society of India (ASI) award for the year 2011, ISRO Performance Excellence Award in 2013, ISRO Team Excellence Award-2013 as Team Leader of PSLV C-25/Mars Orbiter Mission and Swadesi Sastra Puraskar for the year 2015. He is the National President of Indian Society of Systems for Science & Engineering - ISSE, Fellow of INAE and Fellow of AP Academy of Sciences. In recognition of his outstanding contributions, Jawaharlal Nehru Technological University (JNTU), Anantapur, AP has conferred him with Honorary Degree of Doctor of Science in the year 2016. He has also been honoured with the Vigyan Pratibha Samman 2017 by the Government of Madhya Pradesh.

He has represented ISRO in various international conferences and events.

P.G. DIWAKAR
Director, Earth Observation Applications &
Disaster Management Support Program, ISRO HQ, Bengaluru

Space Application Programme, Societal Applications and their Benefits

Space technology based inputs are substantially being used for various national requirements, particularly towards natural resources development and governance related applications in the country. Geospatial technologies, remote sensing, satellite communication and navigation systems are providing many new ways for effective management of natural resources. This has resulted in enabling variety of data and information products for societal benefits and also helping planners and decision-makers to embark upon unique people-centric services. Considering the power of space technology, the government has effectively adopted this to ensure unique services to the common man and at the same time it is used for scientific planning, monitoring and management purposes. Web-Geoportal and mobile technologies (Bhuvan geoportal) are other popular platforms, being used by Governments, to provide information services and solutions at all levels, which are proving to be most effective. Not only the common man, even the Government system has learnt to adopt to such technologies for the benefit of people at large. ISRO works closely with a large number of Central and State Government departments/ ministries, Industry and Academia in ensuring best of solutions for optimal management of Natural Resources, while enabling solutions for Governance and society at large. Through a well-coordinated effort, this system has been able to provide several important applications that are touching human lives today.

Speaker Profile

Dr. P.G. Diwakar, is a PhD in "Participatory Geomatics", from National Institute of Technology (NITK), Suratkal. His Research interests include Digital Image Processing, He has been in ISRO for the past 34 years and has worked as – Head, Regional Remote Sensing Centre, Bengaluru (2003-2009); – Associate Director, Earth Observation Systems (2009-2011); – Programme Director, Earth Observation Systems and Disaster Management Support Program, ISRO (2011-2013). – Deputy Director, National Remote Sensing Centre, Hyderabad, ISRO (2013 – 2016); – Scientific Secretary, ISRO, Bengaluru (2016 – 2018).

He has been recipient of a) ISRO Team Excellence Awards for 4 major ISRO programs (2009 – 2010) [i) Bhuvan Geoportal, ii) Crop Acreage & Production Estimation, iii) Village Resource Centres , iv) Water Resource Information System]; b) ISRO Merit award - for innovative use of technologies for user services (2010); c) Astronautically Society of India (ASI) Award for Development of "Bhuvan Geoportal" (2010); d) National Gold Award for "Innovative usage of technology and e-Governance". (2009); e) Globe Forum award "Globe Sustainability Research Award 2010", Stockholm, Sweden, innovative technologies for rural development; f) Geospatial Excellence Award, Kaulalumpur, Malaysia – 2010; g) World Bank Best Practices Award – 2011 for Monitoring & Evaluation of watershed Project in Karnataka; h) National Geospatial Award, Indian Society of Geomatics – 2014; i) ISRO-ASI Award for "Space Science & Applications", 2016 and j) Fellow of Indian Society of Remote Sensing, 2016.

He has published over75 papers.

DEEPAK PENTAL
Centre for Genetic Manipulation of Crop Plants, University of Delhi South Campus, Delhi

Transgenic Technologies for Low-input, High-output Agriculture

The global population in 1900 was around 1.6 billion – today it is around 7.3 billion and predicted to plateau out at 10 billion. Under-nutrition is still rampant in many parts of the world. There is over exploitation of natural resources for agricultural production and small farmers face threat to their livelihoods. We need a low-input, high-output agriculture, low-input both in terms of natural resources and economic costs. Every major crop has a number of diseases and pests which either require chemical control or gene based solutions. Fortunately, there are new developments in plant sciences – genomics, molecular markers and transgenics (GE crops). These technologies coupled with better resource management can hopefully meet the challenge. Use of the GE technologies is under attack of environmentalists and ideologues of many hues. While a call for caution in using new technologies is understandable, rejection of the new technologies is foolhardy. The GE technologies hold great promise in achieving low-input, high-output agriculture. This point will be illustrated with examples of what has been achieved and what is possible if a more conducive environment is created for R&D in agriculture.

Speaker Profile

Deepak Pental has been a Professor of Genetics at the University of Delhi South Campus till 2016. From 2005-10 he served as the Vice-chancellor of University of Delhi. His research interests are in breeding of oilseed mustard and cotton using both conventional and genetic engineering technologies. His group has published 94 research papers in peer reviewed journals and received a number of national and international patents. He is an elected member of the National Academy of Agricultural Sciences, the National Academy of Sciences, the Indian Academy of Sciences and the Indian National Science Academy and recipient of many awards which include – Om Prakash Bhasin Award in 2008, FICCI award in 2010, D.Sc (hc) from the University of Nottingham in 2012, J. C. Bose Fellowship of DST in 2009 and 'Life Time Achievement Award in Agriculture' by Mahindra and Mahindra foundation in 2018. He is currently a CSIR-Distinguished Scientist.

RAJEEV K. VARSHNEY

Center of Excellence in Genomics and Systems Biology, RP-Genetic Gains, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, Hyderabad, India

Translational Genomics for Agriculture: some Examples in Grain Legumes

Legume crops such as chickpea, pigeonpea and groundnut contribute to livelihood as well as human nutrition and are mostly grown in semi-arid regions in India and many Asian and African countries. Exposure of these crops to different biotic/abiotic stresses in marginal environments results in low crop productivity. Recent advances in sequencing, automation/robotics and computational biology have started an era of –omics sciences in legumes. A number of –omics approaches have been deployed to understand the genome architecture, genome diversity and complexity of trait. Modern trait mapping approaches have been used to map a number of agronomic traits. Molecular markers and genes identified through various approaches have been used to enhance precision and efficiency of breeding programs. A number of legume lines with improved traits related to production constraints as well nutrition developed through molecular breeding are in advanced stage of field trials under ICAR-AICRPs. In summary, our efforts highlight the role of translational genomics for improving agriculture in India and elsewhere. In my opinion, accelerated and coordinated efforts in the area of translational genomics as well as fast-track release policy of molecular breeding products in combination of better agronomy will be helping delivering faster genetic gains in farmers fields.

Speaker Profile

Rajeev Varshney, Research Program Director, Genetic Gains & Director, Center of Excellence in Genomics and Systems Biology at ICRISAT, has >15 years research experience in international agriculture. In his dual appointment earlier, he served CGIAR Generation Challenge Program as Theme Leader for six years. Before joining ICRISAT, he worked at IPK-Gatersleben, Germany for five years. He is recognized as a leader in applied genomics, genomics-assisted breeding and translational genomics for agriculture. He has genome sequences of 9 crops including pigeonpea, chickpea, peanut and pearl millet and several molecular breeding products in chickpea, peanut and pigeonpea to his credit.

Varshney is an elected fellow/ member/ academician of Leopoldina- German National Academy of Sciences, The World Academy of Sciences, American Association of Advancement in Sciences, Crop Science Society of America (CSSA), American Society of Agronomy, Indian National Science Academy and several other Indian science academies. Varshney has received the Bhatnagar Prize, the most coveted science and technology award from Government of India. He is recipient of numerous prestigious awards including Qilu Friendship Award from Shandong Province of Republic of China, the Young Crop Scientist Award of CSSA, the Illumina Agricultural Greater Good Initiative Award, Research Excellence India Citation Award of Thomson Reuters.

