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R&D Newsletter

Indian Institute of Technology Kanpur

IITK to set up
Centre for
Engineering in Medicine

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Hon'ble Union Minister of Human Resource Development (MHRD) **Shri. Ramesh Pokhriyal 'Nishank'** visited IIT Kanpur on November 02, 2019 as the Chief Guest for the Foundation Day of the Institute. During this visit, Shri Nishank and several other dignitaries were present to witness the demonstration of ten selected incubated startups of the Startup Incubation and Innovation Centre (SIIC), IIT Kanpur. The selected startups for this showcase event were *Earth Analytics*, *CD Space*, *Saptkrishi Scientific*, *Kritsnam Technologies*, *Phool*, *Offgrid Energy*, *Duosis*, *PhotoSpiMedex*, *Acquafront Infrastructure* and *Innoviron*. The visitors had appreciated that IITK incubator is supporting the deep-tech innovations solving the challenges of our country.

Shri. Nishank was also taken on a tour of the **National Centre for Flexible Electronics, C3i Center** and **Flight Laboratory**. Some of the highlights of the research being undertaken at these centres were exhibited. He appreciated the R&D work carried out at IIT Kanpur.



Centre for Engineering in Medicine



IIT Kanpur is poised to set up a 'Centre for Engineering in Medicine' with the generous support from Mr. Rahul Mehta of Mehta Family Foundation. On the 61st foundation day of the institute, director Prof. Abhay Karandikar and Mr. Rahul Mehta signed a memorandum of understanding (MoU). Professor Shankar Subramaniam of the University of California, San Diego, is the first international advisor of the 'The Mehta Family Centre for Engineering in Medicine'. This would be the first centre of its kind in the country in terms of manpower it would train at the interface of engineering and medicine.

The vision of the centre is to generate significant impact in health care in India in terms of research/technology output in addition to the grooming of next generation leaders that are well trained in these interdisciplinary areas. The centre would leverage the existing strengths within core engineering departments of IITK and department of Biological Sciences and Bioengineering (biomedical research) while diversifying into new/frontier areas to enable more impactful research (fundamental and applied).

Simultaneously, IIT Kanpur also proposes to set-up a medical school in the institute. The long term plan is to have the presence of an engineering school, a medical school and a 'Centre for Engineering in Medicine' on the campus with the 'Centre' bridging between the faculty from Sciences, Engineering & Medicine to enable research at the interface of these areas.

Research Focus of the Centre

Regenerative Medicine

- Stem Cell Engineering
- Scaffold Engineering
- Growth Factor Engineering
- Immuno Engineering

Molecular Medicine

- Genome Engineering
- Precision Medicine
- Drug Discovery
- Neuro Engineering

Digital Medicine

- Software-as-a-therapy
- Digital Diagnostics
- Computational drug discovery



Abhivyakti 2019

SIIC organized its annual startup showcase event '**Abhivyakti**' 2019 on November 04, 2019 at IIT Kanpur. Along with other eminent names from the startup and entrepreneurship ecosystem of the country, Shri Alok Singa, Additional Chief Secretary, Electronics & IT, Government of UP graced the occasion as Chief Guest. Over 35 selected incubated companies displayed their products. Endure Air, demonstrated the capabilities of their gasoline powered helicopter drone which can fly for 3.5 hours, 200 km, at a stretch. Another Drone company, CD Space Robotics, displayed their VTOL drone which delivered blood samples from a village in Uttarakhand to the district headquarter. Other major attractions were companies such as Saptkrishi, whose product Sabjkothi could keep green vegetables fresh at ambient temperature for up to 40 days; Invoviran, which has made compostable, water resistant plastic from Keratin available as waste material and Intignus, which has developed a novel method for detecting Preeclampsia, a pregnancy related complication associated with high pressure.



More than 500 students from various schools and colleges of UP, prominent investors (Angel Investors and Venture Catalysts) and FICCI leadership were present in the event.

NTT DATA IITK Innovation Fellowship

SIIC announced the launch of the **NTT DATA IITK Innovation Fellowship** on a event organised on October 23, 2019 at IIT Kanpur. The event was graced by senior team member of NTT DATA which was led by IITK Alumni Dr. Harsh Vinayak who is currently Senior Vice-President, NTT DATA. Any recent graduate can apply for the fellowship program which offers a monthly stipend support upto INR 50,000 per month of a period of 12 months along with other support from SIIC.

