

3.5.7

Centre for Sustainable Technologies

CHAIRPERSON

B V VENKATARAMA REDDY

The faculty members are involved in innovative, multidisciplinary research using geological, geophysical and geochemical tools to understand Earth processes. Equipped with state-of-the-art analytical facilities and wide-ranging expertise, they are working on diverse problems in earthquake geology, global tectonics, core dynamics, ocean-atmosphere interaction, climate change and paleoclimate studies, petrology and geochemistry of igneous, sedimentary and metamorphic rocks, chemical weathering of the continents.

Current Research

BIOENERGY AND BIOMASS

Anaerobic digestion of biomass for energy and treatment of wastewater, including biofilms to treat xenobiotic dosed greywater. The major focus on the thermo-chemical conversion of biomass is towards generating PEM quality hydrogen- 99.999 % purity for transport sector. Establishing renewable energy fuel for Solid Oxide fuel cell (SOFC), Biomass to liquid fuel generation through thermochemical and biochemical route.

Fuel efficient devices: Development of a stove-mould assembly for rapid self-construction of fuel-efficient domestic cooking and bath stoves, jaggery furnaces and driers with high operating efficiency and lower cooking time in comparison other technologies

FACT FILE

Established: 1974

Phone: +91-80-2293 2447/3126/3047

Email: chair.cst@iisc.ac.in

URL <http://cst.iisc.ac.in>

Chairperson: B V Venkatarama Reddy

Degree Programs Offered: PhD and MTech (Res)

IN NUMBERS

5 Academic staff

1 Scientific Staff

26 PhD

26 Publications

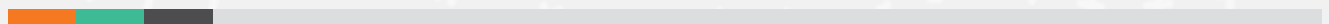
14 Training and Capacity Building Activities

2 PhD, 1 MSc (Engg) & 1 MTech (Res)

Conferments

Core Research

Biomethanation; Energy Efficient Wood Burning Devices; Alternative & Green Building Technologies; Sustainable Architecture and climate-responsive designs; Building Integrated Photovoltaics; Sanitation; Waste Management; Turbomachinery for Renewable Energy; Bioenergy; Plasma reforming of syngas, Plasma activated water and Plasma waste water treatment, Plasma Assisted Combustion, Plasma reforming of heavy hydrocarbons, Grey water treatment and recycling; Hydrogen from Biomass, SOFC, Biomass to liquid fuel generation through thermochemical and biochemical route; Building materials from non-organic solid wastes



Climate responsive architecture: Building and architectural sciences dealing with climate-responsive performance of buildings, experimental investigation into the thermal resilience of vernacular and conventional building materials in response to climate change. Integrability investigations into the BIPV performance comprising building thermal

comfort and PV performance in Tropical Regions

SUSTAINABILITY & DESIGN

Design for the BoP, adopting Capability Approach, in the development of a de-skilling mould for construction of firewood cookstoves. Sustainability science based

on systems thinking to assess and forecast sustainability in design and technology, and the identification of suitable design based interventions

LANDFILL ENGINEERING

Model bioreactors and their performance is against available literature models. Design of landfill components such as liners, covers, leachate collectors and site location are studied using risk and reliability analysis principles

TURBOMACHINERY

Designing and building turbomachinery equipment covering both generation and utilization aspects of renewable energy including decentralized systems. Hydro turbomachinery and thermal turbomachinery (organic rankine cycles, high pressure ration

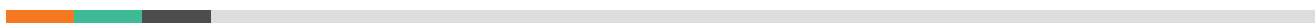
steam, and super critical CO₂) are included. Innovative machinery for pumped hydro energy storage

PLASMA TECHNOLOGY

Non-Thermal Plasma Cleaning, Enrichment and Reforming of Gaseous Hydrocarbons. Plasma activated water characterization and its application for surface hygiene and food preservation. Plasma grey water treatment for recycling purposes. Decentralized wastewater treatment and recycling, Modelling of Plasma systems. Plasma activated water as anti-cancer treatment

BUILDING MATERIALS

Industrial waste blast furnace slag is being studied for its use as fine aggregate in mortar and concrete



Faculty & Staff

H N Chanakya | PhD (UAS), Chief Research Scientist

S Dasappa | PhD (IISc), Associate Professor

Monto Mani | PhD (IIT Madras), Associate Professor

Lakshminarayana Rao M P | PhD (Mcgill Univ, Canada), Assistant Professor

Punit Singh | PhD (Karlsruhe), Assistant Professor

Associate Faculty

G L Siva Kumar Babu | PhD (IISc), Professor

P Balachandra | PhD (IISc), Principal Research Scientist

Jayant M Modak | PhD (Purdue), Professor

K S Nanjunda Rao | PhD (IISc), Principal Research Scientist

T V Ramachandra | PhD (IISc), FNEA, FIE, FIEE(UK), FIH, Scientific Officer

M Sudhakar Rao | PhD (Pune), Professor


B V Venkata Rama Reddy | PhD (IISc), Professor

3.5.8

Divecha Centre for Climate Change

CHAIRPERSON

S K SATHEESH



The primary goal of the Divecha Centre for Climate Change is to understand climate variability and climate change and its impact on the environment. The Centre is working with various departments to identify technologies to mitigate/reduce the severity of climate change. The Centre frequently undertakes outreach activities to create awareness among people and policy makers about climate change and its consequences especially on society.

Current Research

DIVECHA CENTRE GRANT FROM THE GRANTHAM FOUNDATION

Mainly, we are involved in various topics related to atmospheric science, Himalayan glaciers and basic and applied research in renewable energy. Experiments using high-altitude balloons have shown large amounts of black carbon aerosols at higher atmospheric levels. Model simulations have shown that while biomass burning and near-surface anthropogenic activities together with boundary layer dynamics can explain at least part of the lower layer, upper layer can be explained only by including emissions from high-flying aircrafts. Our studies indicate that once black carbon aerosols are emitted at higher atmospheric levels, they can be lofted further via absorption- warming-convection cycles, which could propel them even to the stratospheric heights. Once they reach stratospheric heights, chemical reactions occurring over their surfaces could have strong implications

FACT FILE

Established 2009

Phone +91-80-2293 2075/3425

Fax +91-80-2293 3425

Email chairdccc@iisc.ac.in

URL dccc.iisc.ac.in

IN NUMBERS

30 Publications

for the ozone layer. The effect of atmospheric conditions like aerosols, temperature and water vapour on the power output has been studied using Concentrated Photo Voltaic (CPV) modules on a dual-axis sun tracker. We are also involved in research to fabricate thin film solar cells, which are semi-transparent following low cost processes. The envisaged application for these cells is for windows and skylights of buildings. We have studied various aspects of GHG inventory, mitigation and adaptation for India to meet the requirements of the Paris Agreement. They have identified requirements for modelling and measurements at the national, state, industry and municipal levels as well as research and capacity building requirements for enabling India to meet these requirements.

DST GRANT: Studies on glaciers have shown that though the rates of retreat of individual glaciers are uncertain, on the whole the Himalayan glaciers are losing mass at an increasing rate over the past few decades.

With the changing climate, glaciers would continue to shrink and the rates of retreat may increase even further. This can lead to the formation of glacial lakes, which, with continued accumulation of glacier melt could burst leading to catastrophic impacts on human life, settlement and infrastructure downstream. By using glacier surface velocity, estimated using high spatial resolution satellite data and slope, we have calculated ice thickness, by applying a basic parallel flow model, subsequently outlining the bed topography and located potential lake sites in over-deepening in the bedrocks. We have also developed a model to predict the future expansion of lakes. The slide shows how the measurements go in line with the model projection.

The model predictions have been validated using field investigations. A proposal to avoid flash flood has been accepted by the government of Sikkim, a north eastern state in India.



Associate Faculty

SK Satheesh | PhD (Kerala), FASc, FNASc, FNA, Chairman & Professor

G Bala | PhD (McGill), Professor

GS Bhat | PhD (IISc), FASc, Professor

Arindam Chakraborty | PhD (IISc), Associate Professor

Prosenjit Ghosh | AP (CEAS), Associate Faculty

Anil V Kulkarni | PhD (Kolhapur), Distinguished Scientist

Viraj Kumar | PhD (Illinois), Visiting Professor

Ravi S Nanjundiah | PhD (IISc), Professor

Debasis Sengupta | PhD (Bombay), Professor

J Srinivasan | PhD (Stanford), FASc, FNAE, FNA, Distinguished Scientist

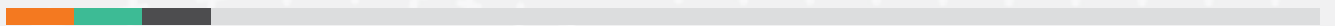
Raman Sukumar | PhD (IISc), Professor

PN Vinayachandran | PhD (IISc), FASc, FNA, Professor

Venugopal Vurputur | PhD (Minnesota), Associate Professor

Core Research

Glaciers, Renewable Energy, Aerosols and their impacts on climate, Atmospheric boundary layer, Cloud Physics, Geophysical fluid dynamics, Monsoon variability and predictability, Numerical simulation of the Atmosphere-Ocean- Climate system, Paleoclimate studies, Physical-Chemical-Biological oceanography, Satellite meteorology, Space-time structure and scaling in geophysical data, Tropical convection





3.5.9

Materials Engineering

CHAIRPERSON

TA ABINANDANAN

Established in 1945 as Department of Metallurgy and re-named in 2006, the Department of Materials Engineering has a rich history of accomplishments, with active groups pursuing research into materials phenomena spanning multiple length and time scales. With nearly 200 research papers published each year, and with academic programmes leading to bachelors, masters and doctoral degrees, it is recognized as a leading academic centre in materials education and research.

Current Research

Two new important discoveries have been reported in the field of piezoelectric and multiferroic materials: (a) a piezoceramic material which in untextured polycrystalline ceramic form has been shown to exhibit a record high electro-strain of 1.3 %. This is a new benchmark value in the field, and (b) a particulate ferroelectric-ferrimagnetic composite (produced by precipitation of ferrimagnetic phase by use of a suitable additive) has been shown to exhibit very good magnetoelectric coupling making them technologically appealing.

In the field of biomaterials, new alloys of beta-Ti with low modulus and high strength have been developed for orthopedic applications. Severe plastic deformation of the surface of these alloys was shown to enhance the bioactivity of the alloys. Also, fibrous polymeric scaffolds have been prepared for bone tissue engineering and enhanced bioactivity using

FACT FILE

Established 1945

Phone +91-80-2293 2259

Fax +91-80-2360 0472

Email <http://materials.iisc.ac.in/>

URL office.mte@iisc.ac.in

Degree Programs offered PhD,

MSc (Engg), ME and BS

IN NUMBERS

18 Academic Staff

4 Scientific Staff

107 PhD Students

21 MTech Students

212 Publications

26 PhD Conferments

Core Research

Polymers and nanocomposites;
Biomaterials; Structural metals and alloys;
High temperature coatings; Electronic and
structural ceramics; Electronic packaging
materials; Mineral processing; Energy
materials; Computational Modelling.

ceramic nanoparticles. In another study, cardiomyocytes on aligned microgrooves have been shown to get organized in a manner similar to the heart tissue; such systems could serve as a promising platform for studying cardiac hypertrophy.

Lightweight, flexible and thermally stable nanocomposites have been developed for microwave absorption. Further, porous polymeric membranes have been designed for water remediation.

A small-scale testing method has been evolved to study creep of high temperature components using cantilevers extracted from boilers or rotors in service. We have shown that data from such tests are consistent with the more traditional, larger-sample uniaxial creep measurements and in the process demonstrated that the creep rates of boiler steels that have seen 25 years services is increased by a factor of 6-8. Further, by using additively extended beams, we have established an alternate method for minimising the size of the extracted coupon. Studies on aluminium beams extending from 5 mm to 0.5 mm thickness also allow us to study length scale effects that may constitute a limitation to data extraction from small samples.

The synergistic effect has been demonstrated during fracture in thin metallic foils due to a combined application of an electric current and mechanical stress. For example, application of mechanical stress can reduce the critical current density required to initiate crack propagation and can also deviate the crack to propagate in mixed mode. In related studies, a coupling between electromigration and thermomigration in thin films has been shown to lead to enhanced mass transport at the cathode and anomalous backward mass transport at the cathode. Further, whisker growth in Sn coatings has been studied extensively to elucidate the role of factors such as electric current, grain orientation, and thermal stresses.

A new experimental method has been developed for studying diffusion in multicomponent systems; this method, together with advances made at IISc in the mathematical analysis of such systems, removes the stringent obstacles to our understanding multicomponent diffusion for over nine decades. It has been used in various multicomponent systems such as Nickel and Cobalt-based superalloys, complex concentrated (high entropy) alloys and high-temperature coatings in jet engines and power sectors.

A new set of high temperature aluminium alloys were developed using a combination of alloying elements such as Sc, Zr, and Mg. On the solar energy front, multilayer solar absorber coatings were designed and developed in collaboration with NAL. Significant progress has been made in the ongoing effort on developing high-temperature cobalt based high strength new class of superalloys. A patent is also filed for a new high-temperature high strength copper alloy.

Aluminium-magnesium alloys have been used as model systems for elucidating the role of stacking fault energy in grain refinement and texture evolution during severe plastic deformation. An interesting correlation of grain size, extent of twinning and stacking fault energy has been established through a study of the effects of severe plastic deformation of a medium stacking fault energy high entropy alloy.

The printed electronics and nanoionics laboratory has been set up to study (a) fully printed FETs with subthermionic transport, and (b) printed short-channel FETs with unprecedented on-currents and transconductance. The laboratory

has developed methods for printing co-continuous, mesoporous structures with pore size tunability, as well as low temperature processed (~100 C) FETs compatible to inexpensive polymer, cellulose substrates.

Studies on microstructure-corrosion property correlation in metal-graphene oxide composite coatings are underway. Multi-component nanoparticle-graphene composites have been synthesized, and their microstructure analyzed using electron microscopy.

Phase-field models have been used for predicting equilibrium shapes of precipitates under the combined influence of coherency stresses (including anisotropy both in the elastic and the interfacial energy), and for simulating electromigration in multiphase systems. A Bridgman set-up has been developed for studying directional solidification of a variety of single and multiphase alloys.

Faculty & Staff

TA Abinandanan | PhD (Carnegie Mellon), Professor
GS Avadhani | PhD (IISc), Principal Research Scientist
Suryasarathi Bose | PhD (IIT Bombay), Assistant Professor
Kaushik Chatterjee | PhD (Penn State), Assistant Professor
Atul H Chokshi | PhD (USC), FASc, FNASc, FNA, FNAE, FIIM, Professor
Abhik N Choudhury | PhD (Karlsruhe), Assistant Professor
Subho Dasgupta | PhD (TUD, Germany), Assistant Professor
RJ Deshpande | MSc (Engg) (IISc), Senior Scientific Officer
Govind S Gupta | PhD (Wollongong), Professor
Vikram Jayaram | PhD (Stanford), FASc, FNASc, FNAE, FACerS, FIIM, Professor
S Karthikeyan | PhD (Ohio State), Associate Professor
Praveen Kumar | PhD (USC), Assistant Professor
Subodh Kumar | PhD (London), Professor
P Padaikathan | MSc (Engg) (Bangalore), Senior Scientific Officer
Aloke Paul | PhD (Delft), Associate Professor
Ashok M Raichur | PhD (Nevada), FRSC, Professor
Praveen C Ramamurthy | PhD (Clemson), Associate Professor

Rajeev Ranjan | PhD (BHU), Associate Professor
R Ravi | PhD (IISc), Principal Research Scientist
Chandan Srivastava | PhD (Alabama), Associate Professor
S Subramanian | PhD (Mysore), FIIM, Professor
Satyam Suwas | PhD (IIT Kanpur), Professor

Honorary And Emeritus Professors

Kamanio Chattopadhyay | PhD (BHU), FASc, FNASc, FNA, FNAE, FIIM, Honorary Professor
KT Jacob | PhD (London), DSc (Engg) (London), FASc, FNASc, FNA, FNAE, FIIM, Emeritus Professor
Kishore | PhD (IISc), Emeritus Professor
KA Natarajan | PhD (Minnesota), DSc (IISc), FASc, FNASc, FNAE, FIIM, Emeritus Professor
S Ranganathan | PhD (Cambridge), FASc, FNA, FNASc, FNAE, FTWAS, FIIM, Emeritus Professor
Dipankar Banerjee | PhD (IISc), FASc, FNA, FNAE, FNASc, FIIM, Honorary Professor
MK Surappa | PhD (IISc), FNAE, FNA, Honorary Professor




3.5.10

Mechanical Engineering

CHAIRPERSON

PRADIP DUTTA



Mechanical Engineering activities at the Indian Institute of Science commenced with the establishment of the Department of Internal Combustion (IC) Engineering in 1945. The Mechanical Engineering section of the Power Engineering Department was established in 1951, and later became a full-fledged Mechanical Engineering department (ME). The IC Engineering Department merged with the ME Department to give it its present form in 1970. Research interests in the department have evolved to span a broad range of areas, from the traditional to emerging fields to achieve a unique balance that strives to extend the research frontiers with applications in related industries. As a result, students are exposed to international standards and current research methodologies to problems of relevance. The department offers Master of Engineering (ME/ MTech), Master of Science in Engineering (MSc/MTech (Res)) and Doctor of Philosophy (PhD) degrees.

Current Research

BIOMECHANICS

Nonlinear mechanics of soft biological tissues and elastomers; protein rubbers; mechanical characterization of biological cells; mechanobiology and bio-micromanipulation; bio reactors

FACT FILE

Established 1945

Phone +91-80-2293 2332/2512

Fax +91-80-2360 0648

Email office.me@iisc.ac.in

URL mecheng.iisc.ac.in/

Degree Programs offered PhD, MTech (Res) and MTech

IN NUMBERS

25 Academic Staff

4 Scientific Staff

115 PhD Students

16 MTech (Res)

27 MTech

94 Publications

3 MSc (Engg), 20 M.Tech Conferments

17 PhD Conferments

and cell culture in scaffolds and computational design of proteins; biomaterials research and biomimetics; tissue engineering.

COMBUSTION & SPRAY RESEARCH

Multi- dimensional modelling of processes involving two- phase flow, turbulence and combustion chemistry; application of laser-based diagnostic techniques in combustion and multiphase flow research; fuel spray characterization using shadowgraphy and Core Research interferometric Mie imaging techniques; trapped- vortex based combustor research, Laser-Induced Incandescence (LII) imaging for soot formation studies.

FLUID MECHANICS

Stability of unsteady boundary layers; unsteady boundary layer separation; transition and turbulence; turbulence modelling; fish- like propulsion; shear flow control, stall flutter; shock boundary layer interaction; drag reduction using micro-bubbles; two-phase electro-hydrodynamics; atomization of liquid jets.

FRACTURE MECHANICS AND TRIBOLOGY

Fretting friction mechanics; impact fracture and Biomechanics, Internal Combustion Engines and Technical Acoustics, Mechanical Systems and Design, MEMS, Semi-solid forming, Solid Mechanics, Thermal Sciences & Fluid Mechanics, Fracture Mechanics and Tribology fragmentation dynamic, mixed mode, indentation; thin film; tribology; contact mechanics of impact and indentation; nanotribology of boundary lubrication; metal cutting, metal working; scanning probe microscopy; fracture of single crystals, polycrystalline alloys and amorphous metals, computational fracture mechanics; nano composite coatings and mechanics at small scales; effect of roughness and surface asperities on the solid-liquid interface, eco-friendly, cutting oil studies.

MECHANICAL SYSTEMS AND DESIGN

Structural and dimensional synthesis of kinematic and compliant mechanisms; theoretical kinematics; multi-disciplinary

design optimization; dynamics and control of robot and multi-body mechanical systems; computer-controlled mechanical systems; bio- medical devices; constructing 3D models from sketches, assembly sequence planning and evaluation, tools for early stages in design, nonlinear dynamics, vibrations, structural shape and topology optimization, kinematic assembly modelling, geometric and topological modelling.

ADVANCED MANUFACTURING AND METAL CASTING

Friction stir welding and friction stir processing; semisolid forming; die casting and squeeze casting; mould design and metal flow analysis by CFD; computer aided design of nearnet shaped castings; meso-scale manufacturing with metals.

MICROSYSTEMS

Modelling, design, and micro-fabrication of Micro-Electro-Mechanical Systems (MEMS); energetics of micro and nano devices; nano-mechanics; acoustic sensors, rate gyroscopes, accelerometers, ultrasound sensors, and polymer pumps; development of analysis tools for coupled multi-physics problems; optimal synthesis methods for MEMS; micromanipulation; in-situ TEM nanoindentation, deformation mechanisms of materials.

THERMAL SCIENCES

Turbulent Rayleigh- Benard convection; double-diffusive convection, mixed convection, heat pipes, heat exchanges, thermal management of electronic systems; heat and mass transfer in buildings natural ventilation, spent nuclear fuel cases, heat and mass transfer in food products; two phase flows and heat transfer, heat transfer in renewable energy systems; solar thermal systems, numerical heat transfer; refrigeration and air-conditioning; automotive climate systems, adsorption coolers and gas storage; mathematical modelling and simulation of thermal systems; thermal modelling and experimentation in solidification; fluid flow and heat transfer at

micro/nano scales, encapsulated nanoparticles for thermal storage.

INTERNAL COMBUSTION ENGINES

Diesel Engines, Spark Ignition Engines with other small engine test beds, eddy-current dynamometers, exhaust gas analyzers, crank angle encoder, manifold and in-cylinder pressure transducers, load panels, data acquisition system, Bio-fuels, Fuels transesterification, Engine Performance, Combustion diagnostics,

Emission analysis, and other engines related experimental as well as computational research work.

TECHNICAL ACOUSTICS

Automotive noise control; vibration diagnosis of rotating machinery; acoustics of ducts and mufflers; industrial noise control; acoustic characterization of absorbing materials. sound from turbulent flows, asymptotics in structural acoustics, nonlinear structural acoustic interactions.



Faculty & Staff

Pradip Dutta | PhD (Columbia), Professor
Ananthasuresh G K | PhD (Michigan), Professor
Aloke Kumar | PhD (Purdue), Assistant Professor
Ashitava Ghosal | PhD (Stanford), Professor
Chandrashekhhar Jog | PhD (Illinois), Professor
Gaurav Tomar | PhD (IIT Kanpur), Associate Professor
Jaywant Arakeri | PhD (Caltech), Professor
KRY Simha | PhD (Maryland), Professor
M S Bobji | PhD (IISc), Professor
Namrata Gundiah | PhD (California), Associate Professor
Narasimham GSVL | PhD (IISc), Chief Research Scientist
Narasimhan R | PhD (Caltech), Professor
Pramod Kumar | PhD (IISc), Associate Professor
Raghuraman N Govardhan | PhD (Cornell), Professor
Ramsharan Rangarajan | PhD (Stanford), Assistant Professor
Ratnesh Shukla | PhD (California), Associate Professor
Ravikrishna R V | PhD (Purdue), Professor
Saptarshi Basu | PhD (Connecticut), Associate Professor
Satish V Kailas | PhD (IISc), Professor
Venkata Sonti | PhD (Purdue), Professor
Susmita Dash | PhD (Purdue), Assistant Professor
Koushik Viswanthan | PhD (Purdue), Assistant Professor
Himabindu M | PhD (Anna), Senior Scientific Officer
R T Naik | PhD (IIT Delhi), Scientific Officer
C Dharuman | MSc (Engg) (IISc), Senior Scientific Officer
Venkataraman M K | MSc (Engg) (IISc), Scientific Officer

Associate Faculty

Gurumoorthy B | PhD (Carnegie Mellon), Professor
Dibakar Sen | PhD (IISc), Professor
G R Jayanth | PhD, (The Ohio State University), Associate Professor



3.6

Division of Physical and Mathematical Sciences



IN NUMBERS

- 78 FACULTY MEMBERS
- 203 PhD STUDENTS
- 10 MASTER'S STUDENTS
- 69 INT PhD STUDENTS

Research in the Division covers a wide variety of areas in the Physical Sciences, including fundamental investigations in String Theory, Particle Phenomenology, Field Theory, Condensed Matter Physics, both theoretical and experimental, Soft-Matter and Complex Systems, Biology-Inspired Physics, Biomolecular Structure and Biophysics, Atomic and Optical Physics, Astronomy and Astrophysics, and cutting-edge Applied Physics research including MEMS-based and Fibre-Optic Sensors, Multifunctional Materials, such as graphene and carbon nanotubes, Super-Resolution Fluorescence Microscopy, Nano-Scale Imaging, Optics and Microfluidics, Energy- and Health-Monitoring Instrumentation, and Cryogenic Technologies, including Cryocoolers, Cryogenic Instrumentation, and Cryogenic treatment on materials. Research in Mathematics covers major areas, both pure and applied, including Probability, Partial Differential Equations, Analysis, Geometry, Topology, Algebra, Algebraic Geometry, and Analytic Number Theory.

THEMES

Given the diversity of this Division, there is a diversity of themes in research. These can be gleaned from the core research areas mentioned above. Many of these areas lie in the exact sciences, both theoretical and experimental. Along with these, there are growing interdisciplinary programmes, such as in Mathematical Biology and Nanoscience. Translational research is also being carried out and products, based on innovative and cutting-edge technologies, are being brought into the market by faculty entrepreneurs in the division.

