

CONNECT

IISc
Press

Newsletter of the
Indian Institute of Science

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Volume 1 • Issue 1



Greetings!

Welcome to the first issue of our newsletter. IISc is an institute that has a lot going for it – cutting edge research, state-of-the-art facilities and a rich history. We have, however, not always been able to communicate effectively, not just to the outside world, about also with each other about what we do, what we have and about our past. *Connect* is an attempt to address this communication deficit. As this newsletter takes its first baby steps, we would love to hear from you about how you think it should evolve.

Editorial team

AN EYE ON THE CHALLAKERE SKY

Joyce and Raju routinely shoot lasers into the sky. No, they are not rehearsing for a rock concert; they are part of my research team engaged in a far more important activity – studying the climate at the new campus of the Indian Institute of Science (IISc) in Challakere. This study is carried out at our sophisticated Climate Research Lab that constantly churns out numbers to reveal aerosol levels in our atmosphere, an indicator of air quality.

The new campus has one thousand five hundred acres of mostly unspoiled terrain. Challakere is situated in the district of Chitradurga in Karnataka in the heart of peninsular India. This represents a typical continental location characterized by

long, dry summers and scanty rainfall. Preliminary results from our lab have confirmed our suspicion that Challakere's location, coupled with negligible atmospheric pollution, makes it an ideal place to study background continental aerosols and surface radiation. Obtaining these measurements is a vital first



A mobile climate lab at Challakere

QUICK LINK

apc.iisc.ernet.in/newsletter

IN THIS ISSUE

Letter from Editorial team	1
An eye on the Challakere Sky	1-2
From the Archives	3
The Archives and Publications Cell: The Bridge from the Past to the Present	4-6
Campus Critters	6
The Spectroscopy / Analytical Test Facility	7-8
Events on Campus: <i>Ripples</i> – An Exhibition by CPDM	9
The Talent Development Center: A School for Teachers	10-12
Awards and Honours	12
Contact and Credits	12

step in understanding how humans impact climate. With these measurements, we can now estimate the proportion of aerosol levels and surface radiation measured in other parts of the country that can be explained by human activity.

There is another advantage to studying Challakere's climate. Climate labs in other parts of India do not have as clear skies and as clean an atmosphere as Challakere does. It therefore makes it difficult for climate researchers to know the extent of aberration in their data caused by atmospheric distortions. Because Challakere has the attributes of a clear sky and clean air, our observatory can also serve as a calibration facility that will provide data to correct for these aberrations.

Our climate study is financially supported by the Indian Space Research Organization (ISRO) and the Ministry of Environment and Forests (MoEF). We have also received funding from the US Department of Energy (USDOE) for our research. IISc has recently signed an MoU with USDOE to set up a *Joint Indo-US Centre for Climate studies*. The Centre will have its main facility at Challakere and two other auxiliary sites – one at IISc in Bangalore and the other in a soon-to-be identified forested location. The finer details of this collaborative effort are still being worked out. This Indo-US venture will be implemented in a phased manner. The Central facility will become operational by the end of 2014 and auxiliary sites will be established by the middle of 2015.



Joyce and Raju collecting data

We expect the Indian climate community to benefit substantially from this collaboration – both from the data we generate as well as from the use of equipment from USDOE that is not available commercially. The equipment will allow us to monitor trace gases and clouds, among other parameters, on a regular basis.

The USDOE came on board after successfully collaborating with IISc on a climate study called the "Ganges Valley Aerosol Experiment". The two million dollar climate study



Some of the equipment used to monitor climate

conducted in 2010-11 provided us with valuable data on parameters of interest to climatologists.