T.R. SHARMA
Executive Director, National Agri-Food Biotechnology Institute (NABI), Mohali, Punjab

Plant Pathogen Interaction - Developing Disease Resistant Plants

Plant diseases cause billion-dollar annual yield loss, and in some instances, these losses have severe consequences for human race leading to famine. One of the most convenient, inexpensive, and environmentally safe ways of plant disease management is to deploy disease-resistance varieties in different agro-climatic zones of India. Development and deployment of varieties is the classical example of rust management in wheat during post-independence India. Similar examples of disease management through host resistance also exist in some of the important food security crops including maize and rice. Rice is mainly affected by rice blast, sheath blight and bacterial leaf blight. Rice blast caused by a fungal pathogen Magnaporthe oryze is one of the important diseases of rice which follows a typical gene-for-gene hypothesis involved in host-pathogen interaction. More than 27 genes for resistance to rice blast pathogen M. oryzae have been cloned during the past 18 years. Of these, we identified a new gene Pi54 in rice line Tetep and isolated it by using positional cloning approach. Functional complementation of the gene has confirmed its stable and high-level of resistance against geographically diverse strains of M. oryzae. We further showed that, the single Pi54 gene regulates a complex defense response mechanism against M. oryzae in rice. Even change in physical position of the gene within the genome does not affect its phenotype. We also cloned and characterized pathogen avirulence gene AvrPi54 from an avirulent strain of M. oryzae. We showed that resistance protein Pi54 physically interacts with Avr-Pi54 protein of the rice blast pathogen M. oryzae. Many alleles of Pi54 gene have also been mined from rice land races collected from different parts of India. The Pi54 blast resistance gene has been extensively used in rice breeding programmes for developing blast resistant rice varieties using marker assisted selection in India and other countries of the world.

Speaker Profile

Dr. T.R. Sharma, Executive Director, National Agri-Food Biotechnology Institute (NABI) (An autonomous Institute of Department of Biotechnology, Govt. of India), Mohali, Punjab For his outstanding research contributions Dr. Sharma has been Awarded various awards like; University Gold Medal and Certificate of Honour in Ph.D, 1990, Young Scientist Award, NAAS, 1998; ICAR Young Scientist Award (Crop Sciences), 1999; Prof. Umakant Sinha Memorial Award in Biochemistry, Biophysics and Biotechnology, Indian Science Congress Association, 2001; International World Technology Award for Biotechnology (jointly to Int. Rice Genome Sequencing Team) in 2003, DBT National Bioscience Award for Career Development, 2007. NAAS Recognition Award 2008; VASVIK Award 2011, Rafi Ahmed Kidwai Award-ICAR, 2011, NASI-Reliance Industries Platinum Jubilee Award, 2013, J C Bose National Fellowship, 2013 and Prof. MGK Menon Lecture Award (NASI) 2017., Prof. Bishan Singh Samundari Memorial lecture award (Guru Nanak Dev University Amritsar) -2017-18 and Prof. K.S. Bilgrami Memorial Medal (INSA)-2018.Dr. Sharma is the fellow of Indian National Science Academy, National Academy of Sciences and National Academy of Agricultural Sciences. His major research interests are in the areas of Genomics and plant disease resistance. Dr. Sharma has contributed extensively to the improvement of rice for over 25 years and cloned and deployed rice blast resistance gene Pi54 in different rice varieties. Dr. Sharma has published more than 130 research papers, filed six Indian patents and associated in the development of two rice varieties Pusa 1637 and HPR2880.

M.L. JAT

Principal Scientist/Systems Agronomist, International Maize and Wheat Improvement Center (CIMMYT), NASC Complex, New Delhi

Conservation Agriculture Based Sustainable Intensification: The Future of Food and Farming

Indian sub-continent particularly agriculture is highly vulnerable to climate change and has emerged as Global Hotspots. It is a paradox that though the region enjoys high economic growth, at the same time suffers from extreme poverty, undernourishment, and the deterioration of its natural resources. The natural resources in India specially in, 'The Green Revolution Corridors' of the region are severely constrained due to mounting pressure to produce more for more population. Conservation agriculture (CA) based sustainable intensification adopted over 180 million hectare have paid dividends across globe for making agriculture more efficient and sustainable, arrest land degradation, protect natural resources and produce more from less without negative environmental externalities. In India, CA based sustainable intensification practices have been researched and deployed to address many of these challenges. Numerous direct and indirect effects of CA notably on crop yields, resource (labor, water, energy) use efficiencies, timeliness of cropping practices, soil quality and ecosystem services have been reported. These directly & immensely contribute to United Nations (UN) Sustainable Development Goals (SDGs) while ensuring sustainable food and nutrition to growing population and making agriculture resilient. In this presentation, I will share the research advancements and impacts of Conservation Agriculture based sustainable intensification in India

Speaker Profile

M.L. Jat is a Principal Scientist/Systems Agronomist at the International Maize and Wheat Improvement Center (CIMMYT) have devoted two decades to intensively work and promote sustainable agriculture and management of natural resources for increasing food security and environmental quality in smallholder systems of South Asia. His major areas of expertise comprised of basic and applied science in agronomy, soils and environment centred around conservation agriculture (CA) and climate smart agriculture (CSA). His research has provided scientifically sound basis and directions for increasing input use efficiency (water, nutrient and energy) and farmers' profitability, while improving soil health and reducing environmental footprints. Dr. Jat's team has also contributed significantly to the development, refinement and scaling of several scale appropriate CA machinery which are used by large number of farmers over millions of hectare across diverse farm typologies. His efforts on Conservation Agriculture Innovations for Development (CAI4D) and CSA have led to policy level impacts, notably the residue management and laser land levelling. He has been on forefront in capacity development to develop new cadre of researchers across the Asian Countries. Research results of his group have been well documented in over 100 peer reviewed high impact journal articles. A Fellow of National Academy of Agricultural Science (NAAS), Dr. Jat has several prestigious awards and recognitions to his credit.

INDER ABROL and RAJ GUPTA
Centre for Advancement of Sustainable Agriculture, Pusa Campus, New Delhi

Indian Agriculture-Future Growth Sources

Evidences bring out that strategies centered on the use of external inputs to exploit higher yield potential of dwarf crop cultivars in regions of assured irrigation are increasingly proving inadequate to sustain past gains and drive future productivity increases. Productivity gains in the high rainfall eastern India and the rainfed dry lands are limited and food production continues to depend on summer monsoon rainfall. Increasing environmental problems are exacerbating resource degradation. New challenges call for a basic change in the way agricultural research problems are defined, prioritized and addressed. Future production systems will have to be more intensive, diversified and better aligned to sustainable use and management of natural resources. This calls for improved practices aimed at: (i) enhancing the effectiveness and use efficiency of monsoon rains, (ii) carbon management to improve and sustain soil health and ecosystem functioning, and (iii) adapting diverse cropping systems/ gene pool to make best use of specific nutrient, moisture and thermal regimes of the soils in different agro-ecologies and also enable crops to respond to external inputs. Farmer centric approaches integrating concerns of productivity, resource conservation and adaptation to climate change is the way forward.

Speaker Profile

Soil scientist by training, Dr. Abrol's researches have contributed significantly to the understanding and management needs of salt affected soils of the Indo-Gangetic Plains. His researches led to initiation of several land reclamation efforts in the country. He served as Chairman, Commission on Salt Affected Soils of the International Union of Soil Sciences (IUSS) and also as President of the International Soil Conservation Organization (ISCO). Dr. Abrol steered the national research programs in the area of natural resource management in the country as Deputy Director General of the Indian Council of Agricultural Research (ICAR). He was responsible for leading a CGIAR eco-regional program on Rice-Wheat systems in South Asia for 5 years. He has served as Member of the Scientific Committee of IGBP and was recently elected as Honorary Member of the International Union of Soil Sciences. He has been President of the Indian Society of Soil Science and a Vice-President of the Academy.

Y. NARAHARI
Indian Institute of Science, Bengaluru

The AI Tsunami

AI-enabled systems are beginning to revolutionize fields such as commerce, healthcare, agriculture, transportation, brain research, and cyber security, and, have the potential to impact nearly all aspects of our society. The AI tsumani that is sweeping across the world presents an excellent opportunity for India to emerge as a global leader in AI. For this to happen, it is critical that India focuses on carefully thought out AI initiatives rather than on routine problems or AI services. This talk provides an introduction to the promise and potential as well as issues and challenges in the context of AI.

Speaker Profile

Y. Narahari is currently a Professor at the Department of Computer Science and Automation, Indian Institute of Science, Bengaluru. He is also heading the Division of Electrical, Electronics, and Computer Sciences. The focus of his research in the last decade has been to explore problems and applications at the interface of computer science and game theory. He has recently brought out a textbook entitled "Game Theory and Mechanism Design" (IISc Press and World Scientific) that explores game theory in the context of modern AI applications. He is a fellow of INSA, IASc, NASI, INAE, and IEEE and a J.C. Bose National Fellow. More details at: http://lcm.csa.iisc.ernet.in/hari/

SANGHAMITRA BANDYPADHYAY
Indian Statistical Institute (ISI), Baranagar, Kolkata

Artificial Intelligence Methods for Biological Data Analysis

Over the past few decades, major developments in the field of biology coupled with advances in various omics technologies, e.g., genomic, transcriptomic, proteomic, as well as in imaging technologies have led to an explosive growth in the biological information generated by the scientific community. This necessitated the use of innovative computational approaches for analyzing biological data in order to better understand the cellular processes, disease biology and make discoveries. Computational biology and bioinformatics, areas that evolved in response to this challenge, can be viewed as the development and use of computational methods to analyze biological data. The volume, variety and complexity of the data, and the biological questions posed made the use of artificial intelligence and pattern recognition techniques immensely popular in this domain. Feature selection, classification, clustering, subspace clustering, outlier detection, optimization all play major roles in modeling and analyzing biological systems.