RESEARCH HIGHLIGHTS

The Division of Physical and Mathematical Sciences comprise the Departments of Instrumentation and Applied Physics, Mathematics, and Physics, including the Astronomy and Astrophysics Programme, and the Centres of High Energy Physics (CHEP) and Cryogenic Technology (CCT)

Faculty members in this Division have received several awards and honours for their research. Their research has been supported by grants from major agencies and ministries such as the Department of Science and Technology, The Council for Scientific and Industrial Research, the Department of Biotechnology, the Defence Research and Development Organisation, the Indian Space Research Organisation, and the University Grants Commission. A brief report of their research, over the past year, is given below

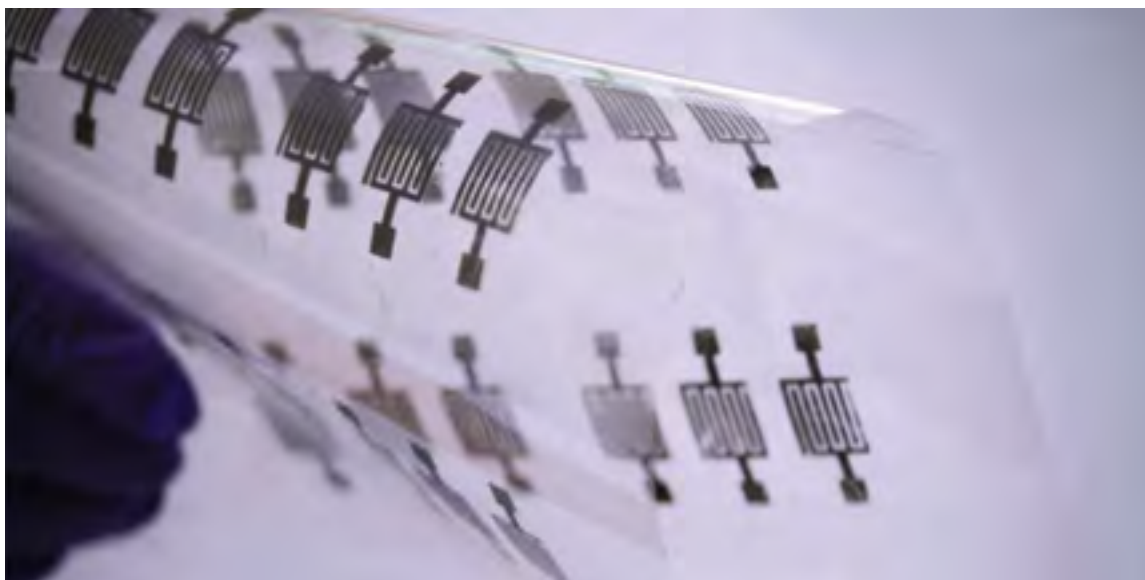
DEPARTMENTS | CENTRES | UNITS

- CENTRE FOR CRYOGENIC TECHNOLOGY
- CENTRE FOR HIGH ENERGY PHYSICS
- INSTRUMENTATION AND APPLIED PHYSICS
- MATHEMATICS
- PHYSICS
- CENTRE FOR ATMOSPHERIC AND OCEANIC SCIENCES
- CENTRE FOR SUSTAINABLE TECHNOLOGIES
- DIVECHA CENTRE FOR CLIMATE CHANGE





Research Snapshots 2018-19

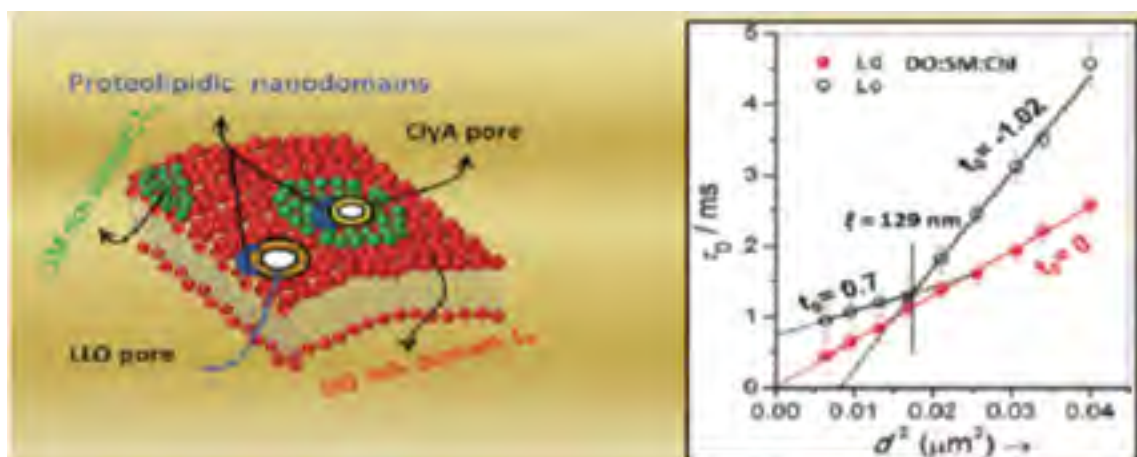


Abha Misra (IAP)

Microsupercapacitors (MSc) store energy with higher power density than batteries. Reducing MSc size effectively without losing efficiency is a major challenge. A simple spray deposition technique is developed, whereby MScs can be printed on any substrate. These MScs can be recharged with higher frequency than usual batteries and have longer life, with possible applications in flexible electronic displays.

Buddha Deka Boruah, Arnab Maji, and Abha Misra Flexible Array of Microsupercapacitor for Additive Energy Storage Performance Over a Large Area, *ACS Appl. Mater. Interfaces*, 2018, 10,18, 15864-15872



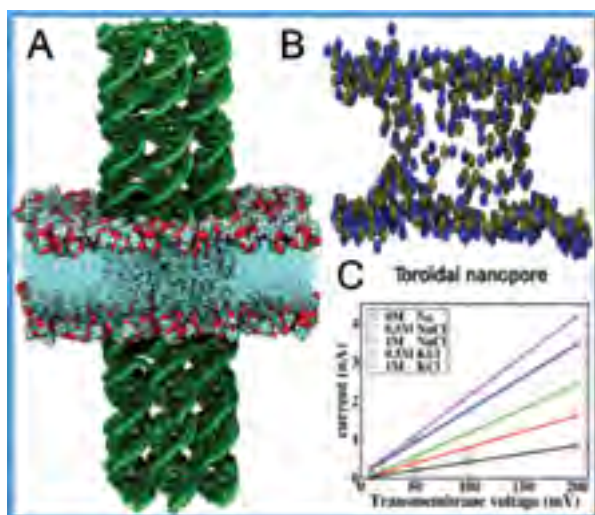


Jaydeep Kumar Basu (Physics)

We have reported the first direct determination of the size of these nanoscale regions in model raft-forming biomembranes using super-resolution stimulated emission depletion nanoscopy coupled with fluorescence correlation spectroscopy. The methodology establishes a new nanobiotechnological protocol which could be useful in preventing their cytotoxic effects.

Nirod Kumar Sarangi and Jaydeep K Basu, Pathways for creation and annihilation of nanoscale biomembrane domains reveal alpha and beta-toxin nanopore formation processes, *Phys. Chem. Chem. Phys.* 20, 29116, 2018.

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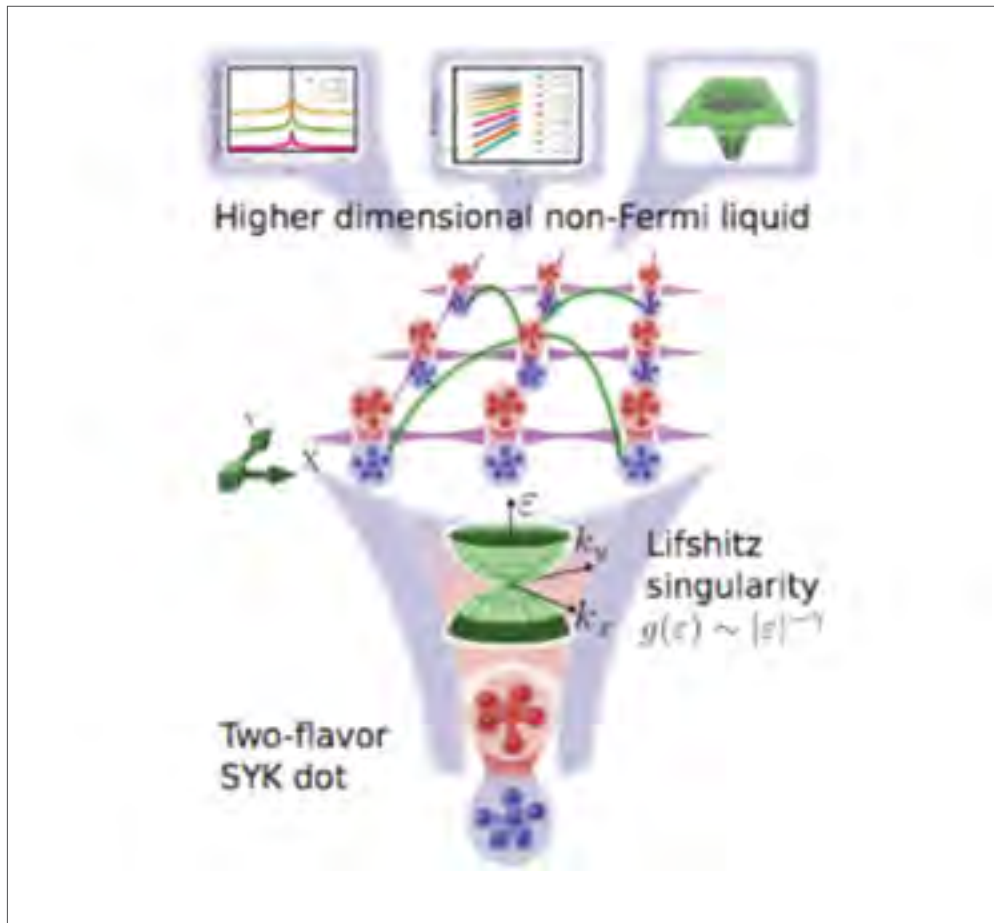


Prabal K. Maiti (Physics)

State-of-the-art DNA nanotechnology was used to mimic the function of naturally occurring transmembrane biological nanopore. Using the analysis of several atomistic MD simulations in

explicit solution, a novel mechanism was proposed to account for the stability of self-assembled DNA nanopore protruding into the lipid bilayer membrane (A). The atoms of lipid headgroups rearrange themselves into a toroidal shape around the DNA nanopore (B). The DNA-based transmembrane ion-channel demonstrates Ohmic characteristics for different ionic conditions (C) when subjected to a constant electric field simulation.

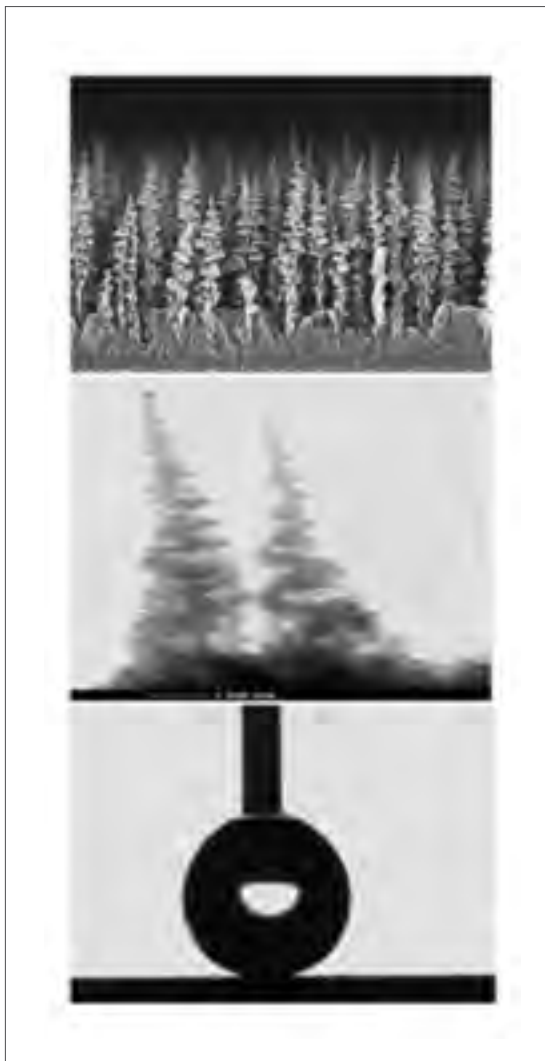
Ref: H. Joshi and P.K. Maiti, Nucleic Acid Research, 46 (5), 2234–2242, 2018.



Sumilan Banerjee (Physics)

Some of the most interesting phenomena in condensed matter occur in high-temperature superconductors and heavy fermions, arising from a parent non-Fermi-liquid background. These often elude a clear theoretical description. Here, the authors develop a model that provides a route to describe non-Fermi liquids realized in condensed matter systems.

Arijit Halder, Sumilan Banerjee, and Vijay B. Shenoy (2018), Higher-dimensional Sachdev-Ye-Kitaev non-Fermi liquids at Lifshitz transitions, Phys. Rev. B 97, 241106(R)

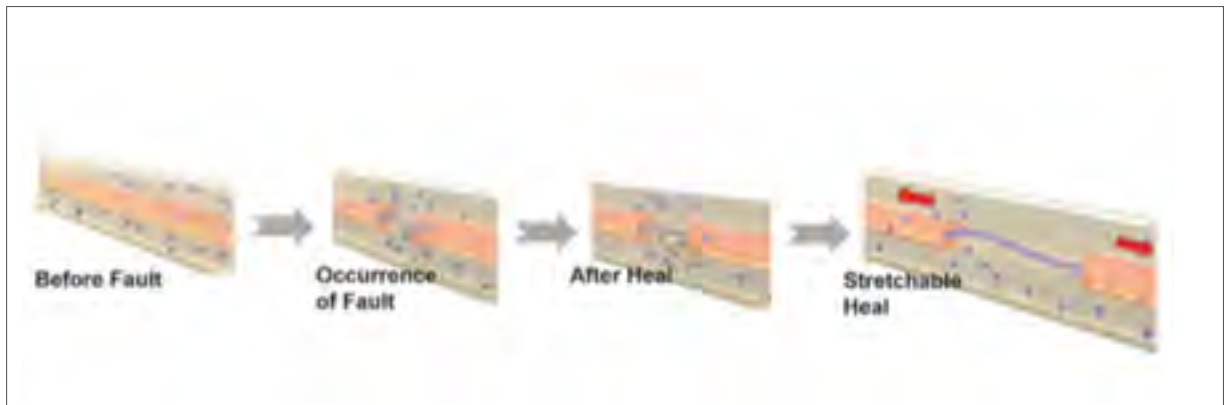


G Mohan Rao (IAP)

Novel tree like carbon nanostructures are grown by using ECR plasma CVD process with Hydrogen and acetylene in 1:3 ratio on a nickel coated silicon substrate. It consists of a central multiwall carbon nanotube with branches of crystalline carbon. The dimensions of the central spine and branches could be controlled by process parameter control. These structures are superhydrophobic, with a water contact angle of 165°. This material, which can be grown in any type of substrate in one step with super-hydrophobic as well as non-sticking properties with ideal Cassie mode of wetting, is a new direction in the field of super-hydrophobic nanostructures with two level roughness.

M. Ghosh, G. Mohan Rao , *Carbon* 133 (2018) 239-248





Sanjiv Sambandan (IAP)

Open circuit failure resistant interconnect is a key technology that would enable reliable flexible electronic circuits. Using a dispersion of conductive particles in an insulating fluid, researchers discuss the physics and engineering behind self-healing interconnects where repair is automatically triggered upon the occurrence of an open fault. Heals having metallic conductivity and nearly plastic stretchability are demonstrated. This work promises high speed, self-healing and stretchable interconnects thereby improving system reliability.

Amit Kumar, Virendra Parab, Arindan Handu, Li Ding, Pushkaraj Joshi, Chen Jiang, and Sanjiv Sambandan, Self-healing Interconnects with Nearly Plastic Stretching of Repairs, *Phys. Rev. Applied* 11, 014057 (2019)



3.6.1

Centre for Cryogenic Technology

CHAIRPERSON

PRABAL KUMAR MAITI

CCT has been supporting all the low temperature activities of the Institute by supplying liquid nitrogen and liquid helium uninterruptedly since many decades. As in the previous past, the Centre could meet the increasing demand by supplying the required quantity of cryogenics to users.

Current Research

project funded by LPSC, ISRO to calibrate LOX and LH2 cryogenic level sensors for launch vehicles is continued. Six sets of level sensors (LOX and LH2) were successfully calibrated and handed over to support their launch activities.

A multiplexed multilayer inductor array based angular displacement sensor and its associated cold electronics which was designed earlier was tested to detect angular displacement of 1°. Testing of the developed sensor was carried out at cryogenic temperatures at 4.2 K using liquid helium.

With the funding of SERB, a non-contact RRR measurement technique using planar inductor sensors was developed. This method was tested for different samples of Niobium having a wide range of RRR values.

Electrical conductivity of this film coated Nb samples have been determined using a miniature inductive Eddy current sensor along with its associated cold electronics components. This

FACT FILE

Established 1971

Phone +91-80-2360 1612, 2293 2339

Fax +91-80-2360 1612

Email cct.office@iisc.ac.in

URL cct.iisc.ac.in

IN NUMBERS

1 Academic Staff

2 Scientific Staff

18 Publications

Core Research

Cryogenic engineering finds applications in various challenging technical areas like space technology, Plasma research, Tokomak etc. The faculty, students and project staff have actively involved in applied research like pulse tube cryocoolers, calibration of temperature and level sensors, thermal conductivity measurement facility down to 4.2K, cryogrinding, low temperature mechanical properties, etc.

sensor was calibrated using a varied sets of Nb sample acquired from IUAC, New Delhi.

The temperature sensor calibration facility continued to LPSC, Mahendragiri. In this period 41 temperature sensors were successfully calibrated in the range of 300-4.2K and delivered for their activities.

Experimental studies on the variation of electrical permittivity of FR-4 material under cryogenic temperatures (down to 4.2 K) have been carried out during this period.

A GM cryocooler based experimental set up has been developed for the measurement of thermal conductivity of various materials in the range of 300K to 4.5K. Experimental studies have been conducted on select adhesives and activated carbons for the development of cryosorption pumps. A high performance cryosorption pump has been developed whose

pumping speed is 3.6 times higher compared to an identical commercial cryopump for helium gas.

A research project titled "Design and development of flexible transfer lines for liquid helium applications" funded by BRNS has been initiated. Towards this, a stainless steel flexible transfer line (with and without super insulation) having 20.5mm ID and 3m long has been fabricated and experimental studies on pressure drop, cool-down and mass flow rates for liquid nitrogen at different inlet pressures have been conducted. Fabrication and testing of another flexible transfer line of 32 mm ID and 5m in length has been carried out and experimental studies are in progress.

A project titled "Cryogenic deflashing of different types of rubber components" funded by M/s. Surface Improvements Pvt. Ltd., Bangalore has been taken up for deflashing

of several rubber components using liquid nitrogen. Both high and low energy machines have been used for deflashing of several rubber components. The results are encouraging.

A project titled “Cryogenic grinding of flashes of different rubber components” funded by M/s C-DAT Pvt Ltd, Bangalore has been taken up to grind flashes of different rubber components at cryogenic temperatures. Also, a continuous grinding and sieving system is to be developed to achieve the ground rubber powder less than 80 mesh.

The project to cryotreat the diaphragms of the pressure transducers for measurement of propellant pressures of launch vehicles

was successfully completed. Nearly 1500 transducers machined from precipitation hardened martensite steel were cryotreated at 98K for 36 hours and delivered to ISRO to support their launch activities.

With the funding from IISc-ISRO Space Technology Cell, a cantilever type rotating beam fatigue testing machine was successfully developed to determine the fatigue strength properties of materials at low temperatures. Experiments on aluminium alloy (Al 7075) and stainless steel (SS304) clearly indicated increase in fatigue strength at cryogenic temperature.

Faculty & Staff

Upendra Behera | PhD (IISc), Principal Research Scientist

R Karunanithi | PhD (IISc), Associate Professor

DS Nadig | MTech (IIT Kharagpur), Principal Research Scientist

Associate Faculty

V Venkataraman | PhD (Princeton), Professor



3.6.2

Centre For High Energy Physics

CHAIRPERSON

JUSTIN R DAVID

The centre for High Energy Physics was carved from the erstwhile Centre for Theoretical Physics in 2004. Faculty in CHEP carry out research in the general area of particle physics, field theory, string theory, quantum gravity and condensed matter physics.

Current Research

Several new directions have been pursued in this centre in almost all the spheres of theoretical physics and experimental high energy physics. The following are the research highlights.

Controlled spatial search combining flip-flop quantum walk with Tulsi's algorithm was analysed. It was shown that this simple algorithm is optimal for spatial search on $D > 4$ dimensional hypercubic lattices, and otherwise matches the best result available in the literature. Using graph powering, the algorithm was then extended to the situation where multiple walk steps are executed between oracle calls. For two-dimensional spatial search, it was shown that the resultant algorithm is optimal with only a logarithmic increase in the number of walk steps. We showed that some spin systems can have bands of magnons which have non-zero Chern numbers; this leads to a thermal Hall effect in such systems. We studied periodically driven systems and demonstrated that they can show phase band crossings at certain values of the driving frequency. We showed that quasiperiodically

FACT FILE

Established 2004

Phone: +91 80 2293 2266

Fax: +91 80 2360 0106

Email: office.chep@iisc.ac.in

URL <http://chep.iisc.ac.in>

Degree Programs offered:

PhD and Int. PhD

IN NUMBERS

12 Academic Staff

17 PhD Students

14 Int. PhD Students

37 Journal Publications

4 Int. PhD Conferments

4 PhD Conferments

driven systems can have novel steady states which are neither periodic nor infinite temperature ensembles.

We have established a new method for solving the dynamical content of the conformal bootstrap equations which lead to analytic determination of critical exponents for the Wilson-Fisher fixed point in the epsilon expansion. We have initiated is the study of circuit complexity in the context of interacting quantum field theories. With growing interest in quantum computation and quantum information theory, it is important to know how a quantum computer would view interacting quantum field theories. We have defined and calculated Circuit Complexity for fermionic field theories. The methods developed for the study of the anomalous magnetic moment of the muon and radius has been extended to the form factor of the pion in 4 different kinematic regimes to yield results with great accuracy including for the regions accessible to experiment, to the lattice as well as the asymptotic region.

We have added to the evidence that if the KKLT construction of de Sitter vacua in string theory is meta-stable, it is indeed a spontaneously supersymmetry-broken, and therefore bona fide vacuum of string theory. The applications of Moonshine in string theory was studied. The gravitational couplings in heterotic string theory compactified on $K3 \times T^2$ orbifolded by actions corresponding to conjugacy classes of the Mathieu group were evaluated. We extract the Gopakumar-Vafa invariants from these couplings, the results point to the existence of a class of Calabi-Yau manifolds related by actions of Mathieu group. We developed a Greens function approach to study localization on Non-compact spaces. The method was applied to study the role of boundary conditions and to obtain the one loop partition function of $N=2$ chiral multiplet on $AdS_3 \times S^1$.

We look for minimal extensions of Standard Model with vector like fermions leading to precision unification of gauge couplings. We have found several classes of models which satisfy all the constraints. In the context of searches for

heavy long-lived particles (LLP) at the LHC, we quantitatively demonstrate that objects which emerge from a secondary vertex due to the decay of a LLP at the TeV scale can be at large angular separations with respect to the direction of the parent LLP. We give examples of how this effect translates into the fraction of energy deposited in the tracker, from particles coming as far as from the hadron calorimeter. One is on multisector supersymmetry breaking and the implications on fine tuning and prospects of discovery at future flavour and proposed 100 TeV colliders. In a second project we constructed a simple and natural model where freeze in dark matter can be realised. It makes use of minimal flavour violation techniques which connects electron Yukawa coupling to the dark matter-standard model coupling, which is in the natural size of the coupling. We studied multisector supersymmetry breaking and the implications on fine tuning and prospects of discovery at future flavour and proposed 100 TeV colliders. We constructed a simple and natural model where freeze in dark matter can be realised. It makes use of minimal flavour violation techniques which connects electron Yukawa coupling to the dark matter-standard model coupling, which is in the natural size of the coupling.

We provided a precise and updated estimate on the chiral crossover temperature which we find to be 156 ± 1.5 MeV. This is the temperature at which nuclear matter changes from a phase in which chiral symmetry is spontaneously broken, to a phase in which the symmetry is restored. The transition is a crossover for the physical values of the quark mass, although it is widely believed to be a genuine second-order phase transition in the chiral limit i.e. when the quarks are massless. The low-energy dynamics of a non-Abelian Yang-Mills theory on $S^3 \times \mathbb{R}$ can be approximated by a finite-dimensional gauge matrix model. Along with my students, I investigated the mass spectrum of this model and showed that in an appropriately

Core Research

The core research areas of the Centre are quantum field theory and its applications, and experimental high energy physics. The theoretical research areas include lattice gauge field theory, conformal field theory, quantum chromodynamics, beyond standard model physics, higher spin field theories, phenomenology of standard model and its extensions, string theory, astro particle physics, quantum field theory applications to condensed matter physics, quantum information and quantum computing. The experimental high energy physics is a part of the CMS experiment at CERN, Geneva.

defined scaling limit, we can reproduce the masses of the low-lying glueball states.

We performed test beam measurements of the CMS High Granularity Calorimeter (HGCAL) prototype modules. We examined the pedestal and noise studies, timing and electronic effects, clustering and particle identification, studies of electron and pion reconstruction and shower shapes (longitudinal and transverse) with HGCAL prototype module in the CERN proton test beam. We studied the Performance of Tau Identification in several processes at the LHC Run-2. We carried out the light pseudoscalar

Higgs boson search pair produced from the decay of the 125 GeV Higgs boson and resulting in 4 tau lepton final states probing the very low mass range from 3.6 to 15 GeV. A report on the search for vector boson fusion production of a massive resonance decaying to a pair of Higgs bosons in the four b quark final state at the HL-LHC using the CMS Phase 2 detector was made. The prospects of beyond the Standard Model physics at the HL-LHC and HE-LHC was summarized.