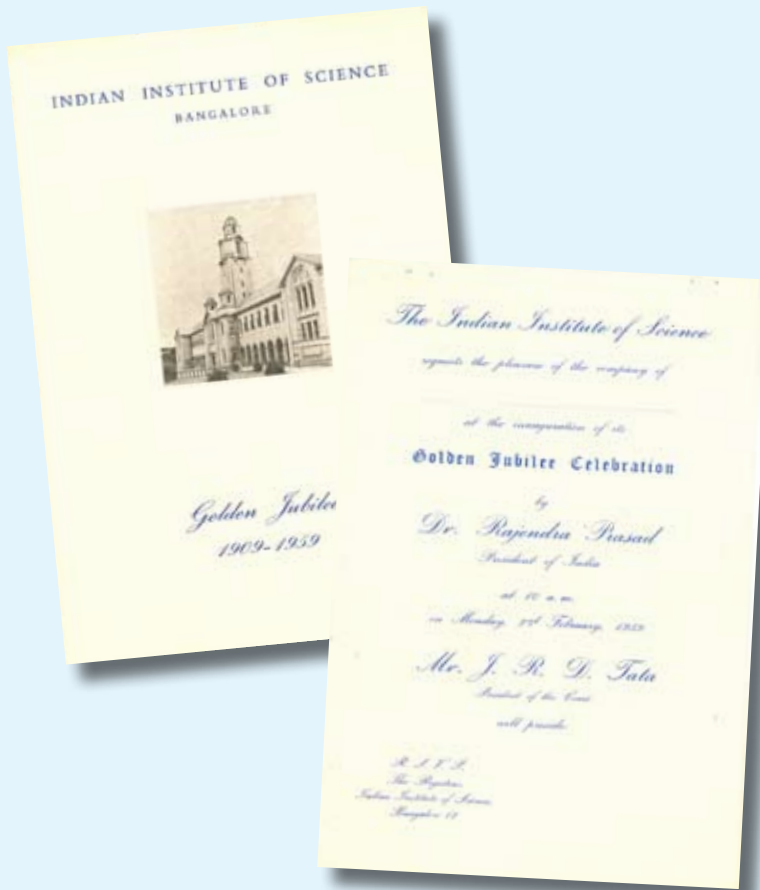
An equally important goal we have is to train students and faculty from around the country in the field of climate studies. The joint Indo-US Centre will contribute towards providing the educational infrastructure required, which will be in place by early 2015. Integral to this collaboration is an exchange program where researchers from India and the US will be appointed in each other's facilities, both on a short and long term basis. The exchange of researchers - doctoral students, postdoctoral fellows, faculty and laboratory staff - will begin towards the end of 2015.

We anticipate that our efforts, both in research and education, will be a catalyst for studying one of the most important issues of our day – climate change.

-- S. K. Satheesh

FROM THE ARCHIVES

The Golden Jubilee Celebrations of the Indian Institute of Science, February 1959



The invite for the programme



Prince Philip, Duke of Edinburgh and the Director of IISc, Prof. S. Bhagavantam



The Maharajah of Mysore, Jayachamarajendra Wadiyar, arriving for the celebrations. Also seen is Prince Philip.



J. R. D. Tata greeting President Rajendra Prasad



Prince Philip, President Rajendra Prasad, J. R. D. Tata and Maharajah of Mysore, Jayachamarajendra Wadiyar (seated from left to right in the first row)



The programme of events



J. R. D. Tata and Prince Philip

THE ARCHIVES AND PUBLICATIONS CELL: THE BRIDGE FROM THE PAST TO THE PRESENT

A sense of warmth greets you as you approach the building that houses the *Archives and the Publications Cell (APC)*. Butterflies flutter from one flower to another seeking the next nectar meal. The flowering plants border a manicured lawn above which dragonflies alternate between gliding aimlessly and darting with purpose. If you walk along the path leading to the entrance of the building, you will almost certainly be accompanied by giant snails and millipedes, the other well known residents of the campus. The building itself has an old world charm about it with its light yellow walls and a roof adorned with red Mangalore tiles. The rectangular building surrounds a small yard sitting directly beneath the open sky.

The *Archives Cell* of the Indian Institute of Science (IISc) was born on the 17th of May in 2007. From its inception until the summer



The current home of APC

of 2012, it was located in the erstwhile Tata Institute of Fundamental Research (TIFR) building. It then moved to its current location opposite the Faculty Club, a location which was previously occupied by the National Centre for Science Information (NCSI). In 2008, the *Archives Cell* was rechristened the *Archives and Publications Cell* as it took on the additional responsibility of publishing as well.