The interface between biology and computer science has reached a phase where on one hand, advanced technology is challenging developers of algorithms to help analyze the data generated, and on the other, the computational scientists are designing methods based on biological principles to solve difficult problems. The synergistic relationship between biology and computer science is destined to grow at an amazing pace, benefiting both the disciplines immensely.

In this talk, we will provide an overview of molecular biology and bioinformatics. This will be followed by the description a few specific biological problems where applications of artificial intelligence and other computational techniques have been successful.

Speaker Profile

Sanghamitra Bandyopadhyay joined the Machine Intelligence Unit of the Indian Statistical Institute as a faculty member, after completing her PhD from the same Institute in 1999. She is currently the Director of the Institute. Her areas of research interest include computational biology and bioinformatics, soft and evolutionary computation, pattern recognition, and data mining. In these areas she has published more than 300 research articles in various journals, conferences, and edited volumes. She has published six authored and edited books from publishers like Springer, World Scientific and Wiley. Sanghamitra has worked in various Universities and Institutes world-wide including in USA, Australia, Germany, France, Italy, China, Slovenia and Mexico, and delivered invited lectures in many more countries. She has received several awards and fellowships including the Bhatnagar Prize, Infosys Prize, TWAS Prize, DBT National Women Bioscientist Award (Young), INAE Silver Jubilee Prize, Young scientist/engineer medals of INSA, INAE and Science Congress, JC Bose Fellowship, Swarnajayanti Fellowship and Humboldt Fellowship. She is a Fellow of INSA, INAE, NASI and IEEE. She is currently a member of the Science, Technology and Innovation Advisory Council of the Prime Minister of India.

VIJAY CHANDRU
Strand Life Sciences, Bengaluru

The Unreasonable Effectiveness of Machine Learning in the Sciences of the Artificial

"The Unreasonable Effectiveness of Mathematics in the Natural Sciences" is the title of an article published in 1960 by the physicist Eugene Wigner and has been often used to justify work in abstract mathematics. In this talk, the speaker will examine an analogous statement about the claims being made about the ubiquitous use of machine learning and its application in solving decision problems in man-made systems. This will take us on a journey of the history of the decision sciences, the power of machine learning and the challenge of backing a one trick pony for problem solving. The talk will also present the subtle interplay between artificial intelligence, intelligence augmentation and intelligence infrastructure.

Speaker Profile

Vijay Chandru had his formal training in Electrical Engineering (BITS, Pilani), in Systems Engineering (UCLA) and in Operations Research (MIT). He has had over three decades of experience in academia and industry. A fellow of IASc, INAE and Operational Research Society of India, his academic career in computational mathematics was at Purdue University (1982-92) and the Indian Institute of Science (IISc) since 1992. He has held visiting positions at University of Pennsylvania, IBM Watson Research Center, MIT and Stanford University.

A technology entrepreneur, he was one of the inventors of the award winning Simputer® and currently serves as the Founder Director of Strand Life Sciences, both spinoffs from IISc. Strand Life Sciences, which he led from 2001 to 2017, is now India's leading precision medicine company and specialty clinical diagnostics company with 27 labs and 850 employees across India. Vijay was named a Technology Pioneer of the World Economic Forum in 2006 and awarded the President's Medal of INFORMS the same year. In July 2018, Vijay was appointed as a national distinguished technologist at the Indian Institute of Science. He serves on the Karnataka State vision group and council for Science and Technology as well as Biotechnology.

PRADEEP MUJUMDAR
Indian Institute of Science, Bengaluru

AI Applications in Hydrology and Water Resources

Hydrometeorological extremes of floods and droughts have, in recent years, emerged as major disasters in recent years, in the country. The Kedarnath floods of 2013 and 2014, Chennai floods of December 2015, Kerala floods of 2018 and the Marathwada drought of 2015-16 are some recent episodes that have caused enormous damage to human life and property. Recurring urban floods in all major cities along with frequent droughts in large regions of the country call for scaled up technological interventions to mitigate their impacts. Additionally, the impending water crisis due to depleting water resources and increasing demands pose a challenge to water management at different temporal and spatial scales. Forecasting the hydrometeorological extremes and real-time operation of water systems thus gains importance. The Artificial Intelligence (AI) tools of machine learning and its subset of deep learning, combined with big data analytics and Internet of Things (IoT) offer an enormous opportunity to address the critical problems related to the extremes in particular and water security, in general. This brief presentation provides an overview of the applications of AI to problems related with flood forecasting, agricultural water management, real-time reservoir operation and water quality monitoring. These are emerging applications with a huge potential for the Indian research community to contribute significantly towards addressing the critical water issues in the country.

Speaker Profile

Prof. P.P. Mujumdar is currently serving as a Professor in the Department of Civil Engineering and as Chairman, Interdisciplinary Centre for Water Research, at the Indian Institute of Science, Bengaluru. His area of specialization is Water Resources with a focus on climate change impacts on hydrology/water resources, statistical downscaling of GCM outputs, urban flooding, planning and operation of large scale water resources systems, and uncertainty modeling. He is a recipient of the Alexander von Humboldt Medal of the European Geosciences Union (EGU) and the Distinguished Visiting Fellowship of the Royal Academy of Engineering, UK. He is a member of the Editorial Board of the journal Advances in Water Resources, and has been serving as a member of several state and national committees dealing with urban flooding, and operational and environmental aspects of water resources in India. He is a Fellow of INSA, IASc, and INAE.

PRADEEP MUJUMDAR
Indian Institute of Science, Bengaluru

Water Futures: The Indian Narrative

As the country stares at an impending water crisis today, the science community needs to take a serious view of the emerging signals of the crisis: Large stretches of our rivers are polluted beyond acceptable levels, most cities and towns face water shortage every year, sizable sections of the population do not have access to safe drinking water, overexploitation of groundwater has put water resource to stress accross the country. Contaminated surface and groundwater has posed health problems; rapidly vanishing water bodies have diminished the resilience of water systems, low efficiencies of irrigation water use implies significant wastage of water and poor water management practices and policies have combined to create the water crisis. An unprecedented and accelerated urbanisation has also posed challenge for urban water management. Increased frequencies of floods and droughts across the country neccesitate scientific and evidence based policies.

The scientific community needs to provide a clarity on the impending stresses on water systems due to the large scale human interventions through changes in climate, landuse, demography and the rapid socio-economic development, to help evolve scientifically sound understanding of the future of water resources in the country.

This session will provide an overview of the current state of scientific understanding of the response of water systems to various anthropogenic forcings, with discussion on some specific issues relevant to India.

Speaker Profile

Prof. P.P. Mujumdar is currently serving as a Professor in the Department of Civil Engineering and as Chairman, Interdisciplinary Centre for Water Research, at the Indian Institute of Science, Bengaluru. His area of specialization is Water Resources with a focus on climate change impacts on hydrology/water resources, statistical downscaling of GCM outputs, urban flooding, planning and operation of large scale water resources systems, and uncertainty modeling. He is a recipient of the Alexander von Humboldt Medal of the European Geosciences Union (EGU) and the Distinguished Visiting Fellowship of the Royal Academy of Engineering, UK. He is a member of the Editorial Board of the journal Advances in Water Resources, and has been serving as a member of several state and national committees dealing with urban flooding, and operational and environmental aspects of water resources in India. He is a Fellow of INSA, IASc, and INAE.

VEENA SRINIVASAN

Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Srirampura, Jakkur, Bengaluru

Human Alterations of Catchment Processes: Understanding the Cauvery Conflict

Achieving water security and mitigating water conflicts in India requires predicting water future availability. But the combination of rapid change, inadequate data and human modifications to watersheds pose a challenge, as researchers face a "poorly constrained" water resources modelling problem.

The case study of the upper Arkavathy catchment, located in the outskirts of Bengaluru in the Cauvery basin, we explain the observed disappearance of surface and groundwater in recent decades. Using primary data collected by an interdisciplinary research team and a multi-scale modelling approach, the study reconstructs the history of the watershed and attributes the observed change to anthropogenic and climatic drivers. The research insights are then upscaled to the whole basin, to understand the wider Cauvery conflict.

