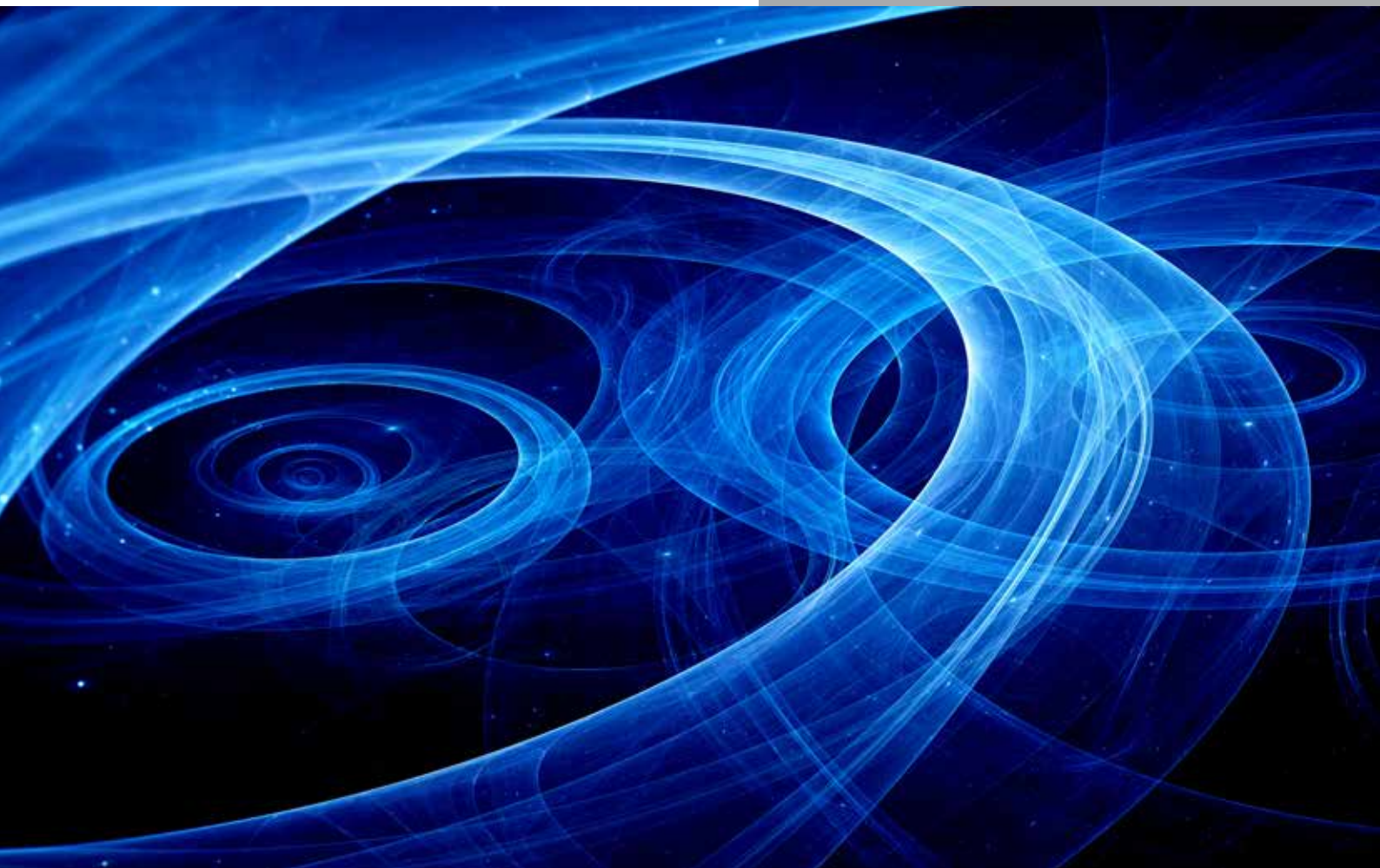
Indo-US Science and Technology Forum

IUSSTF

Annual Report
2013-2014



The Indo-US Science and Technology Forum (IUSSTF) established under an agreement between the Governments of India and the United States of America in March 2000, is an autonomous, bilateral organization jointly funded by both the Governments that promotes science, technology, engineering and biomedical research and innovation through substantive interaction among government, academia and industry.

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From the ED's Desk

It has been the mandate of IUSSTF to catalyze linkages between Indian and US science and technology agencies. As part of this mandate, an Indo-US workshop was organized in 2011 in partnership of Stanford India Bio-design Centre, All India Institute of Medical Sciences, Delhi and the National Institutes of Health (NIH) on grand challenges in health. Hypertension was one of the major tracks of this workshop. We are very happy to report that in the IUSSTF GB meeting held in 2013, the Science and Engineering Research Board (SERB), Ministry of Science and Technology, India and the NIH signed an MoU on Indo-US cooperation on affordable blood pressure measurement devices. As a follow up, discussions were held involving IUSSTF, SERB and NIH to develop the cooperation program. In view of IUSSTF's proven ability to implement cooperation programs with nimbleness and flexibility, IUSSTF was entrusted by SERB to administer this 5 year USD 20 Mn SERB-NIBIB initiative. Separate but synchronized calls were issued in the US and India and after a rigorous review process, 3 teams in India have been selected for initial awards.

> During 2013, more than 100 undergraduate/ masters students from India interned in 15 US universities availing the SN Bose Scholars program, Khorana Scholars program and Viterbi-India program. About 30 US students also availed internships at Indian universities under our programs.

In another endeavor to develop linkages between SERB/DST and NIH, an MoU was also signed by SERB and National Science Foundaiton (NSF) for partnering in the GROW (Graduate Research Opportunities Worldwide) – India program which would provide support for US Ph.D. students to work at Indian academic and research institutions from 3 months to 12 months. IUSSTF has been entrusted with implementing this program. With this, the total number of slots available for exchange visits of US students to India in various IUSSTF programs has increased to 60.

We believe that fellowships for young scientists and internships for students are wonderful tools for developing long term relations between Indian and US scientific communities as it provides them opportunities to forge linkages with their mentors, other faculty and their peers that lasts for several decades. The SN Bose Scholar program launched in 2013 proved to be an immensely popular program with more than 1200 nominations received from Indian institutions, most of them being top students in their classes. During 2013, more than 100 undergraduate / masters students from India interned in 15 US universities availing the SN Bose Scholars program, Khorana Scholars program and Viterbi-India program. About 30 US students also availed internships at Indian universities under our programs.

Another new fellowship program BASE (Bhaskara Advanced Solar Energy Research program) for capacity development in solar energy supported by DST has been entrusted to IUSSTF for implementation. 9 young scientists and 12 students have been shortlisted under this fellowship program for research in US universities for a period of 3 to 6 months.

IUSSTF is also proud to partner with DST and the Intel-Education India for participation of school children in the Intel International Science and Engineering Education Fair (ISEF) in US, which is the world's largest science fair. Under this activity about 20 Indian school children selected from winners of various national science fairs will participate and compete with more than 1600 children from over 70 countries to showcase their research and bid for more than USD 5Mn in awards. These 20 students would then visit selected universities, science parks, museums etc in US to expose them to excitement of science. With this activity, IUSSTF covers a wide spectrum of stakeholders ranging from school children to college students to young scientists through various group targeted activities in addition to core activities that covers scientists and researchers affiliated with academic and research institutions.

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As part of the endeavor to develop linkages between institutions, discussions are on with MIT, Harvard and IITs for enhancing scope of Resonance-India program for organizing summer schools in emerging areas such as neuroscience, disaster mitigation, climate modeling, etc in India involving faculty and post Docs from partnering organizations.

It has also been a continuous effort of IUSSTF to create networks between the future science and engineering leaders in India and the US. With this in mind, IUSSTF has been organizing biennial Indo-American Frontiers

of Science (IAFOS) Symposium in partnership with the National Academy of Sciences since 2004 as a flagship event. In this series, the 5th IAFOS was held from 9th - 12th April 2013 at Agra, India, where more than 70 young scientists from India and the US spent three days together discussing several interesting emerging areas. The 5th Indo-American Frontiers of Engineering (IAFOE) Symposium is being organized in May 2014 at the Infosys Mysore campus with great support of Lockheed Martin and Infosys.

> As part of its Women in Science initiative IUSSTF has been organising annual interaction meets in partnership with DST and US Embassy, Delhi involving women scientists, policy makers and social scientists from India and the US. As part of this initiative, IUSSTF in partnership with DST and the Embassy of the United States of America organized a discussion on "Women in Science and Engineering" with Sunita Williams (NASA Astronaut)

While increasing number of women have pursued science and technology education and professions in recent decades, many female students and professionals still face obstacles to pursuing a career in science. It is essential that the barriers that discourage women from studying science and pursuing it as a career are identified and overcome. As part of its Women in Science initiative IUSSTF has been organising annual interaction meets in partnership with DST and US Embassy, Delhi involving women scientists, policy makers and social scientists from India and the US. As part of this initiative, IUSSTF in partnership with DST and the Embassy of the United States of America organized a discussion on "Women in Science and Engineering" with Sunita Williams (NASA Astronaut) at Fulbright House, New Delhi on 1st April 2013. This was attended by women leaders from Federal Agencies, Academia and Industry. The IUSSTF has also been in discussions with DST, leading Indian women scientists working in this area and Dr. Geri Richmond, President elect American Association for the Advancement of Science (AAAS) and founder of COACh program to evolve suitable training programs for trainers in India.

The three consortia involving more than 100 academic and industry organizations in the area of solar energy, second generation of biofuels and building energy efficiency of the Indo-US Joint Clean Energy Research and Development Centre (JCERDC) have completed one year of collaborative research work. The JCERDC is a 5 year, USD 100 Mn initiative in public private mode with the Indian and the US Governments each committing USD 5 Mn every year and the industry providing matching funds. This program is funded and guided by the Indian Departments of Science and Technology (DST) and Biotechnology (DBT) and the US Department of Energy (DoE). There are several important leads and the Indo-US Energy Dialogue leaders in its meeting held in New Delhi appreciated the progress and noted the possibilities of deployment of research outcomes in a few years time.

There has also been an overwhelming response to the third and fourth calls of US-India Science and Technology Endowment Fund (USISTEF) with over 200 bilateral Indo-US teams applying in each call. After joint review and diligence process, 7 teams were awarded projects in the broad categories of 'Empowering Citizens' and 'Healthy Individual'. With total 11 awardees, several forums and organizations promoting entrepreneurship and innovations are increasingly noticing the USISTEF. Three awardees from initial round have also received offers from angel and venture funds to take their projects at higher levels. IUSSTF organized a startup accelerator workshop in partnership with DST, US Embassy, Federation of Indian Chambers of Commerce and Industries (FICCI) and 91 Springboard, Delhi for awardees of USISTEF, Indo-US Millennium Alliance, Indian Innovation Growth Programme (IIGP) and other programs. The overwhelming response to the workshop was heartening and we intend to continue such efforts that bring together entrepreneurs, investors, policy makers and mentors on a common platform.

The DST-Lockheed Martin India Innovation Growth Program has been taken to another level this year. The quality of the program was further strengthened by joining of Stanford Graduate School of Businessin program as academic partner with support from Lockheed Martin. IUSSTF also organized visit of team comprising of IIGP winners and incubator mangers to Silicon Valley to learn from experience from startups there as well as to showcase their innovations in partnership with TiE Silicon Valley.

As part of regular networking activities, IUSSTF has supported 16 bilateral workshops and training programs through the calls for proposals during the period of the Annual report. 10 new Virtual Joint R&D Network Centers were also initiated and 4 new Joint Centers were approved bringing the total Joint Centers supported/ awarded to 46.

> With the great support of IUSSTF GB members notably DST, DBT, NSF, NIH, Lockheed Martin and other partners such as FICCI, USAID and various Indian and US Universities, the IUSSTF programmatic activities have grown with a lot of synergy between them. Through various programmatic activities, IUSSTF supported exchange visits of about 600 Indian and US scientists during FY 2013-14 and it is estimated that interactions of about 4000 to 5000 scientists were facilitated during these interactions.

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Rajiv Sharma
Executive Director, IUSSTF

History of Indo-US S&T Cooperation

1950's

- Green revolution facilitated with the U.S. PL 480 Rupee Funds
- Establishment of Land Grant Colleges

1960's

- Establishment of IIT, Kanpur
- Establishment of NCERT, New Delhi
- Nuclear Cooperation Agreement
- Tarapur Power Plant

1970's

- NASA-ISRO–SITE (Satellite Instructional Television Experiment)
- Indo-US S&T Subcommission

1980's

- STI (Science & Technology Initiative)
- USIF (US-India Fund)

1990's

- Indo-US Fellowships Program
- ICAR MoU
- Indo-US Vaccine Action Program
- DST-NSF Program
- NASA/NOAA-ISRO/DST MoU
- DBT/ICMR-NIH/CDC Health & Medical Sciences Program

2000's

- Indo-US Science & Technology Forum
- Indo-US Science & Technology Agreement
  - Indo-US Binational S&T Commission
- High Technology Cooperation Group (HTCG)
- Indo-US Strategic Partnership
  - Information & Communication Technology
  - Knowledge Initiative in Agriculture
  - Space Cooperation
  - Energy
  - Safety & Security
  - Health Sciences
- Indo-US S&T Agreement / Joint S&T Commission
- NASA-ISRO Agreement / MOES-NOAA Agreement
- Indo-US Nuclear Agreement
- MoU on Energy Security, Energy Efficiency & Clean Energy and Climate Change
- US-India Science and Technology Endowment Fund
- Indo-US Joint Clean Energy Research & Development Centre

Structure of IUSSTF

Management

The IUSSTF functions as

- Autonomous
- Bilateral
- Not-for-profit organization
- Co-governed and co-founded by Government of India and US Government

Governing Body

To ensure that the activities undertaken by the IUSSTF conform to the highest standards of excellence, a joint Governing Body consisting of seven Indian and seven American eminent scientists provide leadership to IUSSTF. Composition of Governing Body during the report period is :

