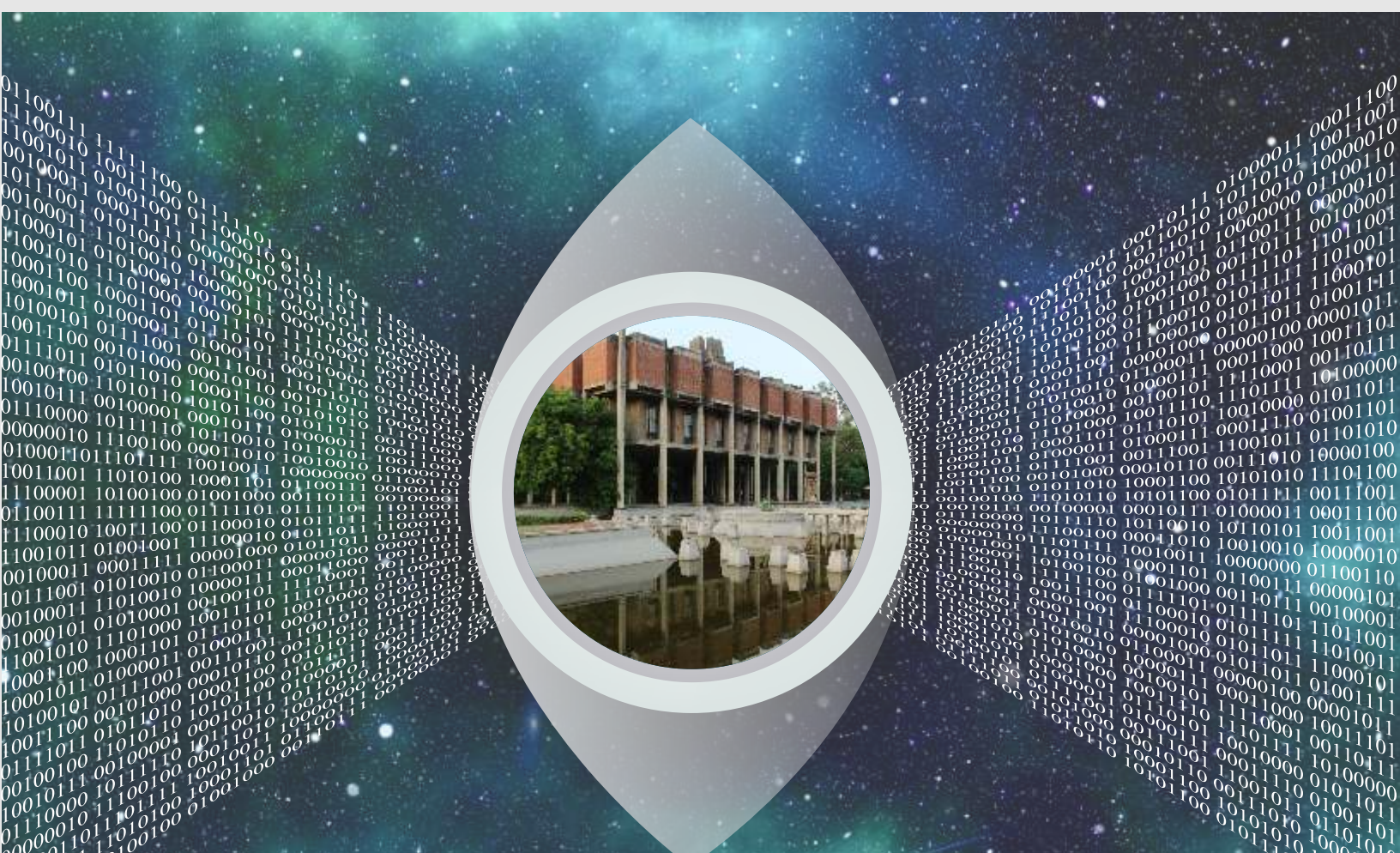


R&D Newsletter

Indian Institute of Technology Kanpur



Highlight of the Issue

- National Science Day Celebration
- Technology Innovation Hub for Cyber Security
- Smart Grid Control Centre
- SIIC Corner
- Foundation Day of Technopark@iitk
- Recent Major Projects
- Institute Lecture Series