Speaker Profile

Veena Srinivasan is a Fellow at the Ashoka Trust for Research in Ecology and the Environment (ATREE), Bengaluru, where she leads the Water, Land and Society Programme. Veena's research interests include inter-sectoral water allocation and conflict transformation, impacts of multiple stressors on water security, ground and surface water linkages, low-cost sensing and citizen science, and sustainable water management policy and practice.

Veena was recently appointed to the Strategic Advisory Group for Monitoring SDG6 by UN-Water. She has won several awards including the 2015 Jim Dooge Award for best paper in Hydrology and Earth System Science from the European Geophysical Union and the 2012 Water Resources Research Editor's Choice Award from the American Geophysical Union. She currently hold the Prins Claus Chair in Netherlands and is a recipient of the Teresa Heinz Environmental Scholars Award.

Veena received her PhD from Stanford University's Emmet Interdisciplinary Program in Environment and Resources (E-IPER). As a post-doctoral scholar at Stanford, she helped establish the Global Freshwater Initiative. Prior to joining Stanford, Veena worked for several years on energy and water issues globally in the private and non-profit sectors. Veena holds a Masters in Energy and Environmental Studies from Boston University and a B-Tech in Engineering Physics from the IIT, Bombay.

M. SEKHAR
Indian Institute of Science, Bengaluru

Adaptation of Irrigated Agriculture under Global Changes

In India, the development of groundwater irrigation contributed largely to the increase of agricutural production, but caused tremendous impacts on water resources and ecosystems. Assessing the sustainability of agricultural systems under climate change has become critical. We present a multidisciplanary approach, based on co-design and assessment of scenarios with an integrated model, to help stakeholders to adapt farming systems to climate change. The research involves i) the development of novel methodologies to gather information on soils, land use, crop and hydrological variables at high spatial and temporal resolution by using both ground and multi-satellite data ii) the development and calibration of a biophysical model based on a thorough study of water and nutrient cycles in tropical irrigated agro-systems iii) the development of a participatory approach to build and assess scenarios of adaptation to climate change

Speaker Profile

Dr. Sekhar Muddu isvq Professor in the Department of Civil Engineering and is an associate faculty in the Interdisciplinary Centre for Water Research & Centre for Infrastructure and Sustainable Transport. He is a member of Indo-French Cell for Water Sciences. His research interests are groundwater hydrology, agro-hydrology, satellite and urban hydrogeology. He in particular worked on modeling the groundwater systems in hard rock aquifers of South India and carried out integrated geochemical & hydrological studies in nested experimental watersheds in the Kabini river basin. He has been the principal investigator from the Indian side of the long-term Kabini CZO , which includes Mule Hole forested experimental catchment monitored since 2002. He leads Indian team developing a framework for spatially distributed agro-hydrological model using field experiments & remote sensing in nested watersheds in South India under Indo-French project "Adaptation of irrigated agriculture to climate change". He is on the editorial board of the Proceedings of Institution of Civil Engineers - Water Management, UK and serves on several state- and national- committees dealing with operational & management aspects of groundwater resources in India.

SUBIMAL GHOSH
Indian Institute of Technology, Bombay

Hydrologic Simulations of Human-Natural Systems: Simple Vs Complex Models

Hydrologic simulations deals with the portioning of water coming from atmosphere to land surface, in terms of precipitation, to Evapo-Transpiration (ET), infiltration and runoff. Such partitioning is affected by climatic conditions (Aridity Index, ratio to Potential ET to Precipitation) and river basin characteristics. This is considered in state-of-art Budyko framework, the simplest form of hydrologic modelling. Budyko framework also helps to understand the dominating attributes based on observed data. Such a framework works well for a natural system. The present-day hydrologic system is a human-natural system, where human interventions, resulting from changing climatic conditions, affect the basin characteristics. Increasing aridity results into increase in irrigation that in turn affects the hydrological processes. Climatic change may result into changing properties of vegetation, such as stomatal closure that leads to changing ET. Hence, aridity index and basin characteristics are no longer two independent factor and there is a need to consider such hydrologic system with an emphasis to each and every factor with their inter-linkages. The new generation land surface model incorporates dynamic vegetation, human intervention etc., however; still the Budyko framework has its own importance in term of quick diagnosis of changing hydrologic system.

Speaker Profile

Dr. Subimal Ghosh is an Associate Professor in Climate Studies and Water Resources Engineering at IIT Bombay. He specializes in hydro-climatology, regional climate modelling, understanding of Indian Monsoon and its variability, mesoscale hydrological modelling, water resources systems and simulating land surface feedbacks to climate. He is a lead author of IPCC assessment report 6 and a member of the Editorial Board of Journal of Earth System Science. He has around 70 journal publications, which include Nature Climate Change, Nature Communications, Geophysical Research Letters. He is Principal Investigator /Co-Investigator in numerous sponsored research projects funded by Ministry of Water Resources and Ministry of Earth Science and other agencies. He is the recipient INSA Young Scientist Award, NASI Young Scientist Award, INAE Young Engineer Award, ISCA Young Scientist Award, among others.

V.M. TIWARI
NGRI, Hyderabad

India's Water Futures: Need for Coupled Surface and Groundwater Hydrological Model

Terrestrial water is only 1% of the total amount of water on Earth, however, it has crucial bearing on terrestrial life, human needs, and climate variability. Quantifying the various components of the hydrological cycle in the changing climatic scenario is paramount in order to meet the future water demand. In India, groundwater remains to be mainstay of agriculture. Groundwater aquifer system in India is diverse due to highly diversified hydrogeologic set-up and requires comprehensive knowledge of the sub-surface, which can be prepared through geophysical mapping. An integrated hydrologic model with inclusion of groundwater aquifer geometries and properties would greatly improve the possibility of providing sustainable water management plan at small scale. This will be discussed through an example.

Speaker Profile

Dr. Virendra M. Tiwari is the Director of CSIR-National Geophysical Research Institute (NGRI), a premier institution for Geoscience research at Hyderabad. Dr. Tiwari studies the lithospheric structure and geodynamics of the Indian tectonic plate through detailed exploration of different geological terrains, mainly by way of gravity and magnetic methods and insightful interpretations of multi-parametric geophysical and geological data. Dr. Tiwari is credited with the initiation of a range of gravimetric studies deploying state-of-the-art concepts and methodologies having considerable societal and scientific impact. Amongst these, a very significant work has been the quantification of extreme water loss ascribed to over exploitation in the north Indian region. Dr. Tiwari has worked towards quantification of subsurface water mass distribution and transport; estimation of effective strength of lithosphere; providing of extent of under-thrusting of Indian crust and crustal eclogitation under Himalaya and southern Tibet; development of a model for localization of large thrust earthquakes in the Sunda-Andaman Subduction zone; initiation of precise absolute gravity measurements and airborne gravity gradiometry; and preparation & publication of Gravity Map Series of India-2006. Along with his research group, he has contributed significantly to the important R&D projects for the Oil and Mineral Industries in India.

AMIT GHOSH
N.I.C.E.D., Kolkata

Evolving Guidelines for Best Practices in Science Research and Academics- Efforts by Indian National Science Academy

The Indian national Science Academy (INSA) has periodically been bringing out policy recommendations to serve as advice to the government. It has taken cognizance of ethical aspects of science practice in all aspects. There is a separate committee on ethics charged with the responsibility to discuss and bring to the attention of Fellows and other scientists need for charting out action programs. In this context a discussion meeting on ethics of science was convened in New Delhi. It was proposed to bring out a stand-alone document. Any prospective authors, both from among those who attended the meeting and some others who did not were assigned topics and requested to submit articles. These were edited multiple times. After approval from respective authors, these were compiled into a book. Recommendations arising from individual articles were culled into a separate chapter. It is not a comprehensive document. Many issues could not be discussed for want of time. However, some of these, for example, animal and medical ethics in clinical practice and research, have been written about by specialized academic bodies. INSA itself, had earlier brought out a document on ethics in use of animals in research and education. We are confident that these guidelines will continue to evolve and be sensitive to all stakeholders. In this symposium, few of the authors will discuss specific aspects. We are hoping for such discussions to feature on a continuing basis during anniversary meetings of INSA to evolve a document more comprehensive than the present one.

Speaker Profile

Dr. Amit Ghosh Ph.D. (Physics) University of Calcutta 1975, Post-doctoral from U. Rochester, Rochester and U. Wisconsin, Madison, USA 1976-1982.

Dr. Ghosh's primary research interest is the molecular biology and epidemiology of diarrhoeagenic pathogens, with particular emphasis on Vibrio cholere, the causative agent of the disease cholera and its viruses. He and his associates at IMTECH in collaboration with scientists at IICB and NICED, Kolkata, have developed an oral recombinant vaccine for cholera using a novel strategy, the first of its kind to be developed anywhere outside USA. His group's work on the molecular epidemiology of cholera has provided one of the first clues on how new clones of V. cholerae can possibly emerge. To date he has published ninety seven scientific papers and has four patents.