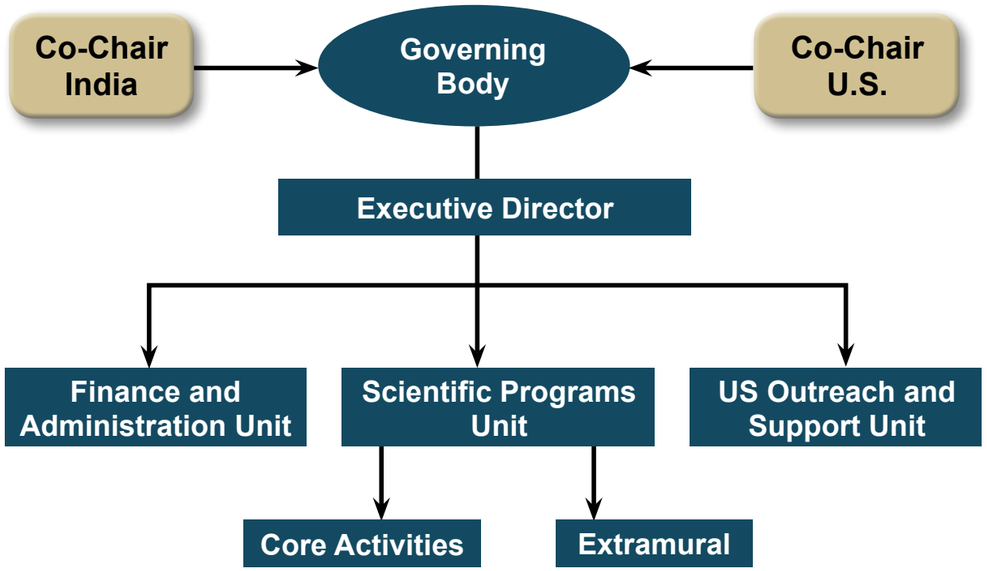
India	United States
T. Ramasami Secretary, Department of Science and Technology	**Norman P. Neureiter** Senior Advisor, American Association for Advancement of Science
K. VijayRaghavan Secretary, Department of Biotechnology	**Michael Clegg** Foreign Secretary, National Academy of Sciences
Director General Council of Scientific and Industrial Research	**Director** National Science Foundation
Indranil Manna Director, Indian Institute of Technology Kanpur	**Roderic Pettigrew** Director, National Institute of Biomedical Imaging and Bioengineering
Vijay Chandru Chairman and CEO, Strand Life Sciences	**Phyllis G. Yoshida** Deputy Assistant Secretary, Department of Energy
Vikram S. Kirloskar Vice Chairman, Toyota Kirloskar Motors	**Ray O. Johnson** Sr. V.P. and C.T.O., Lockheed Martin Corporation
Anuradha Mitra Financial Advisor, Department of Science and Technology	**Leo M. Chalupa** Vice President Research, Gorge Washington University

The Executive Director manages the IUSSTF affairs from its headquarters at the Fulbright House, New Delhi.

Funding

Annual interest earning from the endowment created by the US Government with matching contribution from Government of India through the Department of Science and Technology provides regular funds to administer the IUSSTF programs.

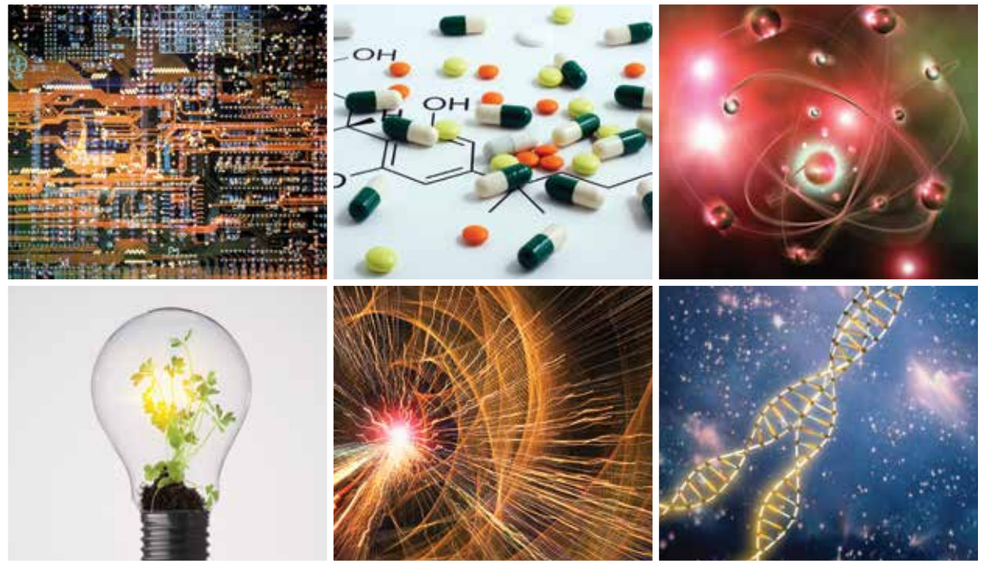
The IUSSTF also has the freedom to receive grants, gifts, donations or other contributions from industries, foundations and private benefactors. Contributions to IUSSTF are tax-exempted under Section 80G of the Indian IT Act. Toward furtherance of its objectives, the IUSSTF welcomes fund contributions both in India and USA. The India Science and Technology Partnership (INSTP) based out of the American Association for the Advancement of Science (AAAS) in Washington D.C. provides outreach and proposals review support.



Objectives of IUSSTF

Catalyst to facilitate seed and promote US-India bilateral collaboration in science, technology, engineering and biomedical research through substantive interaction among academia, R&D laboratories, industry and government.

- Support exciting and enabling science and technology program portfolio that paves way for sustainable interactions and potential collaborations through networking.
- Promote and strengthen strategic partnership in science and technology under various intergovernmental initiatives and declarations.
- Create awareness through exchange and dissemination of information and opportunities toward promoting bilateral scientific and technological cooperation.
- Encourage public-private partnership and technopreneurship to foster elements of innovation and enterprise through knowledge networking between academia and industry.
- Capitalize on the scientific and technological synergy on issues of common concern leading to long-term partnership based on shared values.
- Explore new frontiers by nurturing contacts between young and mid-career scientists to develop mutual trust, leadership and fraternity in research and development.



Partners

Government of India
Department of Science & Technology
Ministry of Science & Technology

Government of India
Department of Biotechnology
Ministry of Science & Technology

Government of India
Science and Engineering Research Board
Ministry of Science & Technology

National Institute of Biomedical Imaging and Bioengineering

Programmatic Activities

Indo-US Joint Clean Energy Research and Development Center

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Recognizing the need to address climate change, ensure mutual energy security, and build a clean energy economy that drives investment, job creation, and economic growth; Prime Minister Manmohan Singh and President Barack Obama launched the U.S.-India Partnership to Advance Clean Energy (PACE) under the U.S.-India Memorandum of Understanding to enhance cooperation on Energy Security, Energy Efficiency, Clean Energy and Climate Change. This MoU was signed on November 24, 2009 during Prime Minister Singh's visit to the United States. As a priority initiative under the PACE umbrella, the U.S. Department of Energy (DOE) and the Government of India signed an agreement to establish the **Joint Clean Energy Research and Development Center (JCERDC)** on November 4, 2010 during President Obama's head of state visit to India. The JCERDC is designed to promote clean energy innovation by teams of scientists and engineers from India and the United States.

The overall aim of the JCERDC is to facilitate joint research and development on clean energy to improve energy access and promote low-carbon growth. To achieve this objective, the Indo-US JCERDC supports multi-institutional network projects using a public-private partnership model of funding. The JCERDC is funded by the Indian Ministry of Science and Technology and the U.S. Department of Energy. The program is being administered in India by the *Indo-U.S. Science and Technology Forum (IUSSTF)*. On the basis of a rigorous binational review and evaluation process, three consortia were selected for award. The awards were announced as a press-release by the Press Information Bureau on 16th April 2012.

A brief summary on the first-year progress of the projects awarded in the space of **Solar Energy**, **Building Energy Efficiency** and **Second-Generation Biofuels** is as follows:

SOLAR ENERGY

The ***Solar Energy Research Institute for India and the United States (SERIIUS)*** is co-led by the Indian Institute of Science (IISc)-Bangalore and the National Renewable Energy Laboratory (NREL).

The JCERDC grant was awarded to SERIIUS on November 22, 2012. The Total JCERDC Grant-in-aid for Indian component of the SERIIUS project (over 5 years) is Rs. 50,07,52,800/- with a first year release of Rs. 1,505.722 Lakhs.

SERIIUS carries out fundamental and applied research, analysis and assessment, outreach, and workforce development through specific bi-national projects in three Research Thrusts - Sustainable Photovoltaics (PV), Multiscale Concentrated Solar Power (CSP), and Solar Energy Integration (SEI). The vision is to ready these solar electricity technologies toward the long-term success of India's Jawaharlal Nehru National Solar Energy Mission and the U.S. Department of Energy (DOE) SunShot Initiative.

The highlights of the first year include the following:

- SERIIUS was officially launched with a special event in Washington, DC, hosted by the U.S. Secretary of Energy and the Government of India at the U.S.-India Clean Energy Dialogue (September 28, 2012) and as a kickoff with the Government of India in Mumbai (December 8, 2012).

SERIIUS Partners

Collaborating Institutions, India	Collaborating Institutions, USA
Lead Institution: Indian Institute of Science, Bangalore	**Lead Institution:** National Renewable Energy Laboratory, Golden
Other Academia Partners • Indian Institute of Technology, Bombay • Indian Association for the Cultivation of Science, Kolkata • ARCI, Hyderabad • Solar Energy Center, Gurgaon • Indian Institute of Technology, Madras • CSTEP, Bangalore	Other Academia Partners • Lawrence Berkeley National Laboratory • Arizona State University • Carnegie Mellon University • Colorado School of Mines • Massachusetts Institute of Technology • Purdue University • Stanford University • University of Central Florida • University of South Florida • Washington University
Other Industry Partners • Thermax Ltd • Clique Developments Ltd • Hindustan Petroleum Corporation Ltd. • Moser Baer India Ltd • TurboTech Precision Engineering Ltd • Wipro Ltd	Other Industry Partners • RAND Corporation • Corning Incorporated • General Electric Company • MEMC Corporation • Solarmer Energy Inc. • Cookson Electronics

- Consortium research projects were initiated (starting January 2013), following the SERIIUS 10-Point Work Plan, developed through an all-SERIIUS consensus process for the Sustainable PV, Multiscale CSP, and SEI Research Thrusts. Administratively, the funding is now with the partner organizations, and there is an agreement on Intellectual Property Management Plan (IPMP) and Intra-Consortium Non-Disclosure Agreement (NDA) finalized.
- SERIIUS Fellowship and Scholar Program were inaugurated (February 2013).
- SERIIUS Web Gateway (www.SERIIUS.org) is in initial full operation, providing information about the Consortium to the public, establishing a special and secure "Consortium Collaboration Tool" for sharing research information among SERIIUS partners, and social media links (Facebook and Twitter).
- SERIIUS research dissemination begins with six journal publications and several conference presentations.
- To provide better focus on research progress, SERIIUS has implemented a procedure for research "Highlights", which reports these accomplishments succinctly on a single-page PowerPoint format that will also be posted on the first page of the Web Gateway.
- Consortium communications advance with teleconference and video conference schedules established for Leadership, Research Thrusts, and Research Projects.
- Inter-SERIIUS-partner organization visits have blossomed, and are key to ensuring research interactions, sharing of results, fostering relationships, and maintaining the enthusiasm for SERIIUS among members.

BUILDING ENERGY EFFICIENCY

The ***U.S.-India Joint Centre for Building Energy Research and Development (CBERD)*** will conduct collaborative research and promote clean energy innovation in the area of energy efficiency in building with measurable results and significant reduction in energy use in both nations. CBERD is co-led by the Centre for Environmental Planning & Technology University-Ahmedabad and the Lawrence Berkeley National Laboratory and includes the following partners.

The JCERDC Indian grant was awarded to CBERD on November

29, 2012. The Total JCERDC Grant-in-aid for the project (over 5 years) is Rs.22,52,69,000/-with a first year release of Rs.550.912 Lakhs. CBERD focuses on the integration of information technology with building controls and physical systems for commercial/high-rise residential units.

The highlights of the first year include the following:

- **Consortia Management Office (CMO)** facilitated interactions between India and US R&D partners as well as industry. For effective research operations, a detailed milestone and deliverable document was prepared jointly by researchers. Under this task IP framework document was prepared covering IP management plan.
- **Simulation and Modeling:** A detailed design specification for the natural ventilation system interface has been developed. To develop materials and construction database for energy simulation, the CBERD team has identified selection criteria to shortlist materials from a wide range of construction materials available in India. The CBERD team also has prepared set of rules for Energy Conservation Building Code of India.
- **Monitoring and Benchmarking:** This study focused on historical summary, anecdotal evidence, markets covered, and methodology analysis of the two major benchmarking programs in India - the BEE Building Star Rating program and the ECO-III benchmarking program. Further, analysis was also conducted of the achievements and limitations of both the programs.
- **Controls and Communication Integration:** Various luminaire products available in India have been identified for effective control mechanism. A concept for Smart Luminaire Controller (SLC) which integrates occupancy status, lux level, temperature and input current to the luminaire has been developed.
- **Envelop/Passive Design:** Development of material characterization database has been initiated with approximately 100+ materials tested. Specification for Guarded Hot Box and Hygrothermal test facilities was developed. Cool roof calculator has been enhanced and the backend is being updated to include radiant barrier systems and to run a parametric simulation to optimize insulation thickness for a given roof albedo and radiant barrier system. Characterization of glass products was done. This data will be available in International Glass Database maintained by LBNL. CBERD team has included 65 weather files for Indian locations in the COMFEN database for the Indian version. This along with India version of COMFEN has been initiated. Criteria of selection for naturally ventilated buildings to be monitored were defined and a matrix was prepared listing all possible candidates for the study.
- **Advanced Technologies:** Literature review and market research on non-compressor based DOAS systems was undertaken to identify various options available in the market, their features, advantages and limitations. Literature review and market research on MCHXs was undertaken to identify various issues that need to be addressed.
- **Comfort Studies:** Research methods for Online Survey finalized. Thermal Comfort Chamber construction initiated with identification specifications and standard procedure to operate.
- **Grid Responsive Buildings:** The team has conducted extensive literature review. This is relative to year 1 and 2 deliverable to conduct a scoping study to link building technologies to Smart Grid needs and integration of building control systems to supply-side.
- **Renewable Integration:** The study of literature, range of RE products for building integration has been done. Discussions were held with the US – R&D institutional partner LBNL. The CBERD team has identified the following technologies for primary considerations in building integration: (1) Solar Air Conditioning (2) Enhanced use of solar energy in buildings: Embedded PV in windows, overhangs, dynamic façade, and optimization of roof top BIPV to be mainly considered.
- **Scientific Collaboration:** CEPT, MNIT and IIIT from India interacted with UCB and RPI to establish student exchange program and expert exchange program. RPI would host a training program in India in the third quarter of 2013. UCB has given a scholarship to a post graduate student to carryout research under the CBERD project.