It is said of drummers in rock bands that you almost never notice the good ones. And that's because they rarely miss a beat. Like these drummers, the inconspicuous members of the APC go about their jobs efficiently. The services they provide to the campus community are crucial as they are diverse.

APC's archiving role is to collect, catalogue, digitize and conserve the heritage of the institute. When the Cell was first established, the Central Office provided it with a variety of documents and memorabilia – Annual Reports, Court and Council Proceedings, Senate papers, Finance Committee Reports, Building Committee Reports, photographs et cetera. Documents and records pertaining to the early years of the Institute from the *National Archives of India* in New Delhi were dug out and donated



A sampling of the archival material and instruments at APC



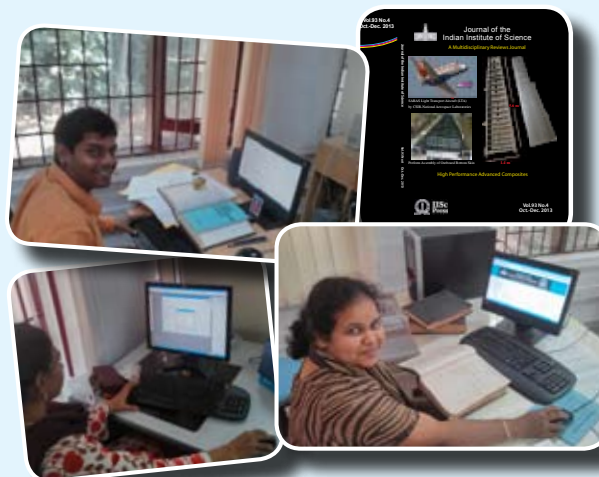
Pictures from a recent Exhibition

to the *Cell* by A. Ratnakar, the former librarian of the Raman Research Institute. Eventually as the APC grew, material was collected from many institutions, both in India and abroad, institutions like the Karnataka State Archives, the Tamil Nadu State Archives, the British Library, the National Archives of the United Kingdom and the US Library of Congress. The material included photographs, documents, letters of correspondence, historical notes and reports corresponding to IISc. APC has also collected material from various departments in IISc since, material ranging from photographs to unused equipment of archival importance.

IISc Press, the publishing wing of APC, brings out an array of diverse publications. Many of these publications are brought out annually. They include the Directory and Planner, Annual Report, Scheme of Instruction, wall and desk Calendars and the Profile of IISc. It also publishes posters, banners, invitations and the like, often at short notice. The books that *IISc Press* has produced include two popular coffee table

books, *Secret Lives* and *A Botanist's Delight*, among others. *IISc Press* has entered into a collaboration with *Cambridge University Press* to publish textbooks and monographs in all major disciplines. These books fall under three categories – *IISc Centenary Lecture Series*, *IISc Lecture Notes Series* and *IISc Research Monographs*.

The Journal of the Indian Institute of Science, also published by *IISc Press*, celebrates its hundredth anniversary in 2014. APC is rapidly digitizing all the issues ever published as we approach its centenary.



APC publishes the *Journal of the Indian Institute of Science*. All issues published in the last one hundred years are currently being digitized

APC was responsible for designing a postal stamp to commemorate one hundred years of IISc's existence in 2009. The stamp was issued by *India Post*. The *Cell* also designed and oversaw the making of the pedestal on which rests the bust of the former Maharajah of Mysore, Jayachamarajendra Wodeyar. The statue now occupies a prominent place in the Main building.

More recently, the *Cell* has also been involved in science outreach and in providing a forum to bring together the disparate IISc community. It has organized a few exhibitions in the past



Some of the books published by IISc press



APC also publishes the Directory and Planner, the Profile, banners and posters. It also designed and printed the stamp to commemorate the one hundredth birthday of IISc

and hopes to make this a regular feature in its calendar. Recently, it showcased flying objects and other structures tested at the Open Wind Tunnel in the Aerospace Engineering Department. This has given way to an exhibition of working models from the Centre for Product Design and Manufacturing (CPDM). This research newsletter that you are reading is also published by APC.

While posterity will be the true judge of the value of APC, let's take a moment to acknowledge the efforts of the unsung drummer in preserving our past and informing the present.