Faculty & Staff

B Anathanarayan | PhD (Delaware), Professor
Biplob Bhattacharjee | PhD (Calcutta), Assistant Professor
Somnath Choudhury | PhD (CEA Saclay), Assistant Professor
Justin R. David | PhD (TIFR, Mumbai) | FASc, Professor
Prasad Satish Hegde | PhD (Stony Brook), Assistant Professor
Jyothsna Rani Komaragiri | PhD (TIFR, Mumbai), Assistant Professor
Chethan Krishnan | PhD (Texas), Associate Professor
Apoorva Patel | PhD (Caltech), Professor
Diptiman Sen | PhD (Princeton), FASc, FNA, FNASc, Professor
Aninda Sinha | PhD (Cambridge), Associate Professor
Sachindeo Vaidya | PhD (Syracuse), Professor
Sudhir Kumar Vempati | PhD (PRL, Gujarat), Associate Professor

Honorary Faculty

Rohini Godbole | PhD (Stony Brook), FASc, FNA, FNASc, FTWAS, Professor

Emeritus Faculty

N Mukunda | PhD (Rochester), FASc, FNA, Professor
J Pasupathy | PhD (Rochester), FASc, Professor



3.6.3

Instrumentation and Applied Physics

CHAIRPERSON
S ASOKAN

The Department of Instrumentation and Applied Physics was established in the year of 1996. The Department pursues a wide area of interdisciplinary research activities in the domain of applied physics and provides post-graduate degrees in this area. With 17 faculty members teaching 18 courses, the department is making a dent in creating social impact.

Current Research

The research in the department of instrumentation and applied physics (IAP) is highly interdisciplinary and spans the horizons of physics and engineering applied in the areas of healthcare, food-processing, life-sciences, electronics among others.

In the area of atomic force microscopy (AFM), a novel automated tip-exchange module was developed and experimentally evaluated. A diamagnetically levitated stage was developed for in-plane motion control during tip-replacement. Batch fabrication of AFM tips and tip-less cantilevers was also undertaken at IAP. In the area of magnetic tweezers, a magnetic micro-bead was successfully manipulated in three dimensions by employing parametric excitation. An optical beam-deflection based system was developed for parallel, high-speed dynamic characterization of MEMS devices along 3 axes. This measurement strategy was also employed to control a high-speed in-plane nano-positioner with range of 4 micrometers.

FACT FILE

Established: 1996
Phone: +91-80-2293 2269
Fax: +91-80-2360 0135
Email: office.iap@iisc.ac.in
URL iap.iisc.ac.in
Degree Programs offered: PhD, MTech (Research) and MTech

IN NUMBERS

11 Academic Staff
5 Scientific Staff
Current Strength: 57 PhD Students, 4 MTech Research and 6 MTech Students
50 Publications
Conferment's: 3 MTech, 1 MTech Research, and 15 PhD

Further research has been carried out on self-powered super capacitor using spray coating method that allows coating of super capacitor on any surface including metal, dielectric, plastic etc. The self-powering was induced by designing the materials capable to transporting ionic changes spontaneously. This work was highlighted in several media houses. Further engineering of two-dimensional materials resulted in localised charge trap region where gas sensitivity was found to be three orders of magnitude large than any other report on such chemical sensors.

Our department has developed innovative technologies for analysing peripheral blood smear and our department has successfully demonstrated its relevance during malaria diagnosis. Staying with technology developed, our department has designed a method to aid identification of defects in silk cocoons, thus helping farmers and silk weavers in selecting the best cocoons for producing silk. Milk adulteration being a fundamental problem, our department has developed a device to measure the amount of melamine, a chemical added in milk to increase its apparent protein content. This work received attention in media.

Further for improving healthcare, our department has focused on developing Fiber Bragg Grating (FBG) based device for knee and joint angle measurements. Further, FBG based pulse probe method was used to perform carotid arterial pulse waveform measurements. FBG based device was developed to measure the force required for lumbar puncture with different gauges of spinal needle. More recently, our department has also developed FBG based system for eye tracking which would have potential applications in neuro-science. Many of these FBG works have been highlighted in popular media houses. FBG investigations were also being conducted on the electrical switching behaviour of fast ionic conducting glasses.

In the area of semiconductor devices, the focus is on understanding self-healing circuits and further understand device physics of TFTs

experiencing high bending curvature. The department also works in understanding toroidal ion traps and implementing a generating voltmeter. Developing light-sheet, super-resolution and fluorescence microscopy techniques for understanding zebrafish and C. Elegans models are also undergone in IAP department.

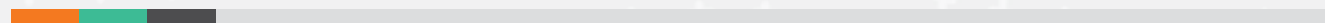
In the area of medical physics, Compton scattering and photoelectric effect are the dominant interactions when x-ray photons impinge the subject during radiological examination. These two coefficients are important in tissue characterization by Dual-Energy CT (DECT), determination of electron density and dose calculation in treatment planning system. Our department proposed an iterative method to computed Compton scattering and photoelectric effect thereby enabling radiologists to perform better examination.

In the area of condensed matter physics, we are focusing on precisely tuning the interlayer coupling in van der Waals heterostructures, in pursuit of twist controlled tunneling, commensurate and incommensurate structures and other novel physics. Further, our department is involved in studying electrical transport in Au/AuPt wires to understand the Metal to insulator transition on decreasing the wire diameter. Next, MoS₂ transistors are being fabricated on flexible Kapton substrates for Piezotronic sensing.

Our department has further collaborated with GATET, DRDO for integrating thin film strain gauge on to the blades of a compressor in aeroengine. Further our faculty was also involved in developing super hydrophobic carbon tree like nanostructures using electron cycle resonance plasma assisted chemical vapour deposition process, which find application as self-cleaning surfaces, electrodes in batteries and super capacitors. Initiatives have been taken to create a new centre of excellence in additive manufacturing, which has been sanctioned

Core Research

The core research areas pursued in the department encompass amorphous semiconductors, phase change memories, fibre optic sensors, nanometrology, precision motion control, microrobotics, chemical sensor, photodetector, supercapacitor, metamaterials, 2D materials, piezotronics, photoacoustic imaging, photoacoustic spectroscopy, light-sheet microscopy, super resolution microscopy, nanolithography, biophysics, cell biology, imaging cytometry, optical traps, sensors, nanostructured materials, vacuum and thin-film technology, plasma science and technology, semiconductor devices and integrated circuits, flexible electronic systems, mass spectrometry, electromagnetism, scientific computation, tomography, inverse problems, optofluidics, biomedical instrumentation, microfluidics and lab-on-a-chip, optical metrology, nanoscale device physics and electron transport, quantum computation using superconducting circuits, quantum acoustics, quantum dots, self-assembled mono-layers, and more.



by the Department of Heavy Industries, under which work on building a e-beam based AM machine will be started.

In the area of Quantum dots, we have fabricated CdSe quantum dots and further studied their emission and absorption characteristics. The procedure for synthesizing Carbon quantum dots was optimized and surface functionalised carbon dots was done. We were able to observe emission of white light from Carbon dots by varying the synthesis parameters. Quantum yield of 31 % was achieved in the surface functionalized dots. IAP has also

installed the optical fiber drawing set up and winding system for the fiber draw designed. Self-assembled monolayers for selective deposition- Dodecane thiol, hexadecane thiol and Octadecane thiol were deposited on Au and Ag films. Properties of Thiol SAMs were investigated with FTIR and Raman spectroscopy along with studying the stability behaviour of thiolSAMs.

Lastly, we have also developed a cryosorption pump and analytical models to predict the thermal conductivity of the materials.

Faculty & Staff

Asha Bharadwaj | PhD (IIT Delhi), Assistant Professor
Asokan S | PhD (IISc), FNASc, Professor
Sai Siva Gorthi | PhD (EPFL), Associate Professor
K R Gunasekhar | PhD (IISc), Principal Research Scientist
G R Jayanth | PhD (Ohio State), Associate Professor
Abha Misra | PhD (IIT Bombay), Associate Professor
Atanu K Mohanty | PhD (Polytechnique Univ.), Associate Professor
T K Mondal | PhD (IISc), Principal Research Scientist
Partha P Mondal | PhD (IISc), Associate Professor
S Ramgopal | MSc (Engg) (IISc), Principal Research Scientist
G Mohan Rao | PhD (IISc), Professor
Sanjiv Sambandan | PhD (Waterloo), Associate Professor
N C Shivaprakash | PhD (Mysore), Chief Research Scientist
Baladitya Suri | PhD (Univ. Maryland), Assistant Professor
Chandni U | PhD (IISc), Assistant Professor
Chatterjee Vani V | PhD (IISc), Senior Scientific Officer

Associate Faculty

K Rajan | PhD (IISc), Professor
S Umapathy | PhD (Otago), Professor

Honorary & Distinguished Faculty

Konandur Rajanna | PhD (IISc), Honorary Professor



3.6.4

Mathematics

CHAIRPERSON

GADADHAR MISRA

The Department of Mathematics comprises 24 faculty and over 60 affiliated researchers. Its research profile represents diverse interests, ranging from pure to applied mathematics, and collaborations with related fields. It has a vibrant atmosphere in which members with different interests collaborate with each other, and with mathematicians internationally.

Current Research

It was shown that practical measurement impairments such as sub-sampling, additive noise, and finite sample effects can lead to suppression of Granger causal relationship, as well as its false detection. Two alternative test statistics for causality detection are proposed. These detectors are analytically tractable, which allows us to design the detection threshold and determine the number of samples required to achieve a given missed detection and false alarm rate. Stochastic dynamic games both in continuous and discrete times with risk-sensitive criteria were studied. Established the existence of Nash equilibria.

Numerical methods which stabilize the numerical solutions of the convection-dominated diffusion problems were developed. The method is called as Patch-wise local projection stabilized finite element method. Applications to scalar convection problems and vector convection problems like Oseen problem are analyzed. A quadratic finite element method

FACT FILE

Established 1956

Phone +91-80-2293 2265

Fax +91-80-2360 0146/0683

Email office.math@iisc.ac.in

URL math.iisc.ac.in

Degree Programs offered PhD and Int. PhD

IN NUMBERS

26 Academic Staff

30 PhD Students

35 Int PhD Students

48 Publications

2 Int PhD Conferments

3 PhD Conferments

for three-dimensional obstacle problem was also developed. In the general area of Partial Differential Equations, new unfolding operators were developed to handle rapid oscillations. Study of boundary value problem for the Laplacian in a domain, a part of whose boundary is highly oscillating (periodically), involving non-homogeneous non-linear Neumann or Robin boundary condition on the periodically oscillating boundary.

The classification of homogeneous holomorphic Hermitizable vector bundles over bounded symmetric domains was completed. Irreducible components of the Bergman module under the action of the permutation group S_n has been identified and their mutual equivalence established. The Nevanlinna interpolation problem was studied for the bidisc, symmetrized bidisc and the annulus with special emphasis on classifying the extremal functions. A special class of tuples of bounded operators on a Hilbert space was introduced. It is called the Agler Young class. Major results about this class include a Wold decomposition and a dilation theorem. The structure of the dilation is completely spelt out. A characterization of this class using the hereditary functional calculus of Agler is obtained and examples are discussed. Toeplitz operators play a major role in this research. An Agler-Young pair arising from a truncated Toeplitz operator is characterized. Thus, we extend results obtained in the case of commuting operators by several authors over many decades to the non-commutative situation. Major results about Toeplitz operators on the symmetrized bidisc have been proved.

Multispecies versions of random juggling models were studied and exact stationary distributions were obtained using combinatorial techniques. For one variant, ultrafast convergence to stationarity was proved. A new totally asymmetric exclusion process with two species of particles on a finite one-dimensional lattice in contact with reservoirs was introduced, where the second-class particle is impermeable to the right reservoir. The stationary distribution

was obtained using a matrix ansatz and the nonequilibrium phase diagram was computed in the thermodynamic limit. This was later extended to multiple species of particles and the phase diagram was computed. A new interacting particle system called the Hilbert-Galton board was introduced and various theorems about this process were proved.

A PolyMath project with Prof. Terence Tao (UCLA) was completed and additional results were obtained. The solution combines ideas from Group theory, Banach spaces, length functions, and tools from probability theory. In a collaboration that became PolyMath 14, a complete description of length functions on groups that satisfy homogeneity was given. These turn out to be norms. A variation where additive errors are allowed was also considered, obtaining similar results in some cases and showing they do not hold in others. Development of methods to learn using generative models and entropies to discover and prove mathematical results was done. This involved implementing appropriate foundations of mathematics.

The representation zeta function of $SL_2(O)$ for a complete discrete valuation ring O of the even characteristic was studied. The Whittaker model for $GL_n(O_i)$ and $SL_n(O_i)$, where O_i are finite quotients of complete discrete valuation rings were studied, and it was proved that these are multiplicity free representations. The connection between root multiplicities of Borcherds algebras and graph colorings was discovered and the classification of the regular subalgebras of affine Kac-Moody algebras was completed. Hypergeometric functions or Heckman-Opdam hypergeometric functions associated to root systems with standard multiplicities were studied. Standard multiplicities involve multiplicities that are non-positive and they arise when one studies spherical functions that transform according to certain representations of the maximal compact subgroup in a connected non-compact semisimple Lie group. Bounded

Core Research

Algebraic and combinatorial topology, automated theorem proving, combinatorics, commutative algebra and algebraic geometry, complex geometry, differential geometry, functional analysis, harmonic analysis, mathematical physics, nonlinear dynamics, numerical analysis, partial differential equations, probability and stochastic processes, representation theory, several complex variables, statistical mechanics, time-series analysis, Teichmüller theory.



hypergeometric functions arising out of this setup were characterized which is a first step to harmonic analysis of these functions.

Every semi-equivelar map on the torus was shown to be a quotient of an Archimedean tiling on the plane and that the number of $\text{Aut}(X)$ -orbits of vertices for any semi-equivelar map X on the torus is at most six. Further, the Pachner graph of n -vertex flag 2-spheres distinct from the double cone is connected. In contrast, the Pachner graph of n -vertex stacked 2-spheres has at least as many connected components as there are trees of maximum degree at most 4 on $[(n-5)/3]$ vertices. Finally, a semi-equivelar map on the 2-sphere is the boundary of a Platonic solid, an Archimedean solid, the prism, a drum, an antiprism or

the pseudorhombicuboctahedron. As a consequence, every semi-equivelar map on the real projective plane is vertex-transitive.

A sparse bound for the lacunary spherical means on the Heisenberg group has been proved. This leads to new weighted and unweighted norm inequalities for the same.

Work was done on the determination of vector-valued Siegel modular forms from fundamental Fourier coefficients, analytic properties of twisted real-analytic Hermitian Klingen-type Eisenstein series was studied; sup-norm problem for Jacobi and Siegel cusp forms was considered and certain Linnik-type problems viz. bounds on the first negative eigenvalue of Yoshida lifts was obtained. Moreover, function field analogues

of primes in short intervals, was studied for quadratic polynomials.

Developing a correspondence between meromorphic quadratic differentials and certain geometric structures on punctured Riemann surfaces, arose out of an effort to understand how such meromorphic geometric structures arise in degenerations, in the context of hyperbolic structures. Non-trivial corrections were proposed on a theorem of Nori on certain non-Kähler manifolds. Introduced a vector bundle version of the Monge-Ampère equation, a stability condition for rank-2 bundles on surfaces, a Chern class inequality, and proved a Kobayashi-Hitchin type correspondence for a dimensional reduction of it. Interpolation properties (or the lack of thereof) of some non-uniformly flat affine hypersurfaces were studied. An adiabatic convergence result for Yang Mills connections on a K3 surfaces, as the fibres of the elliptic fibration shrink. This verifies a conjecture of Fukaya's in this setting, motivated by considerations of mirror symmetry. Initiated the study of coupled Kähler Einstein metrics and obtained a moment map interpretation for this system. A gap theorem for the Yamabe constants of Einstein metrics on the 4-sphere was proved. A necessary and sufficient condition for the existence of negative scalar curvature Hermitian metrics on a symmetric product of Riemann surfaces was established.

Further work was undertaken on an ongoing project -- which now has many participants internationally -- to show that the Kobayashi distance exhibits a weak form of negative curvature, known as visibility, on a wide range of bounded domains in complex Euclidean spaces. The class of domains that are visibility domains with respect to the Kobayashi distance was significantly broadened. Furthermore, a Wolff-Denjoy-type theorem was established for the latter type of domains. Results on the structure of a dominant holomorphic map between certain n -fold symmetric products of two higher-genus compact Riemann surfaces or of a proper holomorphic map between all n -fold symmetric products, $n > 1$, of two smoothly

bounded planar domains was extended to all n -fold symmetric products of two bordered Riemann surfaces with C^2 -smooth boundaries. The results show that the given holomorphic map is induced by a univariate holomorphic map. Some aspects of the higher dimensional Suita conjecture were studied on a class of pseudoconvex domains. Ergodic properties of the random dynamical system formed by taking a compact family of Henon maps were studied and bounds on entropy were obtained

Study of the Nullstellensatz and applications and Counting number of real zeros of zero-dimensional real algebraic varieties.

n^{3/τ_1} scaling of distance in the maximal components of critical inhomogeneous random graphs with degree exponent $\tau \in (3,4)$ has been rigorously established supporting predictions made in the statistical physics literature. This work also establishes, for the first time, the existence of a new universality class of scaling limits of critical random graphs. Another piece of work establishes the scaling limit of the minimal spanning tree on random 3 -regular graphs. This is a first step in the broader program of establishing universality of minimal spanning trees. We derived the critical radius for the vanishing of Čech and Vietoris-Rips complexes in random geometric graphs for up and down connectivity. A Poisson convergence for isolated complexes in the Vietoris-Rips case was derived. Defined and derived tight bounds on the capacity of wireless cellular networks and showed that as the base station intensity increases the capacity increases at a polynomial rate for small values of the base station density and then decays exponentially at large values. It was shown that any transmission strategy having non-zero capacity must use power control. Demonstration of a power control strategy that achieves the capacity.

Some aspects of the higher dimensional Suita conjecture were studied on a class of

pseudoconvex domains. Ergodic properties of the random dynamical system formed by taking a compact family of Henon maps were studied

and bounds on entropy were obtained.



Faculty

Arvind Ayyer | PhD (Rutgers), Assistant Professor
Abhishek Banerjee | PhD (Johns Hopkins), Assistant Professor
Gautam Bharali | PhD (Wisconsin), Associate Professor
Tirthankar Bhattacharyya | PhD (ISI), Professor
Soumya Das | PhD (HRI, Allahabad), Assistant Professor
Ved Datar | PhD (Rutgers), Assistant Professor
Basudeb Datta | PhD (ISI), FASc, FNASc, Professor
Siddhartha Gadgil | PhD (Caltech), Professor
Mrinal K Ghosh | PhD (TIFR-IISc), FASc, FNASc, Professor
Subhojoy Gupta | PhD (Yale), Assistant Professor
Apoorva Khare | PhD (Chicago), Assistant Professor
Srikanth Krishnan Iyer | PhD (UC Santa Barbara), Professor
Manjunath Krishnapur | PhD (UC Berkeley), Associate Professor
Gadadhar Misra | PhD (SUNY Stony Brook), FNA, FASc, FNASc, Professor
AK Nandakumaran | PhD (TIFR-IISc), Professor
EK Narayanan | PhD (ISI), Associate Professor
Dilip P Patil | PhD (TIFR), Professor
Vamsi Pritham Pingali | PhD (Stony Brook Univ), Assistant Professor
G Rangarajan | PhD (Maryland), FASc, FNASc, Professor
Sanchayan Sen | PhD (Courant Institute), Assistant Professor
Harish Seshadri | PhD (SUNY, Stony Brook), Associate Professor
Pooja Singla | PhD (IMSc), Assistant Professor
S Thangavelu | PhD (Princeton), FASc, FNA, Professor
Thirupathi, Gudi | PhD (IIT Bombay), Assistant Professor
R Venkatesh | PhD (IMSc), Assistant Professor
Kaushal Verma | PhD (Indiana), FASc, Professor

Emeritus Professors

Aloknath Chakrabarti | PhD (Calcutta), Professor (NASI Honorary Scientist)
Phoolan Prasad | PhD (IISc), Professor (NASI Senior Scientist Platinum Jubilee Fellow)

Distinguished Professor

MS Narasimhan | PhD (TIFR), FRS, FNA, FASc, Fnasc
KB Sinha | PhD (Rochester), FNA, FASc, FTWAS
VS Borkar | PhD (Berkeley), FNA, FASc, FNASc, FNAE, & FIEEE, FTWAS, FAMS

3.6.5

Physics

CHAIRPERSON

PRABAL KUMAR MAITI

The Department of Physics was established in 1933 by the Nobel Laureate C.V. Raman and several other illustrious names of Indian Science such as Homi Bhabha, Vikram Sarabhai, R.S.Krishnan, G.N.Ramachandran, S.Ramaseshan and T.V. Ramakrishnan have been associated with this Department. It is now well-established research centre for condensed matter physics and astrophysics.

Current Research

THEORETICAL CONDENSED MATTER PHYSICS

Theoretical condensed matter physics groups into soft and hard condensed matter systems, studying statistical, classical, and quantum phenomena. Some of the main recent focuses include superconductivity, flat-band physics, many-body localization, ab-initio predictions of emergent properties, non-Hermitian quantum order, diverse turbulent phenomena, cardiac arrhythmias, DNA, and others. Existence of ultra-flat band in twisted bilayer transition metal dichalcogenides, the emergence of unconventional superconductivity, enhanced Seebeck coefficient, and specular Andreev reflections in the flat band of twisted bilayer graphene have been studied by various groups. Theory of non-Hermitian superconductivity was developed last year. It was shown that the so-called SYK model of random interaction can give non-Fermi-liquid like strange metal, as well as exotic Mott insulator states. Theory of many-body localization has recently been extended to decorated optical lattices. Unusual transport,

FACT FILE

Established 1933

Phone +91-80-2293 2315

Fax +91-80-2360 2602

Email chair.physics@iisc.ac.in

URL physics.iisc.ac.in

Degree Programs offered PhD, Int. PhD and BSc (Research)

IN NUMBERS

29 Academic Staff

5 Scientific and 1 Technical Staff

99 PhD Students

20 Int PhD Students

137 Publications

03 Int PhD Conferments

42 PhD Conferments

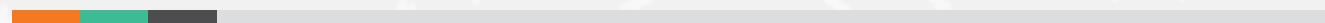
Core Research

Astronomy and Astrophysics: Cosmology, black holes, Nuclear astrophysics, Galactic dynamics, interstellar matter, solar physics, and plasma physics

Atomic and Optical Physics: Laser cooling and atom trapping, laser tweezers

Experimental Condensed Matter Physics: Spectroscopy, Electrical Transport, Bulk and Thin films, Low-temperature physics

Theoretical Condensed Matter Physics: Strongly correlated electrons, topological insulators, soft matter, biophysics, and nonlinear physics



multifractality, and the breakdown of single-parameter scaling at the localization transition in quasiperiodic systems are recently demonstrated with analytical modelling and numerical simulator. Through numerical simulation, the disparity in fast-gain and slow-loss of energy by heavy inertial particles in turbulent flows are quantified. It is also demonstrated that some aspects of superfluid density can be well studied via the Gross-Pitaevskii equations of ten used in classical

physics. Molecular dynamics simulations show that self-assembled DNA nanopore rearrange into DNA-based transmembrane ion-channel which demonstrate Ohmic characteristics for different ionic conditions with constant electric field.

EXPERIMENTAL CONDENSED MATTER PHYSICS

High pressure measurements using Raman, x-ray diffraction, electrical transport and DFT

analysis were carried out in weyl semimetals NbP, TaP, NbAs and TaAs and on transition metal dichalcogenides. Unconventional effects were seen in superconductivity in van der Waals heterostructures of two-dimensional materials like transition metal dichalcogenides and graphene. Interplay of superconductivity and quantum hall effect of Dirac fermions provided deep insights into the carrier dynamics in such systems. In the field of superconducting devices, superconducting cavity-optomechanical devices fabricated with high-T_c material BSCCO and hybrid cavity optomechanical devices were developed using three-dimensional waveguide cavity. Electrical noise was probed in electronic devices to probe strongly localized systems such as the transition metal dichalcogenide family and the unusual exponential behavior of noise magnitude in these systems with temperature. The non-linear Pockels effect was observed and quantified for the interface between amorphous titanium dioxide and different metals.

In the field of materials, a lot of effort was put into developing novel thermoelectric materials and on preparation of chalcogenide glassy bulk materials as well as multilayers thin film and study the structural and optical properties of these materials as well as to carry out the photo induced effects on these glassy system. Physical properties of few rare-earth manganites and orthoferrites single crystals grown by float-zone technique were investigated. Permittivity switching was observed from positive to negative in carbon coated iron nanoparticle -PDMS polymer nanocomposites in the range of 100 Hz-100 MHz and the switching frequency varies with wt % of the filler material in the polymer matrix. Other studies on similar material classes included study of glass transitions and NMR signals.

Optical studies included using Rydberg levels of atoms to study EIT and EIA, studying malarial infection using optical tweezers, self assembly of cyclic polygon shaped fluid colloidal membranes through pinning and study of the underlying physical principles that govern nanoparticle binding, uptake, or diffusion on cells.