Science Day Celebration at IITK

On February 28, 2020, IIT Kanpur celebrated the National Science Day with a thematic workshop on **Space Science** designed to introduce recent exciting developments in this field to the IIT community. Prof. Pankaj Jain, Department of Physics coordinated the event. It provided a platform to the Space Science community within IIT Kanpur to share their research experiences and ideas. The workshop was divided into three sessions chaired by Prof. Kumar Vaibhav Srivastava, Prof. Abhishek and Prof. Sagar Chakraborty respectively. A Public lecture was organised on **Space Science – the everlasting excitement** by Prof. V. Koteswara Rao, Vikram Sarabhai Distinguished Professor, ISRO. The final event in the Science Day celebrations was a night sky viewing session organized by the Astronomy Club at the air strip.



Speakers of the Workshop

- Dr. Santosh Vadawale
Physical Research Laboratory, Ahmedabad
New dimensions of Indian hard X-ray Astronomy
- Prof. Saikat Ghosh
IIT Kanpur
How gravitational wave detectors measure sub-nuclear displacements?
- Mr. Bharath
IIT Kanpur
Rings around minor planets
- Prof. B. Nagarajan
IIT Kanpur
Very Long Baseline Interferometric Technique - Its Applications in Geodetic Studies
- Prof. Supratik Banerjee
IIT Kanpur
In-situ data analysis to study the solar wind plasma
- Dr. Sharvari Nadkarni-Ghosh
IIT Kanpur
Where is the matter in our Universe and what is the matter with it?
- Mr. Omkar Bait
National Center of Radio Astrophysics, Pune
GMRT discovery of a large ring of atomic hydrogen gas around a red and dead galaxy
- Prof. Sanjay Kumar
IIT Kanpur
Shocking granular flows
- Prof. J. S. Yadav
IIT Kanpur
Understanding Black-holes in our Galaxy with LAXPC/AstroSat
- Prof. Debabrata Goswami
IIT Kanpur
Ultrafast table-top spectroscopy for Space Science
- Prof. Ishan Sharma
IIT Kanpur
Granular Minor Planets
- Mr. Akhil B. Krishna and Bharath
IIT Kanpur
Space Debris Mitigation
- Mr. Kaustav K. Das
IIT Kanpur
Gaia DR2 Informed Distance Constraint to the North Polar Spur
- Dr. Suratna Das
IIT Kanpur
Dark Energy: One of the greatest puzzles of Modern Science
- Mr. B HariHaran
TIFR Mumbai
The staggering power of thunderstorms
- Prof. Balaji Devaraju
IIT Kanpur
Satellites as Gravimeters





National Technology Hub for Cyber Security of Cyber Physical Systems

The National Mission on Interdisciplinary Cyber Physical Systems (NM-ICPS) under the auspices of the Department of Science and Technology has declared IIT Kanpur as the site for Technology Innovation Hub (TIH) in Cyber Security of Cyber Physical Systems. It is a five year project with funding of more than Rs 120 Crores. The Hub will be a single point source for all information related to the cyber security and applications. It will be the source of fundamental knowledge and technologies that will be needed to keep India prepared for the next generation of technologies. The Hub will build on existing Center for Cyber security of Critical Infrastructure (C3i) at IIT Kanpur, and will address security issues at nine abstraction layers from hardware upwards. Its focus will be on three verticals: **Critical Infrastructure, Automotive and Unmanned Aerial Vehicle security.**

The TIH has been named NaTCyCPS (National Technology Hub for Cyber Security of Cyber Physical systems). IIT Kanpur partners with SEALS lab in IIT Kharagpur, Cyber Security groups at IISc, IIIT Allahabad and AKTU Lucknow as initial national academic partners. The initial international partners are University of California, San Diego, New York University, New York and Abu-Dhabi Campus, Tel Aviv University and Ben Gurion University in Israel.