-- Karthik Ramaswamy

CAMPUS CRITTERS: POTTER WASP



A potter wasp with construction material as she builds her nest.

Photograph by Natasha Mhatre. The picture recently won the National Wildlife Federation Photo Contest (NWF is an American Conservation organization). Reprinted with permission from IISc Press.

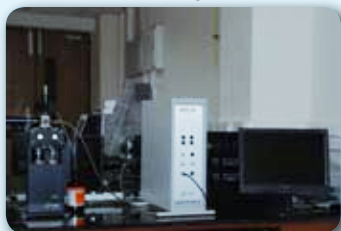
THE SPECTROSCOPY / ANALYTICAL TEST FACILITY

When electromagnetic radiation falls on molecules or atoms of different substances in their solid, liquid or gaseous states, each substance responds differently to the incident radiation. The differences in their absorption, emission and scattering properties are exploited in the field of spectroscopy. Spectroscopic data, often represented by a spectrum, yields a fingerprint that is unique to each atom or molecule, thus revealing the identity of an unknown substance.

The Indian Institute of Science (IISc) has a state-of-the-art Spectroscopy/Analytical Test Facility (SATF) which was established in 2006. The centralized facility was set up for easy and quick access to a large number of spectroscopic/analytical instruments by all researchers both within the institute as well as those from other government and private organizations (URL: <http://sid.iisc.ernet.in/satf/index.html>). In this feature, we highlight some of the equipment in our facility.

Stopped Flow Spectrometer

It measures the rate of a fast chemical or biological reaction/change by following one of the species involved in the reaction /change spectroscopically.



Model: MOS-450/AF (BIOLOGIC)

Location: 1st floor, C wing, Division of Biological Sciences, IISc

Light source: Xe and/or Xe(Hg) lamp

Acquisition modes: (Single and scanning wavelengths)

- Absorbance and transmittance mode
- Fluorescence

Wavelength: 180-999 nm

Sampling Period: 10 μ s to 10s

Acquisition software: BioKine v 4.42

Application: Rapid kinetics using transient recorder

Samples: Solids, Liquids & Films

Modes:

- Transmission
- Diffused reflectance
- Specular reflectance

Raman Accessory: 90 $^{\circ}$ & 180 $^{\circ}$

Inductively Coupled Optical Emission Spectrometer (ICP-OES)



It is used to measure multiple metal ion concentrations in a single run. In this technique emission from a metal ion after ionization is compared to a known standard

solution of the metal and thus the concentration of the metal in a sample of water, soil, food material, etc. is obtained.

Fourier Transform (FT) Infrared (IR) and Raman Spectrometer



An IR spectrum reveals the identity of the functional groups present in a substance and thus leads to chemical identification of the compound. Raman spectrum provides

information about the vibrational and/or rotational state of a molecule and this is complementary to the IR spectrum.

Model: Thermo Nicolet 6700 (Thermo Electron)

Location: Entrepreneurship Center, SID, IISc

Range: Mid IR region of 4000-400 cm^{-1}

Maximum Resolution: 0.2 cm^{-1}

Model: iCAP 6000 Series (Thermo)

Location: Department of Civil Engineering, IISc

Range: Concentration in ppm

Source: 1600w solid state generator operating at 27.12 MHz

Detector: RACID86 Charge Injection Device (CID); High-performance solid state CID camera system

Imaging: Allows the entire spectrum for a sample to be measured in seconds

Wavelength Coverage: 166.250 nm to 847.0 nm

Time-resolved Fluorescence Spectrometer

It enables us to measure the fluorescence life-time, anisotropy of emission, rotational correlation time, etc. of a compound. This is used to monitor the local environment of a fluorescent molecule in a complex mixture.



Model: *Horiba Jobin Yuvon Fluorocube-01-NL* Fluorescence Life time System (Horiba Scientific)

Location: Entrepreneurship Center, SID, IISc

Excitation Source:

Picoseconds laser diodes as excitation source; shortest pulse duration is 70 ps.