SOFT MATTER PHYSICS

A microscopic understanding of the underlying physical principles that govern nanoparticle binding, uptake, or diffusion on cells is lacking. The first experimental studies of nanoparticle diffusion on model biomembranes was reported and the results correlated to the existence of nanoscale dynamics and structural heterogeneities using super-resolution stimulated emission depletion (STED) microscopy. Raft-like functional domains with putative sizes of 20-200 nm and which are evolving dynamically are believed to be the most crucial regions in cellular membranes which determine cell signaling and various functions of cells. The first direct determination of the size of these nanoscale regions in model raft-forming biomembranes using the method of super-resolution STED nanoscopy coupled with fluorescence correlation spectroscopy was reported. It was also demonstrated the influence of the interfacial layer dynamics on the fragility and dynamical heterogeneity of glassy polymer nanocomposites. Further, studies have been performed on “self assembly of cyclic polygon shaped fluid colloidal membranes through pinning”. Conventionally, fluid droplets are spherically symmetric in shape due to surface tension. These studies outline an assembly pathway where we shape 2-D fluid droplets into shape anisotropic cyclic polygon geometry. The molecular mechanism at play that led to this pathway was also determined. A method to directly quantify the dynamics of amorphous–amorphous interfaces in bulk supercooled colloidal liquids was devised. The surface tension of the interfaces was measured and it was shown that it increases rapidly across the mode-coupling area fraction. The procedure also helped unveil a non-monotonic evolution in dynamical correlations with supercooling in bulk liquids. These experiments support a thermodynamic origin of the glass transition.

ASTROPHYSICS

The research interests of the Astronomy, Astrophysics and Cosmology group span over a variety of different topics such as solar physics, MHD turbulence, theoretical astrophysics of galaxies, accretion disks, physics of black holes and white dwarfs, nuclear astrophysics, plasma astrophysics, numerical simulations, properties of the intergalactic medium, statistical analysis and estimation of cosmological parameters, radio astronomy, neutral hydrogen 21-cm, turbulence in the interstellar medium, theoretical cosmology and physics of the early universe.

In solar physics, the group has extensively worked on understanding the fluctuations of the solar dynamo and providing the physics behind the solar cycles which has led to correctly predicting the next solar cycle. In understanding astrophysics of galaxies, the group has studied the dynamics of dwarf irregular galaxies with extended HI disks having a dense and compact dark matter halo. It has been shown that the presence of the dominant dark matter halo naturally explains the lack of spiral arms in these gas rich galaxies and could prevent further dynamical evolution. Within accretion physics, the group has focused on applications of magnetohydrodynamics and electromagnetism in resolving various physics problems including astrophysics of accretion disks and underlying physics of black holes and white dwarfs. Statistical analysis of large datasets provide a very useful tool to compare theoretical models with observations. The group has recently

discussed a possibility to consistently take care of errors using Bayesian technique and was able to extract the evolution of the peculiar velocities as a function of redshift which has led to an improvement in the estimation of cosmological parameters. In plasma astrophysics, the group has worked on diverse topics such as AGN feedback simulations in galaxy clusters, galactic outflows, 21-cm global reionization signature and quasi-periodic oscillations in accretion flows. Understanding the properties of the various phases of the interstellar medium has implications for our overall understanding of the stars and the galaxies. The group has focussed on using neutral hydrogen 21 cm survey data to understand the nature of turbulence in diffuse neutral interstellar medium and also investigated the properties of warm neutral medium of the Milky Way Galaxy. In theoretical cosmology, the group has provided an interesting insight into the origin of the effective chemical potential in spontaneous baryogenesis in the early universe. The group has also worked on the generation of primordial black holes during inflation which can provide a novel candidate for the cold dark matter in the universe as well as contribute to a background of stochastic gravitation waves which can be detected in future.

PLASMA PHYSICS

Kinetic theory and massively parallel particle-in-cell simulations of fusion and space plasmas, with relevance to ITER & magnetic confinement.

Faculty & Staff

Sumilan Banerjee | PhD (IISc), Assistant Professor

Jayadeep Kumar Basu | PhD (Calcutta), Professor

Aveek Bid | PhD (IISc), Associate Professor

Prasad Vishnu Bhotla | PhD (IISc), Chief Research Scientist

Arnab Rai Choudhuri | PhD (Chicago), FASc, FNASc, FNA, Professor

Anindya Das | PhD (IISc), Assistant Professor

Tanmoy Das | PhD (Northeastern), Assistant Professor

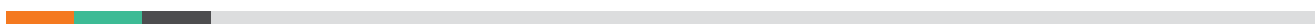
Suja Elizabeth | PhD (IISc), Chief Research Scientist
R Ganesan | PhD (IISc), Principal Research Scientist
Arindam Ghosh | PhD (IISc), FASc, FNASc, Professor
Manish Jain | PhD (Minnesota), Assistant Professor
Rajeev Kumar Jain | PhD (Allahabad), Assistant Professor
Chanda J Jog | PhD (New York), FASc, FNASc, FNA, FTWAS, Professor
PS Anil Kumar | PhD (Pune), Professor
Animesh Kuley | PhD (IIT Delhi), Assistant Professor
Prabal K Maiti | PhD (IIT Kanpur), FASc, Professor
Ramesh Chandra Mallik | PhD (IIT Madras), Associate Professor
Reghu Menon | PhD (IISc), Professor
Srimanta Middey | PhD (Calcutta), Assistant Professor
Subroto Mukerjee | PhD (Princeton), Associate Professor
Banibrata Mukhopadhyay | PhD (Calcutta), Associate Professor
DV Suvisesha Muthu | PhD (IIT Kanpur), Principal Research Scientist
Vasant Natarajan | PhD (MIT), Professor
Rahul Pandit | PhD (Illinois), FASc, FNA, FTWAS, Professor
K Rajan | PhD (IISc), Professor
Sriram Ramaswamy | PhD (Chicago), FASc, FNA, FRS, Professor
K Ramesh | PhD (IISc), Principal Research Scientist
KP Ramesh | PhD (Bangalore), Professor
Nirupam Roy | PhD (NCRA-TIFR), Assistant Professor
Tarun Deep Saini | PhD (Pune), Assistant Professor
Prateek Sharma | PhD (Princeton), Associate Professor
Prerna Sharma | PhD (TIFR Bombay), Assistant Professor
Vibhor Singh | PhD (TIFR), Assistant Professor
V Venkataraman | PhD (Princeton), Professor

Associated Faculty

Ambarish Ghosh | PhD (Brown), Associate Professor

Honorary & Distinguished Faculty

TV Ramakrishnan | PhD (Columbia), FNASc, FASc, FNA, FTWAS, FRS, Foreign Associate, Academie Desscience (Paris), Distinguished Associate
AK Sood | PhD (IISc), FASc, FNASc, FNA, FTWAS, FRS, Professor
H R Krishnamurthy | PhD (Cornell), FASc, FNASc, FNA, FAPS, FTWAS, Professor
Chandan Dasgupta | PhD (Pennsylvania), FASc, FNASc, FNA, Professor







3.7

Centres Under the Director



3.7.1

J R D Tata Memorial Library

LIBRARIAN
ANANDA T BYRAPPA



J R D Tata Memorial Library, at the Indian Institute of Science, is one of the oldest yet modern Science and Technology libraries in India. Started in 1911, as one of the first set of departments in the Institute, it has become a precious national resource center in the field of Science and Technology. The collection of the Library which includes books, journals, reports, theses, Indian Patents and standards is regarded as one of the richest collections in the country. This rich and valuable collection built over ten decades has some of the rare reference materials and back volumes of several important journals. Apart from its print resources, the Library has access to a large collection of e-journals, eBooks and online databases. Functioning as an effective support system for information services across the campus continues to be the primary goal of the library.

During the Financial year 2018-19, the Library added 1451 documents including 1003 books, 110 donated books, 10 eJournals, 10 eBooks, 323 theses (PhD. and M.S. Dissertations), and 5 ISO Standards. The total holdings of the Library had now increased to about 5 lakh plus physical documents which includes others materials like Technical reports, Standards, Theses & Dissertation. Library continues to primarily subscribe electronic-only journals and over 3200+ e-journals are being currently subscribed

spending nearly Rs.14.50 crores. The 'Electronic Theses Repository' (etd@IISc) contains about 4000+theses, the Electronic Publications Repository (ePrints@IISc) contains about 49,000+ research publications, and the Faculty Profiles Database contains 552 records.

The Circulation section has registered 686 new members. A total number of 22640 transactions were carried out by the Circulation section during the period. Work such as reshelving, shelf rectification, shifting etc. are being carried out in the library on a daily basis.

The Library continued to maintain pre-eminence in providing access to a large number of e-resources. Some of the major e-resources include the complete journal publication of the following publishers and Societies:

1. American Chemical Society - ALL journals and its Archive
2. American Institute of Physics - Journals and Archive
3. American Physical Society Journals, including Physical review Online (PROLA) Collection
4. American Society for Microbiology - ALL Journals
5. ASCE Journals
6. ASME Journals
7. Association of Computing Machinery Journals
8. ASTM Journals and Standards
9. Elsevier collection
10. Emerald full text
11. IEEE / IEE Journals
12. Institute of Physics Publishing - Complete collection including its Archive

13. JSTOR Archive
14. Oxford University Press - Complete Mathematics, Physical and Life Science Collections
15. Royal Society of Chemistry - ALL Journals and its Archive
16. Society for Industrial and Applied Mathematics (SIAM) - Complete journal collection and its Archive
17. Springer Nature
18. Wiley collection

Some of the journal backfile collections to which access is provided on a perpetual access basis include:

1. Elsevier Backfiles in eleven subjects categories such as Biochemistry, Organic Chemistry, Inorganic Chemistry, Physical and Analytical Chemistry, Chemical Engineering, Materials Science, Mathematics, Physics

General, Pharmacology, Neuroscience, Engineering Technology

2. Wiley InterScience backfiles in eight subject categories which include Biochemistry, Polymer Science, Analytical Science, Cell and Developmental Biology, Chemistry, Genetics & Evolution, Materials Science, Physics and Astronomy

3. With the support of Authorities and approval of the Journal Purchase Committee, the following backfiles have been added to the e-collection:

- Nature backfiles
- American Chemical Society Legacy Archive
- Institute of Physics Publishing Journal Archive
- OUP Archive

E-SHOD SINDHU CONSORTIUM

Ministry of HRD, Government of India has formed a new Consortia merging erstwhile consortiums such as INDEST-AICTE, UGC Infonet and N-List Programme. The new consortium is named as e-Shod Sindhu (ess) and is managed by INFLIBNET, head quartered at Ahmedabad. IISc has online access to the following list of important e-resources subscribed under ess.

	PUBLISHER
	List of e-resources procured under e-Shodh Sindhu in 2017-18
1	ACM Digital Library
2	American Institute of Physics
3	American Physical Society
4	Annual Reviews
5	ASCE Journals Online
6	ASME Journals Online
7	JSTOR
8	Oxford University Press -262 titles
9	Project Muse
10	Springer Link 1700 Collection + Nature Journal
	Sub Total
	Databases
1	Economic & Political Weekly
2	Institute for Studies in Industrial Development (ISID) Database
3	JGate Plus (JCCC)
4	MathSciNet
5	Web of Science

LIBSYS SOFTWARE / DATABASE

Library has been using LIBSYS, a Library Management Software, for its functions such as Acquisition, Cataloguing, Serials Control, and Circulation. Online access to Library holdings data is through WEB-OPAC. Users have the facility to browse and search the Library resources and view the status of a document or their own transactions and make on-line reservations for a document issued out.

HARDWARE-SOFTWARE RESOURCES

The Library has been providing photocopies of documents available in the Library within the copyright laws to Scientists/academicians/students. UGC has identified the Library as Document Delivery Center for the Southern Region and fixed charges for these services. Initially financial assistance was provided by UGC-INFLIBNET for the purpose. The Library continues to provide this service. In addition, as a member of Consortium, the Library provides document delivery to other Consortium members through JGate Plus (JCCC) document delivery service.

In addition, the Library continues to provide, e-mail based services like, new additions of books and journals, Interactive services like reminders, reservations and overdue intimation and e-mail based reference service. Library web site has been redesigned to disseminate up-to-date information from the Library. The website provides comprehensive information on the collections, e-resources, databases, new additions and all the services provided by the Library. The site also serves as a portal to access e-resources.

The Library procures books by placing order on vendors who offer substantial discount while providing prompt supply. This has resulted in a discount ranging from 25% to 36% across various publishers.

The Library is recognized as the Resource Center for Mathematics for the South Region by the National Board of Higher Mathematics, Dept. of Atomic Energy, Government of India., and is

receiving financial assistance for developing this collection on Mathematics. In coordination with the Department of mathematics, 26 journals are being subscribed from the NBHM grant

EPRINTS & ETD DIGITAL REPOSITORIES

ePrints@IISc (eprints.iisc.ernet.in) is one of the earliest and largest Institutional Repositories in the country. The ePrints@IISc was started by the erstwhile National Centre for Science Information. It is currently being managed by the J.R.D. Library. The repository collects, preserves, and disseminates in digital format the research output created by the IISc research community. The repository content can be accessed through the search and browse functionalities. As on date, the total number of publications in the repository is about 49,000+.

etd@IISc (etd.iisc.ernet.in) is the digital repository of Theses and Dissertations of IISc, Bangalore, India. This repository has been developed to capture, disseminate and preserve the research theses of IISc. The repository content can be accessed through the search and browse functionalities. As on date, the total number of records in the repository is about 4000+.

NEW INITIATIVES

- An "Office of Data" has been set up in institute. The Office of Data will create and maintain a web site for the public dissemination of appropriate parts of the IISc data, in a visually appealing and dynamic manner. It will be headed by the chief librarian.

- Low cost computing using Raspberry-Pi Board: Raspberry-Pi is a very popular low cost, single board computer (SBC) developed by the Raspberry-Pi Foundation in the UK. The board costs around INR 3,500.00 and including other peripherals like Monitor, Keyboard and Mouse it works out to less than INR 10,000/- to build a PC. It runs on Raspbian, an open source Debian-based operating system for Raspberry Pi. We have used Raspberry-Pi based PC in the Library as Web OPAC (Online Public Access Catalogue) terminal and for online exit survey (Graduating

students and retiring Staff/Faculty). It is working well since last six months and has proved to be a cheaper alternative to costly Desktop PC's. Future plans include replacing two OPAC terminals with Raspberry-PI based PCs and also implement it for User counter, Fire/burglar alarm and CCTV surveillance systems.

- All the IT-based services from the library, namely, ePrints@IISc, etd@IISc, LibSys Server, and the library portal have been moved to the Microsoft Azure cloud platform.

- Apart from displaying newly procured books every Monday, library celebrates special occasions by displaying books pertaining to the occasions, which creates curiosity amongst the readers to read more.

- Faculty Profiles: The Library has completed the development of Faculty Profiles database. The database includes the details of Faculty publications, citations and metrics like h-index. The database will be updated on a regular basis to keep the profiles up-to-date. The software developed by INFLIBNET is being used for this purpose.

- ORCID ID initiative: The Library is continuing the initiative to create awareness and register

all the students and the Faculty members to obtain their unique ORCID IDs to have recognition and also avoid duplication of their profiles. We could enroll about an additional 200 members through our proactive approach.

RECRUITMENT OF PROJECT TRAINEES

- 12 Library and Information Management and 2 Electronic Resources Management project trainees were recruited for a period of 2 years.

PROJECTS

A six-month consultancy Project on Setting up Integrated Digital Library and Training Information Management System for the Postal Training Centre, Madurai, Tamilnadu, was successfully completed. The project deliverables included development of a web portal, development of a digital library, and development of library management system.

INVITED TALKS

The top level library staff also delivered many invited talks in institutes in India during the year on modern library practices thus contributing to the much needed modern developments and transformations that libraries are undergoing everywhere.



3.7.2

Archives and Publications Cell

CHAIRPERSON
KAUSHAL VERMA

The Archives Cell was established in 2007 with a mandate to collect, catalogue and preserve all documents, images, and other articles of relevance to the Institute. It became Archives and Publications Cell (APC) in 2008 with the additional responsibility to coordinate and facilitate the publication activities of the Institute through the IIScPress.

Some notable initiatives are the following:

- APC has extended the copy-editing services to the Institute community, students and faculty members for their papers, thesis, books etc.,
- IISc Open Day materials: Brochures, Posters, Banners, ID Cards, etc.,
- Convocation materials: Backdrop, Banners, Posters, Invitations, Mementos to Dignitaries, etc.,
- Gifts and memento display and sale are one of the major tasks at APC since from 2018. The list of items that are being sold:
 - o Centenary Copper Medallion with a wooden gift box;
 - o Key chain and pen drive in customized wooden box;
 - o Book-Marks (set of twelve) neatly packed;
 - o Parker pen, Roller pen, Gen pen with a

IISc logo engraved and gift box with a logo

- o IISc Mugs (Big and Small) of various designs (Madhubani paintings – original campus images converted into paintings);
- o Leather folders.
- o Main building gem stone painting
- o IIScPress books.
- o IIScPress Jute Bags
- o Hand made paper bags of various sizes
- o Snippets from Archives
- o Set of Picture Postcards of various themes: Dignitaries at the Institute, Aerospace 75, Early dept. buildings, Jubilee years, Main building, Tata Statue Complex.

IIScPress was invited to set up stalls in the major Conferences at the Institute to display and sell the above mentioned mementos.

IN-HOUSE PUBLISHING

APC is coordinating the overall publication process like Copy Editing, Design and Layout and printing of the in-house publications of the Institute to the following documents:

- Annual Reports (Hindi and English)
- Annual Accounts (Hindi and English)
- KERNEL (the annual showcase magazine of IISc)

- Court Report
- Connect (quarterly magazine of IISc)
- Journal of the Indian Institute of Science -Quarterly (co-published by Springer)
- IISc Directory and Planner
- Student Information Handbook and Scheme of Instructions (Four Year Bachelor of Science (Research) programme)
- Quarks (a magazine of the undergraduate students)
- Desk and Wall Calendar
- IISc Diaries and Note pads.
- Faculty Information Handbook.
- Students Certificates and Transcripts along with folders.
- Medal Certificates and Folders.
- Faculty Award Certificates and special folders.

IIScPRESS

The following committee for IIScPress is continuing with effect from January 2017:

Chair: **Amaresh Chakrabarti**

Members: **Diptiman Sen**, Series Editor, Lecture Notes Series

Prabal Kumar Maiti, Series Editor, Research Monographs

S P Arun, Series Editor, Popular Science Series

Ex-officio Chair, APC: **Kaushal Verma**

Admin: Kavitha Harish

IIScPress was established in 2008, with a mission to bring quality books at affordable prices for helping Indian post-graduated education in science and engineering. Prof. Anurag Kumar was appointed as the first Chairperson of the IIScPress.

Besides self-publishing, IIScPress publishes a variety of books with its co-publishing partners, and brings out research monographs, collected works of distinguished scientists, lecture notes, text-books, biographies, popular science books, general books and also other books.

The IIScPress has been publishing books in collaboration with World Scientific Publishing Company (WSPC) since 2008. In 2013, IIScPress signed a co-publishing agreement with Cambridge University Press (CUP).

The series that will be published with co-publishers are:

IIScPRESS – CAMBRIDGE SERIES

Cambridge-IISc Research Monographs

Cambridge-IISc Centenary Lectures

Cambridge-IISc Lecture Notes

The following books have been published under these series:

Other than co-publishing agreement, IIScPress also published the following books:

- Water Futures of India by P P Mujumdar and V M Tiwari (co-published with INSA).
- Genomic Quirks by Ramesh Hariharan (Co-published with Strand Life Sciences)
- Popular Problems and Puzzles in Mathematics by Asok Kumar Mallik – SECOND EDITION
- The Story of Numbers by Asok Kumar Mallik – (Indian Edition through World Scientific Publishing Co.,)

All the new books that are published by IIScPress will be released by the Director, IISc. The second edition of Popular Problems and Puzzles in Mathematics was released at Planetarium, Bangalore during the Conference visit of Dept, of Mechanical Engg., for the first time outside the campus.

JOURNAL OF THE INDIAN INSTITUTE OF SCIENCE

Director appointed a new committee for Journal with the external members w.e.f., 9th October 2018:

Editor-in-Chief: G. K. Ananthasuresh, P/Mech., Engg., IISc

Executive Editor: Kaushal Verma, P/Mathematics | Chair, Archives and Publications Cell

Editorial Board

E. Arunan, P/ Inorganic and Physical Chemistry (IPC), IISc

Rashna Bhandari, Centre for DNA Fingerprinting and Diagnostics (CDFD)

Madhavi Latha Gali, P/Civil Engg., IISc

Anil Kumar, Dept. of Chemistry, IIT Bombay

Prabal Maiti, P/Physics, IISc

Biman B. Mandal, Biosciences and Bioengineering, IIT Guwahati (IITG)

Sanjay P. Sane, NCBS, Bangalore

Aravind Srinivasan, Department of Computer Science and UMIACS at UMD,

Rajesh Sundaresan, P/RBCCPS, IISc

Gaurav Tomar, AcP, Mech. Engg., IISc

Editorial Assistant: Kavitha Harish

The Journal of the Indian Institute of Science has been published by the Institute since 1914. Previously, the Journal published original research work carried out by the faculty and students of the Institute as well as other

institutions around the world. Since 2007, however, the Journal format has been changed. It became a quarterly Journal and publishes only invited review articles, each issue being guest edited by eminent researchers. Since 2017, the Journal has been co-published by Springer.

The following special issues appeared in the Journal during 2018 (Volume 98):

• Vol. 98 (1), January-March 2018

"Immunoengineering: From Biologics to Biomaterials"

Guest Editor: Siddharth Jhunjunwala

• Vol. 97(2), April-June 2018

"Microfluidics – Theory and Applications"

Guest Editor: Suman Chakraborty, Alok Kumar, Prosenjit sen

• Vol.98 (3), Jul.-Sep. 2018

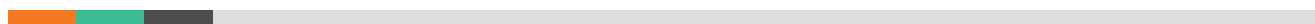
'Recent advances in Structural Biology'

Guest Editors: Somnath Dutta (MBU, IISc) and Tanweer Hussain (MRDG, IISc)

• Vol.98 (4), Oct.-Dec. 2018

'Transport processes in droplets: Fundamentals to Applications'

Guest Editor: Saptarshi Basu (Mech. Engg., IISc)



3.7.3

Office of International Relations

CHAIRPERSON

PHANEENDRA K
YALAVARTHY

Establishment of the Office of International Relations (OIR) at the Indian Institute of Science (IISc), Bangalore reflects the Institute's commitment to facilitate global cooperation and association through various programmes and opportunities. The OIR acts as a liaison to oversee and coordinate the following international programmes and activities of the Institute:

- Admission of full-time international students to the MTech. research program in Engineering and PhD. program in Science & Engineering of the Institute;
- Facilitate the academic and industrial collaboration through international cooperation in research and education and exchange of students/researchers;
- Formulate the Memoranda of Understanding (MoU) between participating Institutes and Organizations;
- Coordinate the academic collaborations, student/faculty exchange programmes and mobility, including that of incoming and outgoing students, at the Institute with institutions and universities abroad;

- Identify the various international funding opportunities and promote collaborative research at the Institute;
- Organize the visits of representatives of international universities and delegations of public bodies to the Institute;
- Facilitate the special lectures of internationally acclaimed scientists in association with international agencies;
- To act as an advisory body to the growing number of foreign students and visitors at the Institute.

During the year 2018-19, OIR has coordinated various activities to strengthen the Institute's International profile that included:

Visiting Academic Delegations: Every year, the academic delegations, dignitaries and diplomatic staff from various parts of the world visit IISc with an aim of learning more about the Institute's activities, identify the possible areas of mutual cooperation in research and education, and explore the modes to establish new collaborations or continue the existing ones. Generally, the Chair or faculty members associated with the OIR interact with the international visitors, provide a brief overview of the Institute, academic programmes, and discuss the possible ways of our collaboration/hosting visitors. About 86 such meetings were hosted by the OIR

in the period April 1, 2018 to March 31, 2019. During this duration, some of the prominent international delegations included Hon'ble Minister of Queensland; the Governor of Victoria State; Vice Chancellor of Umaru Musa Yar'adua University, Nigeria; President of the China University of Geosciences, Beijing; President of Nagasaki University, Japan; President of Niigata University, Japan; Vice Chancellor of Western Sydney University, Australia; President and Vice-Chancellor of University of Illinois, USA; Vice Chancellor of the University of Essex, UK; President and Vice-Chancellor of the University of New Brunswick, Canada; Rector/President, KU Leuven, Belgium; President and Provost of University College, London, UK and Founder & CEO, Dewey International University, Cambodia.

MoU/Agreements with Academic/Industrial partners: To enhance the international cooperation, the OIR has assisted the formulation of 29 MoUs/agreements with various foreign Universities/Institutes. IISc has initiated the Joint PhD. supervision programme as one of its bilateral initiative. Agreements in this program are noteworthy as both IISc and the partner institution commit to provide financial support to the enrolled PhD students, while they visit the partner institution as a part of their jointly supervised research work. This joint PhD. supervision programme was started with Technical University of Delft (TUD), Netherlands (currently enrolled are two IISc students and two TUD students). IISc-CNRS-Thales-University of Brest agreement provides doctoral fellowship to the joint supervision of fellows of IISc' Electrical Communication Engineering (currently enrolled is one IISc student). The KTH Royal Institute of Technology in Stockholm, University of Southern California (USC) in USA, Nanyang Technological University in Singapore, Australian National University (ANU) and Western Sydney University (WSU) in Australia are our recent partners, with whom IISc offer jointly supervised PhD research programs. We are also pleased to report that the joint PhD. supervision programme with our recent partners is also progressing as with the Technical University of Delft, Netherlands. Currently, the program has enrolled one PhD

student each with USC and ANU, two with WSU and three PhD students with NTU, Singapore.