CBERD PARTNERS

Collaborating Institutions, India	Collaborating Institutions, USA
Lead Institution: Center for Environmental Planning and Technology (CEPT) University, Ahmedabad	**Lead Institution:** Lawrence Berkeley National Laboratory, Berkeley
Other Academia Partners • International Institute of Information Technology, Hyderabad • Malaviya National Institute of Technology, Jaipur • Indian Institute of Technology, Bombay • Indian Institute of Management, Ahmedabad • Auroville Center for Scientific Research • Indian Green Building Center, CII • Indian Society of Heating Refrigeration and Air Conditioning Engineers • Rajasthan Electronics and Instruments Limited • Indian Society of Lighting Engineers	Other Academia Partners • Oak Ridge National Laboratory • University of California Berkeley • Carnegie Mellon University • Rensselaer Polytechnic Institute
Other Industry Partners • Asahi India Glass • Biodiversity Conservation India • Infosys Technologies. • Neosilica Technologies • Oorja Energy Engineering Services • Paharpur Business Centre/Green Spaces • PLUSS Polymers • Philips Electronics India • Saint Gobain Corp • Schneider Electric India • Sintex Industries Limited • Skyshade Daylights • Wipro EcoEnergy • Glazing Society of India	Other Industry Partners • Autodesk, Inc. • California Energy Commission • Delphi • enLighted Inc. • Honeywell • Infosys Public Services • Ingersoll-Rand/Trane • Lighting Science Group Corp • Nexant • Saint Gobain Corp • SAGE Electrochromics • SynapSense • The Weidt Group • Bay Area Photovoltaic Consortium • City of San Jose • HOK Architects • Natural Resources Defense Council

SECOND GENERATION BIOFUELS

The **U.S.-India Consortium for development of Sustainable Advanced Lignocellulosic Biofuel Systems (SALBS)** emphasizes on sustainable feedstock cultivation and supply, biochemical conversion technologies for production of second generation biofuels with minimal environmental impact, and analysis of overall sustainability and supply chain of feedstock. The consortium is co-led by the Indian Institute of Chemical Technology-Hyderabad and the University of Florida-

Gainesville and includes the partners given in the table below.

The Indian JCERDC grant was awarded on November 22, 2012. The Total JCERDC Grant-in-aid for the project (over 5 years) is Rs. 12,88,86,000/- with a first year release of Rs. 555.14 Lakhs. The project comprises of three work packages – WP-1 involves the feedstock development and supply, WP-2 focuses on the conversion technologies, and WP-3 addresses sustainability, marketing and policy.

The highlights of first year are as follows:

- High biomass sorghum genotypes were screened for various agronomic traits (plant height, fresh yield, stover yield, etc.) during the post-rainy season for potential high biomass producing lines. Thirty-six HBM genotypes were identified, out of which 10 showed superior stalk yields.
- Similarly, 10 high biomass producing sorghum lines tolerant to drought stress were identified on the basis of screening done under glass house conditions. Seed multiplication of the potential sorghum lines was performed during the post-rainy (rabi) season for conducting multilocation trials (MLTs) in the partner organizations for the rainy (kharif) season.
- Land survey for the cultivation of coarse cereals as well as sorghum was conducted in various areas of Madhya Pradesh involving ICRISAT, DSR and RVSKVV scientists. Sites for conducting MLTs for sorghum and pearl millet were identified as well. Preliminary interactive survey with local farmers with regards to cultivation of sorghum and pearl millet for biomass production was conducted by CESS group.
- Abellon has collected 20 different bamboo germplasm from various parts of India after consulting with National Bamboo Mission (NBM). Six out of 20 germplasm lines have been established at Modasa for further studies, while others are in the process of being established.
- A stress tolerance study of existing *Bambusa balcooa* under *in-vitro* and *in-vivo* conditions is ongoing. Genetic variation studies conducted on 6 varieties of Bamboo using molecular approaches showed *Bambusa balcooa* to be the most diverse variety. Pre-processing and commutation of 5 lignocellulosic biomass samples of sorghum and pearl millet was optimized at HPCL and the commuted biomass was dispatched to the WP-2 partners involved in conversion technology.
- Cellulolytic fungi from various biosphere zones were isolated and 21 fungal cultures were identified at TNAU. Standardization of alcohol fermentation to establish base levels on glucose substrate using in-house *Saccharomyces cerevisiae* has been initiated at IIT-D. Similarly, standardization of pre-treatment variables of the biomass samples, isolation of microbial strains from various biosphere zones, and screening of biomass degrading-enzymes (xylanase and cellulase) have been initiated at IICT.
- Abellon has reviewed and compiled globally available documents on certification systems. They have consulted three independent experts working in the fields of social/woman development, extension education, CESS, and an NGO group for their inputs on the design of the baseline survey forms.
- Similarly, primary and secondary data with respect to non-food based biofuels has been reviewed and compiled. CESS has independently compiled a questionnaire for the baseline survey after a preliminary visit to the field sites of Indore and Gwalior in Madhya Pradesh.
- Other JCERDC-related news….

SALBS PARTNERS

Collaborating Institutions, India	Collaborating Institutions, USA
Lead Institution: Indian Institute of Chemical Technology, Hyderabad	**Lead Institution:** University of Florida, Gainesville
Other R &D Institutions and Academia Partners: • International Crops Research Institute for the Semi-Arid Tropics- Hyderabad • Directorate of Sorghum Research-Hyderabad • Jawaharlal Nehru Technological University-Hyderabad • Tamil Nadu Agricultural University • Rajamatha Vijayaraje Sindia Krishi Vishwa Vidyalay, Gwalior • Centre for Economic and Social Studies • Indian Institute of Technology-Delhi • Indian Institute of Technology-Chennai	Other R & D Institutions and Academia Partners: • University of Missouri • Virginia Tech • Montclair State University • Texas A&M University
Industry Partners: • Abellon Clean Energy • Hindustan Petroleum Corporation Limited	Industry Partners: • Show Me Energy • Green Technologies

The **India-U.S. Energy Dialogue** was held in New Delhi on 11th March 2014. The Dialogue was co-chaired by Dr. Montek Singh Ahluwalia, Deputy Chairman of the Planning Commission, and Dr. Ernest Moniz, Secretary, U.S. Department of Energy. The Energy Dialogue is part of the broader India-U.S. Strategic Dialogue. The Energy Dialogue was launched in May 2005 with the last meeting held in September 2012 in Washington DC. Secretary Moniz led the U.S. delegation comprising of senior officials from the Department of Energy and various national laboratories. India and the United States affirmed that both countries had

a strong commitment to collaborating on energy and promoting greater technological innovation, scientific collaboration, trade, research and development, deploying environment-friendly technologies and products, and promoting sound regulatory frameworks to deliver energy solutions for sustainable growth.

Officials from the two sides held meetings from 5th March to 11th March, 2014, and reviewed the full range of cooperation under the U.S. – India Energy Dialogue.

The Co-chairs of the dialogue, Dr. Ahluwalia, and Secretary Moniz discussed progress made by the working groups in renewable energy and new technologies, cooperation in shale gas, LNG imports, energy efficiency and low carbon technologies. The joint consortia members from the **Indo-U.S. Joint Clean Energy Research and Development Center (JCERDC)** also presented their progress in solar, advanced bio-fuels, and energy efficiency research projects under PACE-R, a unique program for funding joint research by Indian and US institutes.

In their concluding remarks, the two co-chairs expressed satisfaction at the progress made in the energy sector through the co-operative process. They directed the members of the Working Groups to continue their efforts, especially in the newer areas of mutual interest.

US-India Science and Technology Endowment Fund Program

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The **United States–India Science & Technology Endowment Fund (USISTEF)** was established in 2009 by the Governments of the United States of America (through the Department of State) and India (through the Department of Science & Technology). The fund envisages to support and foster joint applied R&D to generate public good through commercialization of technology achieved through sustained partnerships between US and Indian researchers and entrepreneurial initiatives. These initiatives can originate from government, academic, non-governmental or commercial entities, and any combination thereof provided they focus on applied R&D, incorporate a business plan and proof of commercial concept, and have significant sustainable commercial potential. The program is coordinated and administered through the bi-national **Indo-US Science and Technology Forum (IUSSTF)**. The areas covered under the program are (1) **Healthy Individual** with a focus on affordable biomedical devices, diagnostic/ preventive/ curative measures, or food and nutrition products to improve health, and (2) **Empowering Citizens** with a focus on reducing the digital/ technology divide including others, information and communication technologies with societal impact in areas such as water, agriculture, financial inclusion, and education.

Third Call of Proposals

Over 202 Executive Summaries were submitted under the third call and after the expert panels review, 19 proposals (9 in Empowering Citizens and 10 in Healthy Individual categories) were shortlisted for Stage II: Business Plans submission. The shortlisted teams were requested to submit their detailed business plans online. Two Joint Indo-US Expert Panels, one in each category, interacted with the teams face to face or through skype on 24 and 25 April 2013 at Santa Clara, CA. On the basis of a

Joint Expert Panels review, 7 finalists (3 in Empowering Citizens and 4 in Healthy Individual) were taken up for Stage III: Site Inspection and Due Diligence process. Based on the recommendations of the due-diligence experts and Endowment Board co-Chairs, the USI- S&T Endowment Board approved five proposals (3 in Empowering Citizens and 2 in Health Individual category) under the third call.

U.S.-India Strategic Dialogue

U.S. Secretary of State John F. Kerry and External Affairs Minister of India Shri Salman Khurshid met in New Delhi co-chaired the fourth U.S.-India Strategic Dialogue on June 24, 2013. During their first meeting, they reviewed the extensive transformation of the bilateral relationship and identified key sectors of cooperation that will continue to add strategic depth to the partnership. In the event, the following three Endowment Awardees showcased their technologies/products related to proposals.

Nahush Katti and Vikram Arun, DoctorOn for proposal "Blindness Prevention through Integrated Smartphone Technology" (submitted with Dr Sheila John, Shankar Netralaya, Chennai)

Sidhant Jena, Janacare Solutions Private Limited, New Delhi for proposal "Mobile Phone based HbA1c Analyzer" (submitted with Stephen Chen, Teco Diagnostics, Anaheim)

Neha Juneja, Greenway Grameen Infra Pvt. Ltd., Navi Mumbai for proposal "Affordable, clean cookstove and electric power sources for rural India (submitted with Aleksandr Kushch, Hi-Z Technology Inc. San Diego, CA, USA)

US-India Green and Affordable Event

Another US-India Green and Affordable Event was being jointly organised by Indo-US S&T Forum (IUSSTF), Federation of Indian Chambers of Commerce and Industry (FICCI), Ministry of Science and Technology and USAID at FICCI House, New Delhi. This event was graced by the presence of Shri S. Jaipal Reddy, Hon'ble Minister for Science and Technology and Earth Sciences; Dr. John Holdren, Director of the White Office of Science and Technology Policy; Dr. Rajiv Shah, Administrator, U.S. Agency for International Development, USAID; Dr. T. Ramasami, Secretary, Department of Science & Technology, Government of India, Dr. K. Vijay Raghvan, Secretary, Department of Biotechnology, Government of India. The second and third call Endowment Awardees and Millennium Alliance maiden call awardees were awarded and felicitated in the same.

Easy to use, Integrated Neonatal Resuscitation Solution

Avijit Bansal
Windmill Health Technologies
New Delhi, India

Dan Harden
Whipsaw, San Jose, USA

Avijit Bansal (Windmill Health Technologies New Delhi, India); Dan Harden (Whipsaw, San Jose, CA, USA) and Anurag Mairal (Stanford Global Biodesign, Pala Alto,. CA, USA)

The Problem: In India, birth Asphyxia causes deaths in several neo-natal, which is largely preventable by basic resuscitation. Current devices are difficult to use, ineffective especially in developing world.

The Solution: The innovation (NeoBreathe TM) is an integrated neonatal resuscitation solution that's much easier to use and suitable for field conditions. It will therefore empower front-line health workers such as medical professionals, community health workers, midwives and other skilled birth attendants to perform basic neonatal resuscitation effectively – with minimal training.

Affordable and User-Centric Knee Joints to Remobilize Above-Knee Amputees in India and Globally

Pooja Sandeepan
Bhagwan Mahaveer Viklan Sahayata Samiti
Jaipur, India

Krista Donaldson
D-Rev, Design Revolution
San Francisco, USA

Pooja Sandeepan (Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS), Jaipur, India) and Krista Donaldson (D-Rev (Design Revolution), San Francisco, CA, USA)

The Problem: Over 1.9 million people in India are above-the-knee amputees and unable to live productive lives. With 77% of India's population living under $2 a day, amputees rarely receive rehabilitation and have no access to quality prostheses.

The Solution: The team proposes to co-develop an affordable polycentric and user-centric knee joints the ReMotion Knee version 3 to remobilize above-knee amputees in India globally. The ReMotion Knee is a high performance, low cost prosthetic knee joint for lower resource users. ReMotion is radically and affordable. Unlike other prosthetic knees, ReMotion will be optimized specifically for the environment, activities and price parameters of low-resource users. The USISTEF will support the final development, testing and launch of the Re-Motion knee (version 3). This project places India and the US at the forefront of affordable quality medical products design and implementation, and is the first step in global scaling and commercialization of the ReMotion Knee.

