

**Department of Science & Technology**  
**Monthly Report**  
**September, 2022**

**I. Important policy decisions taken and major achievements during the month:**

**A. Science for Society**

1. Vigyan Prasar (VP) was assigned with the conduct & organisation of a national level programme called Swachh Sagar Surakshit Sagar. VP organised pre-final mass awareness & coastal cleanup drives at 24 Locations, and led major programmes at 8 other locations.
2. Beach cleaning activity conducted at Alibag, Murud beaches in Maharashtra and Auroville beach in Puducherry by Indian Institute of Geomagnetism. Also slogan competition was organized under “Swachh Sagar Surakshit Sagar” campaign.
3. In SCTIMST a dedicated Fontan Clinic has been inaugurated on 26.09.2022. The Fontan Clinic shall be a dedicated clinic for evaluation and management of patients who have undergone total cavopulmonary connection (TCPC), commonly referred to as the Fontan surgery, the destination surgery of a series of surgeries for complex univentricular congenital heart diseases. The Congenital Heart Services Team of SCTIMST including the Departments of Cardiology, Cardiovascular and Thoracic Surgery, Cardiac Anesthesiology and Imaging Sciences and Interventional Radiology have vast expertise in treating complex congenital heart diseases. SCTIMST has over 250 patients who have undergone all stages of univentricular palliation, and the number is ever increasing. This is set to be the first dedicated clinic for Fontan patients in the country. Other functional Fontan Clinics: Boston Children’s Hospital, Cincinnati Children's Hospital, Stanford, Cleveland Clinic, Vanderbilt, St Louis. None in Asia
4. The 9th National Level Exhibition and Projection Competition (NLEPC) of INSPIRE Awards – MANAK was organized by NIF and DST at ITPO, New Delhi followed by the award function at Vigyan Bhawan, New Delhi on 16th September 2022.
5. National Innovation Foundation (NIF), Ahmedabad facilitated granting of 12 patents during the month. These are; Artificial Assistance For Recognizing People Or Place; A Walking Aid; Biodegradable Polyester And Its Method Thereof; Automated Cutting Device For Sugarcane; Wind Operated Ceiling Fan; A Door

Actuation Mechanism; A Natural Water Cooler And Filtration Unit; Talking Calendar; A Machine For Drying Green Tea And Edible Item; Device For Detecting Of Foreign Particles In Food Products; Herbal composition and medicament to increase and thereby improve milk yield in livestock; Herbal composition and medicament for expulsion of placenta.

6. “Genius Energy Critical Innovation Private Limited”, a grassroots innovation based start-up recognized by the Govt. of India and incubated by NIF, and the underlying technology being "saving energy in boilers by recycling steam" has commenced the operation of its 2nd unit at Behror, Alwar, Rajasthan. The value proposition of the start-up is to customise the technology for use in different industries and integrate it with existing boiler infrastructure to save the used energy.
7. The 'River Cauvery - the Lifeline' an interactive socio-scientific gallery, established by the National Academy of Sciences India at Mysuru with the support of Government of Karnataka and the National Council of Science Museums, was inaugurated.
8. Sophisticated Analytical Instrument Centre of Institute of Advanced Study in Science and Technology organized a training program supported by Department of Science and Technology (DST), Government of India, to impart training on ten numbers of sophisticated instruments used for scientific research. The instruments included in the training were: FE-SEM, TEM, XRD, HPLC, LC-MS/MS, GC-MS/MS, CHNS/O analyser, Raman spectrometer, Confocal microscope and BET surface area analyser. Thirty-one participants from the different educational and research organizations of NE region participated in the program at IASST.
9. Startups supported under NM-ICPS from 6 Technology Innovation Hubs (TIHs) established at IIT Kanpur, IIT Patna, IIT Mandi, IIT Bhilai, IISER Pune & IISc Bangalore, showcased their technologies/products during Centre-State Science Conclave at Science City Ahmedabad on Sep 10 - 11 September, 2022 inaugurated by Hon'ble Prime Minister online.

## **B. Technology Development**

1. Centre for Nano and Soft Matter Sciences has signed an MoU with Milmann Thin Films, Pune for development of various functional coating materials.