Awards and Honours: Dr. Ghosh is a recipient of the 1998 Ranbaxy Award 2000, CSIR Shield for Process Technology (Team Member) (2002), Lifetime achievement Award of the Biotechnology Research Society of India and the Life Time Acheivement Award of the Association of Microbiologists,India, 2016.His other honours include Membership of Sigma¬Xi, Scientific Research Society of North America, Science Congress Platinum Jubilee Lecture (2005), 2006 Prof. B.K. Bachhawat Memorial Lecture at NIPGR, 4th Prof. B.K. Bachhawat Memorial Lecture, JNU (2009), Professor Sibte Hasan Zaidi Oration of ITRC (now, Indian Institute of Toxicology Research), Lucknow and CSIR Foundation Day Lecture at IICB, Kolkata in 2015. Fellowship of the Indian National Science Academy (INSA) Delhi, National Academy of Sciences, Allahabad, Indian Academy of Sciences, Bengaluru, Biotechnology Research Society of India and West Bengal Academy of Science and Technology.

He published 97 Publication with 4 patents.

KAMBADUR MURALIDHAR
University of Hyserabad, Hyderabad

Ethics in Science Research and Education-A Perspective

Ethics in the practice of science has been discussed by many concerned scientists and sociologists. The number of reported cases of such misconduct has increased alarmingly in recent past. The increased misconduct in all aspects of practicing, organizing, communicating, and funding of research and education in science has drawn the attention of policy makers, practioners and concerned educated layman. A historical perspective leads us to speculate that this aberrant behavior could be due to both the way science is organized and practiced and possibly, to perceived and real cultural and philosophical conflicts in the minds of the practioners. Professional ethics has to be defined and put into place by professional guilds and academic bodies. INSA has been taking initiatives in formulating guidelines for selected aspects of scientific research like use of animals in biomedical research, publishing scientific findings, and others. A standalone document summarizing recommendations on all aspects of ethics, however has not yet resulted. Such a document is also important for public understanding of science policy and practice. Organizations like society for scientific ethics have done commendable job in this area. What is urgently needed is the establishment of an Offices for Scientific Integrity in all scientific and educational institutions including funding agencies. Professional misconduct cannot be left to the sense of morality of individual scientist or academician nor can it be subject to judicial scrutiny like crime and punishment. As science is another philosophy of life in search of Truth, the casualties of unethical practices are both 'excellence' in science and 'Truth' itself in a broader level. These selective aspects of ethics will be discussed in the presentation.

Speaker Profile

Prof. Kambadur Muralidhar is a distinguished endocrinologist in the country. He has established a Hormone Research Laboratory in the University of Delhi as part of the National Buffalo Embryo Transfer Technology Programme and has developed technologies for producing all the native and recombinant hormones and their monoclonal and poly clonal antibodies indigenously, thus achieving self-sufficiency in buffalo endocrinology. He is an outstanding and inspiring teacher who contributed and set standards in Biology education at the school, undergraduate and post-graduate levels. (E-mail: kambadurmuralidhar@rediffmail.com).

PRAVEEN CHADDAH
Idea Plagiarism and Ethics, Gurugram

Ethics in Publication

Publication is initiated after research is completed, and we are ready to inform our peer group about our new findings. Fabrication, falsification and plagiarism (FFP) are three forms of unethical behaviour that can occur at this stage, and must be scrupulously avoided by all researchers. We shall briefly outline these three types of ethical misdemeanours which should definitely be condemned, even if they are not yet legally punishable.

Plagiarism is defined as 'the appropriation of another person's ideas, processes, results, or words without giving appropriate credit'. There is a perpetrator in form of the authors who steal credit, and there is a victim in the author(s) whose credit is stolen.

Various institutional mechanisms are being put in place in India to 'punish' any perpetrator of plagiarism of words. As active researchers in India are encouraged to move from confirmatory research to incremental research, and further to path-breaking research, the role of ideas becomes more important than the role of words in our research papers. In this talk I look at the plight of the victims of plagiarism, and suggest methods to avoid becoming victims. I talk about the little protection or support victims of idea-plagiarism presently have, and what recourses they should have.[1]

[1] Chaddah, Praveen (2018). Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN: 978-9387480865

Speaker Profile

Praveen Chaddah is a condensed matter physicist who worked on solid helium, superconductors, and 'broad and interrupted first order phase transitions' of magnetic materials. His contributions on the last topic have been highlighted in his recent book "First order phase transitions of magnetic materials: broad and interrupted transitions".

He was with DAE during 1973-2013, and was the Director of the UGC-DAE Consortium for Scientific Research during 2005-2013. He is a Fellow of INSA, of IASc and of NASI.

He has been vocal about increasing the visibility of Indian research and reforming methods of research dissemination, and has written extensively about plagiarism, including in his book "Ethics in competitive research: do not get scooped; do not get plagiarized"

SUNIL MUKHI

Indian Institute of Science Education and Research (IISER), Dr. Homi Bhabha Road, NCL Colony, Pashan, Pune

Ethics in Work Places

In this talk I will highlight how appropriate behaviour in the workplace is governed by ethical norms. These can broadly be classified under: (i) unbiased professional dealings with colleagues, (ii) prevention of bullying and harassment, (iii) administrative integrity..

Speaker Profile

Prof. Sunil Mukhi obtained a Ph.D. in Theoretical Physics from Stony Brook University in 1981. His research specialisation is elementary particle physics with a focus on quantum field theory, gravitation and string theory. After working at the Tata Institute of Fundamental Research, Mumbai for 27 years, he moved to the Indian Institute of Science Education and Research, Pune in 2012 to engage in pedagogy at a larger scale. He has taken sabbaticals at CERN (Geneva) and the Institute for Advanced Study (Princeton) and has been a Visiting Fellow Commoner at Trinity College, Cambridge.

He is a Fellow of the Indian Academy of Sciences, the Indian National Science Academy and The World Academy of Sciences, and received the Government of India's Shanti Swarup Bhatnagar Prize in Physical Sciences in 1999. He has been an Editor of the Journal of High Energy Physics since its inception in 1997. Currently he is Chair of the Panel on Scientific Values of the Indian Academy of Sciences as well as the Academic Ethics Committee of IISER Pune.

SHOBHONA SHARMA
Senior Professor (Retired), Tata Institute of Fundamental Research, Dr. Homi Bhabha Road, Colaba, Mumbai

Gender Discrimination as an Ethical Issue

Academic inquiry consists of pursuit of truth, and ethical values in such a pursuit are absolutely essential. One should pursue knowledge without any bias or barrier. Our interactions with our partners in this journey should be in an atmosphere wherein everyone participates with the same rigour without any anxiety or fear. Discrimination in the workplace, based on religion, age, ethnicity, disability, skin colour, caste, race or gender, is clearly unethical and in several contexts illegal. In India the 'Right to equality' has been provided for in Articles 14-18 of the Constitution. While it is important for ethical guidelines to cover each type of discrimination, in this talk we will limit the discussion to gender discrimination. There are inequities that exist in the workplace, perhaps for both sexes, but these are more heavily biased against women. This is apparent from the very small numbers of women reaching senior positions, even though the numbers of women enrolled for scientific degrees is considerable and are often comparable to men. Apart from social and family pressures for women towards obligatory roles for child and parental care, there is a gender stereotyping that hinders women from participating at an equal footing. For overt sexual harassment, there are legal guidelines. However, a pattern of insidious low-level misbehaviour or discrimination against women exists and has been widely perceived by them even in academia. This may be due to unintentional bias, rather than explicit, actionable harassment, but is nonetheless very damaging. It renders the workplace unpleasant and non-viable for the discriminated individuals on a daily basis, lowers their confidence level and impacts their ability to function on an equal footing with colleagues. What can Organizations do to eliminate such discrimination? This talk will centre around such a discussion.

Speaker Profile

Shobhona Sharma has served as a faculty at the Tata Institute of Fundamental Research, Mumbai, for over three decades. She has about 130 publications in peer-reviewed journals, which include Science, Journal of Immunology, PloS Pathogens and Journal of Biological Chemistry. She has filed for 3 patents, and has procured extramural funds from several sources such as WHO, DST, DBT, ICMR and Indo-French agencies. Shobhona Sharma has many awards and honours to her credit. Throughout her University years, she received National Science Talent Scholarship; Prof. Seshadri Prize for first rank in B.Sc. Chemistry (Hons), Delhi University; Science Exhibition Awards and Best student award in Chemistry from Miranda House for both B.Sc. and M.Sc. She has been engaged in research work on malaria, and for this she has received Award for excellence ing Molecular Aspects of Vector Borne Diseases; Wisitex Foundation Award Vigyan Ratna in Science; Research Award from Johns Hopkins Malaria Research Institute, USA; Prof M.R. Baichwal Visiting Fellowship in Pharmaceutical Science and Technology and Pratima Sucharu Chakrabarty Science Samman. She is a fellow of two National Science Academies in India. In collaboration with ICT, Mumbai, Shobhona Sharma has demonstrated effective nanolipid carrier-mediated delivery of antimalarials, and currently she is serving as a consultant for BlissGV Company for clinical trials of the same.