Affordable, clean cookstove and electric power sources for rural India

Neha Juneja
Greenway Grameen
Infra Pvt. Ltd.
Navi Mumbai, India

Aleksandr Kushch
Hi-Z Technology Inc.
San Diego, USA

Neha Juneja (Greenway Grameen Infra Pvt. Ltd., Navi Mumbai, India) and Aleksandr Kushch (Hi-Z Technology Inc. San Diego, CA, USA)

The Problem: Over 70% of India's population are cooking on polluting cookstoves/indoor open fires. Half of the households do not have access to reliable electricity.

The Solution: The project aims to provide a complete household energy solution that combines clean cooking and reliable, on-demand power generation. The project aims to develop a stove called "The Greenway Power Stove" which will employ a novel clean combustion technology and a low cost thermoelectric module to generate electricity from the stove during cooking for mobile phone charging.

Solar Electric Tractor - Agriculture and Power

Parimal Shah
Lovson Enterprises Pvt. Ltd.,
Ahmedabad, India

Keith Rutledge
Solectrac LLC Willits, USA

Parimal Shah (Lovson Enterprises Pvt. Ltd., Ahmedabad, India) and Keith Rutledge (Solectrac LLC Willits, CA, USA)

The Problem: Rising diesel prices make it very difficult for subsistence farmers in less developed countries to afford tractors to increase agricultural production.

The Solution: The primary aim of the project is to develop a full function agricultural tractor with a operating efficiency higher than a diesel tractor performing the same farming tasks. Solectracs can also be used for portable power, home power, water pumping and mechanical functions as well as for hauling and transportation needs.

A battery-inverter system based on patented "quick change" battery packs would provide electric power anywhere anytime. Its batteries can be charged directly by clean renewable energy sources or from low cost electric utility grid at off-peak rates.

Commercialization of cultivated sea plants based organic bio-stimulants for applications in the USA

Abhiram Seth
Aquagri Processing Pvt. Ltd.
New Delhi, India

Ganesh Vishwanath
GloBridge Ventures
LLC Fremont, CA, USA

Abhiram Seth (Aquagri Processing Pvt. Ltd. New Delhi, India) and Ganesh Vishwanath (GloBridge Ventures LLC Fremont, CA, USA)

The Problem: There are two fundamental problems that are attempted the endemic poverty in India and the rising consumer demand for organic products in the US Market.

The Solution: Aquagri has pioneered seaweed cultivation in India with a prime focus on creation of livelihood opportunities for the coastal communities and to enhance its sustainability by developing a wide range of value added products. Aquagri through sea plant cultivation would help in expanding the cultivation base itself. GloBridge Ventures LLC plans to work in collaboration with Aquagri to market and distribute the products/ solutions with a focus on organic segments that improves efficiency, lowers cost and improves the health of livestock and crop productivity.

Young Entrepreneur Award

*The US India S&T Endowment Board (USISTEB) on 26 April approved a 25K USD Youth Entrepreneur Award to the proposal Ref. No: HI138, titled "***Blindness Prevention through Integrated Smartphone Technology***" submitted by Nahush Katti and Vikram Arun, DoctorOn, LLC, Columbia and Sheila John, Sankara Nethralaya, Chennai.*

Nahush Katti
Doctor On, LLC, Columbia

Vikram Arun
DoctorOn, LLC, Columbia

The Problem: According to World Health Organization, estimates suggest that over 80% of all undiagnosed cataract conditions will lead to permanent blindness as acute ophthalmic problem is exacerbated without timely diagnosis.

The Solution: The ultimate objective of the proposal is to serve the rural/ impoverished population of the world in meeting their most important ophthalmic diagnostic requirements. The team strongly believe that their innovative smartphone based diagnostic technology has tremendous commercial potential because of its simplicity and its ability to provide high-resolution images for the accurate diagnosis of cataract and various other debilitating human diseases for rural and impoverished patients.

OneBreath: Affordable mechanical ventilation for India

Ashwin Naik (Vaatsalya Healthcare, Bangalore, India) and Matthew Callaghan (OneBreath, Inc., CA, USA)

Ashwin Naik
Vaatsalya Healthcare, Bangalore, India

Matthew Callaghan
OneBreath, Inc., CA, USA

The Problem: Respiratory illness is a leading cause of hospitalization and death in developing nations. Each year thousands of patients die because of lack of early access to mechanical ventilation.

The Solution: In this project, Vaatsalya Healthcare and OneBreath will develop a novel ventilator and commercialize it specifically to address the need for high quality, pre-hospital and emergency care in India's lower income population. The cost, durability and ease of use are critical factors to be considered.

Commercializing a scalable low-cost arsenic remediation technology for societal impact

Joyashree Roy (Jadavpur University, Kolkata), Raja Mohanty (Luminous Water Technologies Pvt. Ltd., Gurgaon, India) and Ashok Gadgil (Lawrence Berkeley National Laboratory, CA, USA)

Joyashree Roy
Jadavpur University
Kolkata

Ashok Gadgil
Lawrence Berkeley
National Laboratory, CA, USA

The Problem: About 60 million people in India and Bangladesh are exposed to high levels of naturally occurring arsenic every time they drink from their local well. Nearly all household and community scale solutions deployed have failed because they were not maintained, repaired, or affordable.

The Solution: The team have developed and patented Electro Chemical Arsenic Remediation (ECAR) which enables locally-affordable arsenic-remediation of water, within a sustainable service delivery model. Under this model, safe water is provided to school children while excess is sold at a locally-affordable price. This public-private partnership avoids the abandonment due to failed maintenance that has plagued other implementations.

Fourth Call of Proposals: In October 2013, the IUSSTF announced Fourth Call for Executive Summaries. Over 192 executive summaries (83 in Empowering Citizens and 109 Healthy Individual categories) were received in response. After a Joint Expert Panel review process, 18 shortlisted teams (9 in each category) were asked to submit their detailed business plans online. Two Joint Indo-US Expert Panels, one in each category, interacted with the teams face to face or through skype on February 25-28, 2014 at Santa Clara, CA. On the basis of a Joint Expert Panels review, following 4 finalists (2 in Empowering Citizens and 2 in Healthy Individual) were taken up for Stage III: Site Inspection and Due Diligence process.

Ref. No.	Project Title	Lead Partners
HI042	Transforming arsenic and fluoride crisis in drinking water into an economic enterprise	**Mike German** WIST Inc., Brighton, MA **Abhijeet Gan**, Rite Water Solutions (I) Pvt. Ltd., Nagpur **Arup K Sengupta**, Society for Technology with a Human Face, Kolkata
HI094	Development of a low-cost, portable auto-refractor	**Shivang R. Dave** PlenOptika, Somerville, MA **Sriram Ravilla** Aurolab, Madhurai
EC062	Developing novel biological seed treatments to confer abiotic stress tolerance in crops	**Rusty Rodriguez** Adaptive Symbiotic Technologies, Seattle, WA **Anup Karwa** SFPL Crop Life Sciences Pvt. Ltd., Krishidhan Seeds, Jalna
HI113	Commercializing a transformational modular roofing solution for low-income urban homes	**Shashi Buluswar** LIGTT Corporation, Oakland **Hasit Ganatra** Re-Materials, Ahmedabad

Flagship Program : Fifth Indo-American Frontiers of Science Symposium

Organizing Co-Chairs:

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University of California, Santa Barbara
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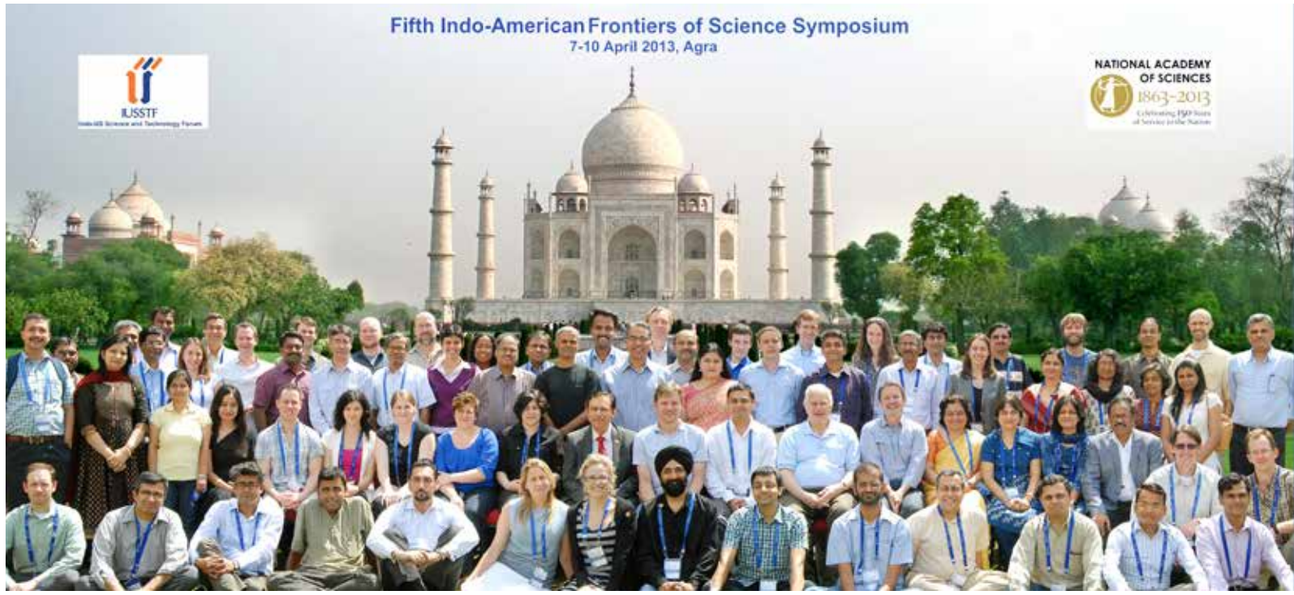
The fifth ***Indo-American Frontiers of Science (IAFOS) Symposium*** was convened by the Indo-US Science and Technology Forum (IUSSTF) as its annual flagship event in partnership with the US National Academy of Sciences (NAS) from April 7th to 10th at Agra, India. The symposium brought together about 70 brilliant young scientists and technologists from Indian and U.S. academia, laboratories and industry. At the symposium, attendees presented their talks as part of eight interdisciplinary sessions on contemporary research topics to colleagues outside their field with a view to both conveying and deriving cross-disciplinary information and insights through a format, which allows informed one-to-one discussions amongst the participants.

Session I: The acquisition of renewable, low-carbon forms of energy is perhaps the most important challenge facing mankind today. The introductory speaker in the session on ***Materials for energy conversion and storage: Discovery through experimental and computational approaches*** was *Don Seigel* (University of Michigan) who spoke on Materials for energy conversion and storage and what can be done to secure a sustainable energy future. *Jeff Sakamoto* (Michigan State University) delivered a talk on keeping up with the increasing demands for electrical energy storage and conversion. *Aninda Bhattacharyya* (Indian Institute of Science) spoke about materials for modern rechargeable batteries using Lithium-based battery as a case-study.



Session II: The lead speaker in the session on ***Planet/star formation*** was *Sujan Kumar Sengupta* (Indian Institute of Astrophysics) who spoke about more than 800 extra-solar planets that have revolutionized our understanding of planets and their formation. *Maheswar Gopinathan* (Aryabhatta Research Institute of Observational Sciences) delivered a talk on the Bok Globules that are identified as the sites of low mass star formation in the solar neighborhood. The origin of the earth and solar system is one of the longest-standing questions in science and *Andrew Youdin* (University of Colorado-Boulder) spoke about the birth of planets in the solar system and beyond.

Session III: The session on ***Systems biology and medicine*** began with a talk by *K.V. Venkatesh* (IIT-Bombay) who gave an overview of the field with system science principles in conjunction with experimental methodologies required to achieve a system level understanding of cellular behavior. *Raul Rabadan* (Columbia College of Physicians and Surgeons) delivered a talk on fast evolutionary processes by genome analysis of tumors and RNA viruses. *Anurag Agrawal* (CSIR-Institute of Genomics and Integrative Biology) spoke about how systems medicine is an exciting new frontier of science and translational applications of analytical concepts from systems biology to physiological or clinical data is rewarding.

Session IV: *Alison Pischedda* (University of California-Santa Barbara) delivered the introductory talk in the session titled ***Battle of the sexes*** and spoke about interactions between males and females being fundamental to the evolution of

sexual mating systems. *Ryan Calsbeek* (Dartmouth University) spoke about the resolution of sexual conflict and *N.G. Prasad* (IISER-Mohali) talked about interlocus sexual conflict and the evolution of life-histories.

Session V: In the session on ***Quasiparticles and semiconducting devices***, the lead speaker *Andrea Young* (MIT) spoke about massless electrons and fractionally charged particles in graphene. *Mandar Deshmukh* (Tata Institute of Fundamental Research) presented the efforts to develop a simple technique for lateral nanowire wrap around gate devices with high capacitive coupling. *Jay Sau* (Harvard University) talked about topological quantum computation and the search for non-abelian majorana modes in solid-state systems.

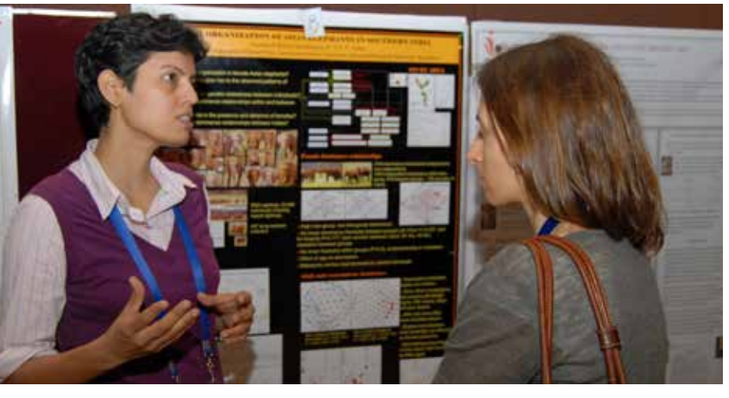
Session VI: *Subha Majumdar* (Tata Institute of Fundamental Research) delivered the introductory talk in the session on ***Dark matter/dark energy***. *Sudhir Vempati* (Institute Institute of Science) discussed particle physics models of dark matter. *Marcelle Soares-Santos* (Fermilab) presented an overview on dark energy and discussed prospects for shedding light on this problem with current and upcoming methods.