2. The know-how for manufacturing the product “Drug Eluting Bioactive Calcium Sulfate Cement”, developed in the Bioceramics Division of Sree Chitra Tirumal Institute for Medical Sciences and Technology has been transferred to a company.
3. The design improvement of 3 technologies viz. Device for chilli bag filling, Drone for rescuing drowning people and Pinkloo/Standing toilet for women were undertaken by National Innovation Foundation.
4. Super-hydrophilic based anti-soiling coating, with omni-transparent and high self-clean photocatalytic properties, was successfully developed by International Advanced Research Centre for Powder Metallurgy and New Materials and an Indian patent application for it has been filed.
5. Under the project on the National Centre for the development of advanced material and manufacturing processes for clean coal technologies for power applications, ARCI produced pure spherical Fe-Al (Zr) powders in 3 batches (nearly 20 kg) by inert gas atomization.
6. Perovskite solar cells were fabricated by ARCI with sputtered metal cathodes. Cells, with both organic and inorganic hole-transporting material (HTM), showed good performance with >10% cell efficiency, which is comparable with the thermally evaporated metal cathode.
7. Indian patent on “Method of Producing Carbon Nanostructure Materials for Heat Transfer, Lubrication and Energy Storage Applications” was granted to ARCI.

### **C. International Cooperation**

1. **BRICS STI cooperation:** The online 10th BRICS Science and Technology ministerial meeting was held on 27th September 2022. This meeting was preceded by the BRICS Senior Officials Meeting on 26th September 2022. Science and Technology Ministers or their deputy attended the meeting from all BRICS countries. The Minister of Science & Technology and Ministry of Earth Sciences, Dr. Jitendra Singh led the Indian delegation. The key deliverable of the meeting includes the adoption of two documents (i) BRICS Science, Technology and Innovation Declaration (STI), 2022 (iii) BRICS Calendar of Science, Technology and Innovation activities 2022-2023.
2. **Indo-Japan Science & Technology meetings:** Dr. S Chandrasekhar, Secretary DST led a delegation, including Adviser & Head, International Cooperation Division, DST and Joint Secretary, DST and Surveyor General of India

(officiating), to Japan during 26-28 September, 2022. Secretary DST had meetings with his counterparts in the Japanese Ministry of Education, Culture, Sports, Science & Technology (MEXT); Ministry of Economy, Trade and Industry (METI); Japanese Agency for Medical Research & Development (AMED); Japanese Society for Promotion of Science (JSPS); Japanese Science & Technology Agency (JST).

3. **Launch of CV Raman Fellowship:** Department of Science and Technology (DST) and Ministry of External Affairs (MEA), Government of India (GoI), through the Federation of Indian Chambers of Commerce & Industry (FICCI), have launched the C.V. Raman Fellowship for African Researchers programme under the India-Africa Forum Summit to promote human capacity building through scientific and technological cooperation between Africa and India. The objective of this Fellowship is to provide an opportunity for African researchers to conduct collaborative research in various areas of science and technology in different Indian universities and R&D institutions under the guidance of host scientists in India. This prestigious fellowship aims to strengthen further the bond between India and African nations in science and technology.
4. **Outreach programme of Indo German Science and Technology Centre (IGSTC):** The Outreach programme of Indo German Science and Technology Centre (IGSTC) was conducted in Coimbatore on 26th September where the Director of IGSTC, the Director of Indo-French Centre, officials from Indo-US Science and Technology Centre, and the International Cooperation Division of DST presented activities of the respective organization. Around 60 participants including faculties and industry representatives were present at the IGSTC Outreach event. They interacted with the representatives of these centres and DST officials regarding various available opportunities.
5. **12<sup>th</sup> Indo-German Frontiers of Engineering (INDOGFOE-2022) Symposium:** Department of Science and Technology participated in 12<sup>th</sup> Indo-German Frontiers of Engineering (INDOGFOE-2022) which was organized in Bremen, Germany for four day from September 29<sup>th</sup>, 2022 to 2<sup>nd</sup> October. The symposium covered the following topics: Electric Vehicle Systems for Future Carbon-Neutral Mobility; Nano biotechnology for Life Science Applications; Surveillance vs. Privacy: Data Security in the Digital Age and Thin Film Science and Engineering.