PALLAVA BAGLA
Correspondent, SCIENCE; Science Editor, New Delhi Television (NDTV)

The Ethics of Science Messaging; Messenger; and Message. What is Right or Wrong in Indian Science Communication?

Why is the Indian public increasingly getting dis-connected with Indian science? Is Indian science communication on a slippery downhill slope? Does the blame lie with the messenger, or is the messaging itself incorrect or almost lacking. Why does the Indian space agency shine like a star in the somewhat understated coverage of science and technology of India? How does a global magazine like Science choose its India based S&T coverage and how does the 24x7 television channel New Delhi Television go about its coverage of science. Personal insights from a practitioner who has spent nearly 25 years, hopefully upholding the right values, principles and ethics. Is the government doing enough to promote science communication? Can the situation be improved to increase outreach and how to make science people friendly?

Speaker Profile

Pallava Bagla (56) is a charismatic science communicator respected for his deep understanding of Indian S&T system. He has won many national and international awards for his work. Explaining complexities of science in a simple language is his forte. His pioneering work show casing India's maiden mission to Mars and Moon has been applauded this aired in English and Hindi for New Delhi Television. In his over two decades of writing for the prestigious American weekly Science, his stories have highlighted India to the world.

He was won three national awards for his science writing. In 2017 the Indian National Science Academy (INSA) conferred the `Indira Gandhi Prize for Popularization of Science'. In 2010, he was awarded the `David Perlman Award for Excellence in Science Journalism' considered the Oscar of science journalism and given by the American Geophysical Union, Washington DC, for his landmark writings which exposed the Himalayan glacier blunder by the UN's Intergovernmental Panel on Climate Change (IPCC).

He runs a daily photo blog on Twitter, Facebook and Instagram titled `Enjoy Nature' and has authored several books. He is photographer for the world's top photo agency Getty Images. His YouTube Channel Frontiers in Science and Development is very popular.

He served as `Shri Raman Pai chair Visiting Professor in Science Communication' at the National Institute of Advanced Studies, Bengaluru which resulted in the book `Bridging the Communication Gap in Science and Technology: Lessons from India' edited by Pallava Bagla and V. V. Binoy and published by Springer in 2017.

He served as President of the International Science Writers Association and was a member of the Executive Board of the World Federation of Science Journalists.

Dr. MADHU DIKSHIT
THSTI National Chair, NCR Biotech Science Cluster, 3rd Milestone, Faridabad-Gurgaon Expressway, Faridabad, Haryana

Epigenetics and Therapeutics

Post independence, Indian researchers proved their mettle in developing new technologies for huge number of genrics and help Indian Pharma earn the sobriquet of the 'pharmacy of the world'. This evolution of Indian Pharma Industry, has occurred in broadly three phases. During the first phase upto late seventies, when we didn't even have technology for production of paracetamol, the government institutions alongwith Pharma researchers contributed immensely to shape the contours of this evolving industry. The second phase of development up to 2000 was noticeable for the expansion of R&D by several Pharma players, and for the initiation of Biotechnology ventures in India . The third phase from 2000 onwards marks the Industry coming of age with entry into complex generic, biosimilars, etc.

The complex NDDR in India is at a crucial stage. With major Pharma exiting from NDDR and slow incorporation of new biology, the area needs serious thoughts and focused efforts. In the present symposium, some aspects of this complex endevour shall be discussed.

Speaker Profile

Dr. Madhu Dikshit is a leading scientist of the country and have made significant contributions to the general area of Molecular Pharmacology with special interest in redox biology. Dr. Dikshit has impacted the area of neutrophil biology, by enhancing our understanding that how nitric oxide modulates neutrophil free radical generation, chemotaxis, phagocytosis, apoptosis and also differentiation. She has systematically investigated the enzymatic synthesis of NO during neutrophil maturation and role of redox sensitive tetrahydobiopterin and L-arginine. Moreover, the molecular mechanisms involved in the translocation of NOS to the phagosomal compartment and inflammatory potential of neutrophil extracellular traps has also been delineated by her pioneering work. She also initiated and led the team of anti-thrombotic drug discovery at CDRI, which has seen two of CDRI anti-thrombotic molecules advancing to pre-clinical stage. One of the molecule has reached the IND stage.

Dr. Dikshit has published more than 160 well cited papers in peer reviewed journals, has nine patents and has supervised more than 30 Ph.D., 10 MD theses, and has given training to more than 50 graduate students.

Dr. DEEPA JOSHI
Vice President, Discovery Research & Clinical Development, Torrent Pharmaceuticals Ltd, Ahmedabad

Drug Discovery and Development: an Industry Perspective

Drug development today is faced with challenges on many fronts. Increasing costs, greater failures and dwindling revenues due to patent cliffs are some of the key contributors. It has been estimated that costs per drug brought to the market is 4 billion USD or more, driven by actual costs as well as attrition, i.e., the inclusion of costs for drugs that failed in development. Truly innovative drugs are inherently associated with higher risk. This talk will focus on the risks at different stages of drug development and suggest some of the approaches that could help.

One prominent challenge is that mechanisms behind many diseases are still poorly understood. Coupled to this, the inability of animal models to accu¬rately predict efficacy is a challenge to drug development, especially in certain therapeutic categories wherein imitations of existing animal models have resulted in translational failure. Reproducibility of published data from one lab to another is critical for the successful translation of discovery research, scientific validity and reproducibility of preclinical data being very important when making decisions regarding whether to go into clinical development.

Human phenotypes may better inform drug discovery; therefore, starting in humans first, then validating in animal models, may be beneficial to drug development. Due to the complexity and heterogeneity of patients, a greater em¬phasis on multipronged approaches might result in an increased number of successful drugs.

To address these challenges, one needs a shift in paradigm from the traditional approaches. Public–private partnerships and the extension of the precompetitive space among academia, industry, and government could help de-risk research. Industry is successful at processes that require scale and infrastructure, whereas academia con¬tinues to be a source of new knowledge in biomedical research needed for drug discovery. To overcome regulatory challenges, harmonization of requirements among different regulatory agencies and well defined path with predictable examination and approval timelines will result in higher rates of and faster times to drug approvals. Understanding patient phenotype and genotype to enable stratifying patients with an aim to identify predictive biomarkers could help accelerate development. Expanded access to human samples is another critical parameter that can help significantly in characterizing target population. And finally, creating patient registries will enable rapid and cost-efficient development.

A perspective on overall drug discovery and development process will provide the context against which the issues from will be highlighted from an industry perspective.

Speaker Profile

Dr. Deepa did Ph. D., in Experimental Medicine from McGill University, Montreal, Canada. She was the Head, Discovery Medicine & Clinical Pharmacology, Bristol-Myers Squibb, Bengaluru, India; Head-Early Development, Reliance Clinical Research Services, Mumbai & Bengaluru. and Head, Pharmacology & Clinical Pharmacology, B.V. Patel Pharmaceutical Education and Research Development Centre, Ahmedabad, India. She worked as a Research Associate, Department of Obstetrics and Gynecology, McGill University, Montreal.