4 Major Charters of Technology Innovation Hub

Research & Development	Industrial Collaboration	Startup Ecosystem	Human Resource Development
The interdisciplinary center for Cyber security and Cyber defense of critical infrastructures (C3i Center) at IITK has established itself as a pioneer in the field of Cyber Security of Cyber Physical Systems. The TIH will extend the capabilities in cyber security already built in the field and carry out research in cyber security to protect the national critical infrastructures. The TIH will develop patentable IPs, copyrighted software, and cyber security technology products.	C3i has understanding and projects with companies such as L&T technology services, Tech Mahindra, Hitachi etc. Under the TIH, these relations will be strengthened and further partnerships will be developed.	TIH will have a technology entrepreneurship program, so that at least 30 new startups are incubated, all dedicated to novel and indigenous Cyber Security products and services.	TIH will provide fellowships to Post-doctoral, PhD, and Masters students, and will have UG fellowships as well for building future generation Cyber Security manpower in the country. It will also have faculty fellows and chair positions to attract high quality faculty in Cyber Security field. Various online courses will be created to impart training in Cyber Security to a large audience.

IIT Kanpur executes Smart City Project

A Smart Grid Control Centre, set up at IIT Kanpur, was inaugurated by joint secretary, Ministry of Power, Mr. Mrityunjay Kumar Narayan along with Prof Abhay Karandikar, Director IIT Kanpur and Mr. AK Mishra, Director, National Smart Grid Mission (Project management unit) NSGM-NPMU, on February 24, 2020. The centre has been set up as part of the smart grid pilot project jointly funded by the Ministry of Power (MoP) and IITK. This is one of the 14 Smart City pilot projects sanctioned by the Ministry of Power in 2014.



Key Components of the Project

SCADA (Supervisory Control and Data Acquisition): Remote terminal units (RTUs) are installed in all substations in the campus. Measurements from substations are collected via communication network at the IITK Smart Grid Control Centre. The entire power distribution system of IITK campus is now monitored and controlled by **SCADA**

AMI (Advanced Metering Infrastructure): Single-phase smart meters are installed in several houses, and three-phase smart meters are installed in student hostels and academic buildings. **AMI** integrates these smart meters with the help of dedicated ICT infrastructure. Meter Data Acquisition System (MDAS) and Meter Data Management System (MDMS) are in place to collect, process, analyze, visualize, and take further actions based on the meter data.

Renewable Energy Integration: Solar PV panels of capacity 5 kWp are installed on the rooftops of a number of houses, for feeding the local load; the surplus is fed to the Grid. Out of these houses, four houses have hybrid inverters with battery storage of 24 kWh installed. Remaining houses have grid-tied inverters without battery storage.

Home Automation Solution: Wi-Fi, ZigBee, and Z-wave enabled devices and smart plugs are installed inside the chosen houses. Essential loads, such as lights and fans, and non-essential loads, such as air conditioners and geysers, are monitored and controlled through mobile apps and system integration software present at the central control centre, allowing the consumers to actively participate in Demand Response (DR).

Smart Grid Control Centre: At the control centre, the software for receiving and storing all the data from SCADA, smart meters, solar PV inverters, and smart home devices are installed on servers. The operator can run various monitoring and control applications with the help of this integrated platform.

The main benefit is that the prototype will act as a testbed for smart-city related research, development, and training activities for industries, research institutes, and academicians in India. The key achievements/impact include implementing network reconfiguration, distribution system state estimation algorithm usable by typical Indian utilities, improvement in the overall power quality, reduction in the duration of outages by implementing fast restoration techniques, implementing demand response algorithms, savings on electricity bills for households with renewable solar PV and battery storage, improvement in overall customer DR participation and satisfaction, and the design of hybrid solar inverter suitable for the Indian condition.



Leadership Orientation for REC Innovation Platform



REC Innovation Platform has been conceptualized and executed by the SIIC to identify and support young innovators among students in engineering and science colleges. The program is supported by the Rural Electrification Corporation Limited (RECL), a public sector undertaking, in the state of Uttar Pradesh. SIIC will be onboarding 1200 students from 20 colleges to be mentored by a team of research experts from IIT Kanpur and faculty members of their institution. The faculty members from the participating institutes such as KNIT Sultanpur, BIET Jhansi, REC Kannauj, FGIET Raibareilly, UIET CSJMU, and AITH Kanpur, attended the orientation event on 27 February 2020 and

discussed various ideas along with the detailed execution plan of the program.