Bilateral exploratory workshops: During the year 2018-19, OIR was involved in coordinating five joint workshops to enhance our bilateral academic interactions with Nanyang Technological University (NTU), Singapore; Australian National University (ANU), Australia; Kyoto University, Japan; Pennsylvania State University (PSU), USA and University of Cote d'Azur, France through a series of technical talks and in-depth discussions. The focus areas of these workshops were Physics, Chemistry, Mathematics, Biological Sciences, Earth Sciences, Energy Research, Nanoscience, Data-Intensive Biomedical, Cognitive and Brain Sciences.

Coordination of international opportunities for IISc members: Apart from announcing the calls/opportunities by various funding agencies, OIR also coordinates the nomination process, when required for highly competitive scholarship programs. Here, OIR has coordinated the selection process for nominating the IISc students for Schmidt Science postdoctoral fellowship and ANU's 'Future Research Talent' (FRT) travel award.

IISc delegation abroad: During the reporting period, OIR has coordinated 3 delegations of high-level, led by the Director to explore/expand our joint cooperation in research and education by visiting the campus of foreign universities, their remarkable laboratories/facilities and meeting their senior executives. On May 23-25, 2018, the IISc delegation visited Massachusetts Institute of Technology and Brandeis University in USA. Our delegates visited Nanyang Technological University, Singapore on June 1-2, 2018 for signing the "IISc-NTU Memorandum of Agreement for Joint Supervision program", in the presence of the Indian Prime Minister, Mr. Narendra Modi. In Japan, IISc delegation visited Riken, Tokyo Denki University, Tokyo University of Science,

University of Tokyo and Kyoto University on March 25-29, 2019. In addition, the delegation met the President of the University of Montenegro, Podgorica, Montenegro and signed the “Letter of Intent” to begin our interactions with Montenegro.

International Students at IISc: This year, OIR has organized its second Orientation program to newly admitted international students by providing an overview of the Institute, OIR activities, and general guidelines for their India stay. Both the deans, registrar and joint registrar attended the program and welcomed the new students. The program also acted as a platform to formally introduce new students to our on-roll students.

Full-time International Students: As of March 2019, IISc has 40 full-time foreign students from different parts of the world. A total of 188 online applications were received for the academic year 2019, out of which 50 candidates were shortlisted for the interviews at various departments and 7 students were selected and offered Ph. D. in Science and Engineering (4) and M. Tech. in Engineering (3).

Short-term Students/Visitors: As a sizable international student and staff population provides a stimulating international environment and facilitates the exchange of best ideas and practices, IISc strongly encourages short term international visitors. Majority of our short-term students come with

secured funding, which are often sponsored and co-developed by their IISc faculty host. Some examples of funders are bilateral programmes like Newton-Bhabha, S N Bose, DAAD, TWAS and Fulbright (USIEF). IISc also attracts visitors using the several new initiatives of the Government of India (GIAN and VAJRA programs) and its own Infosys Foundation Chair professorship, Pratiksha Trust Chairs, IISc’s Centenary and other endowed lectures. During this period, a total of 148 students/faculty/visitors visited the Institute for course studies or conducting collaborative research from several countries, including Japan, France, USA, UK, Germany, Netherlands, Switzerland, Bangladesh, Ethiopia, South Africa and Australia.

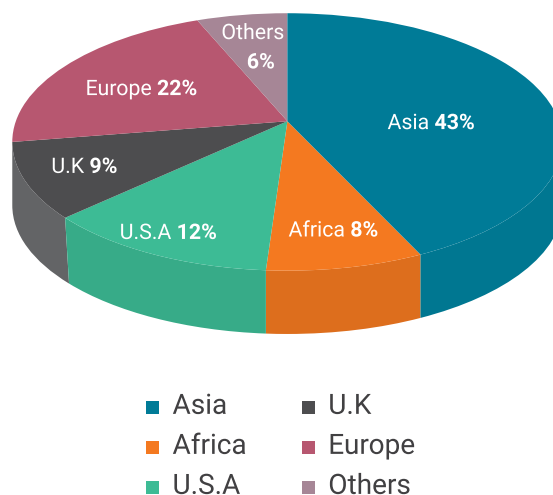


Figure. 1: Global distribution of Short-term international students/visitors at IISc (2018-19).



3.7.4

Centre for Continuing Education

CHAIRPERSON

G L SIVAKUMAR BABU

The Centre for Continuing Education has been rendering and organized several refresher /specialized courses for teachers/working professionals from different target groups ranging from high school science teacher to research scientists/engineers of the industries/ institutions. In the view of rapid advancements in science and technology, continuous education for teachers and working professionals is required to update their knowledge with regard to latest trends. CCE caters various programmes for the benefit of teachers.

SL.NO.	PROGRAMME TYPE	DETAILS	STUDENTS/ PARTICIPANTS BENEFITED
1	National Programmes	a) QIP: Degree program (PhD./ME/M.Tech)	22
		b) QIP Short Term Courses : (Engineering College Teachers)	534
2	Industry Oriented programmes	a) CCE - Proficiency : 39 Semester long courses	559
		b) Industry sponsored short term/full term courses (Self Support)	355

PROGRAMMES IN DETAIL

1. National Programmes

a) QIP (Quality Improvement Programme)

Programmes Leading to Award of Degrees

During the current year, under this programme, 10 teachers were admitted for PhD. and No intake for M.E/M.Tech. Apart from this, 10 persons were given advance admission for PhD. during 2018.

DURING THE YEAR 2018 - 19	AT IISc	
	PhD.	ME/MTech
Students admitted	10	-----
On Roll	10	-----

b) QIP – Short Term Courses

These courses are sponsored by Government agencies such as AICTE- QIP. and are primarily for teachers from engineering/science colleges. During the year 22 one week short-term courses were organised with a total participation of 534 faculty members from Engineering colleges and other Pvt. Organisations.

2. Industry Programmes

a) CCE – Proficiency Program

The programme is the first of its kind and unique in India. Under the CCE - PROFICIENCE programme in 2 semesters during the year 2018, 39 evening courses were conducted, 772 students/professionals attended out of which 559 successfully completed the program. Under this programme, a sum of Rs. 1,07,74,900 has been received, towards application and course fee.

b) Self-supporting Intensive Courses

The CCE organises various refresher/extension programmes to enable the participation of scientists and engineers working in different organizations. During the year, 14 such courses were organized for different organizations with a total participation of 355. Under this programme a total sum of Rs. 1, 09, 50, 837 has been received as overheads to the Institute:

c) Curriculum Development Cell

The Curriculum Development Cell provides financial assistance for book writing, Preparation of Laboratory Manuals, Holding of Conference, Workshops, Seminars, Special Lectures and Panel Discussions, for the preparation of monographs and audio-visual aids for teaching etc. Since 1979, the Centre has provided financial assistance for 96 faculty members for Book Writing, out of which, 54 books have been published/completed. The CCE is using CCE-FACE funds for this purpose.

3. Extension Lecture Programme

This programme is also unique in the Country. Under the Continuing Education Program Extension Lectures have been organized by the Institute faculty since 1990 in institutions of higher learning at the technical level, in Engineering and science colleges and in schools, public/cultural organizations, Doordarshan and All India Radio at the popular level. These extension lectures are expected to be of great help in the transfer of information on the latest scientific developments in this Institute and other organization in India and abroad.

These lectures are arranged not only in Bangalore, but also in centres in the entire state of Karnataka and sometimes even outside the state. Even though the majority of these are in English, lectures are also arranged in regional languages like Kannada, if specific requests are received. Many of these lectures are supported by demonstration, slides, and models.

Two-day training programme for science teachers was conducted at 3 places in and around Bangalore

1. JSS Science & Technology University, Mysore, during 27th and 28th December 2018 and about 250 teachers and students benefitted by this training.

2. Presidency University, Yelahanka, Rajanakunte, during 23rd-24th November, 2018 and about 150 teachers and students were benefitted by this training.

3. Bangalore University, Jnana Bharathi Campus, Bangalore, during 15th and 16th November, 2018 and about 500 teachers and students were benefitted by this training.

4. Hoysala Guest House

CCE runs a guest house, named after the famous Hoysala Dynasty, which ruled ancient Karnataka. It has 60 self-contained and fully furnished single rooms. These are mainly intended for accommodating the participants of the programmes conducted under CCE, like short term courses and invitees to the Institute. During the year **222** faculty from other universities/research laboratories/colleges who visited the Institute, **2503** participants for short term courses and workshops/seminars. Revenue of about **Rs.38,17,640** is received through Hoysala Guest House.



3.7.5

Centre for Sponsored Schemes and Projects

IN CHARGE
V RAJARAJAN
REGISTRAR

Most of the research contributions come from research and development sponsored by over a hundred plus agencies, comprising a total of 980 projects with an outlay of Rs.1566.68 Crores and an annual cash in flow of Rs.352.50 Crores during 2018-2019.

The primary sponsors are Department of Science and Technology, Department of Biotechnology, Space Technology Cell, Indian Space Research Organization, Aeronautical Research and Development Board, Council of Scientific and Industrial Research, Department of Atomic Energy, Ministry of Information Technology, Defence Research & Development Organisation, Ministry of Human Resources and Development, UK-India Education and Research Initiative and Ministry of Non-Conventional Energy Source.

The International Sponsors include Boeing Company, European Union, The Wellcome Trust UK, IBM, Asian Office of Aerospace Research and Development, Indo-French Centre for Promotion of Advanced Research, Korea Institute of Science and Technology, Tokyo Electron Limited, Nokia, Rufford Small Grants Foundation, University of Southern California, Uppsala University, Texas Instruments, United Nations Educational Scientific & Cultural Organisation, National Institute of Health, MERCK & Co., INC, Institute DE Recherche Pour Le Development France, The Grantham Foundation for the Protection of the Environment.

The domestic private Sponsoring Agencies include Robert Bosch Centre for Cyber Physical Systems, Jamshetji Tata Trust, Shakti Sustainable Energy Foundation, Sonata Software Limited, St. Johns Research Institute, GE, Intel, Microsoft, Renault Nissan Technology & Business Centre Indian Pvt Ltd.

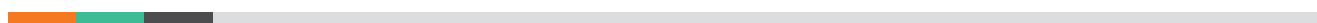
In 2018-2019, Science Divisions received a total of 519 Projects with a total outlay of Rs. 744.85 Crores. The Engineering Divisions received 461 Projects with a total outlay of Rs.821.84 Crores. There has been a changing trend in recent times in terms of the industrial relevance of the projects. In a few projects, industries are involved from the initial stages, are partially funded, identify technology transfer terms and mutually agree on when the research should mature. The table (1) below show the Division-wise breakup of projects and the financial outlay and the table (2) shows the details of each sponsored agency.

TABLE -1		
DIVISION WISE RESEARCH PROJECTS		
Divisions	No. of Projects	Outlay (Rs. in Crores)
A. SCIENCE DIVISIONS		
Division of Biological Sciences	259	472.29
Division of Chemical Sciences	119	182.94
Division of Physical and Mathematical Sciences	141	89.61
Total	519	744.85
B. ENGINEERING DIVISIONS		
Division of Electrical Sciences	164	228.48
Division of Mechanical Sciences	240	259.22
Division of Interdisciplinary Research	57	334.14
Total	461	821.84
Grand Total	980	1566.68

TABLE -2				
AGENCY WISE RESEARCH PROJECTS				
Sl. No.	Funding Agency Code	Fund Agency Name	No of Projects	Total Budget (Crores)
1	ADAO	AERONAUTICAL DEVELOPMENT AGENCY	4	2.15
2	AITP	ASIAN TECHNOLOGY PROGRAMME	1	0.02
3	AMDO	ADVANCED MICRO DEVICES	1	0.44
4	AOAD	ASIAN OFFICE OF AEROSPACE RESEARCH & DEVELOPMENT	1	0.99
5	ARDB	AERONAUTICS RESEARCH & DEVELOPMENT BOARD	8	14.75
6	AUOO	ANNA UNIVERSITY	1	0.40
7	BCOO	BRITISH COUNCIL,	1	0.01
8	BOCO	BOEING COMPANY	12	9.28
9	CIST	CENTRE FOR INFRASTRUCTURE TRANSPORTATION & URBAN PLANNING	3	22.18
10	COLO	THE COMMONWEALTH OF LEARNING	1	0.15
11	CPRI	CENTRAL POWER RESEARCH INSTITUTE	2	0.41
12	CSIR	COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH	16	3.20
13	DAEO	DEPARTMENT OF ATOMIC ENERGY	13	5.08
14	DBTO	DEPARTMENT OF BIOTECHNOLOGY.	96	167.34
15	DEOO	DEPARTMENT OF ENVIRONMENT	1	1.06
16	DMOO	DEPARTMENT OF MINES	3	0.58
17	DRDO	DEFENCE RESEARCH & DEVELOPMENT ORGANISATION	23	95.92
18	DSTO	DEPARTMENT OF SCIENCE & TECHNOLOGY	545	683.05

19	EPFO	ECOLE POLYTECHNIQUE DE FEDERAL	1	0.21
20	EU00	EUROPEON UNION	2	0.23
21	GEIT	GE INDIA TECHNOLOGY CENTRE	2	0.32
22	GFPE	THE GRANTHAM FOUNDATION FOR THE PROTECTION OF THE ENVIRONMENT	1	35.67
23	GK00	GOVERNMENT OF KARNATAKA, DEPARTMENT OF SCIENCE	1	8.50
24	GMOO	GENERAL MOTORS TECHNICAL CENTRE INDIA PVT. LTD.	1	0.10
25	HALO	HINDUSTAN AERONAUTICS LIMITED	1	0.39
26	IAVI	INTERNATIONAL AIDS VACCINE INITIATIVE	1	1.77
27	IBMC	INTERNATIONAL BUSINESS MACHINE CORPORATION	6	0.57
28	ICAR	INDIAN COUNCIL OF AGRICULTURAL RESEARCH	2	3.07
29	ICMR	INDIAN COUNCIL OF MEDICAL RESEARCH	2	0.40
30	ICSR	INDIAN COUNCIL OF SOCIAL SCIENCE RESEARCH	1	0.25
31	IDRC	INTERNATIONAL DEVELOPMENT RESEARCH CENTRE	1	0.63
32	IFCP	INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH(IFCPAR)	13	6.17
33	IGCA	INDIRA GANDHI CENTRE FOR ATOMIC RESEARCH	3	9.93
34	IIIS	INDIAN INSTITUTE OF SCIENCE	3	0.67
35	INAE	INDIAN NATIONAL ACADEMY OF ENGINEERING	3	0.95
36	INCO	INDIAN NATIONAL CENTRE FOR OCEAN INFORMATION SERVICES	1	0.98
37	INRA	INRA BIOTECHNOLOGIES, FRANCE	1	0.57
38	INSA	INDIAN NATIONAL SCIENCE ACADEMY	3	0.35
39	INTL	INTEL TECHNOLOGIES INDIA PVT., LTD.,	2	0.86
40	IRDO	INSTITUT DE RECHERCHE POUR LE DEVELOPMENT, FRANCE	4	4.84
41	ISRO	INDIAN SPACE RESEARCH ORGANISATION	26	32.86
42	ISTC	ISRO-IISc SPACE TECHNOLOGY CELL	40	8.17
43	IUSF	INDO-US SCIENCE & TECHNOLOGY FORUM	7	3.79
44	JATP	JOINT ADVANCED TECHNOLOGY PROGRAMME	5	0.64
45	JTTO	JAMSETJI TATA TRUST	1	124.24
46	KSTE	KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY & ENVIRONMENT	3	0.14
47	LANS	LOS ALAMOS NATIONAL LABORATORY	1	1.94
48	MCBT	MADRAS CROCODILE BANK TRUST	1	0.05
49	MDWS	MINISTRY OF DRINKING WATER AND SANITATION	1	2.79
50	MEFO	MINISTRY OF ENVIRONMENT & FORESTS	2	0.20
51	MERK	MERCK & Co., INC	2	1.51
52	MESO	MINISTRY OF EARTH SCIENCES	8	9.24

53	MHRD	MINISTRY OF HUMAN RESOURCE DEVELOPMENT	11	17.40
54	MITO	MINISTRY OF INFORMATION TECHNOLOGY	9	106.77
55	MNRE	MINISTRY OF NEW & RENEWABLE ENERGY	3	11.65
56	MSCI	MICROSOFT CORPORATION INDIA (p) LTD.	1	0.26
57	MSME	MicroSmall Medium Enterprises	1	5.00
58	MWRO	MINISTRY OF WATER RESOURCES	2	1.36
59	NBRC	NATIONAL BRAIN RESEARCH CENTRE	1	0.88
60	NIHO	NATIONAL INSTITUTES OF HEALTH, USA	1	2.85
61	NKIO	NOKIA	3	0.29
62	NRBO	NAVAL RESEARCH BOARD	1	0.48
63	OPSA	OFFICE OF THE PRINCIPAL SCIENTIFIC ADVISER	6	17.07
64	RBCO	ROBERT BOSCH ENGINEERING & BUSINESS SOLUTIONS LIMITED	10	45.91
65	RNTB	RENAULT NISSAN TECHNOLOGY & BUSINESS CENTRE INDIA PVT LTD	2	1.1
66	RROO	ROLLS ROYCE	1	0.41
67	TIPL	TEXAS INSTRUMENTS PVT LTD	1	0.56
68	TOEL	TOKYO ELECTRON LIMITED	2	0.95
69	UGCO	UNIVERSITY GRANTS COMMISSION	12	10.89
70	UNES	UNITED NATIONS EDUCATIONAL SCIENTIFIC & CULTURAL ORGANISATION	1	0.06
71	USCO	UNIVERSITY OF SOUTHERN CALIFORNIA	1	0.17
72	UUOO	UPPSALA UNIVERSITY	1	0.2
73	VSSC	VIKRAM SARABHAI SPACE CENTER	1	0.15
74	VTSK	VETENSKAPSRADET	1	0.04
75	WELT	THE WELLCOME TRUST,UK	24	72.18
		Grand Total	980	1566.68



3.7.6

Office of Development and Alumni Affairs

**DIVISIONAL
CHAIRPERSON
IN-CHARGE**

GOVINDAN RANGARAJAN

The Office of Development and Alumni Affairs (ODAA) was established at the Indian Institute of Science in 2015 to build a vibrant Industry-Institute-Alumni ecosystem, and raise funds for various special projects from corporates, philanthropists and alumni. In addition, the ODAA provides support for alumni-related activities and engagement programmes at the Institute.

CHIEF DEVELOPMENT OFFICER

Ram Turaga

DEVELOPMENT OFFICER

Ranjini Raghunath

PROJECTS PURSUED

Some major projects that the ODAA pursued for fundraising during 2018-19 include:

- Smart-X Hub – a 180,000 sq. ft. building to house four centres under the Division of Interdisciplinary Research
- New women's hostel block
- Endowed Young Investigator positions supporting young Assistant Professors or new faculty candidates, and Chair Professorships supporting senior faculty members
- Teachers' training programme at IISc Challakere
- Support for research, education and outreach initiatives at the department level
- Student travel funds for international conferences

CORPORATE PARTNERSHIPS

In addition to several ongoing projects, many organizations and individuals have funded several new projects this year through Corporate Social Responsibility (CSR), philanthropy and research grants.

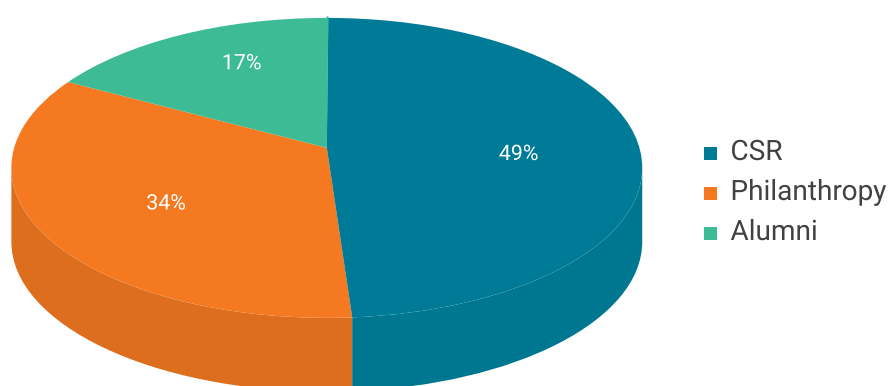
NEW PROJECTS FUNDED UNDER CSR

- Huawei Technologies India: Research, innovation and manpower in the areas of intelligent data analytics and cloud computing at CDS, IISc
- IFTAS: IFTAS-CDS Collaborative Lab
- Tata Elxsi: Support for emerging technologies in wireless communication
- Apra Labs: Travel funds for women students in ECE
- Accel Partners: CSA golden jubilee fund

NEW PHILANTHROPIC CONTRIBUTIONS AND GRANTS

- Ms. Indumati Srinivasan & Dr. Seshadri Shekar Chakravarthy: Endowment to support research in electrical engineering and high voltage engineering
- Mindtree Limited: Mindtree Associate Professor Chair
- Sitaram Jindal Foundation: Sitaram Jindal Foundation Medal
- DRDO: Grant-in-aid for Associate Professors in the Division of Mechanical Sciences
- Mr. Kris Gopalakrishnan: IISc-NTU student exchange program
- Ricoh & Maersk: M. Tech. scholarships in CDS
- NetApp via Silicon Valley Community Foundation: Research projects on coded distributed storage and IoT
- Wipro: Wipro-IISc Research & Innovation Network
- Booking.com: Scholarships for women students pursuing M. Tech. in engineering fields
- Tata Trusts
 - o Faculty & student travel fund for international conferences
 - o Faculty fund for short-term international visits
 - o International PhD scholarships
 - o Salaries for special administrative positions

Funds received (2018-19)



ALUMNI RELATIONS

Since 2015, the ODAA has maintained an exclusive alumni portal to help alumni connect with each other and with the Institute (www.alumni.iisc.ac.in). More than 5800 alumni have currently registered for this free website, and receive periodic announcements through this portal. In an effort to build this database, since 2018 all graduating students have been mandated to register on this alumni portal as part of their no dues process.

The ODAA has also built a large network of alumni through LinkedIn (~6000).

ALUMNI CONTRIBUTIONS

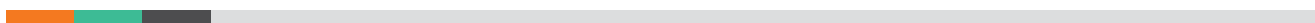
The Institute has been receiving generous funding from alumni towards several projects. Apart from ongoing projects, contributions were made by alumni towards the following new initiatives in 2018-19:

- Revati & Satya Nadham Atluri Associate Professor Chair in Biological Sciences (Dr. Satya Nadham Atluri)
- Digital Library of Life at CES, unrestricted IISc corpus, endowed Young Investigator positions & travel grant (Mr. N Lakshmi Narayanan)
- Lakshmi & Aravamudan Student Travel Fund (Mr. Murali Aravamudan)
- Prof. VVS Sarma Memorial Lecture (various alumni)
- Prof. Roddam Narasimha Lecture (Prof. KR Sreenivasan)
- CSA golden jubilee fund (various alumni)
- Durgam & Sudha Chakrapani Family Trust Medal (Dr. Durgam Chakrapani)
- Manish Narayan Memorial Fund (various alumni)

ANNUAL ALUMNI REUNION

The ODAA organizes an annual reunion to encourage alumni to return to campus, and connect with the Institute and their departments.

IISc's 3rd annual alumni reunion was held on December 16, 2018. It featured talks by Dr. Shekhar Mande (DG, CSIR), Dr. Seshu Bhagavathula (CTO, Ashok Leyland) & eminent cricketer Mr. Anil Kumble. It also included a panel discussion on "Giving to IISc", chaired by Mr. Kris Gopalakrishnan, as well as departmental get-togethers. The IISc Distinguished Alumnus Awards 2018 were awarded to Dr. Narendra Ahuja ('74 ME ECE), Prof. Dipankar Banerjee ('79 PhD Met), Dr. PS Goel ('70 ME EE) and Dr. K Sivan ('82 ME Aero).



3.7.7

Intellectual Property and Technology Licensing

CHAIRPERSON
SRINIVASAN RAGHAVAN

1. DEPARTMENT PROFILE

IPTeL (Intellectual Property and Technology Licensing) is the Institute's gateway to filing for intellectual property protection and technology licensing. This mandate of this office is to ensure that the knowledge being generated at the Institute is protected and then leveraged, by responsible licensing, for the benefit of the Institute and thereby to the society at large. IPTeL strives to enable rapid filing for IP protection, so that it does not unduly delay the submission of results to academic journals.

The activities at IPTeL thus fall in two large buckets. One is IP management that includes all the processes from IP disclosure by IISc staff and students to maintaining the patent till its point of expiry. Two, licensing of the IP so generated in the form of know – how and patents. During the calendar year 2017 IPTeL embarked on the process of automating the IP management system, so that more emphasis could be placed on licensing. Towards this end, IPTeL has planned in 2018 to increase its interface with industry by various licensing modes.