Session VII: Graphs are one of the most ubiquitous models of both natural and human-made structures. *Prahladh Harsha* (Tata Institute of Fundamental Research) delivered the introductory talk of the session on ***Graphs, randomness and computation*** and surveyed the area of graph theory and its applications. *Nikhil Srivastava* (Microsoft Research) spoke about a recent line of work with Batson, Speilman and Teng which showed that every graph can be approximated by one which is very sparse. *David Liben-Nowell* (Carleton College) talked about some recent computational research that studies information propagation through the digital traces of online activity.

Session VIII: *Mahesh Sankaran* (Tata Institute of Fundamental Research) delivered the introductory talk in the session on ***Ecological impacts of climate change***. He spoke about how human activities are transforming our planet and its climate in unprecedented ways and the fact that understanding the consequences of these changes represents one of the most pressing problems faced by ecologists today. *Sabin T.P.* (Indian Institute of Tropical Meteorology) talked about high-resolution regional climate downscaling. *Joshua Lawler* (University of Washington) spoke about projected future changes in climate and how they will likely result in shifts in flora and fauna to track suitable conditions.

At the FOS, *Bruce Alberts* (Editor-in-Chief, Science 2008-2013, U.S. Science Envoy 2009-2011 and President, U.S. National Academy of Sciences 1992-2005) delivered a talk on ***Science and the world's future*** where he spoke about knowledge sharing and capacity building; and, connecting scientists to each other and to their local communities.

A unique dimension of the Indo-US FOS Symposium is the **Frontiers of Science (FOS) Awards** that have been instituted by IUSSTF and was announced by *Rajiv Sharma* (Executive Director, IUSSTF). The award consists of USD 10,000 to be shared between the partnering Indian and American awardees, spread over a period of two years.



India-U.S. Grand Challenge: Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in India and the U.S.

Contact Person

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Hypertension diagnosis and management is a critical healthcare issue. However, the basic underlying approach for the measurement of Blood Pressure has essentially remained the same for the past several decades. This is an obvious area that is ripe for disruptive technological innovation. The **Science & Engineering Research Board** (SERB), Department of Science & Technology, Government of India has partnered with the **National Institute of Biomedical Imaging and Bioengineering** (NIBIB, NIH), USA to announce the **Indo-U.S. Grand Challenge Initiative on *Affordable Blood Pressure Measurement Technologies for Low-Resource Settings in India and the U.S.*** The purpose of the initiative is to encourage collaborative research within and between both the countries to propose new approaches to the measurement of Blood Pressure that are unobtrusive or passive, low cost and which can automatically provide frequent data recording and reporting to healthcare workers as well as feedback to the patients. SERB and NIBIB have launched two separate and parallel, but fully coordinated, funding opportunity announcements in India and the U.S. respectively to promote research in this area and generate alternate scientific approaches and technological options. It is expected that this partnership between the two countries will leverage knowledge and material resources to develop new technologies which are relevant for low resource settings not only in their respective political domain but other similar settings all over the world.

IUSSTF received 57 Expressions of Intent (EOI) in response to the call for EOIs announced in August 2013. The Expert Committee set up by SERB and IUSSTF shortlisted 15 Expressions of Intent for further submission of detailed proposals. After an in-depth review and evaluation process, the following 3 proposals were selected for support.

Title of the Proposal	Name of the Lead PI
Development of a low cost arterial tonometry based blood pressure monitoring device	**Santosh Noronha** Indian Institute of Technology, Bombay
Arterial Compliance Probe for Cuff less Blood Pressure Measurement	**Mohanasankar Sivaprakasam** Indian Institute of Technology, Madras
Rapid Real time Blood Pressure Measurement and Hypertensive Predisposition Diagnostics using Pulse Transit Time and Blood Pressure Variability	**Bala Pesala** Senior Scientist CSIR-Central Electronics Engineering Research Institute (CSIR-CEERI), Pilani

DST-Lockheed Martin India Innovation Growth Program

The **DST-Lockheed Martin India Innovation Growth Program (IIGP)** was launched in 2008 to enhance the growth and development of entrepreneurial economy in India by adopting the prevalent best practices both in US and India. IIGP is designed as an accelerated technology assessment and commercialization initiative through a business plan competition involving commercial assessment of technology; business development; and finally technology commercialization through structured mentoring. The program is a joint initiative of the Department of Science and Technology, Govt. of India; Lockheed Martin Corporation; Indo-US Science and Technology Forum, Federation of Indian Chambers of Commerce and Industry; Stanford Graduate School of Business and the IC^2 Institute at the University of Texas.

The Program is open to technologies in areas such as aeronautics, agriculture, biotechnology, chemistry, communications, computing,defence, electronics, environment, IT, manufacturing, marine, materials, medical/life sciences, nanotechnology, etc.

The IIGP received an overwhelming response from the innovators in 2013. A total of 996 applications were received as a result of nationwide roadshows. 19 pan-India Roadshows were conducted in Ahmedabad, Hyderabad, Goa, Mumbai, Pune, Nagpur, Chennai, Bangalore, Delhi, Vadodara, Kolkata, Bhubaneswar, Jaipur, Cochin, Guwahati, Ludhiana, Ranchi, Patna and Indore. A ***Technology Commercialization and Entrepreneurship Workshop*** was organized to provide training to the innovators and also prepare them to participate in an Innovator's Competition during April 14-19, 2013 at Goa. The selected top 50 innovators were given week-long training in basic principles of product commercialization, readiness for market, business models, IP rights, competitive positioning, and mechanisms for revenue by experienced faculty members from the Stanford Graduate School of Business.

An ***Innovators' Competition*** was organized during April 29 – May 1, 2013 at Federation House, New Delhi followed by the Awards Ceremony on May 2, 2013. The top 50 innovators presented their innovations to a panel of technologists and commercialization experts from India and the United States. At the end of the competition, the following innovations were awarded:

Contact Person

Nirankar Saxena

Federation of Indian Chambers of Commerce and Industries, New Delhi

E-mail: innovations@ficci.com

Innovation	Innovators
A novel antibiotic adjuvant entity for lowering antimicrobial resistance	**Manu Chaudhary** Venus Medicine Research Centre
Simple soil nutrient analysis using Alternative Analytical Technology	**J Arunkumar** Shri AMM Murugappa Chettiar Research Centre
Low cost Indigenous raw materials for making sanitary napkins	**Jaydeep Mandal** Aakar Innovations Pvt. Ltd.
Flame ware / ceramic cooking ware	**Bharat Gidwani** Ninads Pottery
Light weight unmanned drone	**Aakash Sinha** and **Suryansh Saxena** Omnipresent Robot Technologies Pvt. Ltd.
Mobile shoe charger	**Mandar Tulankar** Zero Point Energy Pvt. Ltd.
DeTect (normal/high temperature defect detection technology)	**Tarun Kumar Mishra** Indian Institute of Technology Madras
Mobile Harvest	**Sachin Gaur** Mobile Harvest Solution Private Limited
Decision making tools using digital maps	**Amarsh Chaturvedi** Transerve Technologies Pvt. Ltd.
Hand pump integrated with filtration system for treating contaminated ground water /Jeevan Dhara	**Kirti Ranjan** PayJal Solutions
Alvel Omega 3 Egg	**Surekha S Bhalerao** Center for innovation in nutrition health and diseases.
SES- Molecular Diagnostic Services	**Ravi Kumar** XCyton Diagnostics Pvt. Ltd.
Environmental Remediation Catalyst	**Bharat Lodha** Battelle Science and Technology India Pvt. Ltd.
Fault tolerant unmanned aerial vehicle autopilot	**Srinath Mallikarjunan** Unmanned Dynamics

Innovation	Innovators
Dr M Hope Cloud based SaaS application for Hospital	**B. K. Murali** and **Dr M Hope**
OcuDA: Ocular Digital Adaptor	**Ramesh S.Ve** Manipal University
Democratization of Business Intelligence with 1KEY	**Vikram Kole** MAIA Intelligence Pvt. Ltd.
Papyrus Eficiencia - most eco-friendly and cost efficient paper	**Anurag Kumar Kyal** KIIT school of Biotechnology
Clean energy generation using plasma process	**Rajeev Prasad Gupta** Green Systems
CareMother- Mobile Pre and High Risk Care	**Shantanu Pathak** Science for Society Techno Services Pvt Ltd.
Multifuel/fuel-hydrid I.C. Engine	**Das Ajee Kamath** GYATK RVCR Apparatus Private Limited
Universal Multifunction Accelerator	**Venu Kandadai** Manjeera Digital Systems Pvt. Ltd.
Vertical axis wind turbine	**Orlando Fernandes** Nontional Conventional Power Devices Pvt. Ltd.
Beta thalassemia carrier detection kit	**Mahabaleshwar V Hegde**
An organic plant growth enhancer and yield promoter	**M.S. Rao** Indian Institute of Horticultural Research
Photo dynamic therapy laser system	**Ramadas M R Pillai** Vinvish Technologies Pvt. Ltd.
VAJRA (Vessel desk)	**Raghunath P. Lohar** Center for innovation and business acceleration
Solar powered crop harvester	**T. J. David** ENTICE-IIIT
BASP biotech processing and filtration system	**Vikrant Patil** BASP Industries
Bamboo Greenhouse	**Arupratan Ghosh**

The Department of Science and Technology, Government of India jointly with IUSSTF and FICCI took a delegation of 9 innovators and 5 incubation managers/ Govt. of India Officials to the Silicon Valley during August 26 – 30, 2013. The delegation was hosted at the Silicon Valley by The Indus Entrepreneurs (TiE) for understanding the Innovation and Entrepreneurship ecosystem at Silicon Valley. The week-long program included TiE's immersion (boot camp) for innovators, visits to iconic/global Silicon Valley companies, start-ups, incubators and universities. The delegation also spent a day at Stanford University's Graduate School of Business.

Two technology expositions were organized in 2013 (in Ahmedabad on 6 September 2013 and in Patna on 5 December 2013) to showcase the commercialization deals signed by the Indian innovators with leading industry partners. The innovators also got a platform to exhibit their technologies at these expositions to potential industry partners, investors and other start- ups.

Indo-U.S. Startup Accelerator Workshop

22 - 23 November 2013

The **Indo-U.S. Science and Technology Forum** in partnership with the **Federation of Indian Chambers of Commerce & Industry**, the **U.S. Embassy**, the **Department of Science and Technology** and **91 springboard** organized the ***Indo-U.S. Startup Accelerator Workshop*** at New Delhi. The workshop, using an unconventional format, brought together startups, aspiring entrepreneurs, innovators, angel investors and venture capitalists from across the country to brainstorm and debate on the broad challenges that a startup faces.

In his keynote address at workshop **Mr. Nandan Nilekani**, (Chairman, Unique Identification Authority of India) said that the government needs to create platforms for entrepreneurs and innovation to flourish in the country. He remarked that the Unique Identification (UID) platform was created after looking at the two successful innovations that took place in the U.S. namely, internet and GPS. Both became platforms for numerous entrepreneurs and startups. However, he added that both these platforms initially were funded publically. Citing the example of the Aadhar Card, he said, platforms lead to expansion. Aadhar cards have led to creation of an infrastructure of unique identity of people, digital authentication of a person, electronic KYC (Know Your Customer) and capability of creating a financial address.

Dr. T. Ramasami (Secretary, Department of Science & Technology) identified financial support, access to

market, material and technology as the challenges that entrepreneurs and startups face. He said that the government and entrepreneurs should learn and gain from each other's experiences. Startups have the advantage of being sensitive to the needs of the place and can be a part of the development process.

Ms. Nancy J. Powell (U.S. Ambassador to India) in her special address, remarked, "Entrepreneurship is the engine for global economic growth and increased productivity of workers in any economy. This is true for both developed and developing economies. The challenge for governments and private stakeholders is to provide an environment where entrepreneurship can flourish and where entrepreneurs can quickly bring their ideas and products to market. Entrepreneurs are by nature risk takers and sometimes their ventures fail. Many successful entrepreneurs achieved their success on third or fourth attempt to start a viable business." She emphasized that it is the entrepreneurs in clean energy, medicine, advanced manufacturing, information technology, robotics, nanotechnologies and other fields who will build the new industries of the 21st century, and solve some of our toughest global challenges. She added that as the world becomes more interconnected, and more countries become knowledge-based economies, it is no longer optional - but essential – for public and private enterprises to collaborate across borders. "We live in an exciting time where economic and social challenges can be overcome by human ingenuity. We look forward to continuing our work with the Indian government on promoting a collaborative entrepreneurial environment. The potential for mutual benefit through our cooperation is limitless". While moderating the session, **Mr. Samuel Kotis** (Deputy Minister Counselor for Environment, Science & Technology Affairs, US Embassy) said that there is a need to increase the success rate. **Dr. Rajiv Sharma** (Executive Director, Indo-U.S. Science & Technology Forum) said that in India a series of events are being organized in collaboration with the U.S. to promote entrepreneurship and startups in the country. **Mr. Manav Subodh** (Global Manager for Entrepreneurship & Innovation, and Higher Education at Corporate Affairs Group, Intel) said that there is a need to create an ecosystem where entrepreneurs are allowed to fail without being reprimanded. It is necessary to realize that failures are bound to happen but one must look at a failed entrepreneur as an experienced entrepreneur. He said that startups will come and go but entrepreneurs will stay. Hence, one must build a relationship with the individual entrepreneur because he will have many more innovative ideas to explore and work on.

Text courtesy: FICCI Media Division
http://www.ficci.com/past-Events-page.asp?evid=21727

U.S.-India Science & Technology Innovation Awards

The Government of India, the United States Government, the Federation of Indian Chambers of Commerce and Industry, and the Indo-U.S. Science and Technology Forum announced the winners of the Millennium Alliance and U.S.-India Science and Technology Endowment Fund awards.