Launch of TIDE 2.0 scheme supported by MeitY

MeitY had bestowed SIIC with the prestigious **TIDE 2.0 G1 Center**. As the TIDE G1 center, SIIC is mandated to sharing of resources, best practices, and strengths among the other TIDE Centers. The TIDE 2.0 program also allows SIIC to engage and support 15 startups and entrepreneurs in the ICT domain every year for the next 5 years. The startups engaged are also from all over the spectrum, from early-stage to 'market ready' ones.

Startup Orientation for India Agritech Incubation Network (IAIN)

In the first call for application, 13 startups were selected for the incubation and financial support by SIIC under the IAIN. The orientation program for the selected startups was organized on the February 4 and 5, 2020. The start-ups were briefed about the agricultural environment of Uttar Pradesh by the experts from Tata Trusts.

Innovations for Sustainable Development Goals (SDGs) and the role of CSR

On February 27, 2020 SIIC organized an exclusive roundtable to understand how can India achieve SDGs through innovations and the role of CSR funds in assisting the attainment of the goals. This selective meeting was attended by the CSR Heads of various corporations and the leadership of IIT Kanpur.

Parikalp - Season I



Parikalp - Pathway for Research Idea and Knowledge from Academia to Large commercial-Production, was presented by the celebrated academician **Prof. Rinti Banerjee** (FBAO, FASc), Madhuri Sinha Chair Professor at the Department of Biosciences & Bioengineering at IIT Bombay. Prof. Banerjee talked about the challenges and opportunities in her translational journey from academia to business and the challenges faced during the growth.

Tech Talk - Season II

Tech Talk series is a monthly event organized by Startup Incubation and Innovation Centre (SIIC) IIT Kanpur. The program is being supported by Capri Global through its CSR initiative.



Mr Vijay Jaiswal
Head, Ecosystem Development, Future Mobility, British High Commission
Ecosystem development for electric vehicle adoption



Dr. Deepak Padmanabhan
Electrophysiology & Cardiology specialist
The Pantheon of Problems in an Advanced Healthcare Cardiac Care Setup.

RAA Labs for Samagra Shiksha, Delhi

Sponsor: Unit of Science and Educational Development (UNISED)

PI: Prof. Amey Karkare (karkare@iitk.ac.in)

Department of Computer Science and Engineering



IIT Kanpur is setting up **Rashtriya Avishkar Abhiyan** (RAA) labs in 136 government schools in Delhi. RAA Labs are based on Atal Tinkering labs of NITI Ayog and aim to leverage the potential for Science, Mathematics and Technology (SMT) learning in non-classroom settings. IIT Kanpur will be involved in assisting teachers in demonstrating experiments and conducting activities, content development (computer simulations, audio/visuals), and measuring the effectiveness of the program through national level competitions like NTSE and children science congress.

Objective of the Project

- Enabling children to become motivated and engaged in SMT through observation, experimentation, inference, drawing, model building, rational reasoning, etc.
- Creating curiosity, excitement and exploration among school children.
- Creating a culture of thinking, inventing, tinkering and doing to promote enquiry-based learning.

First Foundation Day of Technopark@iitk

IIT Kanpur Research and Technology Park celebrated the successful completion of one year of its formal operations on March 02, 2020. The year was replete with local industry events, special interest group meets, visits by industry experts and many insightful interactions on industry-academia partnerships. A series of events was planned to mark its First Foundation Day. The Chief Guest for the program was honourable NITI Aayog member Dr V.K. Saraswat. Dr Saraswat delivered a plenary talk titled 'Importance and way forward for industry-academia interactions' sharing his personal experiences on the nature of academia-industry interactions and how they have evolved over time. The event was also graced by Prof. Abhay Karandikar, Director and Prof. Manindra Agrawal, the former Deputy Director, IIT Kanpur. Prof. Avinash Kumar Agarwal, the founder Professor In-charge of Technopark@iitk, shared the past, present and the future growth trajectory of Technopark@iitk.