2. PATENT LICENSING

IPTeL is getting increasingly involved in licensing and pursuing transfer of technologies to various companies. We have, in the past one-year, entered into exploratory agreements with many companies. A sample list of such engagements is as follows:

INDUSTRY/COMPANY	TECHNOLOGY
Antsceramics	Indegenous Ceramic Femoral Head development
Jiva Sciences Pvt Ltd	Multidimensional Fluid Focusing Device
Bionaut Labs	Selective Manipulation and Positioning of Colloidal Particles by Magnetic-Plasmonic Hybrid Device with Spatial Control
RI Instruments	Laser Based System for Studying Adsorption Kinetics
NEU Integrals	A Compliant Hinge Mechanism
Reva technologies, Pune	H2S Scrubbing Technology
M/s Praj Industries Ltd	H2S Scrubbing Technology
Superwave Technologies	Novel Technique for Hypersonic Drag Control Using Heat Addition in the Shock Layer
Mynvax	Protein Model Discrimination Using Saturation-Suppressor Mutagenesis

Mymic	A Haptic Device for Endoscopy
Sickle Innovations	A Harvesting Machine
Open Water	Fluid Filtration Device
PathShodh Healthcare Pvt Ltd	Device and Method for Non-Enzymatic and Electrochemical Detection of Glucose Bioanalyte
APE Research	Micro-Scale Ball-and-Socket Joint
Ducom	A Dental Implant Assemble for Dental Prosthesis
Agrinnovate	Pest Control
Monsanto	Pest Control
Jindal Steel	Semiconductor Nanocrystals
Phoenix Medical Systems Pvt Ltd	Reduced Graphene Oxide Nanomaterial Coated Cotton Fabric as a Heating Device and a Method Thereof
Tata Motors	Switched Reluctance Device

• **IISC PATENTS LICENSED FROM IISC START – UPS:**

- Superwave Technologies
- Pathshodh
- Mynvax
- In Scientific
- Sickle
- Open Water
- Mimyk

3. BASIC PORTFOLIO INDEX (1995-JUNE 2019)

In 2017 the IPTeL embarked on the process of compiling our existing portfolio in soft format to aid subsequent automation and make the licensing procedure easier. This portfolio is now available online and is being updated on a monthly basis. The current portfolio is as follows

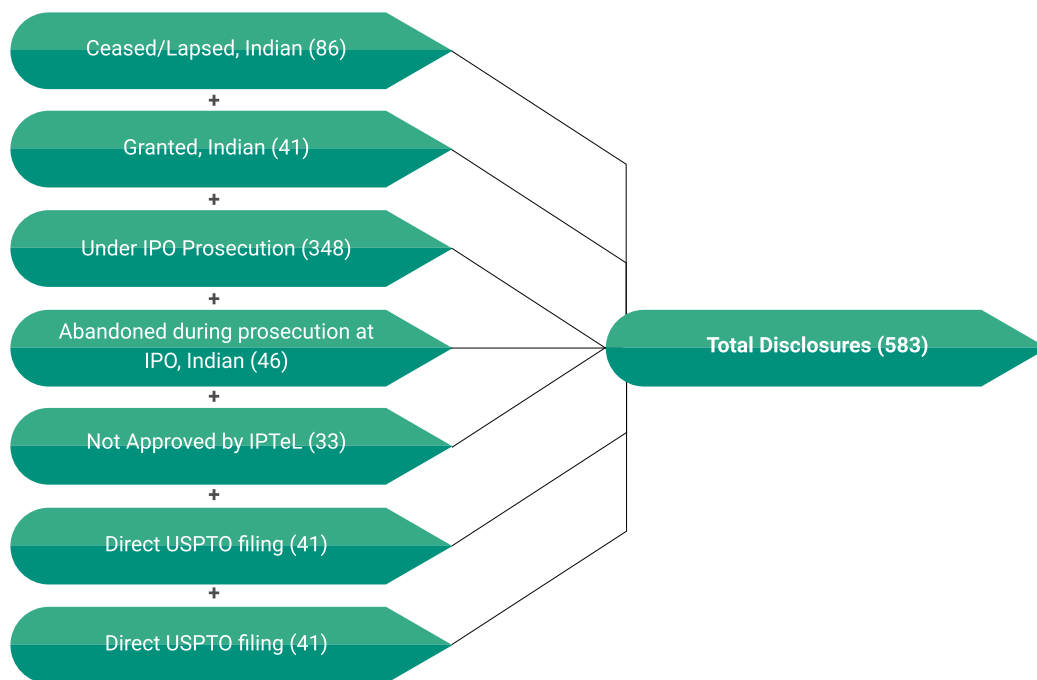
- Patent Families (1995-June 2019): (A family is a set of patents filed in different countries against the same disclosure. Family does not include patents filed only in India)

Number of Families: 182

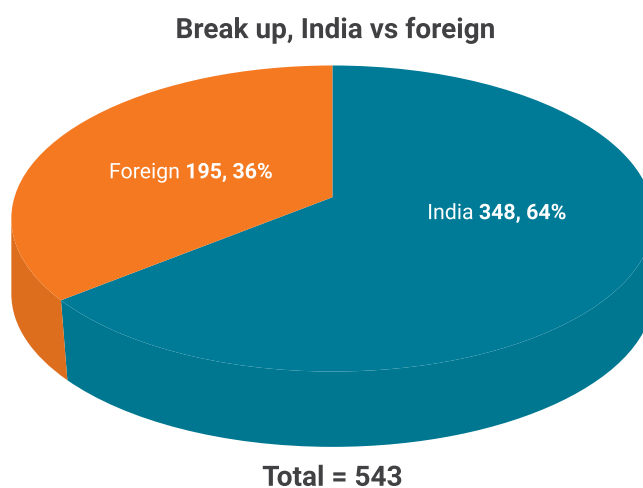
Number filed directly to PCT/USPTO: 23 (No Indian Patent was filed)

Number of Indian patents filed in the family bucket: 159

• Total disclosures submitted by IISc faculty to IPTeL (1995 – June 2019): 583

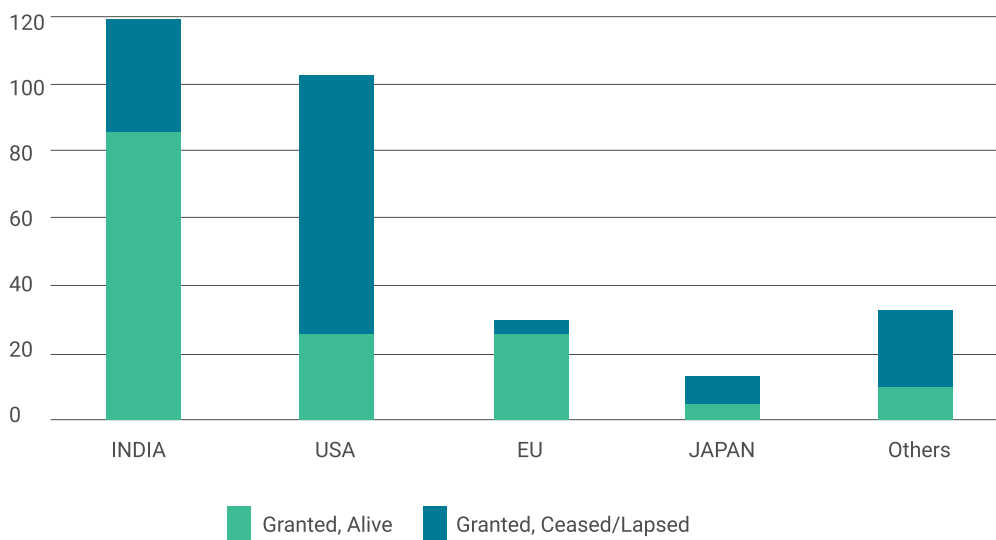


• Total number of Indian and Foreign patents filed and under prosecution (1995-June 2019): 543
a) Indian: 348
b) Foreign: 195



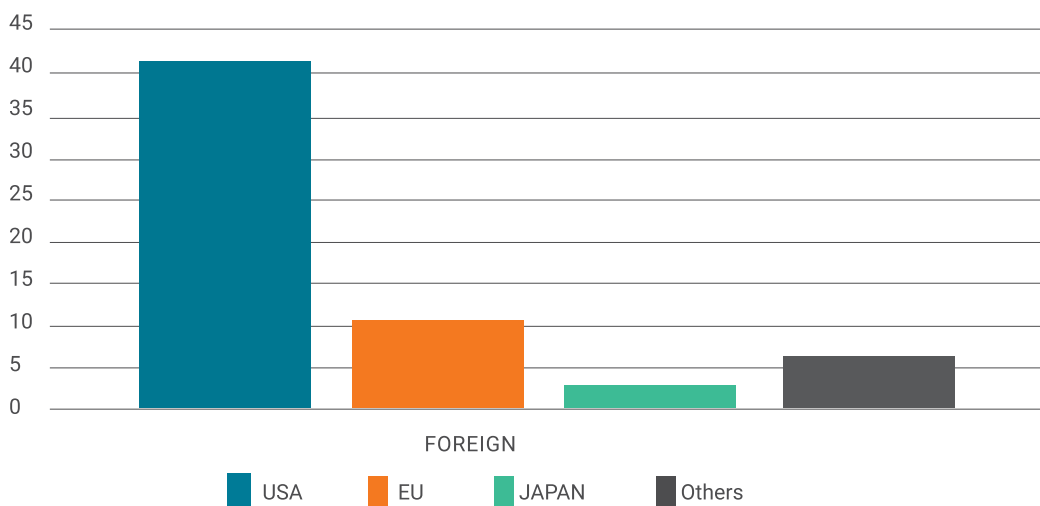
- Break-up of granted patents into “Alive” and “Lapsed/Ceased”:

PATENTS, GRANTED & CEASED/LAPSED



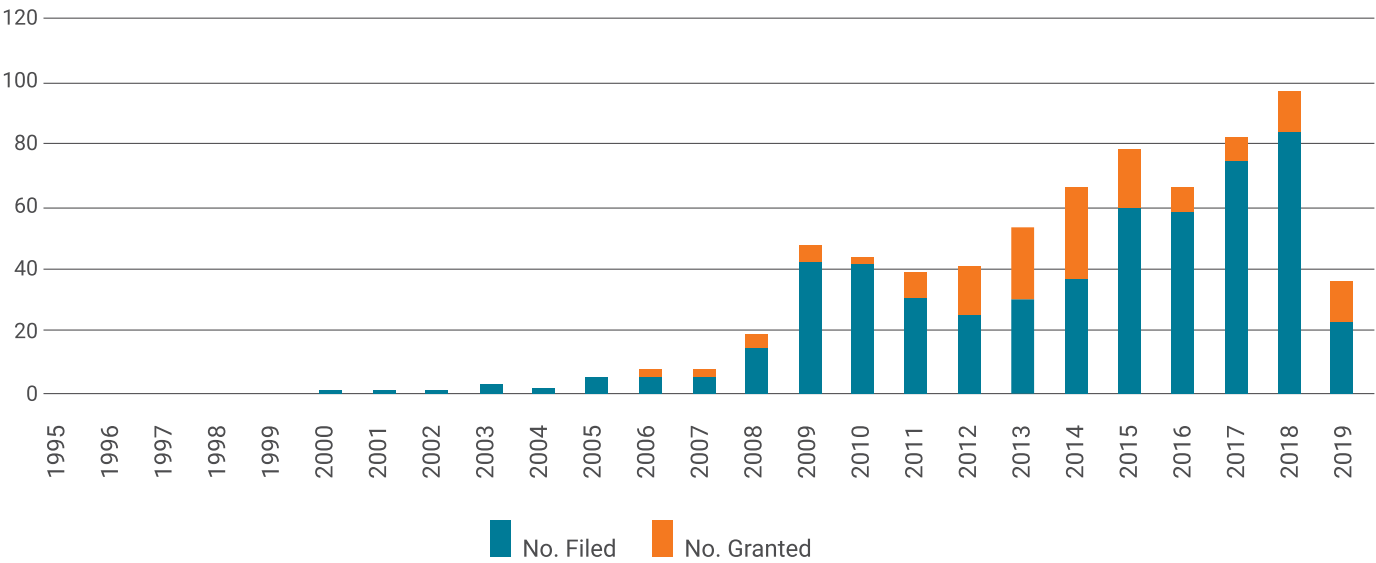
- Foreign patents under prosecution: 63

UNDER PROSECUTION, FOREIGN



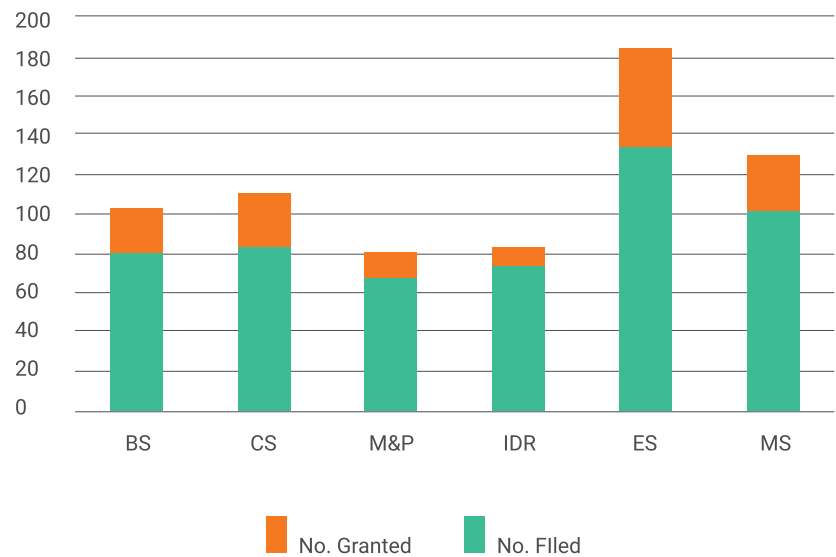
• Year wise break-up (1995-June 2019) of patents granted and under prosecution:

4A. GRANTED, ALIVE & UNDER PROSECUTION



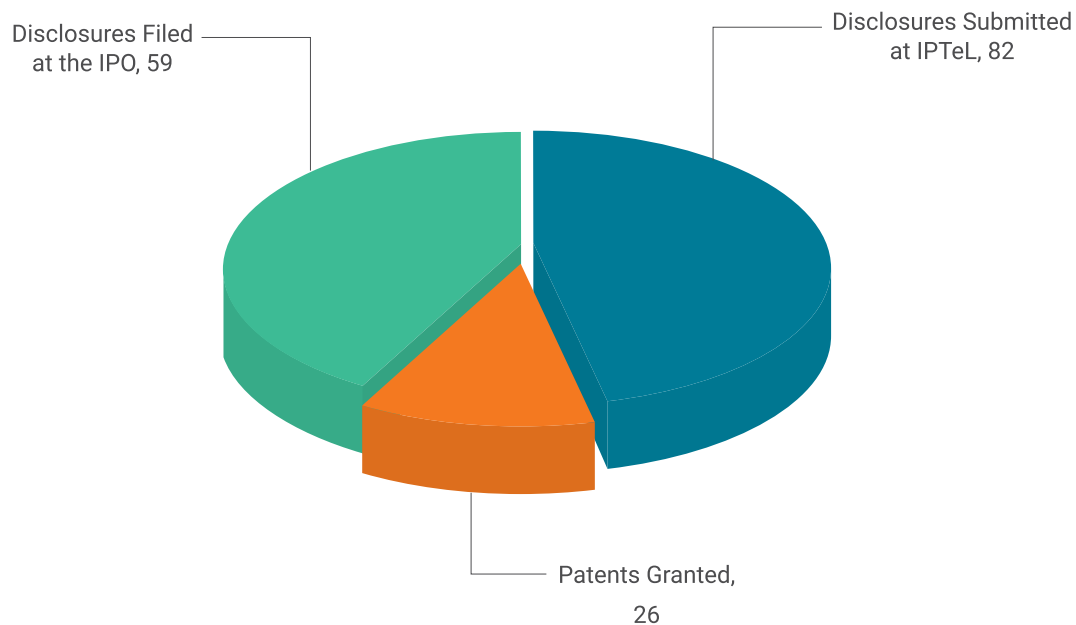
• Division wise break-up of number of disclosures filed & submitted (1995-June 2019)

4B. GRANTED, ALIVE & UNDER PROSECUTION



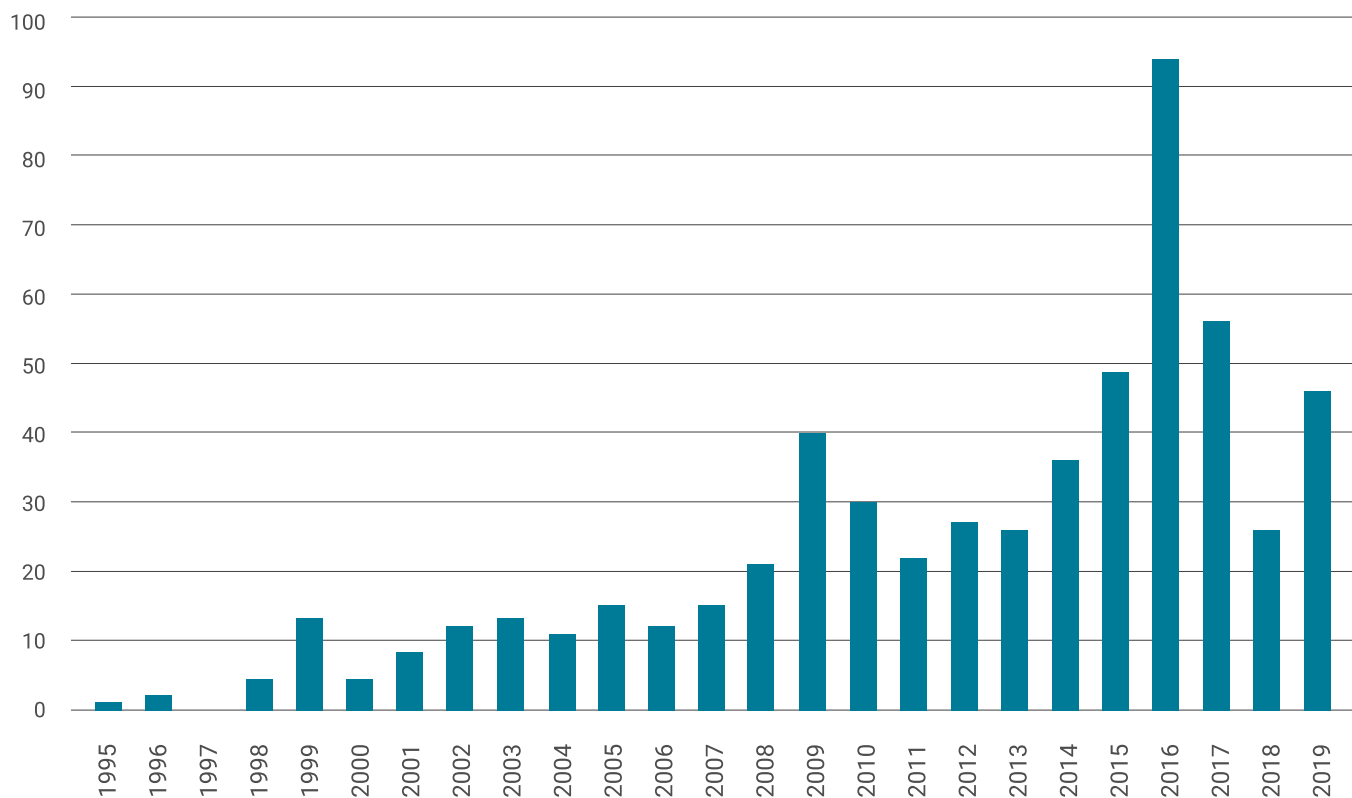
• IP filing status for the year 2018-June 2019• Foreign patents under prosecution: 63

PATENTS, GRANTED & CEASED/LAPSED



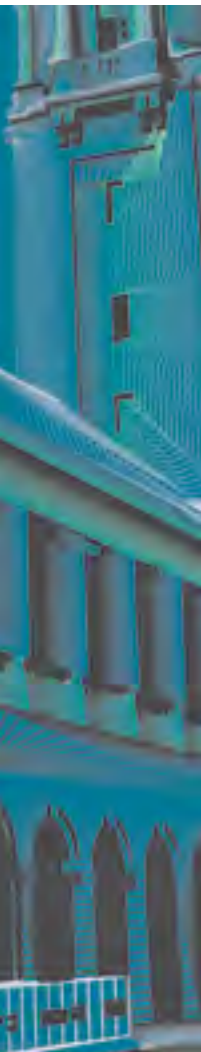
• Year Wise Break-up of Disclosures Submitted to IPTeL

NO OF DISCLOSURES SUBMITTED TO IPTEL



3.7.8

Challakere Campus / Talent Development Center Kudapura



The Institute is in possession of 1500 acres of land allotted by the Government of Karnataka during 2009 in Challakere taluk of Chitradurga District. This second campus of IISc being set up in Kudapura village is officially known as “Challakere Campus”. It is 220 km from Bangalore and takes about 4 hours to reach the campus. Development of infrastructure in the new campus has been a challenge given the geo-climatic conditions.

In the first phase of infrastructure development, several basic facilities have been established. Construction of 10 km long peripheral road and the compound along with an imposing entrance, construction of two check dams for harvesting rainwater and drawing HT power connection from the nearby receiving station were some of the initial steps. Indeed the ground water level in the region has risen, and this seems to have served as a step-in-aid for agriculture and allied activities in the surrounding region.

Major infrastructural activities during 2018-19 are: construction of water supply system, widening of the peripheral road to serve as the trunk line for a few decades in future, construction of RCC trench to carry all power and utility cables along the peripheral road, and providing street lights. All these civil and electrical works have been completed. Water from the KUWSSB has already been drawn to fill the reservoirs and this assures supply of drinking water for the next few decades. The peripheral road is now lit in the nights to facilitate movements in the night.

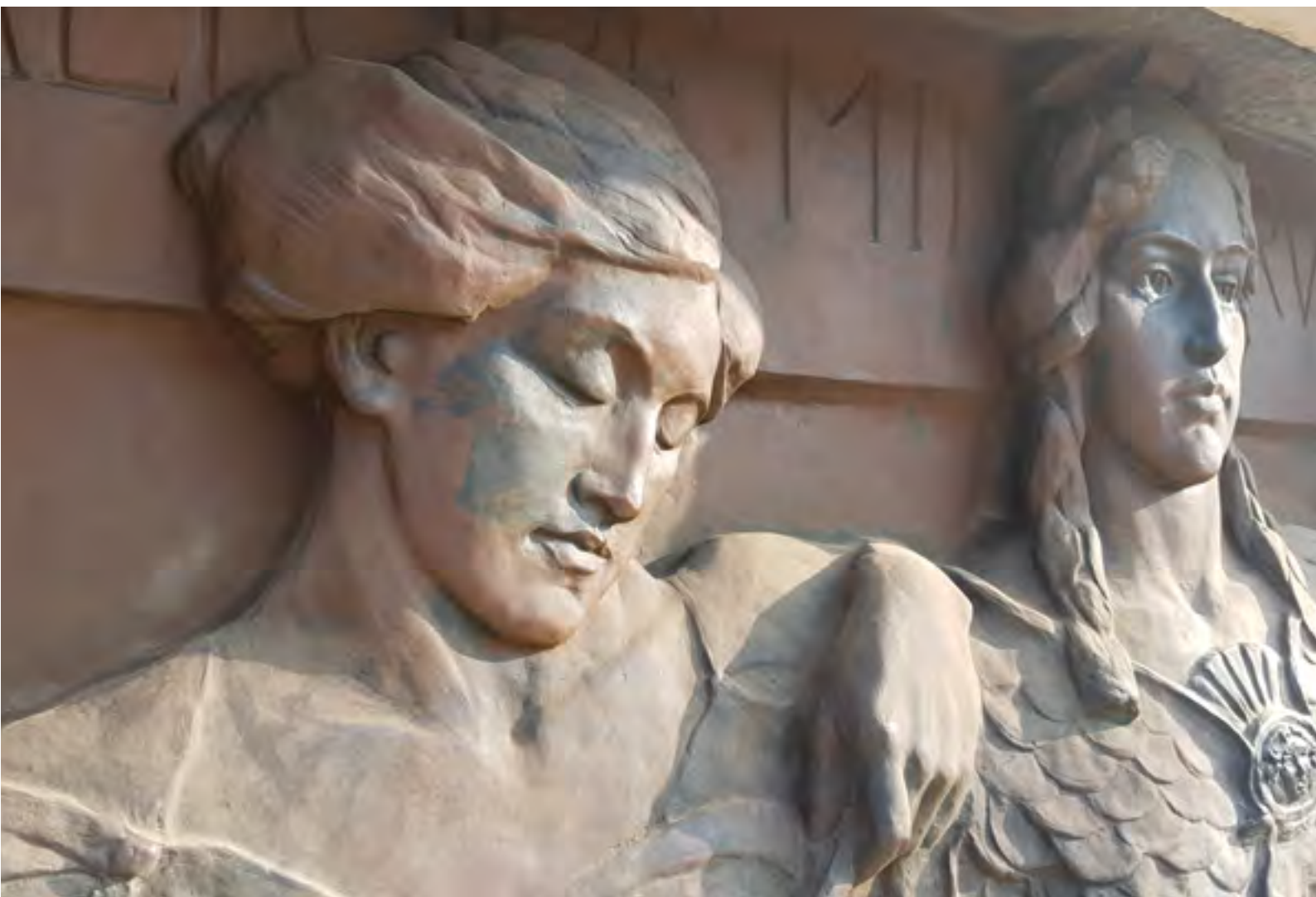
Greening of the campus is vigorously pursued. With an MoU with Karnataka Biofuel Board, about 1100 samplings of biofuel species are being planted. Further with the help of State Forest Department another 2000 fruit bearing species are also being raised. A nursery is under construction to aid this activity in future

A major construction activity of this year is the building of Skill Development Centre and a Hostel Complex. This prominent outreach project has received CSR support from HAL and is entrusted to CPWD. The buildings are nearing completion and are expected to become functional by the middle of this academic year. It will house workshops and laboratories for skilling in mechanical and electronics manufacturing in addition to the science and mathematics teacher training programs.

The R&D facilities related to Solar Energy and Climate Research have been functional and the research results have been published by the concerned groups. Dissemination and capacity building towards adapting and promoting low-C and biomass centric technologies developed by Centre for Sustainable Technologies (CST) are in progress. Under this project funded by

the State, a few training programmes for surrounding villagers as well as to those from neighboring states have been completed. Initially funded by the Government of Karnataka, this project has received a major fillip from HDFC under CSR funding.