#### **D. Human Capacity Building**

1. Seven awareness programs on climate change were organized by the Sikkim State Climate Change Cell (SSCCC) benefitting around 900 participants including farmers, students and general public. The major themes of the awareness programs were impact of climate change on water resources, agriculture, forest and biodiversity and human health and application of remote sensing and GIS in climate change along with the adaptation and mitigation strategies to withstand climate change.
2. Around 700 participants including Govt. Officials, Faculty members, Urban Planners, International Delegates, Representative of NGOs, students benefitted from online training programmes and webinars conducted by National Institute for Disaster Management (NIDM), New Delhi under National Mission for Sustaining Himalayan Ecosystem (NMSHE) mission on issues pertaining to disaster risk reduction and rehabilitation etc.

#### **E. Scientific Research**

1. An international team of scientists, including a scientist from Aryabhata Research Institute of Observational Sciences, has detected surprising rapid oscillations of brightness, termed quasi-periodic oscillations (QPOs), in a blazar jet rich in gamma rays. These oscillations have been attributed to twists in the magnetic field in the jet.
2. Palynofloral and the palynofacies analysis of the Karharbari sediments of the Nandira colliery, Talcher basin, Odisha, conducted by Birbal Sahni Institute of Palaeo sciences suggests that the recovered palynoflora from the carbonaceous shale sample shows its affinity towards Upper Karharbari palynoflora of early Artinskian (middle early Permian) age. The abundant occurrence of the monosaccates along with glossopterids in the sediments demonstrates swampy settings with cool-temperate climatic conditions. Dominant occurrence of the opaque phytoclasts associated with the coal sediments is an explicit indication of the palaeo fire in early Artinskian. Based on the recovery of the different types of organic matter along with the palynofloral evidence, it has been concluded by the scientist of BSIP that the Karharbari sediments of the Nandira colliery are purely continental.
3. A positively charged amine-functionalized ceria nanoparticles ( $\text{CeO}_2\text{-NH}_2\text{NPs}$ ) were prepared first, and then a natural flavonoid, morin was adsorbed on the surface of NPs via metal- ligand coordination to form a nanohybrid (morin- $\text{CeO}_2\text{-}$

NH2) by Bose Institute. The results of the present investigation highlighted that the nanoceria-mediated drug delivery systems could help to increase the antioxidant and antibacterial potential of morin.

4. Supervised learning models have been developed by BI with support vector machine (SVM), random forest (RF), Naive Bayes (NB) and multi-layer perceptron (MLP) algorithms. Models were trained with spirometry data of 1163 patients using 5-fold cross validation (CV) and further validated with a blind dataset of 151 patients for external validation. The machine learning models were able to predict obstructive and non-obstructive pulmonary diseases with good accuracy, based on spirometry data. The web application can be used by clinicians and patients as a tool for early prediction.
5. Water soluble and biocompatible carbon dots (CDs) have been synthesized by BI from taurine via thermal decomposition method. The results of the investigation with CD's clearly reflected that synthesized CDs and their nanohybrids can be used for several biomedical applications.
6. Scientist from Centre for Nano and Soft Matter Sciences (CeNS) have used a synchrotron-based variable energy photoelectron spectroscopy to probe the chemical composition variation in such hetero-structured materials and interfaces. More specifically, the team shows how the internal hetero structures of lead halide perovskites (LHP) nanocrystals are generated due to the surface chemistry and post-synthesis anion exchange. LHPs are of great interest for their optoelectronic properties and photovoltaic applications. Various hetero structures are created in these materials to achieve favorable optical properties and improved stability at the interfaces during the fabrication of devices.
7. Studies on Amino acid containing amphiphilic hydro-gelators with antibacterial and antiparasitic activities were conducted at Indian Association for the Cultivation of Science.
8. It was found that the amino acid based hydrogelators are not only active against Gram-Positive and Gram-negative bacteria but also kill a variety of protozoal parasites including Indian varieties of *Leishmania donovani* and also destroy several drug-resistant parasitic strains including BHU-575, MILR and CPTR cells. Moreover, these gelators exhibit non-cytotoxicity to host macrophage cells. This indicates the potential application of these gels as therapeutic agents against multiple forms of leishmaniasis (Black fever, "Kala-azar").
9. A correlation is found by Indian Institute of Astrophysics, between the ambient magnetic field and core orientations in selected molecular clouds. Large and

small-scale field lines are found connected to each other. The estimated magnetic field strength and the mass-to-flux ratio suggest that all the clouds are in a magnetically critical state except L1333, L1521E and L183 where the cloud envelope could be strongly supported by the magnetic field lines.