Application form is available at:
<https://siincubator.com/initiatives/iitk-innovation-fellowship/>

Structure, Function & Allosteric Modulation of the Human Duffy Antigen Receptor for Chemokines, a unique Seven-Transmembrane Receptor

PI: Prof. Arun K. Shukla (arshukla@iitk.ac.in)

Department of Biological Sciences & Bioengineering

Sponsor: Department of Science & Technology

The project is awarded as Swarnajayanti Fellowship 2019



Human Duffy antigen receptor for chemokine (DARC) represents a unique and enigmatic example of a seven transmembrane (7TM) receptor in the human genome. Despite harboring highly conserved 7TM architecture, characteristic of G protein-coupled receptors (GPCRs), DARC does not interact with either heterotrimeric G-proteins or β -arrestins. This unique and unprecedented profile of DARC makes it an interesting candidate to discover novel structural aspects of ligand recognition by 7TM fold and new downstream signaling pathways independent of classical effector cascades. Moreover, the expression of DARC on erythrocytes is a key determinant of *Plasmodium vivax* attachment and invasion of erythrocytes causing malaria. This interaction between *P. vivax* and DARC is mediated primarily by the Duffy Binding Protein of *Plasmodium* (PvDBP) and therefore, modulation of this protein-protein interaction may have therapeutic implications. This project intends to employ a multidisciplinary approach comprising of biochemical, proteomics, structural and synthetic biology methods to comprehensively investigate the structure and function of DARC.

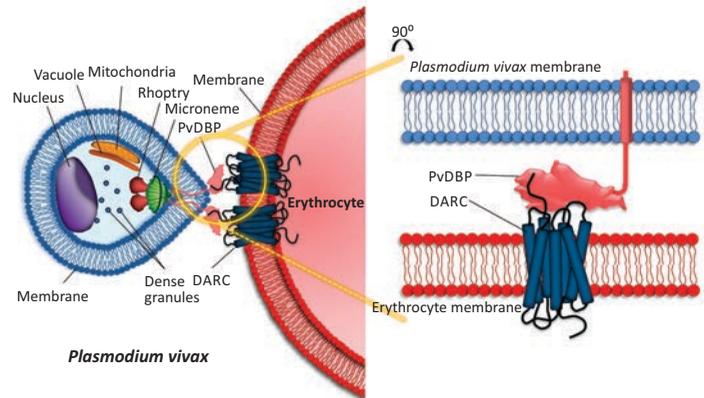


Image Credit: Pragma Gupta

SIG Meet held by Technopark@iitk on AI, IoT & Robotics

Technopark@IITK hosted a Special Interest Group Meet on Artificial Intelligence (AI), Internet of Things (IoT) & Robotics on November 09, 2019 at IIT Kanpur. The One-Day Meet provided an opportunity to eminent industry professionals & academia of IIT Kanpur to exchange views on current & future trends, applications & industry expectations in the fields of AI, IoT & Robotics. Industry leaders from Tech Mahindra, Analog Devices, GE Aviation, Microsoft, Wipro, Gaia Smart Cities and Boeing gave series of talks. IITK faculty talks highlighted their research in the areas of AI, IoT & Robotics. The Science and Technology Club comprising IITK students exhibited its innovations and products. The event provided an open platform and opportunity for fruitful discussions and collaborations between industry and academia for mutually beneficial long-term partnership. Post SIG Meet, Technopark@iitk has started discussions with Wipro, Tech Mahindra and Boeing India to plan the future course of action.



Ferroelectric Quantum Transistors for Integrated Circuits

PI: Prof. Yogesh Singh Chauhan (chauhan@iitk.ac.in)

Department of Electrical Engineering

Sponsor: Department of Science & Technology

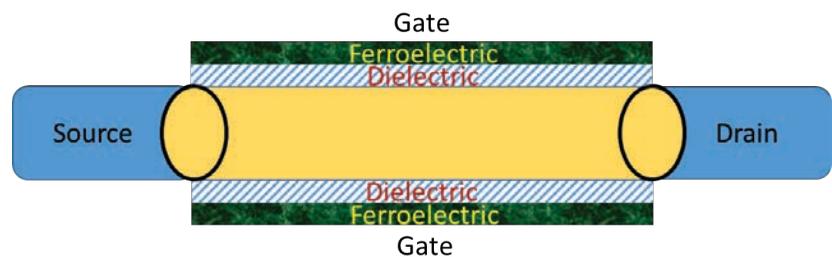
The project is awarded as Swarnajayanti Fellowship 2019



The Quantum Transistors are atomic scale digital switches with few nanometers channel thickness and gate length, in which device behavior is dominated by quantum effects. These transistors will be designed using extremely thin channel material to operate in ballistic and quasi-ballistic regimes. Novel channel materials like SiGe, III-V and 2D semiconductors and novel devices such as ferroelectric quantum transistors are serious contenders for replacing Si-transistors in future integrated circuits. This proposal aims to first understand the physics of these novel transistors and develop models for the same to guide the design of these devices for future applications. Also, the statistical variations in geometry and material properties, which are critical at the nanoscale will be investigated and included in the physics-based device models. In-depth insights of device operation under diffusive, ballistic, quasi-ballistic transport will be gained by employing quantum mechanical numerical simulations, device characterization and device modeling at multiple temperatures. The ultimate goal of this project will be to develop fundamental understanding of various phenomena that govern the operation of extremely thin and short channel ferroelectric transistors.