The Talent Development Centre is vigorously pursuing its popular programme of providing training to High School Science Teachers, supported by the Government of Karnataka. The Ministry of Human Resource Development, Government of India has identified the IISc Challakere Campus as the Centre of Excellence in Science and Mathematics Teacher Training under the scheme under "Pandit Madan Mohan Malaviya National Mission on Teachers & Teaching (PMMMNMTT)". Under this scheme, training is imparted to science teachers in high schools including those from Kendriya Vidyalaya and Navodaya schools. Also batches of UG/PG lecturers across the country have benefited by this scheme. This has now assumed pan-India dimensions and so far, nearly 13500 teachers have received hands-on training in this centre.



3.7.9

Centre For Scientific and Industrial Consultancy

CHAIRPERSON
K J VINOY



During the year under review, the Centre for Scientific and Industrial Consultancy (CSIC) has strengthened the faculty-industry interactions in the form of informal discussions and advice to formal projects, involving design, development and transfer of technology. The Centre has strived to enhance, qualitatively and quantitatively, the nature of Institute - Industry linkages. The Centre has undertaken major consultancy projects of national significance involving scientific and technological challenges, with the ultimate goal of technology transfer for industrial development.

The range of professional consultancy services offered by the Institute faculty through CSIC include:

- Systems design/analysis
- Software development
- Product design/development
- Process design/development
- Model investigations
- Advice on R & D
- Transfer of technology
- Evaluation/overview
- Diagnostics

The above services have been utilised by a wide range of clientele, comprising of educational/research institutions, health / pharmaceuticals industries, department of space, defence laboratories/ organisations, irrigation departments, electricity boards, electronics/telecom industries, engineering industries and chemical industries from both the public and the private sector.

During the financial year starting from April 01, 2018 to March 31, 2019, a total of 339 consultancy project proposals costing Rs 1874.69 lakhs were communicated to the clients. In the above said period 252 consultancy projects with an outlay of Rs. 1552.20 lakhs materialised. Receipts from consultancy projects and consultancy test projects amounted to Rs. 1582.24 lakhs.

3.7.10

Digital Campus and IT Services Office

CHAIRPERSON
Y NARAHARI

DIGITS (Digital Campus and IT Services) Office is a unit set up by the Institute to conceive, plan, and create a best-in-class information technology (IT) and networking system, and implement agile IT and networking services for operational excellence in the Institute. The DIGITS office has the mandate of consolidating and coordinating all digitalisation activities and services in the Institute.

During April 2018-March 2019, the activities of DIGITS have resulted in the following outcomes.

Project ISTAR: Project ISTAR (Implementing SAP S/4 HANA for Transforming Administration and Research) for ERP implementation commenced on February 15, 2018. The implementation is being executed by Wipro. Project ISTAR is being executed in two waves:

- WAVE 1 modules: Finance & Accounts; CSSP; HR & Payroll; Stores & Procurement
- WAVE 2 modules: Academics; CCMD; Hostel, Mess, and Guest House

During April 2018 to March 2019, the various phases in the implementation of WAVE 1 were executed in an aggressive way by the Wipro and IISc teams. The major steps in the implementation include: (1) Preparation of Business Blueprint Documents (2) Realisation of the business blueprints using SAP S/4 HANA software (3) Conference Room Pilots Demonstration (4) Master Data Migration (5) User Acceptance Testing (6) Go Live. Step 1 was completed by August 2018. During Sep. – Nov. 2018, Steps 2 and 3 were completed. Step 4 (master data migration) which is a major exercise was completed in February 2019. Step 5, which involves comprehensive testing of all functionalities by the actual users of the system was completed in March 2019.

WAVE 1 was scheduled to go live by April 1, 2019 but this was postponed to June 2019 to ensure a smooth transition to the new system. Since it is paramount importance to migrate the data from the legacy systems to the new system in a completely error free manner, it has taken the implementation team more time than anticipated to migrate the data to the new system. In order to rigorously check out all important business functions with migrated data, it was decided to create a pre-production system to enable comprehensive testing.

Project ISTAR is being monitored by the Operations Committee with the Registrar as Chair and the Financial Controller as Co-Chair. The overall project is reviewed every month by the Executive Committee with DD (A&F) as Chair and DC-EECS Division as Co-Chair.

Maintenance of the Current IT and Networking Operations: Since it would take until the end of 2019 for a fully operational implementation of the S4/HANA system at the Institute, there is a need to maintain the current IT and network services in a stable way. An IT services company Integra Micro Systems is helping DIGITS to run the existing operations in a reliable and robust way, and in implementing additional applications. Integra Micro systems is now fully maintaining the following applications in cooperation with DIGITS: Admissions; Post-admissions Academic operations; Stores & Purchase; CSSP; Health Centre; Hostel & Mess Management; and IISc website. They have also been involved in the master data migration exercise for the ISTAR project.

Enhancements to IT Services and new IT Services: DIGITS, with the help of its staff and outsourced team, launched the online course registration and grading module in January 2018. During March-May 2018, the application had to be stabilised due to several operational difficulties. The stabilised version of this module was successfully used for the course registration in August 2018 for the Aug-Dec. courses. During Sep. – Nov. 2018, DIGITS, with the help of its staff and outsourced team, has developed, tested, and implemented an online portal for recruitment of non-teaching staff. It has developed a portal for faculty recruitment which is set to be tested. A portal for annual reporting by faculty members has been developed and launched in January 2019. Portals for receiving student feedback and for feedback on amenities are now ready to be launched.

Internet and Networking Infrastructure and Services: Single sign-on for all IT applications is being implemented. It has now been implemented for WiFi services, VPN connection, and for online course feedback. Eduroam services have been implemented. A detailed plan has been drawn up for procuring equipment for a modern networked campus. The equipment is being procured through NICSI, a subsidiary of NIC and a Govt. of India company.

DIGITS WEBSITE

DIGITS has launched a website and is continuously updating the website with content that will be helpful for all ongoing initiatives. Please look up <https://digits.iisc.ac.in>.

SUBSCRIPTION BASED BROADCAST

There is a long-felt need for streamlining the process of delivering broadcast emails so that users are not inundated with all varieties of broadcast emails. A subscription-based system has been implemented and will be launched anytime now. Under this scheme, there will be different categories of broadcast emails and each user will be able to subscribe to only those categories in which he/she is interested. Only the emails belonging to subscribed categories will be delivered to the mailbox of the user. However, all broadcast emails will be available in a portal and users would be able to access these by logging into the portal. DIGITS is also working on a standard list of “subject” headers so that individual users will be able to set up their own custom filters.

FaRE (FACULTY REPORTING ENVIRONMENT)

DIGITS has designed and implemented a portal for faculty members to report their activities during a calendar year. The portal can be accessed using the faculty member's iisc.ac.in email account at: <https://fare.iisc.ac.in>. This portal will be extended in the future to enable faculty members to report their activities during any given time period. If the information is filled in and submitted for multiple years, the portal can be used to generate a pdf file that aggregates all the information for those years into a single pdf file.

OPStaR (ONLINE PORTAL FOR STAFF RECRUITMENT)

DIGITS has designed and implemented an online portal for prospective technical and non-technical staff applicants to upload their applications and all other documents required. OPStaR sends automatic acknowledgment to the candidates, prepares a single pdf file of the application package, and forwards the same to the Council Section. It also archives all the information for each recruitment exercise. It has been successfully deployed for recruiting Assistant Registrars and Deputy Registrars.

FRP (FACULTY RECRUITMENT PORTAL)

DIGITS has designed and implemented an online portal for prospective faculty members to upload their applications and all other documents and publications required. FRP sends automatic acknowledgment to the candidates, prepares a single pdf file of the application material, and forwards the same to Council Section and all Departments concerned. After the concerned department completes the processing and uploads all relevant documents, FRP archives all the information. FRP also generates a single pdf file containing all the paperwork required for setting up a faculty selection committee.

WISE (VIDEO SECURITY EQUIPMENT) - PHASE 2

Phase 1 of the WISE project involved 26 cameras installed in 16 locations. The WISE committee headed by Prof. Venkatesh Babu has drawn up the specification for Phase 2 which includes 124 cameras in 70 locations. For operational purposes, Phase 2 has been grouped into two clusters:

- Phase 2A: This rides on the existing OFC (Optical Fibre Cable) backbone. Trenching and laying of conduits are the major work elements here.
- Phase 2B: This will require the new OFC ring to be in place. Trenching and laying of conduits will not be required.

A tender has been issued for Phase 2A and the procurement process is underway. It is expected that all the cameras will be installed and functional by July 2019.

ONLINE PROCESSING OF PHD. THESIS EVALUATION THROUGH SCHOLAR ONE

The DIGITS team worked with Clarivate Analytics (formerly Thomson Reuters) to customize the Scholar One Platform for online processing of PhD. theses. The tool was rolled out in October 2017. This tool has now stabilised after an initial year of continuous improvement. Remarkably, over a one-year period, the tool has halved the cycle time from the submission of thesis to the receipt of the final report. The tool is being currently customised for processing M.Tech. (Research) dissertations as well.

ASSET DATA CREATION

The ongoing ISTAR project requires an online database of equipment and furniture in each department and centre in the Institute. IISc departments have traditionally maintained an Equipment Register for this purpose and most departments/centres follow a manual process for this purpose. DIGITS has undertaken an elaborate process, under the guidance of Financial controller, Ms. Indumati Srinivasan, to create an online database of equipment and furniture for all departments and centres. This exercise has been completed in SERC, CSA, ECE, ESE, and EE departments. Currently, four departments under the Division of Mechanical Sciences, have been taken up. This initiative is likely to be completed by the end of April 2019.

3.7.11

Society for Innovation and Development

CHIEF EXECUTIVE
B GURUMOORTHY

PROJECTS SANCTIONED

During the period under review SID got 28 projects sanctioned covering different departments of the Institute involving the participation of more number of faculty.

INDUSTRY R&D CENTRES IN SID/IISC CAMPUS

A) I-HUB Centres

- United Technologies Corporation India Private Limited (Pratt & Whitney R&D Centre)
- Tata Motors Limited
- i2n Technology Private Limited

B) OTHER CENTRES

- Robert Bosch Centre for Cyber Physical Systems
- Spectroscopy Analytical Test Facility
- Centre for Infrastructure, Sustainable Transportation and Urban Planning
- Energy Storage Systems Initiative
- Centre for Brain Research

COMPANIES/INDUSTRIES WITH WHICH AGREEMENTS/ MOU'S SIGNED DURING 2018-19

MoU / Agreements have been entered into between the following companies for long-term collaboration and for establishing R&D Centers on the campus of the Institute:

1. Thalesat Innovations Private Limited
2. Karnataka Biotechnology and Information Technology Services (KBITS)
3. WIPRO Limited (Collaboration Agreement)
4. Wipro Enterprises (P) Limited
5. Shell India Markets Private Limited

Agreement signed under Uchhatar Avishkar Yojana

1. INTECH DMLS Private Limited
2. Mynvax Private Limited
3. Log 9 Materials Scientific Pvt. Ltd

INTERACTION MEETINGS

SID has regularly been connecting with private industries, public sector, government of India entities across segments to scale sponsored research collaboration for establishment of I-HUB R&D Centers and projects. SID continues to organize the interact sessions between the scientists/technologists from industries and faculty of IISc to showcase the capabilities of the Institute and facilitations that would provided in the growth of applied research. The following organizations participated in the interact sessions.

S. NO.	COMPANY
1	Toyota Kirloskar Motors
2	YESKAWA
3	Wipro Consumer Care
4	LERC
5	FLIPKART
6	QUALCOMM
7	INDIAN NAVY
8	Johnson & Johnson
9	MERCK
10	MNRE
11	Ashok Leyland
12	Duracell
13	Swiss Re
14	GATES Foundation
15	Tata Steel
16	Tata Chemicals

UCHHATAR AVISHKAR YOJANA

IISc has submitted 19 project proposals in response to the second call for proposals under this scheme and 4 proposals have been approved.

SL. NO	PROJECT TITLE	CHIEF PROJECT EXECUTIVE	DURATION OF THE PROJECT	INDUSTRY PARTNER	PARTICIPATING MINISTRY	TOTAL BUDGET IN RS
1.	Deep learning based eco-system for aircraft health management using visual and sensor data	Ambedkar Dukkupati and R Venkatesh Babu	36 months	GE india Industrial pvt. Ltd	Department of Space	3,27,00,000
2.	3D Printing of Metallic Orthopaedic Implants	Kaushik Chatterjee	36 months	INTECH DMLS Private Limited	Ministry of Health and Family Welfare	1,20,00,000
3.	Development of stem immunogens for a broadly protective influenza vaccine	Raghavan Varadarajan	36 months	Mynvax Private Limited	Ministry of Health and Family Welfare	3,14,50,000
4.	Development of EMI shielding material for aircraft	Suryasarathi Bose	24 months	Log 9 Materials Scientific Pvt. Ltd	Department of Space	1,15,03,000

STEM CELL

The following startups have been incubated by SID

SL NO	INCUBATION MM/YY	COMPANY	INCUBATEE	TECHNOLOGY AREA	STATUS	IMPACT AREA
1	Jan/2018	Shono Research Pvt Ltd	Joydeep Maitra	Low Cost Medical Device	Prototype in Progress	Rural Health
2	Jan/2018	Protein Design Pvt Ltd	Rajan Dighe	BioSciences	Yet to begin	Healthcare
3	May/2017	General Aeronautics	Kota Harinarayana	Aerospace	Developmental phase	Aerospace industry
4	May 2017	Mimyk Healthcare	Shantanu Chakraborty	Laproscope Simulator	Prototype Developed	Healthcare
5	Jan/2017	Bellatrix Aerospace	Rohan M. Ganapathy	Orbital launch vehicles	Signed Contract with ISRO	Aerospace Industry
6	Jan/2017	Lab to market innovations	S. K. Sinha	IoT based applications	Development phase	Transportation Industry (Railways)
7	Aug/2016	SIAMAF Healthcare Pvt Ltd	Subhasis Sarangi	Nano technology-based diagnostics	Clinical Trials in Progress	Health care
8	Jan/2016	Astrome Technologies	Neha Satak	Satellite Based Internet Services	Developmental phase + Testing to begin	Digital India
9	Apr/2014	Azooka Life Sciences	Fathima Benazir	DNA Stains	Developmental phase	Societal
10	Jan/2014	Pratimesh Labs	Prakhar Jain	Low- Cost Medical Devices	Developmental phase	Rural Health

COMPANIES INCUBATED UNDER THE FACULTY ENTREPRENEURSHIP PROGRAMME

SL NO	INCUBATION MM/YY	COMPANY	INCUBATEE	TECHNOLOGY AREA	STATUS	IMPACT AREA
1	Aug/2018	Invitrosense Pvt Ltd	V Venkatraman	BioSciences	Early Stage	Bioscience, Chemicals
2	Aug 2017	Mynvax Pvt Ltd	Raghavan Vardharajan	Vaccines for local diseases	Early Stage	Healthcare
3	May 2017	Simyog	Dipanjan Gope	Computational tool for modelling and simulation in electromagnetics	Product-Development; Strategic investor on board	Electric vehicle
4	Jan 2017	OpenWater	Sanjiv Sambandan	Water Purification	Beta Testing with Customers in progress	Water / Societal / Industries
5	Aug 2016	Shanmukha innovations Private limited	Sai Siva Gorthi	Optics and Microfluidics Instrumentation	Developmental Phase	Medical Diagnostics
6	Aug 2016	Bio-Synth	B. Gopal	Enzyme engineering	Product Development	Biotechnology, Chemicals, Pharma
7	Sep 2015	Pathshodh Healthcare Pvt Ltd	Navakanta Bhat	Diabetes Diagnostics	Graduated out of Incubation; Early Revenue	Societal
8	Apr 2015	Equine Biotech Pvt. Ltd.	Utpal Tatu	Veterinary Diagnostics	Revenue Positive	Animal Health
9	Sep 2014	Superwave Technology Pvt. Ltd	K.P.J Reddy/G Jagadeesh	Shock Wave Dynamics	Revenue Positive	Petroleum, Tea Industry and Healthcare

SID HAS RECEIVED NEW PROPOSALS ON FACULTY ENTREPRENEURSHIP AND THESE ARE IN VARIOUS STAGES OF EVALUATION AND PROCESSING.

INCUBATION PIPELINE

DOMAIN	PRODUCT / INITIAL OFFERING
Industrial IOT	LPG Sensors by Praveen R
Healthcare (Devices)	Prosthetic Wearable Arms – Purak Simulators for training doctors and nurses - Meduplay Dry blood transport
Bio-Tech	Antibody design
CS	AG Ramakrishnan, RaGaVeRa Tech (OCR/ASR technology for Vernacular) Partha Talukdar, AI/ML for Dark Data (Unstructured data)

- Selected by NitiAayog for a 10cr grant towards upgradation of Incubation Center.
- Attended a 2-day workshop by NitiAayog for Incubation Managers.
- 1 new startup incubated virtually – Invitrosense Pvt Ltd by Prof Venkatraman
- 3 term sheets offered:
 - o Purak;
 - o Prof Partha Talukdars' new startup Kenome Pvt Ltd
 - o Prof Gurunath Gurralla' new venture UrjaLinks Technology India Pvt Ltd
- 45 Proposals for Incubation Received;
- Visits – GrowX Ventures; InvestIndia from Gol; LetsVenture

AWARDS WON

- Three of our startups have won the Karnataka Govt Elevate 100 award – Lab-2-Market, Azooka and Simyog

TIME²

Manufacturing Excellence Programme

Below is the list of companies which are collaborated with SID-TIME2 in developing products jointly.

SL. NO.	COMPANY	PRODUCT AREA	STATUS
1	Electronics Relay India Pvt Ltd, Bengaluru	Motor controller	Platform prototype done
2	Sadhana Enviro Engineering Solutions, Bengaluru	Desilting Machine	Platform prototype done
3	Volga instruments, Thane	Warehouse Robot	Platform prototype done
4	Inhouse Interior, Bengaluru	Smart furniture	Platform prototype done

PRODUCT INNOVATION CENTER

Vikas Composites has signed an MoU with SID for participating in the collaborative design program to develop a product in the personal thermal management space. The PI has been identified and lab has been setup.

Three companies expressed their interest in collaborating under PIC programme.

FOCUSED PRODUCT INNOVATION CENTER

Discussions underway with strategic sector to support Defense PIC. The DEFPIC will collaborate with 10 industries towards technology and product development of defense requirements.

INDUSTRY INTERACTION

28 industries participated in the Time 2 Leap summit

20 industries showed interest to participate in different programs of TIME²

Had one on one meeting with all the 20 industries and selected 8 industries for day long brainstorming workshop

Visited these 8 industries and finally selected 4 industries for MxP program.

SUMMIT

Organized TIME² LEAP summit, a one-day summit to disseminate information about TIME² activity among SME industries.

INDUSTRY SECTOR	COUNTS
Electronics	7
Robotics	3
Sheet metal	1
Solar	3
Solid waste Management	2
Automotive	2
Aerospace & Defence	2
Furniture	2
Plastics	3
Medical	1

SOME NOTABLE ACTIVITIES

- Represented SID, IISc at the roundtable at the Festival of Innovation & Entrepreneurship, FINE-2018 at Rashtrapati Bhavan
- Represented SID, IISc at Electronic Warfare Symposium at Indian Airforce 12 BRD
- Represented IISc and exhibited in Industry Expos namely India Manufacturing Show 2017 & Bangalore Tech Summit 2017
- Visited the Hannover Messe Trade Show, focused on Industry 4.0, Industrial Automation, Energy, IoT
- Attended IMTEX 2018 & India Defense Expo 2018
- Participated in several workshops and trade association events: National workshop on SMEs by Ministry of MSME (Delhi), Indo- Israel Workshop on SME innovation system (IIM Bangalore), IESS Conference (Chennai)

3.7.12

Centre For Brain Research

DIRECTOR
VIJAYALAKSHMI
RAVINDRANATH

The Centre for Brain Research (CBR) was established in 2014 at IISc to focus on research on ageing brain with a goal to identify risk and protective factors that contribute to pathological aging leading to disorders, such as dementia. CBR has been established through a generous gift from Pratiksha Trusts founded by Mr. Kris Gopalakrishnan, co – founder of Infosys and Mrs. Sudha Gopalakrishnan. This is a unique initiative in the current research environment in India, wherein, conventionally, most of the academic research has been carried out through public funding. The funding of CBR by philanthropy offers unprecedented flexibility in faculty and staff recruitment and operation that is necessary for large scale scientific endeavour with long term goals.

CBR activities are currently carried out in a temporary location within IISc. A state-of-the-art Brain Research Laboratory is being established in the IISc Campus with the built-up area of 1,10,000 sq. ft to house a unique world class facility.

The faculty of CBR are involved in multiple focus areas of research that can collectively improve the understanding of neuro-degenerative disorders, their mechanisms, causes and prognosis. One of these areas is to understand the contribution of factors, such as genetic pre-disposition, lifestyle and environment to the incidence and prognosis of neurodegenerative disorders. Another focus area is to improve understanding of the shared genetic architecture between conditions such as diabetes and abdominal adiposity with neurodegenerative disorders, including genetic overlap between different disorders (i.e. pleiotropy) and genetic and phenotypic heterogeneity within disorders in Indian population. The group also focuses on the development of analysis methods for prediction and classification of population from anthropometric, socio-demographic, biochemical, cognitive, and imaging studies. Animal models are also being studied to understand the dysfunction in specific neural circuits underlying dementia including Alzheimer's disease (AD).

RESEARCH PROJECTS AT CBR

Srinivasapura Aging, Neuro Senescence and Cognition (SANSCOG) study which is envisioned as a long-term prospective study with multiple follow-up to understand the risk and protective risk factors for dementia in the Indian population has completed its Phase-1 in March 2019. With the completion of this phase 1,000 people above the age of 45 years from Srinivasapura have been enrolled into the study. The study now moves into its next phase to collect additional samples so that the total number reaches 10,000, thus this study will be one of the largest longitudinal studies in India with focus on dementia and other neurodegenerative diseases. The comprehensive design of the study enables all participants to undergo anthropometry, sociodemographic, blood biochemistry, neuro-psychiatric, cognitive, genetics

and brain MRI exams so that we have detailed list of factors that might lead to neurodegenerative diseases. The Phase-1 of the study has given us some insight into vascular risk factors that might play an important role in predisposing to neurodegenerative diseases in the elderly. Complete data analysis of this phase is under way.

It is proposed to also introduce monitoring of air, water and soil quality in areas where the participants of this study reside to have a better understanding of air and water pollution and effect of pesticide use in predisposing to neurodegenerative diseases. Monitoring of physical activity and sleep quality through wearable actigraphy devices is planned to be introduced as these are important risk factors.

In order to facilitate large scale data collection conforming to Ethics and Privacy requirements, a digitised data collection initiative has been introduced, where participants are assigned a barcode ID which is used to track their data across various types of data collection and for follow ups studies. The data collection works in both online and offline modes with a robust database backup system at the backend.

GenomeIndia is a pan Indian initiative focused on Whole Genome Sequencing of at least 10,000 individuals representing diverse ethnic and linguistic groups across various geographical regions of the country. This is a pioneering effort aimed at identifying the genetic variation in Indians. GenomeIndia proposal is currently under consideration by DBT for funding. Eight working group meetings have been held till date at various collaborating institutes across the country. This project is led by Centre for Brain Research (CBR), with collaboration from twenty-one national institutes across India, including IITs, AIIMS, NIMHANS and leading basic science research institutes of the country. Genetic variations in individuals, which is mostly geographic and ethnicity-specific, play a major role in determining our health conditions and susceptibility to diseases. Therefore, this comprehensive guide of genetic variations of the Indian population developed through GenomeIndia will decisively identify our predisposition to common and rare genetic diseases. This information will also facilitate the development of a genome wide association chip for Indian population which will aid further large-scale genetic studies to be performed in a cost-effective manner. The comprehensive list of genetic variation obtained from healthy individuals will serve as filter for non-causal mutations and help perform genetic studies on monogenic disorders. The results from this project would thus be a valuable national resource for the country and will be made publicly available through an interactive web portal.

Next generation sequencing platform (Illumina Novaseq 6000 for WGS) and high-throughput whole genome genotyping facility has been established at IISc through funding from Tata Trusts. Whole Genome Sequencing runs have been executed for first batch of samples after standardizing and finalizing the whole genome sequencing library preparation and other allied procedures. This run has been completed using the latest S4 flow cell. CBR has optimized the pipeline for data analyses from whole genome sequencing (WGS) of individuals. In addition to WGS and genotyping, brief demographic and epidemiological details of the study subjects are documented. The subjects also undergo detailed blood biochemical investigations, anthropometric and physical examination. This large-scale genetic and phenotypic information will help answer further scientific questions about disease susceptibilities for the Indian population.

Re-orchestrating neuronal mechanisms to counter Alzheimer's disease (AD): This translational project aims to identify alterations at molecular, cellular and neural circuit level during early pathogenesis of Alzheimer's disease. Using human cells and genetic mouse models, the overarching goals are to study the 1) Molecular mechanisms underlying disease mutations in

catapulting the disease pathogenesis. 2) Relationship between altered neural circuits involved in learning and somatosensory integration, and the early behavioural manifestations of the disease. Elucidating the role of certain molecular pathways and/or neuronal circuits that get dysfunctional during pathogenesis might help in designing the novel tools or strategies to reverse the disease phenotype.

AWARDS

SERB Early Career Research Award was granted in February 2019 to Dr. Bratati Kahali.