Mass Spectrometers (MS)

A mass spectrometer measures the mass to charge ratio of a charged gaseous molecule. It has three major components: ionisation, analyser and detector. Mass Spectrometry coupled with Liquid and Gas Chromatography can identify and quantify small molecules (<1500Da) as well as large biomolecules like peptides (>1000Da) and proteins (>5000Da). With high resolution mass spectrometry, we can also determine the structure of small molecules. SATF hosts four different types of mass spectrometers which are used based on the type (high and low) of masses that need to be separated and the state (solid, liquid and gaseous) in which the samples are prepared.

Electrospray Ionization (ESI)/Atmospheric Pressure Chemical Ionization (APCI) Ion trap Mass Spectrometer (MS)

It is used for qualitative and quantitative analysis of chemical compounds, peptides and proteins.



Model: *LCQ Deca XP Max* (Thermo)

Location: 1st Floor, C wing, Division of Biological Sciences

Ionisation : Electrospray (ESI) and Atmospheric Pressure Chemical

Ionisation (APCI) and offline Nano Spray Ionization (NSI)

Analyser: Ion trap

Mass range : 15-4000 m/z

Analysis software: Xcalibur , ProMass

Database : NIST 2008

Electrospray Ionization (ESI) Quadruple Time of Flight (QToF) Mass Spectrometer (MS)



It is used for qualitative and quantitative analysis of metabolites, peptides and proteins. It sequences peptides using the collision induced dissociation (CID) as the dissociation technique.

Model: *Maxis Impact HD* (Bruker)

Location: 1st Floor, C wing, Division of Biological Sciences

Ionisation: Electrospray (ESI)

Analyser: Quadrupole and Time of Flight

Mass range: 50-8000 m/z

Resolution: 40000 FWHM

Analysis software: Data analysis, Biotoools

Search Engine: MASCOT v 2.4.1

Other instruments at SATF

Name of the instrument	Model	Location
Gas Chromatography (GC)	<i>7890A (Agilent)</i>	1st floor, C wing, Division of Biological Sciences , IISc
	<i>6890N Network (Agilent)</i>	
	<i>Trace GC Ultra (Thermo)</i>	
Mass Spectrometer (single quad)	<i>5975c (Agilent)</i>	
	<i>5973 Network (Agilent)</i>	
	<i>DSQ II (Thermo)</i>	
Thermal Desorption System (coupled to Agilent GC)	<i>Markes International Ltd</i>	
Liquid Chromatography	<i>1120 Compact (Agilent)</i>	
	<i>UltiMate 3000 (Thermo)</i>	
	<i>Surveyor Plus (Thermo)</i>	
Microscope Fluorescence	<i>IX-71 (Olympus)</i>	
Microscope Polarizing	<i>BX51 (Olympus)</i>	
UV spectrophotometer	<i>SPECORD (Analytic Jena)</i>	
C,H,N,S & O Micro Analyzer	<i>Flash2000 (Thermo)</i>	Entrepreneurship Center, SID, IISc
Differential Scanning Calorimeter	<i>DSC_1 (Mettler Toledo)</i>	

-- S. Sandya, P.D. Deepalakshmi and M. Sunitha

EVENTS ON CAMPUS: *RIPPLES* – AN EXHIBITION BY CPDM

The Centre for Product Design and Manufacturing (CPDM) along with the Archives and Publication Cell (APC) has organized an exhibition of posters and models of products conceived, designed and built by CPDM. The exhibition, *Ripples – Knowledge in Action... 15 years and Counting*, was inaugurated on December 9th 2013 and will continue until January 10th, 2014. It is being held at the Exhibition Hall of APC from Monday through Friday.