Project Objective

- Investigate complex phenomena in Quantum Transistors
- Impact of channel thickness and channel length in nanoscale transistors
- Variation in material properties from bulk to single atomic layer
- Influence of ferroelectric material on transistor properties – Negative DIBL, NDR, Reverse short channel effects etc.
- Physics of domains and grains in ferroelectric material, and their impact on MOSFETs
- SPICE modeling for Ferroelectric Quantum Transistors



Ferroelectric Quantum Transistors

Pseudo-dynamic test facility

A pseudo-dynamic test facility (PDTF) has been set up at IIT Kanpur with the generous support from Department of Science and Technology. This state-of-the-art facility, the first of its kind in India, will be used for testing of prototype structures for evaluation of seismic performance. Prof. Ashutosh Sharma, Secretary, DST inaugurated the facility on September 21, 2019.



EMI/EMC and Electrical Safety Testing Facility at IIT Kanpur

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Department of Electrical Engineering

Sponsor: BIRAC

Team Members: Profs. A R Harish, K V Srivastava, N K Verma, N Gupta, A. Bandyopadhyay
Department of Electrical engineering



The main aim of this new project is to establish a world class EMI/EMC (Electromagnetic Interference and Compatibility) test facility at IITK, where the major focus would be to test the EMC compliance of modern electronic instruments and gadgets presently used in the medical industry. The major challenge with the usage of digital electronic gadgets is the mitigation of the electromagnetic interference (EMI) as they continuously generate broadband undesired electromagnetic (EM) fields. It is more challenging for the electronic instruments used in the medical field because of the human health risk involved in addition to the compliance with the regulatory EMC standard. The EMI/EMC testing facility will have special emphasis on medical instruments starting from low frequency to RF range, which would especially be quite helpful to start-ups developing new electronic and medical instruments. The proposed facility would conduct the electromagnetic interference and electrical safety tests as per IEC 60601, CISPR 11, and CISPR 16 standards.

At present, there are no certified EMI/EMC facility to test electronic instrument in general and medical gadgets in particular in the northern, central and eastern part of India. The proposed facility at IIT Kanpur would fill in this gap, and would eventually facilitate the growth of MedTech industry including startups in this part of the country. The medical institutes, public hospitals, private medical practitioners etc., especially in the surrounding region would be encouraged to get all their biomedical instruments and electronic gadgets certified by the designated EMI/EMC Center at regular intervals. Additionally, the EMI/EMC Test Center at IIT Kanpur would conduct various workshops and short courses at regular intervals to create awareness about the significance of EMI/EMC issue among the medical professionals, the product designers as well as the academic community.

Establishment of a State-of-the-art Facility for Design and Fabrication of Medical Devices and Equipment with In House Quality Control System for Cultivating a Local Production Hub Of Medical Grade Technology and Solution Industry

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Department of Mechanical Engineering

Sponsor: BIRAC

Team Members: Dr. Amandeep Singh, Imagineering Lab IITK



As India progresses on her transformational journey towards global economic leadership, the biotechnology sector is recognized as one of the key contributing drivers. 'MedTech IIT Kanpur' would be a dedicated medical-grade product design and development center in this direction, which is being established while augmenting the existing facility, Imagineering Laboratory, at IIT Kanpur.

The facility would cater to the medical devices research requirements of around 30 crore population in North India. After the development of high fidelity physical prototypes, the fabrication of devices could

be further incubated using the materials and processes intended to be used in batch or mass-scale production. It is intended to establish a cost-effective and efficient fabrication facility at IIT Kanpur which will benefit from utilizing the resources under industry-academia collaborative effort for increasing the indigenization of Bio-pharma and medical devices in India. The facility will focus on both manufacturing design and industrial design where factors such as ergonomics, aesthetics will be given importance along with functionality and manufacturability.

Institute Lecture (August 2019 - November 2019)



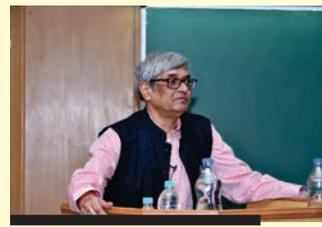
Prof. Vishwanath Prasad
University of North Texas

Energy: Human Evolution to Present Day Conflicts



Prof. Alper Erturk
Georgia Institute of Technology

Dynamics of Next-Generation Smart/Meta Structures: Energy Harvesting, Bio-Inspiration and Vibration Mitigation



Dr. Bibek Debroy
Chairman, Economic Advisory Council to the Prime Minister

Contemporary Issues in Indian Economic Development



Prof. Sumit Chakraborty
Ruhr Universität Bochum

Time will tell: Tales of crustal evolution from the global to the atomic scale



Prof. Ing. Habil Ulrich L. Rohde
Chairman, Synergy Microwave Corp., NJ, USA

New Radio Networks and Emerging Trends: SDR, 5G and IoT



Prof. Will Featherstone
University of Curtin

Geodesy? What on Earth's that?



Prof. Shankar Subramaniam
University of California San Diego

Is Big Data the *sine qua non* of Human Future? Challenges at the interface of Data and Life Sciences



Prof. Pankaj Jalote
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R&D Profile at a glance

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