The award ceremony took place in the presence of the Honorable Minister for Science and Technology and Earth Sciences Mr. S. Jaipal Reddy; U.S. Ambassador to India Nancy J. Powell; Assistant to the U.S. President for Science and Technology Dr. John Holdren; U.S. Agency for International Development (USAID) Administrator Dr. Rajiv Shah; Secretary of Department of Science & Technology Dr. T. Ramasami; and FICCI National Executive Committee Member and CA Technologies India Chairman Mr. Saurabh Srivastava.

The U.S.-India Science & Technology Endowment Board,

a bi-national initiative to support commercialization of jointly developed innovative technologies with social impact, awarded eight winners and two young entrepreneurs from its second and third calls for proposals. The winners will each receive up to INR 2.5 crores and the entrepreneurs will together receive approximately INR 14 lakhs. The Millennium Alliance is a partnership between USAID, FICCI, and India's Technology Development Fund, Department of Science and Technology to support new innovations that strengthen early-grade reading as well as increase access to clean and affordable energy, safe drinking water, quality health care, and a nutritious food supply to those most in need. Out of over 1,400 applications in the first round, nine awardees were announced with the award amount totaling approximately INR 8.9 crores.

Text Courtesy: **U.S. Embassy** New Delhi
Full text can be accessed at http://newdelhi.usembassy.gov/pr130624.html

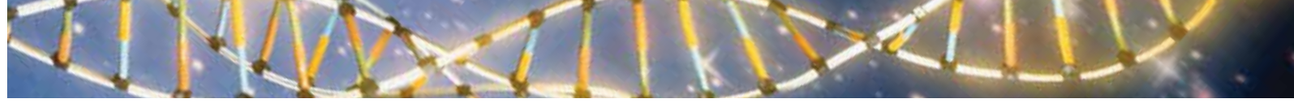
Leadership of Women in Science and Technology

The Indo-U.S. Science and Technology Forum in partnership with the Department of Science and Technology (Govt. of India) and the Embassy of the United States of America, organized a discussion on "Women in Science and Engineering" with Sunita Williams (NASA Astronaut) at Fulbright House, New Delhi on 1st April 2013. The Open Discussion on Issues of Leadership of Women in Science & Engineering was moderated by Dr. Vinita Sharma (Advisor, Department of Science & Technology, Govt. of India) and was attended by women leaders from Federal Agencies, Academia and Industry.

Captain Williams received her commission as an Ensign in the United States Navy in May 1987. She was designated a Naval Aviator in July 1989. Selected by NASA in June 1998, she reported for training in August 1998. Astronaut Candidate Training included orientation briefings and tours, numerous scientific and technical briefings, intensive instruction in shuttle and International Space Station systems,

physiological training and ground school to prepare for T-38 flight training, as well as learning water and wilderness survival techniques. Following a period of training and evaluation, Williams worked in Moscow with the Russian Space Agency on the Russian contribution to the space station and with the first Expedition Crew. Following the return of Expedition 1, Williams worked within the Robotics branch on the station's Robotic Arm and the follow-on Special Purpose Dexterous Manipulator. As a NEEMO2 crew member, she lived underwater in the Aquarius habitat for 9 days. After her first flight, she served as Deputy Chief of the Astronaut Office. She then supported a long duration mission as Flight Engineer for Expedition 32 and International Space Station Commander for Expedition 33. Williams has spent a total of 322 days in space on two missions; she ranks sixth on the all-time U.S. endurance list and second all-time for a female. With 50 hours 40 minutes, she also holds the record total cumulative spacewalk time by a female astronaut.

Visitation Programs



Indo-US Research Fellowships

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In an effort to augment scientific excellence in emerging areas of science and technology, IUSSTF announced the fifth batch of ***Indo-US Research Fellowships*** awarded to outstanding young researchers from India below the age of 40, to carry out research in frontier areas of science and technology at a leading institution in the United States. This fellowship is aimed to introduce Indian scientists and engineers from leading academic institutions and laboratories, in the early stages of their careers, to research opportunities in the US thereby helping to forge long-term collaborative relationships and linkages between the scientific communities of the two nations.

This prestigious fellowship scheme is implemented with funding support from the Science and Engineering Research Board (SERB) of the Department of Science and Technology (DST), Government of India. The fellowship will allow the awardees to spend between 3 to 12 months in any premier host institution in USA and will cover monthly stipend, return air-fare, preparatory allowances, conference allowances, etc.

The areas covered under the fellowship include atmospheric and earth sciences; chemical sciences; engineering sciences; life sciences; medical sciences; mathematical and computational sciences; and, physical sciences.

The following 45 Indian researchers were chosen for the 2013 awards :

Indian Researcher	US Host	Subject Area
A. Vanniarajan Aravind Medical Research Foundation, Chennai	**Arupa Ganguly** University of Pennsylvenia Philadelphia	Retinoblastoma genetics
Amit Sethi Indian Institute of Technology, Guwahati	**Peter Gann** University of Illinois at Chicago	Application of machine learning and image processing to the study of prostate cancer risk assessment and treatment responce using morphmetry of histological images
Ankhi Roy Indian Institute of Technology, Indore	**Moskov Amaryan** Old Dominion University, Norfolk	Experimental hadron physics
Arup Kumar Nandi, CSIR-Central Mechanical Engineering Research Institute, Durgapur	**Robert G. Landers** Missouri University of Science and Technology, Rolla	Manufacturing
Ashutosh Tiwari, Translational Health Science & Technology Institute, Gurgaon	**Anindya Bagchi** Masonic Cancer Center, University of Minnesota, Minneapolis	Molecular biology
B. Parameswari, Sugarcane Breeding Institute, Coimbatore	**S.P. Dinesh Kumar** University of California, Davis	Virus induced gene silencing
Bapurao B. Shingate Dr. Babasaheb Ambedkar Marathwada University, Aurangabad	**Larry E. Overman** University of California Irvine	Organic synthesis
Bilal Ahmad Bhat CSIR-Indian Institute of Integrative Medicine, Srinagar	**Salvatore D. Lepore** Florida Atlantic University Boca Raton	Total synthesis of natural products
Bireswar Das Indian Institute of Technology, Gandhinagar	**Eric Allender** Rutgers University New Jersey	Computational complexity theory
Bittagopal Mondal CSIR-Central Mechanical Engineering Research Institute, Durgapur	**Partha P. Mukherjee** Texas A&M University, College Station	Water management in PEM fuel cell
Debarati Paul Amity Institute of Biotechnology, Noida	**Andy Ogram** University of Florida, Gainesville	Molecular microbial ecology with respect to bioremediation of contaminated environment
Dhanjit Kumar Das National Institute for Research in Reproductive Health, Mumbai	**Vishwajit L. Nimgaonkar** University of Pittsburgh, Pittsburgh	Molecular genetics
Dibyendu Chakravarty The International Advanced Research Centre for Powder Metallurgy and New Materials, Hyderabad	**P M Ajayan** Rice University, Houston	Synthesis of nanopowders using Induction plasma technique, spark plasma sintering of nanocomposites for structural applications
Erathimmanna Bhoje Gowd CSIR-National Institute for Interdisciplinary Science and Technology	**Tadanori Koga** Stony Brook University Stony Brook	Polymer science and technology
Himadri Sekhar Das Assam University, Silchar	**LudmillaKolokolova** University of Maryland	Astrophysics
K. Tirumalesh Bhabha Atomic Research Centre Mumbai	**Carol Kendall** and **Megan Young** Isotope Tracers Project, US Geological Survey	Contaminant hydrology and biogeochemistry in surface and groundwater systems
Konjengbam Darunkumar Singh Indian Institute of Technology Guwahati	**Zdenek P. Bazant** Northwestern University Evanston	Tubular structures

Indian Researcher	US Host	Subject Area
Madhurima Jana National Institute of Technology Rourkela	**Alexander D. MacKerell Jr.** University of Maryland	Computer simulation of biomolecules
Madhusudan Reddy Nandineni Centre for DNA Fingerprinting and Diagnostics, Hyderabad	**Arthur Eisenberg** University of North Texas Health Science Center, Fort Worth	Human forensic DNA profiling
Manas Kumar Dalai CSIR-National Physical Laboratory, New Delhi	**T. C. Chiang** University of Illinois at Urbana-Champaign	Experimental condensed matter physics
Mani Bhushan Indian Institute of Technology, Mumbai	**Lorenz T. Biegler** Carnegie Mellon University Pittsburgh	Efficient decentralized constrained state estimation
Manish Tiwari National Centre for Antarctic & Ocean Research, Goa	**Syee Weldeab** University of California Santa Barbara	Palaeoclimatology and Palaeoceanography
Manjusha V. Shelke CSIR-National Chemical Laboratory, Pune	**P. M. Ajayan** Rice University, Houston	Synthesis of functional nanomaterials and hybrid devices for electrochemical charge storage
Nripen Chanda CSIR-Central Mechanical Engineering Research Institute, Durgapur	**Michael J** and **Sharon R. Bukstein** University of Missouri-Columbia	Fabrication of micro/nano devices (e.g. sensors, actuators, drug delivery systems) for biomedical application
Parimal Acharjee National Institute of Technology, Durgapur	**Sukumar Brahma** and **Wenxin Liu** New Mexico State University Las Cruces	Intelligent control and protection of smart grid
Patri Venkata Srilakshmi National Institute of Technology Warangal	**Kaushal Rege** Arizona State University, Tempe	Bio-organic Chemistry (Non-viral gene delivery)
Priyanka Ghosh Indian Institute of Technology, Kanpur	**Ronald Y.S. Park** University of Colorado, Boulder	Soil dynamics and earthquake geotechnical engineering
Rahul Swarup Sharma Dayalbagh Educational Institute, Agra	**R D K Misra** University of Louisiana at Lafayette	Bulk nanostructured materials for medical implants
Rajarshi Pal Manipal University, Manipal	**Kapil Bharti** National Eye Institute, Bethesda	Stem cell biology
Rakesh Kumar Singh Banaras Hindu University, Varanasi	**H L. Nakhasi** Centre for Biologics Evaluation and Research, Bethesda	Infectious tropical diseases
Ram Rup Sarkar CSIR-National Chemical Laboratory, Pune	**Ilya Shmulevich** Institute for Systems Biology, Seattle	Theoretical studies of biological systems at different levels and scales
Ramakrishnan Ganeshan Birla Institute of Technology & Science-Pilani, Hyderabad Campus	**Ganpati Ramanath** Renesselaer Polytechnic Institute, Troy, New York	Mesostructured nanothermoelectric materials for heat management and energy harvesting
Ranjan Kumar Jana S.V National Institute of Technology, Surat	**Bruce C. Berndt** University of Illinois at Urbana-Champaign	Bessel function series
Ranjan Tamuli Indian Institute of Technology, Guwahati	**Katherine A. Borkovich** University of California Riverside	Cell signaling in *Neurosporacrassa*

Indian Researcher	US Host	Subject Area
Sandeep Kumar Sharma Bhabha Atomic Research Centre, Mumbai	**Allen Paine Mills Jr.** University of California Riverside	Fabrication and testing of micro cavities for Bose-Einstein condensation of positronium and annihilation gamma ray laser research
Sanjay Yadav CSIR-Indian Institute of Toxicology Research, Lucknow	**Levi J. Beverly** James Graham Brown Cancer Center, Louisville	Lung cancer and post-transcriptional regulation of ubiquitin
Sanjib Kumar Panda Assam University, Silchar	**Leslie M.Hicks** Donald Danforth Plant Science Center, St Louis	Plant proteomics
Sarika CSIR-Central Drug Research Institute, Lucknow	**Dwight German** University of Texas, Dallas	Central Nervous System diseases
Seraj Ahmad Ansari Bhabha Atomic Research Centre, Mumbai	**Linfeng Rao** Lawrence Berkeley National Laboratory, Berkeley	Nuclear waste remediation
Shivakumar Angadi CSIR-Institute of Minerals and Materials Technology, Bhubaneswar	**J. D. Miller** The University of Utah, Salt Lake City	Processing of rare earth minerals
Suboj Babykutty Mar Ivanios College, Trivandrum	**Rakesh K. Jain** Harvard Medical School, Boston	Role of nitric oxide in tumor metastasis
Sudheesh Kumar Kattumannil, Indian Statistical Institute, Kolkata	**Hira L Koul** Michigan State University, East Lansing	Time series analysis
Suresh Kumar University of Delhi, New Delhi	**Filip G. Kondev** Argonne National Laboratory, Lemont	Experimental nuclear physics and nuclear data evaluation
Uma Shankar CSIR-National Geophysical Research Institute, Hyderabad	**Anne Martin Trehu** Oregon State University, Corvallis	Gas hydrates (marine seismic)
Vivek Bindal Sir Ganga Ram Hospital, New Delhi	**Pier Cristoforo Giulianotti** University of Illinois at Chicago	Robotic surgery and its application in gastrointestinal surgery

Indo-US Public Health Fellowship

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In an effort to augment scientific excellence in area of public health, the Indo-US Science and Technology Forum (IUSSTF) in partnership with the Public Health Foundation of India launched the ***Indo-US Public Health Fellowships*** program supported by the Science and Engineering Research Board (SERB), Government of India. The objective of this program is to promote research and capacity building in the crucial area of public health. It is envisaged that these fellowships will help strengthen and expand the knowledge base of Indian public health research and education.

This prestigious fellowship scheme was formally launched in March 2012 and will allow the awardees to spend between 3 to 12 months in any premier host institution in USA and will cover monthly stipend, return air-fare, preparatory allowances, conference allowances, etc. These fellowships will encourage young and mid-career scientists to interact with the international public health community and build long-term sustainable linkages.