The seven companies currently housed in Technopark@iitk namely VTOL Aviation India, Injectoplast, Threads India, AR Thermosets, iSMRITI, Kanopy Techno Solutions and Dataman Solutions presented their work and the ongoing R&D collaborations with IITK. They put up their company stalls as well and interacted with faculty, students and other industry participants. Besides, IITK Student-Industry engagement program titled ReWoP 'IITK Students tackling Real World Problems' was once again launched and received an overwhelming response from industry and students. In this program, students will get a chance to work on real industry problems and industry will be benefited by out-of-the-box solutions as well as future workforce. On this occasion, the first annual progress report 2019-20 of Technopark@iitk was unveiled. The chief guest felicitated all the seven companies for believing in the concept of Technopark@iitk and joining hands with IITK in creating novel technologies.



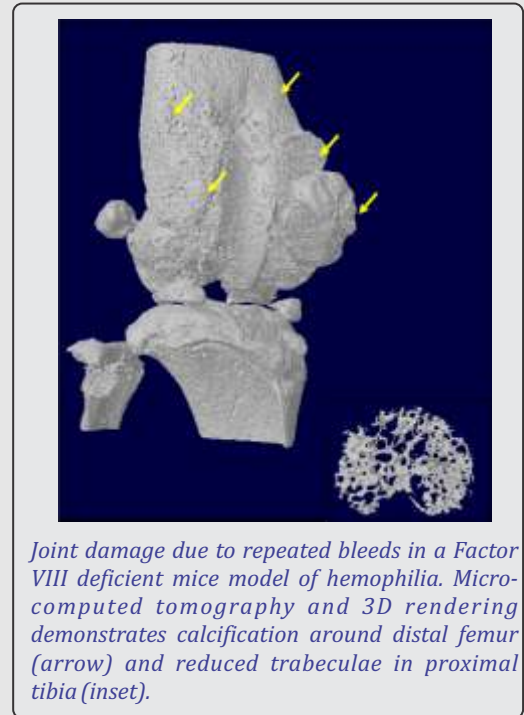
Deciphering the Role of Small RNAs in the Development of Hemophilic Arthropathy and Formulation of a MicroRNA based Therapeutic to Alleviate Joint Damage

Sponsor: Science and Engineering Research Board

PI: Prof. Jayandharan G. Rao (jayrao@iitk.ac.in)

Department of Biological Sciences & Bioengineering

Hemophilic arthropathy (Joint damage) due to repeated bleeds into the articular cavity is a major cause of morbidity in patients with hemophilia, a common genetic disorder, which affects 1 on 5000 in the general population. On an average, these patients have 15 to 35 spontaneous joint and muscle bleeds per year. The current treatment is largely based on prophylactic administration of the missing coagulation factor VIII (recombinant) protein, which is expensive and costs upwards of USD 100,000 per patient per year. Therefore, there is a need for newer and better strategies to prevent or delay the onset of blood-induced joint damage in these patients. Based on our preliminary studies, we reasoned that during these joint bleeds, microRNAs and its related processes play a significant role in the cartilage damage. A complete understanding of this process could not only pinpoint the mechanisms leading to cartilage damage but also reveal biomarkers of the disease and/or targets for intervention. Based on these findings, the project proposes to develop novel gene therapy strategies for this condition in a murine model of hemophilia.



Joint damage due to repeated bleeds in a Factor VIII deficient mice model of hemophilia. Micro-computed tomography and 3D rendering demonstrates calcification around distal femur (arrow) and reduced trabeculae in proximal tibia (inset).