Dr. PARIMAL MISRA
Dr. Reddy's Institute of Life Sciences, University of Hyderabad Campus, Gachibowli, Hyderabad

Discovery of a Potent Activator of AMPK: A Collective Effort of Industry and Academia

Scientists from Academic institutions and Pharmaceutical Indutries need to join hands to identify new targets as well as discover new drugs. This involves collective efforts in view of the strict regulations of regulatory authorities. New drug discovery requires drugable targets, safe and efficacious molecules with desired bioavailability and such understanding can only brought by a team of competent scientists. It is therefore necessary to join hands for a new drug discovery in India. I shall be dwelling upon AMPK, a potential high value target for metabolic disorders. I shall be presenting joint effort of four institutions for molecular modelling, synthesis, *in vitro* and *in vivo* biological activity assessments and AMPK to discover a potent activator of AMPK (Activator 3). *In vitro* and *in vivo* characterization of Activator-3, 2-[2-(4-(trifluoromethyl) phenylamino) thiazol-4-yl] acetic acid, an AMP mimetic and a potent pan-AMPK activator. Activator-3 and AMP likely share common activation mode for AMPK activation. Activator-3 enhanced AMPK phosphorylation by upstream kinase LKB1 and protected AMPK complex against dephosphorylation by PP2C. Molecular modeling analyses followed by in vitro mutant AMPK enzyme assays demonstrate that Activator-3 interacts with R70 and R152 of the CBS1 domain on AMPK γ subunit near AMP binding site. Activator-3 and C2, a recently described AMPK mimetic, bind differently in the γ subunit of AMPK. Activator-3 unlike C2 does not show cooperativity of AMPK activity in the presence of physiological concentration of ATP (2 mM). Activator-3 displays good pharmacokinetic profile in rat blood plasma with minimal brain penetration property. Oral treatment of High Sucrose Diet (HSD) fed diabetic rats with 10 mg/kg dose of Activator-3 once in a day for 30 days significantly enhanced glucose utilization, improved lipid profiles and reduced body weight, demonstrating that Activator-3 is a potent AMPK activator that can alleviate the negative metabolic impact of high sucrose diet in rat model.

Speaker Profile

Prof. (Dr.) Parimal Misra is Senior Professor and Chief Scientist, Center for Innovation of Molecular and Pharmaceutical Sciences, Dr. Reddy's Institute of Life Sciences, Hyderabad. He did Bachelors in Chemistry (Hons); M.Sc in Molecular Biology from Kolkata University; PhD at Indian Institute of Chemical Biology, Kolkata, in molecular biology and biochemistry and was awarded Ph.D degree from Jadavpur University, Kolkata in 1995. He worked at Feinberg School of Medicine, Northwestern University, Chicago.

He specializes in transcriptional complex, co-factors, gene-regulation and signal transduction of various transcription factors related to stress induced diabetes and insulin resistance. Dr. Misra worked in Dr. Reddy's for over 22 years on Metabolic Disorder, Inflammation and Genomics-Proteomics; Drug Discovery and Genomics-Proteomics and contributed to five NCEs in different clinical phases including Balaglitazone (Phase 3B), Ragaglitazar (Phase 3A) and AMPK activator. He has 46 articles in scientific journals, two book chapters and 15 international patents and trained over 60 drug discovery scientists.

He is Fellow of the Royal Society, Chemistry (UK) in 2016, the Royal Society of Biology (UK) and recipient of Chairman Excellence Award from Dr. K. Anji Reddy and International Young scientist award in Molecular Biology by IUBMB.

Dr. PRAVEEN KUMAR VEMULA
Institute for Stem Cell Biology and Regenerative Medicine (inStem)
UAS-GKVK Campus, Bellary Road, Bengaluru

Translating Technologies in India, A Scientist's Perspective

Translating technologies that are developed in the laboratory into a viable product to solve unmet needs is a daunting task. It requires non-conventional approaches/expertise from regular academic skill set. Translational research is an exciting area where breakthrough scientific discoveries are converted into viable technologies/products to solve unmet clinical needs. In this translational path, an efficient entrepreneurial practice plays a pivotal role. An intriguing question is; are there any general guiding principles to practice successful science-entrepreneurship in biotech area? To answer this pivotal question, I will discuss various aspects during my talk by taking our own research and entrepreneurial example(s).

Speaker Profile

Dr. Praveen Kumar Vemula is Research Investigator at the Institute for Stem Cell Science and Regenerative Medicine (inStem), Bengaluru. His work spans the fields of biomaterials, drug delivery, medical devices, and chemical biology. He has published >60 peer-reviewed papers, has given >100 national and international invited lectures, and has >20 issued or pending national/international patents. Several technologies developed in his lab have formed the foundation for multiple products on the market and currently under development and for the launch of four companies including Inceptus Innovations (anti-pesticide technologies company, in India), Artus Therapeutics (a drug discovery company for IBDs, in USA), Skintifique (a skincare company, in France), and Alivio Therapeutics (an inflammation targeting company, in USA).

Dr. THELMA B.K.
Department of Genetics, Univ.of Delhi South Campus, New Delhi

Summing up and Overview

I will aim to sum up the highlight of the symposium and discuss the future possiblities in the area of Drug discovery in the Indian Context.

Speaker Profile

Professor Thelma B.K. is a faculty member and Team leader of the Centre of excellence in Genome sciences and predictive medicine in the department of Genetics at the University of Delhi south campus, New Delhi.

Unraveling the genetic basis of both Mendelian disorders and common complex traits is the major focus of her research work. Identification of novel disease causing/risk conferring gene variants for X-linked intellectual disability, Parkinson's disease, Schizophrenia, Rheumatoid arthritis and Ulcerative colitis are some of the highlights of her recent work. Population specific common and rare variant data generated by genome-wide association studies and whole exome sequencing on Indian cohorts are a rich resource generated in her laboratory. As a natural sequel, understanding disease biology by functional characterization of promising genetic leads and computational biology are being pursued in the laboratory. Translation of genetic findings to DNA based diagnostics, pharmacogenetics and lead molecule development is the ultimate goal of her group. To overcome limitations faced in complex trait genetics, an alternate paradigm of Ayurgenomics- combining Ayurveda doctrines with contemporary genome analysis tools is being explored.

Prof. Thelma has several national and international research projects and has published her research in international journals of repute. Prof. Thelma is a fellow of all the three science academies in India. She serves as an expert member in several task force committees of funding agencies and has also served as a member on the Science and Engineering Research Board, India and on the Scientific Advisory Council to the Prime Minister of India.

ASHWINI K. NANGIA
CSIR-National Chemical Laboratory, Pune, and School of Chemistry, University of Hyderabad

Sustainable Energy and Chemical Engineering Platforms

The chemical industry is undergoing a transformation towards processes which are minimal in generating waste, optimize costs and logistics of raw materials sourcing, manage energy, heat and cooling, and carry out the production of chemicals in a safe and economical manner. The shift from batch reactors to flow processes, use of selective catalysis, biomass and crop-waste feedstock, recycling and regeneration of by-products to useful chemicals, energy grid loop, and digitization of chemical processes are integral parameters in this change. In order to mitigate the overuse and dependence on fossil fuels and naphtha, biomass feedstock and biorefinery are the beginning of a new chemistry and chemical industry paradigm. Examples from crystal engineering, catalysis, agrochemicals, biomass, fine chemicals, pharmaceuticals and polymers will be presented as case studies.

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Speaker Profile

Ashwini Kumar Nangia is Professor of Chemistry at University of Hyderabad. He completed MSc from IIT Kanpur (1983) and PhD from Yale University (1988). From 1989 onwards, He worked at the University of Hyderabad as Lecturer and was promoted to Professor in 2002. His research focuses on crystal engineering topics – structure design, inclusion compounds, polymorphism, cocrystals, salts and eutectics, and the applications of these solid forms in pharmaceutical sciences for drug translation. He is a Fellow of three National Science Academies viz., INSA, IASc. and NASI; a recipient of the JC Bose Fellowship from DST. He was awarded the Golden Jubilee Commemoration Medal (Chemical Sciences, 2016) of INSA; Prof. D. N. Dhar Memorial lecture of NASI (2018) and the Prof. L. K. Doraiswamy Chemcon Distinguished Speaker Award for 2016 by IIChE.

He is on the Editorial Boards of subject journals, Crystal Growth & Design (ACS), CrystEngComm (RSC), Journal of Pharmaceutical Sciences (Wiley), Chemistry – An Asian Journal (Wiley-VCH). He was appointed Associate Editor of Acta Crystallographica, Section B, IUCr journals in 2017 and was recently appointed as Member of SERB Empowered Committee. He has published over 270 papers in international journals and 15 patents. He has H index of 54 and over 11,000 citations. He is founder of spin off innovation and R&D venture Crystalin Research in 2010 under "Chalk to Salt" at Technology Business Incubator facility on University campus. He is Chairman of India's first and largest Venture Center on NCL Innovation Park.

AMOL A. KULKARNI
Chem. Eng. & Proc. Dev. Division, CSIR-National Chemical Laboratory, Pune

Continuous Manufacturing Platforms for Fine and Specialty Chemicals Industry: Relevance Toward Sustainability

The specialty chemicals and pharmaceutical industry is conventionally (and almost entirely) based on the use of batch operations. Although batch or semi-batch processing offers some advantages because of the experience and familiarity, it has several disadvantages such as inconsistent performance (viz. product quality, yield, selectivity, etc.), significantly lengthy operations, high utility consumption, large footprint, large inventory, unsteady operations and so on. The advent of continuous flow reactors for small to medium scale operations is an important milestone in the processing of chemicals and intermediates. Small volume continuous flow reactors have been making foot-fall in the pilot and manufacturing scales over last decade. Batch to continuous transformation needs systematic approach. While it saves time for taking a product from lab to market, it demands certain scalability analysis that helps chemical engineers to understand the chemistry and chemists to keep some engineering principles in mind during its development. This presentation will bring out a how continuous manufacturing platforms that use compact reactors are changing the chemical industry with focus on fine and specialty chemicals industry. A few case studies will be presented on the impact of continuous manufacturing on sustainabiity of Indian chemical industry.