Researchers from academia and laboratories chosen for the 2013 awards were:

	Indian Researcher	Broad Area of Research	US Host
1	**Anitha Thippaiah** Indian Institute of Public Health, Hyderabad	Infectious disease epidemiology	**Mo Salman** Colorado State University
2	**Susmita Chattopadhyay** Public Health Foundation of India, New Delhi	Health Economics	**Richard Gosselin** University of California San Francisco
3	**Ramesh S Ve** Manipal University, Karnataka	Epidemiology of glaucoma, Blindness, visual impairment and age induced ocular changes and Tele Optometric Practice and standardization of ophthalmic Image analyzing software	**David S. Friedman** Johns Hopkins University
4	**K. Chandrasekaran** National Institute for Research in Tuberculosis	Spatial Statistics	**Koushik Ghosh** University of Nevada, Las Vegas
5	**Prabhat Kumar Chand** National Institute of Mental Health and Neurosciences, Bangalore	• Substance and drug abuse • Experience in use of technology in providing care in underserved areas	**Sanjeev Arora and Miriam Komaromy** University of New Mexico
6	**Deepak Kumar** College of Veterinary Science & Animal Husbandry R. K. Nagar, Tripura	Zoonotic diseases and food-borne infections	**Siddhartha Thakur** North Carolina State University (NCSU), Raleigh

Stanford India Biodesign Fellowships

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The ***Stanford-India Biodesign (SIB) Fellowship*** is a leadership training program in biomedical technology innovation initiated by the Department of Biotechnology (DBT), Govt. of India, and Stanford University in partnership with IUSSTF. The goal of this program is to train the next generation of biomedical technology innovators in India through a fellowship to be held jointly at Stanford University, the Indian Institute of Technology (IIT)-Delhi, and, All India Institute of Medical Sciences (AIIMS), New Delhi. This program is directed to candidates with advanced degrees in engineering, medicine or business who could be potential innovators in early-stage development of new biomedical technologies for emerging healthcare needs.

Over the course of the one-year program, approximately half of the Fellows' time will be spent in India and the other half at Stanford University. The core objective of the program is a multidisciplinary team-based fellowship where SIB fellows will work with other young innovators with a combination of engineering, medical and industry backgrounds. The team will examine clinical needs within the Indian setting, identify opportunities for biomedical technology innovation with the goal to potentially invent, prototype, develop and patent one or more new technologies. Fellows will also be mentored by "real-world" experts from the biomedical technology, legal and venture capital industries both in the United States and India. The program would also include exchange of faculty between the academic institutions.

In September 2013, a biopsy tool for the liver has been licensed out of the Department of Biotechnology on behalf of the SIB fellows from 2012 (Siraj Bagwan, Sid Joshi, Jonathan Pillai and Jagdish Chaturvedi are the inventors of BioScoop). In December 2013, the 7th Annual Indian MedTech Summit was held in Delhi, with more than 175 participants from India, Singapore, US, Australia

and elsewhere. Several licenses were issued to SIB fellows for furthering their devices:

- Noxeno (foreign body removal from nose) was licensed out to Innaccel, a medtech accelerator based out of Bangalore.
- Parasafe (a kit to perform safer paracentesis) was licensed out to Mecmaan Healthcare Private Limited, New Delhi, an indigenous company that develops and manufactures disposable devices in India.
- Thorashield (a device that makes thoracentesis safer) was licensed out to Mecmaan Healthcare Private Limited, New Delhi.
- Accufeed (an accurate guide to nasogastric feeding) was licensed out to Mecmaan Healthcare Private Limited, New Delhi.

Four outstanding individuals were selected for the 2014 SIB Fellowship:

Deevish N. Dinakar
with a background in Medicine and Surgery

Neeraj Kumar
with a background in Product Design

Pranav Chopra
with a background in Industrial Design Manufacture and Management

Sohail Gupta
with a background in Biochemical Engineering and Biotechnology

Khorana Program Technology Transfer Course

The Department of Biotechnology (DBT), Govt. of India, University of Wisconsin-Madison (UW) and the Indo-US Science and Technology Forum (IUSSTF) partnered to support the ***Technology Transfer Course*** under the aegis of the prestigious Khorana Program named in honor of Dr. Har Gobind Khorana, who won the Nobel Prize in 1968 for his work at the interface of Chemistry and Biology while a member of the UW faculty.

The Technology Transfer Course is specially designed as an intensive two-week program at UW-Madison, aimed to provide participants with significant insight into managing technology in its journey from the laboratory to the marketplace through a series of pedagogical lectures, round table discussions, case studies, and site visits. The course would include some of the following specific aspects: structuring the research environment to facilitate commercialization while at the same time not compromising the scientific process; entrepreneurship business education; management of conflict of interest; patenting – disclosure, screening, filing and defending patents; marketing and licensing new technologies; venture capital – raising funds, selecting investments, mentoring new companies, etc.

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The following **17 candidates** participated in the **Technology Transfer Course** in 2013:

	Name
1	**Vinita Jindal** Biotechnology Industry Research Assistance Council (BIRAC), New Delhi
2	**Ankkur Goel** Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad
3	**Hajimalang Husensab Pattekhan** CSIR-Central Food Technological Research Institute, Mysore
4	**Sanjay Kumar** CSIR-Central Institute of Medicinal and Aromatic Plants, CIMAP, Lucknow
5	**Jyoti Yadav** CSIR-Institute of Genomics & Integrative Biology (IGIB), New Delhi
6	**Anil Sood** CSIR-Institute of Himalayan Bioresource Technology, Palampur H.P
7	**Nitin Shukla Tiwari** CSIR-National Chemical Laboratory, Pune
8	**Daman Saluja** Dr. B. R. Ambedkar Centre for Biomedical Research, University of Delhi
9	**Rabindra Prasad Singh** ICAR-Indian Veterinary Research Institute, Bareilly, Uttar Pradesh

	Name
10	**Rajan Sharma** ICAR-National Dairy Research Institute, Karnal
11	**Prasanna Belur Devarabhatta** National Institute of Technology Karnataka (NITK), Surathkal
12	**Aruna** TIFAC, New Delhi
13	**Koustubh Panda** University of Calcutta
14	**Meenakshi Munshi** Department of Biotechnology, Govt. of India
15	**Sundeep Sarin** Department of Biotechnology, Govt. of India
16	**Dhananjay Kumar Tiwari** Department of Biotechnology, Govt. of India
17	**Kakali Dey Dasgupta** Department of Biotechnology, Govt. of India

American Society for Microbiology (ASM) - IUSSTF Microbiology Visiting Professorships

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Under an arrangement between IUSSTF and American Society for Microbiology (ASM), the **Indo-US Professorship Awards in Microbiology** were instituted in 2003 with the aim to foster scientific cooperation, education, training and capacity building at individual and institutional levels through exchange visitation. The ASM-IUSSTF Visiting Professorships award is administered parallel with the ASM International Professorship Program.

The program enables:

- Microbiologists in India and the United States to visit institutions in the two countries to teach and interactive short course on a topic in any of the microbiological disciplines (Teaching Professor)
- Microbiologists in India to participate in an interactive short course on a topic in any of the microbiological disciplines, or conduct a research project in partnership with colleague in a research facility in the US (Research Professor)

Open to ASM members and non-members alike, the program seeks to broaden collaboration between India and the US on issues of global concern. Up to eight professorships are offered per program year.

The following visitations were awarded in 2013-14:

Daniel O'Sullivan from University of Minnesota, Food Science and Nutrition, St Paul, MN, was awarded the Teaching Professorship to deliver a course on *RNAseq and functional analysis of probiotic bifidobacteria* at CSIR-Central Food Technological Research Institute, India which was hosted by Prakash Halami.

Jamboor Vishwanatha from University of North Texas Health, Science Center was awarded Teaching Professorship to deliver a course on *Bacterial Antibiotic Resistance and Nanotechnologies*, at the Dayananda Sagar College of Engineering, India and was hosted by Rajeshwari Narayanappa.

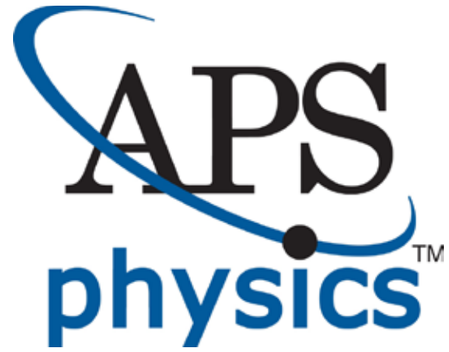
Kalia Vipin from CSIR-Institute of Genomics and Integrative Biology, Delhi was awarded Research Professorship

to pursue the research project titled *Quorum sensing in aid of anticancer therapy* with Thomas Wood at Pennsylvania State University, USA.

Pratyoosh Shukla from M.D. University, Rohtak was awarded a Research Professorship to conduct the research project *Functional genomic characterization of novel fungal P450 oxygenases from basidiomycete genomes with enhanced potential for use in lignocellulosics-based bioprocesses* at the University of Cincinnati, USA with Jagjit Yadav.

Rajesh Sani from South Dakota School of Mines and Technology, was awarded Professorship to deliver a short course entitled *Anaerobic Microbial Processes for Energy and Environment* at Guru Nanak Dev University, India and was hosted by Chadha Bhupinder.

IUSSTF-American Physical Society (APS) Fellowships



IUSSTF and the American Physical Society (APS) have partnered to support a bilateral exchange program that includes the ***Indo-US Professorship Awards in Physics*** which will be awarded to faculties and scientists from India and USA every year to teach short courses or provide physics lecture series and, the ***Indo-US Physics Student Visitation Program*** for student exchange every year. The program was launched in 2008.

'Professorships and Lectureships' consist of 1-2 week courses or a lecture series delivered at an Indian or US institution. Recipients are selected by a joint APS-IUSSTF review committee, with a call for proposals twice each year. Awards are typically used for travel, materials and expenses associated with course delivery. The objective of the Visiting Professorship is to enable physicists to build strong collaborative linkages in physics education and research between the scientific communities of US and India.

The Physics Student Visitation Program aims to mostly support graduate student travel to India by US citizens, while still enabling some students of Indian citizenship to travel to the United States. These studentship programs will help to build early career relationship between the next generation of physicists from US and India. The students can apply for this visitation program to attend a short-course, or summer training; to visit with a professor in his/her field of study; to work temporarily in a lab; or for any other opportunity that the student/professor feels is worthy of support.

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The recipients of the ***2013 Indo-US Professorship Awards in Physics*** are:

Name and Institution	Host	Research area
Michael Weinert University of Wisconsin, Milwaukee	Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore	Lectures and hands-on session on Dirac materials—graphene and topological insulators
V. Kumaran Indian Institute of Science, Bangalore	University of Florida	Lecture series on condensed matter sciences in physics and the PIRE center for multiphase flows in Chemical Engineering

The recipients of the ***2012 Indo-US Physics Students Visitation*** program are:

Name and Institution	Host	Research area
Adam Iaizzi Boston University, Boston	Tata Institute of Fundamental Research, Mumbai	Properties of doped valence-bond solids
Anshuman Das Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore	Massachusetts Institute of Technology	New methods in imaging
Arya Dhar Indian Institute of Astrophysics, Bangalore	Colorado School of Mines	Matrix product states methods
Benjamin Legum Drexel University, Philadelphia	Institute of Science Education and Research, Kolkata	Tribology and heat transfer of carbon nanoparticulates
Karan Jani Georgia Institute of Technology, Atlanta	Tata Institute of Fundamental Research, Mumbai	ICTS Program on Numerical Relativity
Krista Limmer Missouri University of Science and Technology, Rolla	International Workshop on Materials Modeling and Simulation, Bhilai	Materials Modeling and Simulation
Sudeep Ghosh Indian Institute of Technology Indore	Old Dominion University, Norfolk	Analysis of CLAS data

Bhaskara Advanced Solar Energy Fellowship Program

Department of Science & Technology
Govt. of India

IUSSTF
Indo-US Science and Technology Forum

Bhaskara Advanced
SOLAR ENERGY
FELLOWSHIP PROGRAM

Recognizing that climate change, clean and efficient energy and environmental protection are among the biggest challenges facing India and the United States; the Department of Science and Technology, Govt. of India through its Solar Energy Research Initiative, and the Indo-U.S. Science and Technology Forum (IUSSTF) are committed to tackling these issues by building capacity in these frontier areas.

To nurture future innovators and thought leaders in Solar Energy, the **Bhaskara Advanced Solar Energy (BASE) Fellowship Program** - a dynamic and transformative program has been developed to foster contacts between students and scientists from India and the United States.

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Student Internships 2014

	Name	Parent institution	Advisor and Host University	Subject Area
1.	**Anima Ghosh**	Indian School of Mines, Dhanbad	Arunava Gupta, University of Alabama, Tuscaloosa	Structural and optical properties of solar cell materials
2.	**Aparajita Mandal**	Indian Association for the Cultivation of Science, Kolkata	Juejun Hu, University of Delaware, Newark	Processing and characterization of noble light trapping structures for ultimate light trapping enhancement in next generation solar cells
3.	**Arun Kumar Verma**	Indian Institute of Technology, Delhi	Rajit Gadh, Grid Energy Research Center, Los Angeles	Solar energy integration and electrical vehicle interaction to smart grid
4.	**Balaji K.**	Anna University, Chennai	Muthusamy Swami and Richard A. Raustad, Florida Solar Energy Center	Thermodynamic analysis of new working pair for solar absorption heat pump

	Name	Parent institution	Advisor and Host University	Subject Area
5.	**Chalapathi Uppala**	Sri Venkateswara University, Tirupati	Michael A. Scarpullaz, University of Utah	Preparation of high quality Cu_2ZnSnS_4 (CZTS) thin films by a two-stage process and fabrication of a solar cell
6.	**N. Rajamanickam**	Madurai Kamaraj University, Madurai	K. Mahendra Sunkara, University of Louisville, Louisville	Investigation on multiferroic nanomaterials for dye sensitized solar cell application
7.	**Rakesh Kumar**	Indian Institute of Technology, Delhi	Joel W. Ager III, Lawrence Berkeley National Laboratory, Berkeley	Study of defect passivation properties of graphene over-layer on silicon solar cells
8.	**Rajeev Kumar Chauhan**	Indian Institute of Technology, Mandi	Robert Hebner, University of Texas, Austin	Smart energy management system for DC micro-grid
9.	**Saatviki Gupta**	Dayalbagh Educational Institute, Agra	Brian A. Korgel, University of Texas, Austin	Synthesis and characterization of nanorod heterojunctions for solar cell applications
10.	**Santanu Pradhan**	Indian Institute of Technology, Kharagpur	Sean Shaheen, University of Colorado, Boulder	Studies on the methods of enhancing the performance of nanostructured zinc oxide/conjugated polymer based solar cells
11.	**Sreekanth Mandati**	ARCI, Hyderabad	Rakesh Agrawal, Purdue University, West Lafayette	Performance evaluation of CIGS based solar cells fabricated by different techniques
12.	**Venu Sonti**	National Institute of Technology, Warangal	Subhashish Bhattacharya, North Carolina State University, Raleigh	Multilevel inverter based grid connected PV systems