Development of TFT Array and Liquid Crystal Layer and their Integration with Metasurface Antenna

Sponsor: Space Application Centre - ISRO

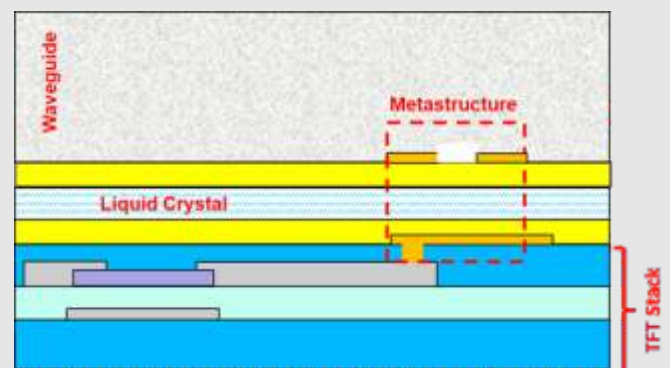
PI: Dr. Ashutosh Kumar Tripathi (aktrip@iitk.ac.in)

National Centre for Flexible Electronics

Co-PI: Prof. Deepak Gupta (saboo@iitk.ac.in)

Department of Materials Science & Engineering

National Centre for Flexible Electronics at IIT Kanpur (FlexE Centre) is developing various enabler technologies in the field of large area flexible and printed electronics. FlexE Centre has a running program on fabrication of thin film transistor (TFT) based circuits for large area electronics. In this project, SAC-ISRO and FlexE Centre are jointly developing Ka-band reconfigurable metasurface antenna integrated with Liquid Crystals that can be tuned using TFT array. Development activities include fabrication of high performance TFT based array, identification and characterization of suitable Liquid Crystals having high dielectric anisotropy, fabrication of Liquid Crystal cells, and integration of metasurface antenna with Liquid Crystals and TFT array. TFT array would act as a backplane for addressing capacitors at switching speeds in milliseconds. Liquid Crystal capacitor will be formed between meta-elements and waveguide structures which will jointly form scattering elements of antenna. Tunable metasurface antenna would enable to achieve electromagnetic (EM) beam steering in the desired angular range.



Schematic of a meta-element

The diagram illustrates the cross-section of a meta-element. It consists of a top layer labeled 'Waveguide' (white), followed by a 'Metasurface' (yellow) with a red dashed box highlighting its structure. Below the metasurface is a 'Liquid Crystal' layer (yellow with blue horizontal lines). At the bottom is a 'TFT Stack' (blue and purple layers). The TFT stack is connected to the metasurface and waveguide structures.

Institute Lecture (January 2020 - March 2020)



Prof. Utpal Banerjee
University of California
Structured Construction & Deconstruction of Research for the early undergraduate Curriculum



Prof. Yuval Gefen
Weizmann Institute Israel
Weak Measurements: A Peephole to the Quantum World



Prof. Pulickel M. Ajayan
Rice University, Houston (USA)
Nano-Engineered Materials



Prof. William Detmold
Massachusetts Institute of Technology
The Secret life of Quarks



Prof. Stephan Winter
The University of Melbourne, Australia
Place in Mobility Research



Prof. Hans-Bernd Schaefer,
Bucerius Law School, Hamburg, Germany
Law and the Poverty of Nation



Prof. Kannan M. Krishnan
University of Washington, Seattle, USA
Magnetic Particle Imaging: Translating Science and Engineering to Medicine



Prof. Maresi Nerad
University of Washington, Seattle, USA
Are They Converging? Doctoral Education Worldwide: Trends and Future Challenges



Prof. Siddharth Ramachandran
Boston University, USA
Space: The Less Explored Dimension of Light



Dr. Pravin Bhagwat
Co-founder & CTO of Mojo Networks
Securing Data from Wi-Fi Network Attacks



Prof. Anatoli Polkovnikov
University of Boston, USA
Chaos and Determinisms: A Two-way Road between Newton's Laws and Thermodynamics



Prof. Harald Schuh
Technische Universität Berlin (TU Berlin)
Contribution of Geodesy to Monitoring Global Changes and Natural Hazards



Prof. Frederic Lefevre
INSA-Lyon, Villeurbanne, France
The Energy-Climate Challenge: IPCC's Contributions



Prof. Eluvathingal D. Jemmis
Indian Institute of Science, Bangalore
Importance of Early Questions

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R&D Profile at a glance

<http://www.iitk.ac.in/dord/data/R&D-profile-flyer-2019-16-08-19.pdf>