10. Biophysicists from Raman Research Institute and collaborators have studied the binding properties of a particular enzyme (Cas9) to sequence specific target DNA. In this work, the Cas9 system was found to robustly bind to the DNA with very high efficiency. This work assumes great significance since the CRISPR-Cas9 system is a powerful technology for genome editing in a wide variety of in vivo and in vitro applications.
11. The cluster of labs at RRI working at the forefront of quantum enabled technologies has given the Institute a leadership role in this field. One active sub area of research is higher dimensional quantum systems (qudits) that present a potentially more efficient means, compared to qubits, for implementing various information theoretic tasks. One of the ubiquitous resources in such explorations is entanglement. Entanglement Monotones (EMs) are of key importance, particularly for assessing the efficacy of a given entangled state as a resource for information theoretic tasks. There is yet no general scheme available for direct determination of the EMs. Consequently, an empirical determination of any EM has not yet been achieved for entangled qudit states. Recent research work at the Institute has filled this lacunae, both theoretically and experimentally.
12. Salient features of research outcome of Wadia Institute of Himalayan Geology include: (i) Confirmed using field, petrographic, geochemical, and zircon U-Pb geochronological datasets that the Jutogh Thrust sheet of eastern Himachal Pradesh is a meta-sedimentary sequence, which was deposited in the active margin set-up at different time scales and metamorphosed during pre-syn-post collisional events of the Himalayan orogeny; (ii) Concluded that seismotectonics of the eastern Himalayas is much different from that of the western Himalaya. Unlike the western Himalayan shallow (0–20 km) thrust faulting Main Himalayan Thrust earthquakes, the eastern Himalayan earthquakes are much dominated by strike-slip faulting at shallower as well as at deeper depths down to 80 km; (iii) Prepared landslide susceptibility maps in the Kali River valley, Kumaun Himalaya using three machine learning algorithms, namely K-nearest neighbour (KNN), random forest (RF) and extreme gradient boosting (XGB) indicating very high susceptible zones concentrated more around Garbyang, Sobla, Tawaghat, Dharchula, Baluwakot and Jauljibi villages.

13. Human Islet Polypeptide (hIAPP) amyloidogenesis for the full-length peptide along with its N- and C-terminal fragments, under different temperatures and sample agitation conditions. It is a comprehensive understanding of the intrinsic role of specific functional epitopes in the primary structure of the peptide that regulates amyloidogenesis and subsequent cytotoxicity. The observations recorded at Satyendra Nath Bose National Centre for Basic Sciences indicate a possible collaborative role of this segment in nucleating hIAPP amyloidogenesis in a physiological scenario, thus making it a potential target for future therapeutic interventions.
14. Five different hydrophobic L-amino acids (Gly, Ala, Val, Leu, Ile) as molecular crowders have been used by SNBNCBS to investigate their role on the enzymatic activity of lysozyme towards *Micrococcus lysodeikticus* (*M. lys.*) cell as substrate. It is found that except Ile, all other amino acids show a bell like profile of catalytic efficiency ( $k(\text{cat})/K\text{-m}$ ) with their increasing concentration whereas for Ile, the value is gradually increasing. The trend of activation energy ( $E\text{-a}$ ) is also well correlated with the catalytic efficiency of lysozyme. At low concentration of amino acids, soft interaction predominates whereas at higher concentration range, excluded volume, viscosity, hydrophobicity combinedly decrease the activity of lysozyme.
15. The reversible photo switching of non-activated spiropyran viz., 1,3,3-Trimethylindolinobenzopyrylospiran (SP) is studied by the Scientists at SNBNCBS by employing UV-Vis spectroscopy and computational based calculations (DFT and MD simulation) under various environmental conditions. The significant structural isomerization of the non-substituted spiropyran at room temperature depending on its micro environmental stimuli may find potential use in target-oriented drug delivery applications.