The exhibition being inaugurated by Prof. Anindya Deb, Chairman of CPDM



BinBoy, a mobile trash compactor

Engrossed visitors queue up after the inauguration



Catamount, an all-terrain manual wheelchair (L)

One of the many design posters on display (R)



Vidyut, the electric mail van



A coconut tree climber

A mechanical shoe stitcher (L)

An electric guitar (R)



Sarvanga, a yoga machine



Scorpionok, the sewer cleaning robot



Vajra, a light-weight electric bicycle

Oryx, the foldable bicycle



Shadow, a classroom chair



Micro N, a micro newton force sensor



Elifas, a household sugarcane juicer

THE TALENT DEVELOPMENT CENTER: A SCHOOL FOR TEACHERS



Entrance to the new IISc campus

Thorny scrubs rest among isolated trees that rise from the reddish brown earth. And during the day, the semi-arid landscape contrasts sharply with bright blue skies, interrupted by patchy white clouds that drift with lazy elegance. In the midst of this landscape in eastern Karnataka rests the new home of the Indian Institute of Science (IISc). The campus came into existence in the summer of 2009 when the Government of Karnataka sanctioned 1500 acres of land to IISc.

The new campus is in the village of Kudapura Kaval in Chitradurga District. Kudapura is about 15 km away from the nearest town of Challakere on the Challakere-Naykanahatti Road. It resides 220 km from the main campus in Bangalore; you can get there in about 3 hours from Bangalore with the help of wrinkle-free roads and an adventurous cab driver.

The Institute's first initiative in the new campus was to set up the *Talent Development Centre* (TDC), a centre to train high school and college science teachers. Being a science institute, IISc has always been involved in



The busy town of Challakere

science outreach. Over the years, the Institute has trained teachers from across the country to help them spread the spirit of scientific inquiry and scientific literacy in our students. The new campus gave the institute an opportunity to establish a facility dedicated to training high school and college teachers throughout the year. The Government of Karnataka contributed Rs. 2 crore towards the establishment of the Centre. TDC was inaugurated in February 2011; it came up after abandoned buildings in a sheep farm were renovated on a war footing with the help of the local district administration. Its Convener, Prof. M.S Hegde was instrumental in establishing



Housing for visiting teachers

the Centre and has been in charge of running it since. In November 2011, the Centre hosted Dr. A.P.J. Abdul Kalam, the former President, whose passion for science education is well-known.



Dining room

Today TDC has a modern training centre as well as renovated residential buildings. These buildings can accommodate over a hundred teachers at any given time. TDC also has guest houses for



The Chemistry Lab

visiting faculty. The training centre has multiple “smart” classrooms with sophisticated teaching aids, separate laboratories for physics, chemistry and biology, all equipped with experimental facilities for 60 teachers and a large dining room with its own kitchen. Besides hosting training programmes and workshops, the training centre also has facilities to design and develop new labs. It has a mechanical workshop to fabricate instruments, a glass blowing facility to make equipment for chemistry labs and an electronics workshop.

TDC currently trains both high school as well as PUC science and math teachers from all over the country. The High School Science Teachers Training Program was the first academic program initiated here. The goal of the program is to help teachers not just to enhance their knowledge in their respective fields, but also to help them inspire their students with the joy of science. The ten-day residential programme is rigorous, yet engaging. Trainee teachers spend 10-12 hours on each of these ten days learning the big ideas in their field with an eye on their syllabus. Mathematics teachers solve over 300 problems a week. Training for science teachers emphasizes hands-on learning. Seventy percent of their time is spent in doing experiments in the lab and the

rest of the time is spent in the classroom. They carry out experiments in physics, chemistry or in biology. These teachers, TDC hopes, will appreciate that science is as much a process as it is a set of concepts. The programme also includes regular *tests* and *question and answer* sessions that are designed to assess the effectiveness of the training. The medium of instruction is English, the language of modern science.



Training session in progress

TDC has also developed a model training program for pre-university teachers in the fields of physics, chemistry, mathematics and biology. The nearly two week long programme, like its high school counterpart, includes learning in both the lab as well as in the classroom. Scientists from IISc and other universities in Karnataka give talks in the fields of their expertise as part of this programme. Teachers are trained in over 40 experiments.



Telescopes to look at the clear night skies

These inquiry-based labs are not limited to those prescribed in the syllabus and are designed to impart a deeper understanding of the theoretical concepts demonstrated by the experiments.