Speaker Profile

Dr. Amol A. Kulkarni is a Scientist in the Chemical Engineering & Process Development Division at the CSIR-National Chemical Laboratory (NCL), Pune (Since 2005). He is a chemical engineer by training (B. Chem. Eng. 1998, and Ph.D. in chemical engineering 2003 from the Institute of Chemical Technology (ICT), Mumbai (popularly known as UDCT)). He did his post doctorate at the MPI-Magdeburg (Germany) as a Humboldt Fellow (2004) and was an IUSSTF Research Fellow at Massachusetts Institute of Technology (MIT), USA in 2010.

He Works in the area of design and development of microreactors and exploring their applications for continuous syntheses of pharmaceutical intermediates, dyes, perfumery chemicals and nanomaterials. He has established the first of its kind microreactor laboratory in India. He also works on multiphase boiling reactors, design of fluid devices, new impeller concepts and experimental fluid dynamics.

He has been awarded with VASVIK Award by VASVIK Foundation for Excellence in Industrial Research (2016), Swarnajayanti Fellowship by the Dept. of Sci. and Tech. (2015), OPPI Young Scientist Award (2015), Scientist of the Year Award of NCL (2014), CSIR Young Scientist Award (2011), INSA Medal for Young Scientists (2009), Young Engineer Award by the Indian National Academy of Engineering (2009). He is also a member of the Selection Committee of Alexander von Humboldt Foundation (Germany).

He has published 75 papers in international peer reviewed journals, supervised 5 PhD students (8 ongoing), filed over 25 patents and also designed several flow reactors that are licensed to Indian industries. He also works on industry sponsored design and feasibility projects and consultant to many industries. He is on the editorial boards of a international peer reviewed journals like Journal of Flow Chemistry (Kluwer Scientific), Advanced Powder Technology (Elsevier) and on the Advisory Board of Reaction Chemistry and Engineering (RSC UK).

APARESH L. DHEPE

Scientist, Catalysis & Inorganic Chemistry Division, CSIR-National Chemical Laboratory, Pune

Sustainable Catalytic Transformations of Renewables into Chemicals and Fuels

Due to geopolitical reasons and several other factors, countries are looking at developing fuels and chemicals from sustainable, and renewable feedstocks such as biomass and CO2. At CSIR-NCL, researchers are working on the synthesis of bio-fuels such as bio-ethanol and bio-diesel from biomass for long for the use as transportation fuel. In these processes, besides these desired products, by-products such as lignin and glycerol are formed and those are also value-added by NCL researchers. Additionally, researchers are working on the conversion of crop waste into industrially relevant value-added chemicals. Due to COP-21 commitments, the levels of CO2 needs to be reduced and hence at NCL programs are undertaken to convert CO2 to syn-gas and further into methanol and DME. Besides this, work on the synthesis of polymers via CO2 utilization is also ongoing. To carry out these works, catalyst design is an integral part to achieve better efficiencies in terms of conversion, selectivity and yields. During presentation, examples on these reactions and how efficient catalysts helped achieve better results would be shown.

Speaker Profile

Dr. Paresh Dhepe obtained his Masters in Organic Chemistry from Pune University and later moved to Japan, Hokkaido University to complete his Ph.D. He received his Ph.D in the year 2003 in the area of heterogeneous catalysts and supercritical fluids. Later he worked as Post-Doctoral Fellow (PDF) at Japan for 3 years during which he worked on the synthesis of water-stable solid acid catalysts for the conversion of cellulose into chemicals. Later, he joined NCL, Pune in the year 2007 and since then has been working in the area of biomass valorization using homogeneous and heterogeneous catalysis. He has published several papers in the area of conversion of cellulose, hemicellulose and lignin. His current research interests are in the area of depolymerization of lignin using solid acid, solid base and ionic liquid catalysts. Also he has interests to work on crop waste to chemicals by designing hetero and homogeneous catalysts.

SANJAY MAHAJANI
Dept. of Chemical Engineering, IIT Powai, Mumbai

Process Intensification through Multifunctional Reactors

Multifunctional reactors combine reaction with other functionality such as simultaneous separation to enhance the overall performance. In this talk, I will discuss our work on two such industrially important multifunctional reactors: Reactive Distillation and Reactive Chromatography. Both of them can be effectively used to enhance conversion for equilibrium limited reactions and selectivity in case of multiple reaction schemes and bring cost-effectiveness and compactness to a Chemical Plant. I will present the process of evaluating their technical feasibility and the steps involved in developing the knowhow. Few examples of esterification, dimerization and aldol condensation from bulk and fine chemical sectors would be considered.

Speaker Profile

Prof. Sanjay Mahajani received his Bachelors and Ph. D. Degrees in Chemical Engineering from UDCT (now known as ICT), Mumbai in 1989 and 1996, respectively, and the Master's degree from IIT Bombay in 1992. After completing his Ph.D., he worked in Monash University, Australia (1996-2000) for a period of four years as post-doctoral research fellow. He joined IIT-Bombay as Assistant Professor in 2000, and is presently a full professor (2008-date) in Department of Chemical engineering. He also holds a position of Professor-in-charge of the newly formed Tata Centre of Technology and Design at IITB.

Prof. Mahajani's research interests are Applied catalysis, Process intensification, and Coal and biomass gasification. He has worked on several industry sponsored projects that include catalyst development, reactive distillation and its applications, and underground coal gasification. He has 120 international papers and has more than 50 conference presentations to his credit. His awards include - IIChE's young scientist Amar Dye Chem award (2002), Manudhane awards for applied research (2006) and UG teaching (2007) at IITB, and IIT-Bombay's excellence in teaching award (2008, 2017). He has guided 27 Ph. D.s and more than 40 Masters students till date.

RAMESH BHUJADE
Reliance Industries Limited, Mumbai

Catalytic Hydrothermal Liquefaction – Sustainable Technology for Biomass Conversion to Drop-in Liquid Fuel

Energy independence has never been so critical for India, as it is now. In view of the recent rise in imported crude prices and falling Indian currency, there is an urgent need to further step up our efforts towards making India energy independent through sustainable technology. Hydrothermal liquefaction (HTL), as a platform technology plays an important role in this context, by producing energy-dense drop-in liquid fuel from waste, and simultaneously mitigating adverse impact of climate change.

HTL is a thermo-chemical conversion process that converts any biomass and organics waste into renewable liquid fuel. It essentially expedites the natural process of oil formation — instead of millions of years as taken by nature, HTL achieves the process in a few minutes. Catalytic HTL developed by Reliance (RCAT-HTL) improves the yield and quality of renewable crude. The unique advantages of RCAT-HTL are: feed flexibility and production of drop-in liquid fuel. The kinetics of the RCAT-HTL reactions can also be tuned in such a way that the desired product mix is obtained to suit the market demand and economics. We will share our experience in advancing this promising technology from lab scale to world's largest pilot plant and achieving the technology readiness level for commercialization.

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Speaker Profile

Ramesh Bhujade, B Tech, CEng, MChemE: Ramesh is the Vice President, Research and Development, Reliance Industries, and Head of Algae to Oil – Downstream Technology, CO2 Management and Process Engineering. He is a Chartered Chemical Engineer, with over 38 years of experience in a wide spectrum of industries – Biofuels, Oil & Gas, Refining, Petrochemicals, and Polymers. He has published many technical papers and has over 35 patents, issued or pending, in the areas of CO2 management, Catalytic hydrothermal liquefaction and biofuel up-gradation.

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The design of this booklet is inspired by IASc book of abstracts.

In this original Academy the old philosophers must have discussed Arts and Letters, Mathematics, and Science as well as Philosophy strictly so called; so that a true Academy, without qualification, should be on as broad a basis.

–L.L. Fermor
President INSA (1935-36)

The great reality of our age is science. The understanding of nature which science provides, and the deep harmony it unfolds, are deeply satisfying to the human mind. The power of science to transform society is immense, perhaps more than any other activity. Equally real and pervasive is human suffering–starvation, pain, devastation, violence, loneliness and deep anguish of the soul. Science will suffer grievously and in the end reduce to a mockery, if all its power is not yoked to alleviate human suffering.

–Prof. D.S. Kothari
President INSA (1973-74)

ANGKOR, New Delhi