LECTURES

CBR has organized several lectures delivered by eminent scientists and clinicians from India and other countries during the academic year 2018-2019. Some of the notable ones are:

1. "Human Origin, Health and Disease: Genomic Perspectives" by K Thangaraj, Chief Scientist and Group Leader at the Centre for Cellular and Molecular Biology (CCMB), Hyderabad, 31st May 2018.
2. Sharvaree Gokhale 2nd Memorial Lecture "Insight into Mental Illness from New Technology—and the Road Ahead" by Steven E Hyman, Department of Stem Cell and Regenerative Biology, Harvard University; and Director, Stanley Centre for Psychiatric Research and Core Member, Broad Institute of MIT and Harvard, 19th September 2018.
3. "Cardiovascular Disease in Indians: From reductionist paradigms to a holistic Context is a cardiologist and epidemiologist by training" by D. Prabhakaran, Vice President (Research & Policy), Public Health Foundation of India. Executive Director of Centre for Chronic Disease Control, New Delhi, India, 4th October 2018.
4. "Human genome research in the context of P4 medicine-How rosy and not so rosy is the picture?" by Thelma B K, Centre of Excellence in Genome Sciences and Predictive Medicine in the Department of Genetics at the University of Delhi South Campus, New Delhi, 15th November 2018.
5. "Early life origins of diabetes in Indians" by C. Yajnik is the Director of the Diabetes Unit at the King Edward Memorial Hospital and Research Centre in Pune, India; 18th January 2019.

3.7.13

Kishore Vaigyanik Protsahan Yojana

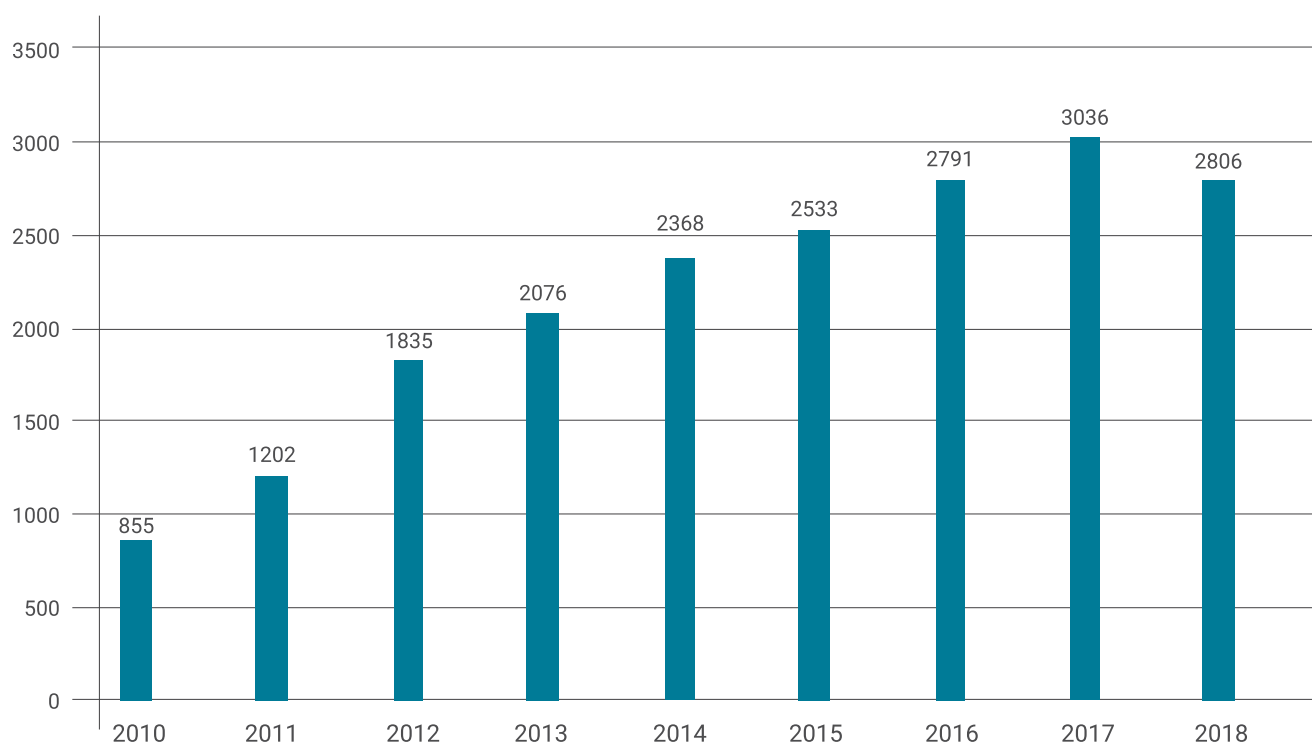
CONVENER

A K NANDAKUMARAN

The Kishore Vaigyanik Protsahan Yojana (KVPY) is a programme established in 1999 by the Department of Science and Technology, Government of India to encourage students to take up research career in Basic/Natural Sciences. The Department of Science and Technology, the nodal agency of the Government has entrusted the overall responsibility for organizing and running the KVPY Program to the Indian Institute of Science, Bangalore and set up a KVPY Management Committee which oversees all the aspects of implementing KVPY program including declaration of results. The National Advisory Committee (NAC) oversees proper implementation of the program and a Core Committee looks after both the day-to-day and academic aspects of the KVPY Program. The aim of the programme is to identify and encourage talented students with an aptitude for research. This programme strives to assist the students to realise their potential and ensure that the best scientific talent is tapped for research and development in the country.

KVPY programme is open to Indian Nationals studying in India. Students enrolled in an undergraduate course in Basic Science subjects such as Chemistry, Physics, Mathematics, Statistics, Biochemistry, Microbiology, Cell Biology, Ecology, Molecular Biology, Botany, Zoology, Physiology, Biotechnology, Neurosciences, Bioinformatics, Marine Biology, Geology, Human Biology, Genetics, Biomedical Sciences, Applied Physics, Geophysics, Materials Science or Environmental Science, in their degree courses leading to B.Sc./B.S./B.Stat./B. Math./Int. M.Sc./Int. M.S., during the academic year in which the fellows awarded are made, are eligible to apply for the KVPY fellowship under various streams – SA, SX and SB. Since 2010 there is more than 350% increase in the number of KVPY Fellowships offered under various categories as depicted in the bar chart.

NUMBER OF KVPY FELLOWSHIPS AWARDED DURING 2010 – 2018



During 2018, 1,90,769 students have registered for KVPY Aptitude Test, out of this 1,73,024 applicants appeared for the online examination held on November 04, 2018. The Aptitude Test was held at 315 examination centres in 99 cities across the country. After evaluation of the Aptitude Test, 3966 candidates were called for interview. The interview for the candidates who had qualified in the Aptitude Test were conducted during the period 15th January – 1st March 2019 across the country. Sixty one Committees have been constituted to interview the above candidates. The interview was held at 24 selected cities across the country. After evaluating the marks obtained by the students in both the Aptitude Test and Interview, 2806 candidates have been recommended for the provisional award of KVPY Fellowship-2018 tenable from August 01, 2019.

EMPOWERMENT INITIATIVE IN THE KVPY PROGRAMME

i. A certain number of fellowships under the various streams as stated above are available for the students belonging to SC/ST community.

ii. A certain number of fellowships under various streams as stated above are available for the students under the category of Person with Disability (Physically and Visually Challenged).

Fellowships (Rs.5000-Rs.7000 p.m and a contingency grant equal to 4 months of fellowship per year) are given up to the Pre-PhD level or for a period of five years whichever is earlier to the selected students.

FELLOWSHIP DETAILS

FELLOWSHIP VALUE	QUALIFICATIONS
Rs. 5000/- p.m.	I to III year B.Sc/B.S/B. Stat/ B. Math/Int. M.Sc/ Int. M.S
Rs. 7000/- p.m.	I/II year M.Sc IV/V year B.S/Int. M.Sc/Int. M.S
Contingency Grant	Equivalent to four months of Fellowship per year

KVPY Fellows SA/SB/SX are eligible to attend the Interview/Counselling for admission to the fiveyear Integrated B.S./M.S. Programme conducted by the Indian Institute of Science Education and Research (IISER) Kolkata/Pune/Mohali/Bhopal/Thiruvananthapuram/ Tirupathi/ Berhampur.

KVPY fellows SA/SX/SB are also eligible to apply for Undergraduate degree programme conducted by IISc Bangalore.

NATIONAL SCIENCE (VIJYOSHI) CAMP

The aim of the annual National Science (Vijyoshi) Camps is to provide a forum for interactions between bright young students and leading researchers in various branches of science and Mathematics. With boundaries between disciplines fast disappearing, these camps serve as an ideal platform for the young participants to get an exciting global viewpoint of questions relating to Basic Sciences as well as application oriented themes.

As in the previous meetings, a comprehensive programme has been designed for the participants. This includes thought provoking lectures followed by a round of discussion at the end of each day's programme. In addition, the previous meetings have ultimately served to motivate and inspire the participants by bringing them together, in what is hoped will be their first step towards a career in research in the Basic Sciences and Mathematics.



During 2018 the National Science (Vijyoshi) Camp was held at Bangalore and Bhopal, the details of the camp along with number of students called and attended are as specified below:

SL.NO.	PLACE	DATE	VENUE	NO. OF STUDENTS CALLED	NO. OF STUDENTS ATTENDED
1	Bangalore	7th – 9th Dec 2018	JN Tata Auditorium, IISc, Bangalore	907	545
2	Bhopal	9th – 11th Dec 2018	IISER-Bhopal	869	431

During 2019, it is proposed to organise National Science (Vijyoshi) Camp at two places for KVPY/ INSPIRE Fellows as detailed below:

SL.NO.	PLACE	DATE	VENUE
1	Bangalore	6th – 8th Dec 2019	JN Tata Auditorium, IISc, Bangalore
2	Kolkata	8th – 10th Dec 2019	IISER-Kolkata

ASIAN SCIENCE CAMP-2018

The Department of Science and Technology sponsors 20 students to the Asian Science Camp, which is normally held during the month of August every year. The responsibility of selecting the students for the Asian Science Camp was vested with HBCSE till 2011. From 2012 onwards the selection of students for the Asian Science Camp was entrusted to KVPY. The KVPY had readily accepted this challenge and taken appropriate actions for selecting the students to represent India at the Asian Science Camp. Requests have been sent to IISER's/IISc and other reputed institutions in the country to nominate the students to take part at the Twelfth Asian Science Camp scheduled to be held at Manado, North Sulawesi, Indonesia during August 3-9, 2018. The students to be nominated should be KVPY/INSPIRE Fellows pursuing Basic Science course in the 1st year BSc/B.S./B. Stat/B.Math/Int. M.Sc./M.S. program during the academic year 2018-19. In response to the KVPY request 41 students have been nominated by the various institutions across the country.

The Selections committee after scrutinizing the eligibility and other aspects had selected 20 students to represent India and take part in the Twelfth Asian Science Camp scheduled to be held at Manado, North Sulawesi, Indonesia during August 3-9, 2018. The delegation of students from various institutions across the country were lead by Prof. Dipshikha Chakravorty, Department of Molecular and Cell Biology, IISc, and Prof. Anjali A Karande, Department of Biochemistry, IISc and Dr. Ujjwala T Tirkey, Scientist'F', International Bilateral Cooperation, DST, New Delhi. The student delegates actively participated in the Asian Science Camp and brought laurel to Indian Student Community. A feedback session was conducted at IISc after the camp, to know the responses from various students who had taken part in the Twelfth Asian Science Camp. The students were very much excited to be part of a camp at an international level and were proud for having represented our country.

Established: 1999
Committee Members
Convener: A.K. Nandakumaran
Co-Convener: Abha Misra

Members of the KVPY Core Committee: Thirupathi Gudi, Patrick D Silva, Abhishek Kumar Singh, Santanu Mukherjee, Manish Jain, Vishwesh Guttal and advisor is S Raju

**TWELFTH ASIAN SCIENCE CAMP - 2018
HELD AT MANADO, NORTH SULAWESI, INDONESIA
DURING 3 - 9 AUGUST 2018**



3.7.14

Karnataka State Council for Science and Technology

SECRETARY
S SUBRAMANIAN

PROFILE

Karnataka State Council for Science and Technology (KSCST) an autonomous S&T organization under Department of Science & Technology, Government of Karnataka established in the year 1975 is one of the first State S&T Councils to be set up in the country. During the last 42 years of its existence, KSCST has been pro-actively engaging itself to identify, propose and implement S&T based solutions to locale specific needs / problems in the broad areas of Agriculture, Water, Education, Energy, Ecology and Environment, Habitat, Health, Solid and Electronic waste and Infrastructure. In co-operation with the Indian Institute of Science and several other premier R&D institutions, KSCST has been executing many projects and programmes aimed at improving socio-economic conditions of the people of the state.

Over the years, a number of technologies have been translated, from research and demonstration phase to the implementation and operational phase. KSCST provides support to the State Government in formulation of S&T based policies and to both Central and State Governments in scientific surveys, project implementation, evaluation, co-ordination & monitoring, organization of scientific meets and awareness campaigns.

VISION

Application of Science & Technology for the management of resources, improvement of environment, quality of life and socio-economic conditions of the people of Karnataka.

MISSION

Co-ordinate R & D activities for generation of knowledge for scientifically based interventions, development and popularization of appropriate technologies for adaptation by the civil society to overcome local-specific problems and, inspire and improve human resources of the S&T sector in the state.

MAJOR PROGRAMMES

- Natural Resources Data Management System (NRDMS) - A Repository of Natural Resources and Socio-economic database to support local level developmental planning.
- Karnataka State Spatial Data Infrastructure (KSSDI) : Karnataka Geoportal is a web portal to find and access spatial information, metadata and associated geographic services/ applications via the Internet.
- Academic and Industry Interaction Cell

- Student Project Programme (SPP) - Support to under-graduate and post-graduate engineering students for nurturing innovation and development of new technology.
- Virtual Classroom (VCR) - To improve access to advanced educational resources, digital contents, Lab experiments in the form of 3D animations using latest IT gadgets and internet
- Science popularization / Communication / Teachers Enrichment programs
- Radio Serial on Climate Change and Global Warming
- National Science Day / National Mathematics Day
- Rainwater Harvesting (RWH) - Awareness and technical support for implementation of rooftop Rainwater Harvesting
- Bioenergy Cell - Demonstration and dissemination of technology and process for biofuel production and use in rural setup.
- Utilization of crude glycerol obtained in biodiesel production as an alternate to glycogenic feed supplement for dairy cows
- Energy Cell – Demonstration, Dissemination of New Technologies, Workshops, training and awareness or energy conservation
- Field testing of hybrid ultra-capacitors (HUC) powered solar lighting kits and solar street lights for grid deprived rural areas, lighting in varying climatic zones of India.
- State Awards for Scientists and Engineers - Provide support to state government to recognize and reward eminence in S&T.
- Patent Information Centre - Awareness creation in Intellectual Property Rights and provision of technical support for securing IPR by establishing IPR centres in academic institutions.

ONGOING PROJECTS

(Supported by DST - GoK and GoI)

- Village Information System – Preparation of digital cadastral/habitation maps using high resolution satellite imageries, GPS, Ground truthing existing cadastral maps and extensive field survey to aid assist village level planning.



Mekuru-Hosakeri Pollibetta Grampanchayat Information

- Digital Geospatial Data Generation and Terrestrial Scanning for 3D Reconstruction of Heritage Site at Hampi.



3.7.15

IISc Alumni Association

P R E S I D E N T
B A S H O K

The Indian Institute of Science Alumni Association (IIScAA) was formed in the year 1976 to provide a common platform for the alumni of the institute to reach out to other alumni across various batches, branches, and interests. Following report summarizes the activities of IIScAA during the financial year 2018-19.

26TH APRIL 2018

IIScAA in association with Seshadripuram First Grade College, Yelahanka New Town Bengaluru, organized Inauguration of Bangalore North Science Forum by Padma Bhushan Prof. P. Balaram, Emeritus Professor, MBU and Former Director, IISc on April 26, 2018 at IV Floor, Multipurpose Auditorium. On this occasion Silver Jubilee Talk by Shri Kailash Satyarthi, Nobel Laureate, was arranged. The Guests of Honour were Padma Vibhushan Dr. V. K. Aatre, Visting Professor, ECE, IISc & Former DG, Defence Research and Development Organisation (DRDO), Alumnus, Seshadripuram High School; Dr. M. P. Ravindra, President, IIScAA; Dr. Wooday P. Krishna, Hon. General Secretary, Seshadripuram Educational Trust. The function was presided by Shri. N. R. Panditharadhya, President, Seshadripuram Educational Trust. Prof. Santanu Dast was the Convenor and Sri G. S. Ravishankar, Treasurer, IIScAA & Prof. Salma Banu were co-convenors of the Programme.

4TH MAY 2018

IIScAA organized the 4th Prof. M. Vijayan Lecture by Professor P. Balaram, Emeritus Professor Molecular Biophysics Unit, IISc, on the topic - " Marine Cone Snails, Mass Spectrometry and Protein Sequences: Research in Retirement ", on May 4, 2018 at the Faculty Hall, IISc. Prof. Dipankar Chatterji, MBU, IISc, was the Moderator.

9TH MAY 2018

IIScAA organized Sri M. S. Vasudeva Memorial Lecture by Professor S. Sreenivasa Murthy, Professor (Retd.), IIT Delhi, on the topic – "Renewable Energy for Electricity to People" on May 9, 2018 at Faculty Hall, IISc. This Lecture was dedicated to the memory of Late Shri. M. S. Vasudeva of Electrical Communication Engineering Department, IISc (sponsored by his close friends).

31ST MAY 2018

IIScAA organized Sri G. B. Meemamsi Award Function on May 31, 2018 at the Golden Jubilee Auditorium, ECE Department, IISc. This award is given to the Topper in ME of ECE Department, IISc. The award carries a CASH AWARD of Rs.15,000/-. The Recipients of this award were as follows:

1. Mr. Kiran Venugopal (Joint Awardee) for 2011-13
2. Mr. Arjun Anand (Joint Awardee) for 2011-13
3. Mr. P. Raviteja for 2012-14
4. Ms. R. Kavitha for 2013-15
5. Ms. A. M. Anjana for 2014-16
6. Mr. Ganesh Ramachandra Kini – for 2015-17
7. Mr. Murali K R (Joint Awardee) – for 2016-18
8. Mr. Soumya Subhra Banerjee (Joint Awardee) – for 2016-18

Prof. A. Chockalingam, Chairperson, ECE Department, IISc, presided over the function and presented the awards.

17TH JUNE 2018

IIScAA organized Sports-cum-Cultural Meet on 17th June 2018 at Gymkhana Ground, IISc and Choksi Hall, IISc. The following events were conducted: INDOOR EVENTS: a) Shuttle – doubles b) Table Tennis – doubles c) Carrom d) Chess e) Musical Chair (f) Tambola (g) Lemon & Spoon Race

CULTURAL EVENTS

(a) Mimicry and Light Film Songs (b) Dance and Fancy Dress

30TH AUGUST 2018

IIScAA in collaboration with OCCAP (Office of Career Counselling and Placement) and EntIISc organized “One Day Workshop on Student Entrepreneurship in Biosciences – 2018 (BioCom ’18)”, on August 30, 2018 at the Biological Sciences Auditorium, IISc. The Inauguration of the Workshop was by Prof. Umesh Varshney, Divisional Chairperson, Biological Sciences, IISc. Prof. C. V. Nataraj, SID, spoke on “Entrepreneurship & Innovation @ IISc. The Key-Note Address was by Prof. G. Padmanabhan, Biochemistry, IISc. Dr. Jagadish Mittur, Lead, KBITs, spoke on “GoK initiatives for Healthtech Startups”. About “Case Studies of Healthtech Entrepreneurs” was delivered by Dr. Shyam Vasudeva Rao, Founder, Forus Healthcare and Mr. Chandrasekhar Nair, Co-founder, Bigtech Labs. Prof. Navakanta Bhat, CeNSE, IISc and Prof. G. K. Ananthasuresh, ME, IISc, spoke about “Startup Experience at IISc”. Prof. K. J. Vinoy, ECE, IISc, delivered Vote of Thanks.

26TH OCTOBER 2018 – FEBRUARY 2019

IIScAA Office was closed. Therefore, no activities were organized during this period.

3RD MARCH 2019

Dr. B. Ashok, Acting President, IIScAA, paid the floral tributes to the founder, J. N. Tata, on the occasion of Founder’s Day on March 3, 2019.

30TH MARCH 2019

IIScAA organized Extra-ordinary General Body Meeting and Annual General Body Meeting on March 30, 2019 at the Faculty Hall, IISc.

MEMBERSHIP STATUS

IIScAA has Members as on 31st March 2019	: 10,086
Total number of members enrolled during the period 2018-2019	: 267

3.7.16

Office of Career Counselling and Placement

The Office of career Counselling and Placement (OCCaP) has Centralized the management of campus Placement & Internships. Several placement activities and events were organized to facilitate interaction between students and industries through special meetings (pre-placement talks, alumni connect meetings, etc) in IISc and helped students hone up their skills to meet industry requirements. This office is managed by a Placement Officer, who is supported by temporary staff for routine activities and by a committee of four professors for policy matters.

Highlights of Placement Activities in Year 2018 (April 2018 to March 2019)

A. Completion of Final Placement for batch 2017-18

B. Connect with Batch 2018-19

C. Online Skill Test

D. Campus Placement Season 2018-19

E. Special counselling for specific students

F. Internship Placements 2019-20

G. Civil Engineering Industry – Academia Meet 2018

H. CPDM Design Meets

I. Special Focus for PhD/ Post Doc students

A. COMPLETION OF FINAL PLACEMENT FOR BATCH 2017-18

The final placements for batch continued and closed in May 2018. MTech/ M Des/ M Mgmt/ UG/ PhD students participated during this campus season.

UG/ MASTERS/ PHD PROGRAM	2017-18	2016-17
Total Students Placed	235	207
Highest CTC (LPA)	45	30
Average Annual CTC (LPA)	16.7	15
No. of Offers Above 40 LPA	1	0
No. of Offers 30 - 40 LPA	10	2
No. of Offers between 20-30 LPA	53	33
No. of PhD Students Placed	31	3
No. of Companies Visited	80	69

B. BATCH 2018-19 STUDENT CONNECT

The students from batch 2018-19 were addressed department wise in June 2018. These interactive sessions with the students were to understand their inclination for campus placements, share information about placement process/ policies and to identify their needs for personal skills and those necessarily requiring additional attention.

C. ONLINE SKILL TESTS

State Govt's and AICTE in association with Youth4work initiated a campaign to schedule and ensure all students (1st to final year) in Institute to appear for an online skills test to assess their technical and personal skills. All students who were looking forward to seek placement support from OCCaP were instructed to take up this test. About 261 students attempted the test to gauge their skills on many areas:

- English Language
- Communication Skills
- Common Sense
- Aptitude
- + Several Core Subjects

Scores in each subject have been reported to us and in general were very good. Being done for the first time, students with poor scores were asked to take special efforts to improve these.

D. COMMENCEMENT AND CONTINUATION OF CAMPUS PLACEMENT SEASON 2018-19

Final campus placements for batch 2018-19 (UG/ Masters and PhD) commenced from 21st October 2019. Campus Placements commence with PPT's on campus followed by interviews.

(i) Pre-Placement Talk (PPT)

Many companies from across all the sectors were invited in the campus to address the students and explain about the opportunities available with them for the students. Around 70+ companies visited the campus for PPT 2018 and interacted with the students from UG/ Masters and PhD programme.

(ii) Schedule of Campus Interviews

PPT's commenced from 10th August 2018 and Final placement interviews commenced from 21st October 2018.

(iii) Placement Statistics-Batch 2018-19

E. SPECIAL COUNSELLING FOR SPECIFIC STUDENTS

UG/ MASTERS/ PHD PROGRAM	2018-19*	2017-18	2016-17
Total Students Placed	264	235	207
Highest CTC (LPA)	62.4	45	30
Average Annual CTC (LPA)	21	16.7	15
No. of Offers Above 40 LPA	8	1	0
No. of Offers 30 - 40 LPA	55	10	2
No. of Offers between 20-30 LPA	65	53	33
No. of PhD Students Placed	35	31	3
No. of Companies Visited	100	80	69

Students who were finding their way difficult to get through the interviews and secure a job were addressed individually to understand their problem areas beyond technical areas and help them overcome the same to prepare for further interviews.

F. INTERNSHIP PLACEMENT (BATCH 2019-20)

Internship Placements for batch 2018-20 commenced from 7th February 2019.

- 53 students secured internship (including 2 PhD)
- 20 Companies participated in internship recruitment

G. CIVIL ENGINEERING INDUSTRY- ACADEMIA MEET 2018

Industry- Academia Meet was organized in the Department of Civil Engineering on 7th September 2018. This Technical meet was a familiarisation program where professionals from reputed organisations were invited to interact with our students (MTech, PhD) and faculty and possibly share the work opportunities in relevant areas for these students.

H. CPDM DESIGN MEETS

CPDM design meets are organized to widen the visibility of CPDM department in industry and to explore relevant opportunities for M.Des students in these industries.

- DESIGN MEET-UP 1.0 was organized on 28th July 2018. About 10 companies participated in this event.

J. FOCUS ON PHD AND POST DOC STUDENTS

- PhD Meet – Chapter 1 was organized 24th November 2018. This meet was specially focussed on PhD students of IISc, a familiarization program where some the IISc Alumni and the PhD students who got placed last year were invited to interact with the current PhD students and make them aware of the available job opportunities and speak about their placement journey with OCCaP respectively.
- PhD/ Post Doc Meet, another meet was arranged where the invitees were PhD of IISc along with the Post Doc students. A new series of meetings were held in April 2019.
- 100+ PhD/ Post Doc students registered for final placements and internships.