The curricula for these training courses have been developed with the help of experienced faculty

of IISc as well as those from different universities across Karnataka. So far more than 1800 high school science teachers and an equal number of PU college teachers from Karnataka have been trained at the Centre. TDC has also trained over 200 teachers from *Navodaya* schools that were set up all over India with the aim of providing quality education to students from rural areas. The feedback from the participating teachers has been encouraging and the results of the knowledge-based surveys, which are taken both

before and after the training programme, have been satisfying. With the establishment of a dedicated training centre for science teachers, IISc has now taken an important step towards realizing an important goal – that of making our students scientifically literate and life-long learners.

-- **Manu Rajan** and **Karthik Ramaswamy**
(with input from Prof. M.S. Hegde, Convener, TDC)

AWARDS AND HONOURS

Bharat Ratna (announced November 2013)

C. N. R. Rao, one of the leading solid state chemists in the world and the Chair of the Scientific Advisory Council to the Prime Minister of India, has been conferred the Bharat Ratna. Besides being a National Research Professor, he is also the Linus Pauling Research Professor and Honorary President of the Jawaharlal Nehru Centre for Advanced Scientific Research. Prof. Rao served as the Director of the Indian Institute of Science from 1984 to 1994.
<http://www.jncasr.ac.in/cnrao>



Shanti Swarup Bhatnagar Prize - 2013

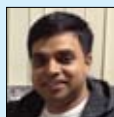
Bikramjit Basu (*Materials Research Centre*) has successfully combined the worlds of engineering and biology to address clinically important problems. His research has direct applications in reconstructive surgery of bones, neural and cardiovascular tissues. He works with a large team of researchers, including clinicians and biomedical entrepreneurs.
http://mrc.iisc.ernet.in/Faculty/Regular/Bikram/Bikram_Profile.htm



Vijay Balakrishna Shenoy (*Physics*) is a theoretician who works on the physics of condensed matter, a field that finds applications in devices ranging from supercomputers to phablets. His work offers us crucial clues for developing high temperature superconductivity which could unleash the potential of quantum computing.
<http://www.physics.iisc.ernet.in/~shenoy>



Sathees Raghavan (*Biochemistry*) studies how normal cells are transformed into cancer cells. He has discovered a molecule that blocks DNA repair in a cancer cell, leading to the death of the cell. This molecule has been shown to impede growth of cancer cells in mice models and could potentially be used in combination with radiotherapy and chemotherapy for cancer treatment.
<http://biochem.iisc.ernet.in/sathees.htm>



Norbert Gerbier MUMM International Award

Govindasamy Bala (*Divecha Center for Climate Change and the Center for Atmospheric and Oceanic Sciences*) uses a modeling approach to understand how carbon dioxide emissions and deforestation resulting from human developmental activities affects our planet's temperature and rainfall patterns.
<http://caos.iisc.ernet.in/faculty/gbala/publications.html>



BM Birla Science Prize – 2012 (announced October 2013)

Banibrata Mukhopadhyay (*Physics*) is a theoretical physicist with a wide range of interests in astrophysics and astronomy. He and his group have recently made significant discoveries about black holes and white dwarfs.
<http://www.physics.iisc.ernet.in/~bm>



Ganesh Nagaraju (*Biochemistry*) studies how genes regulate DNA repair and thus maintain genomic integrity. Mutations in these genes lead to diseases like Fanconi anemia and cancer.
<http://biochem.iisc.ernet.in/ganesh.htm>



DST Young Scientist Research Award in Engineering - 2013.

R.T.Naik (*Mechanical Engineering*) studies internal combustion engines, alternate fuels and simulation of combustion engines.



-- **Manu Rajan**

CONTACT: newsletter@apc.iisc.ernet.in

CONTRIBUTORS: S. K. Satheesh is a Professor at the Centre for Oceanic and Atmospheric Sciences | Karthik Ramaswamy is a Visiting Scientist with the Division of Biological Sciences | Manu Rajan is a Technical Officer at the Archives and Publications Cell | S. Sandya is a Scientific Officer at SATF | P.D Deepalakshmi is a Senior Research Scientist at SATF | M. Sunitha is a Junior Scientific Assistant at SATF

EDITORIAL TEAM: Karthik Ramaswamy, Editor (Visiting Scientist, Biological Sciences) | Manu Rajan (Technical Officer, Archives and Publications Cell) | T.A. Abinandanan (Professor, Materials Engineering)

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