Fellowships 2014

	Name	Parent institution	Advisor and Host University	Subject Area
1.	**Muthukumar Palanisamy**	Indian Institute of Technology, Guwahati	D. Yogi Goswami, University of South Florida, Tampa	Design and performance predictions of high temperature large–scale thermal energy storage system for solar thermal power plant.
2.	**Nanda Gopal Sahoo**	Kumaun University Nainital	James T. McLeskey, Jr., Virginia Commonwealth University	Development of highly efficient transparent polymeric solar cell
3.	**Pratap Pathi**	CSIR - National Physical Laboratory, Delhi	Rana Biswas, Iowa State University, Ames	Light trapping enhancements in thinner c-Si solar cells
4.	**Ranjan Kumar Behera**	Indian Institute of Technology, Patna	Olorunfemi Ojo, Tennessee Tech University, Cookeville	Dynamics and control of all solar hybrid micro-grid
5.	**Sachin Jain**	National Institute of Technology, Warangal	Jih-Sheng (Jason) Lai, Virginia Polytechnic Institute and State University	High efficiency photovoltaic power conversion systems with energy storage
6.	**Subhendu Kumar Panda**	CSIR- Central Electrochemical Research Institute, Karaikudi	Pulickel M. Ajayan, Rice University, Houston	Development of highly efficient hybrid solar cells by incorporation of graphene nanostructures in quantum dot sensitized solar cells

	Name	Parent institution	Advisor and Host University	Subject Area
7.	**Sudhakar Subudhi**	Indian Institute of Technology, Roorkee	Mihir Sen, University of Notre Dame, Notre Dame	Thermal and flow interaction in the series and parallel networking of solar thermal collectors
8.	**Suhash Ranjan Dey**	Indian Institute of Technology, Hyderabad	David Ginley, National Renewable Energy Laboratory, Golden	Pulsed electrodeposition development of $Cu_2ZnSn(S/Se)_4$ p-layer for solar photovoltaic applications
9.	**Suneet Singh**	Indian Institute of Technology, Bombay	Prashant K. Jain, Oak Ridge National Laboratory, Oak Ridge	Solar and nuclear energy integration concepts for dispatchable power and process heat

Research Internships in Science and Engineering

The Indo-US Science and Technology Forum supported ***Research Internships in Science and Engineering (RISE) program*** provides unique opportunities for science, technology, engineering and medical students from the United States to undertake internships in national laboratories, federal research centers, academic research institutes, and private R & D laboratories in India. Objectives of the internships are to provide students on exposure to Indian S&T milieu, gain practical skills and develop collaborative networks. Internships are envisaged as a source of mutual cultural and professional enrichment for both the interns and their host institutions. The result will be the development of joint efforts that builds long-term collaboration and mutually beneficial professional relationships.

Indian and American citizens currently enrolled at a recognized institution of higher education pursuing Doctoral programs in science, engineering, technology and medical disciplines are eligible to apply for the internship. The internships will provide for monthly stipend, accommodation and airfare. The RISE program was formally launched during the IUSSTF Governing Board meeting in December 2008 and was implemented from 2009.

Contact Person

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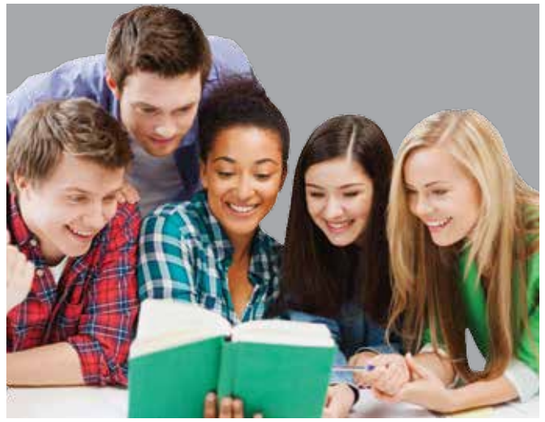
The following **12 students** interned in India under the RISE Program in 2012-2013:

Student	Mentor	Subject Area
Alex Burford University of Wisconsin – Madison	**P. Dasaradhi Palakodetti** inStem, National Center for Biological Sciences, Bangalore	Biochemistry (Autism Syndrome Disorders)
Alexa Renae Wilson Univ. of Massachusetts Boston	**Sarala Khaling** ATREE, Darjeeling	Environmental Biology
Barbara Kelso Klenke University of Michigan	**Ramanan Laxminarayan** Public Health Foundation of India, Delhi	Medical Sciences (Public Health)
Jennifer Lynn Erchinger Texas A&M University	**Prabhat Munshi** Indian Institute of Technology, Kanpur	Health Physics (Radiation Physics)
Mathew Paul Hutchinson University of Michigan	**Prasun Roy** National Brain Research Center, Manesar	Neuroscience and Biomedical Sciences
Sriram Srinivasan University of Nebraska, Omaha	**Niloy Ganguly** Indian Institute of Technology, Kharagpur	Computer Sciences
Supriya Jalukar University of Michigan	**Mrinalini Puranik** & **Raghav Rajan** IISER, Pune	Neurosciences (song initiation in Zebra Finches and using MatLab to understand preparatory mechanism in song development)
Anna Borkowoska University of Iowa	**Akash Gulyani** National Center for Biological Sciences, Bangalore	Chemical Engineering; Pharmaceuticals and Innovative Drug Delivery Methods
Gautam Sankar Surya University of Texas, Austin	**Ramana Athreya** IISER, Pune	Ecology/ Conservation Biology
Lun Ou University of Illinois at Urbana-Champaign	**Alok Adholeya** TERI University, Delhi	Agricultural Sciences (Post-Harvest Technology)
Rahul Harish Panchal University of Illinois at Urbana-Champaign	**Ashwin Dalal** Centre for DNA Fingerprinting and Diagnostics, Hyderabad	Molecular & Cellular Biology
Stephen Gerlt University of Illinois at Urbana-Champaign	**Vivek S. Borkar** IIT Bombay, Mumbai	Nuclear Engineering (Non Proliferation)

Graduate Research Opportunities Worldwide Program



Contact Person

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The ***Graduate Research Opportunities Worldwide (GROW) program*** is a partnership between the **Science and Engineering Research Board** (SERB), Department of Science and Technology (DST), Govt. of India and the **National Science Foundation** (NSF) to provide NSF Graduate Research Fellows with opportunities to enhance their professional development through research collaborations at top-caliber science and engineering research sites in India. National Science Foundation (NSF) Acting Director Cora B. Marrett signed this new research partnership with Dr. T.K. Chandrashekar, Secretary of the Science and Engineering Research Board (SERB). The objectives of the program are to promote research and capacity building in frontline areas of science and technology; to pave way for the next generation scientists and technologists from the United States to interact with their Indian peers, thus helping to build long-term R&D linkages and collaborations; and, to bring talented American students to research laboratories and academic institutions in India to build a deeper appreciation of the culture of innovation and long-standing tradition of scientific enquiry in India.

In his statement Dr. Chandrashekar said "*The GROW Initiative provides an excellent opportunity to introduce talented American students to the S&T landscape and the long-standing tradition of scientific inquiry in India. We also hope that the program helps foster long-term interactions between the next generation of innovators and thought leaders from India and the United States and contributes to the prosperity of not only our respective countries but the world at large.*" Dr. Cora Marrett remarked, "*GROW fosters increased collaboration between Graduate Research Fellows and their peers around the world. Connecting them to leading scientists and research infrastructure outside of the U.S. will help them engage successfully in the global research enterprise.*"

Khorana Program for Scholars

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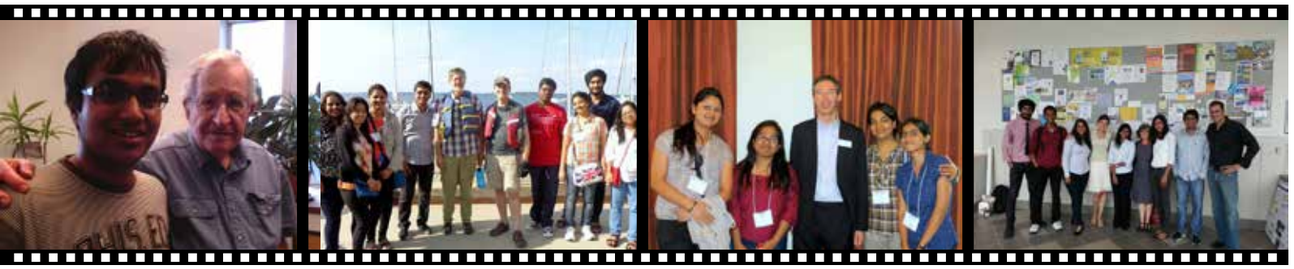
The Khorana Program for Scholars is a tripartite arrangement between the Department of Biotechnology, Govt. of India, the University of Wisconsin-Madison [representing partner US Universities], and the Indo-US Science and Technology Forum in order to nurture contacts between students in the field of biotechnology and biomedical sciences from India and the US. The program is named in honor of Dr. Har Gobind Khorana who won the Nobel Prize for his work at the interface of chemistry and biology in 1968 while a member of the UW faculty.

The Khorana Program is a summer internship program for Indian students (currently enrolled in B. Tech., M. Tech. and M. Sc. programs in Biotechnology and allied areas) to undertake a research internship at UW and partner U.S. Universities for a period of 10-12 weeks. Out of a pool of more than 500 applicants each year, 12 students interned under the Khorana program in 2009 and 15 students were selected in 2010 and 2011 respectively.

The Khorana Program is envisaged to:

- Provide encouragement to young scholars to undertake R&D
- Enable students to carry out research at a premier University in the United States
- Transform research into societal benefits
- Build a seamless scientific community between India and the United States

Keeping in mind the success of the program so far and the large pool of quality applicants available, we have expanded the Khorana Program to several premier US Universities (University of Iowa, University of Illinois, University of Michigan, University of Minnesota, Michigan State University, Indiana University, Georgetown University, MIT and University of Wisconsin-Madison) to enable a larger number of students to gain a transformative international experience. In 2013, the following **29 students** were selected under this program:



	Name	Parent institution	Advisor and Host University	Subject Area
1.	**Abhishek Persad**	Indian Institute of Technology, Delhi	Harkamal Walia, University of Nebraska, Lincoln	Computational modeling of biological systems
2.	**Adithie Maddaala**	SRM University, Chennai	Chi Zhang, University of Nebraska – Lincoln	Bioinformatics and computational biology
3.	**Aditi Bhat**	A.C. College of Technology, Anna University, Chennai	Roger Innes, Indiana University	Molecular plant-microbe interactions
4.	**Animesh Anand Mishra**	Indian Institute of Science Education and Research, Bhopal	Charles Brenner, University of Iowa	Non-enzymatic acetylation of proteins
5.	**Anjaney Kothari**	Indian Institute of Technology, Kanpur	Adam C. Martin, Massachusetts Institute of Technology	Developmental biomechanics
6.	**Annie Rathore**	Indian Institute of Technology, Roorkee	Michael K. Schultz, University of Iowa	Small molecule oxidative metabolism inhibitors for metastatic melanoma therapy
7.	**Archita Sanjeev Agrawal**	VIT University, Vellore	C. Cheng Kao, Indiana University	Innate immunity; cell signaling; antiviral responses
8.	**Avantika Gupta**	Birla Institute of Technology and Science, Pilani	Chandan Kumar, University of Michigan	Gene fusions in prostate cancer
9.	**Babukrishna Maniyadath**	National Institute of Technology, Calicut	Kannanganattu V. Prasanth, University of Illinois at Urbana-Champaign	Noncoding RNAs and gene regulation
10.	**Dennis Robert**	Indian Institute of Technology, Kharagpur	Mari Palta, University of Wisconsin-Madison	Biostatistics and Epidemiology
11.	**Eddy Hudson**	Indian Institute of Technology, Madras	Xin Huang, University of Wisconsin-Madison	Systems Neuroscience
12.	**Kaivalya Shantanu Shevade**	Institute of Bioinformatics and Biotechnology, University of Pune	Harkamal Walia, University of Nebraska, Lincoln	Bioinformatic analysis of microarray and RNA seq dataset in rice
13.	**Kanika Khanna**	Indian Institute of Technology, Delhi	Aseem Ansari, University of Wisconsin-Madison	Exploring DNA-binding preferences of human transcription factors using CSI-Seq
14.	**Kanupriya Tiwari**	Indian Institute of Technology, Banaras Hindu University, Varanasi	Claire Vieille, Michigan State University	Bacterial genetic engineering
15.	**Kanwal Puneet Kaur**	Indian Institute of Science Education and Research, Mohali	Andrew C. Zelhof, Indiana University	Photoreceptor biology
16.	**Mainak Mustafi**	Indian Institute of Technology, Kharagpur	Heedeok Hong, Michigan State University	Biophysical Chemistry
17.	**Mohanish Borana**	University of Mumbai-Department Of Atomic Energy- Centre for Excellence in Basic Sciences (UM-DAE-CEBS), Mumbai	Mark D. Distefano, University of Minnesota	Protein prenylation and protein labeling of Hcp1 and CNTF proteins
18.	**Mohd Tayyab Adil**	Indian Institute of Technology, Roorkee	Meelad Dawlaty, Massachusetts Institute of Technology	Epigenetics of stem cells and development
19.	**Munish Chhabra**	Delhi Technological University	Heedeok Hong, Michigan State University	FtSH purification, expression and characterization
20.	**Ovia Margaret Thirukkumaran**	Bannari Amman Institute of Technology, Tamil Nadu	Ruma Banerjee, University of Michigan	Enzymology
21.	**Raghavendran Partha**	Indian Institute of Technology, Madras	Jeffrey P. Mower, University of Nebraska-Lincoln	Comparative genomics of chloroplast genomes within the plant genus *Plantago*
22.	**Ria Mishra**	National Institute of Technology, Durgapur	James Glazier, Indiana University	Effects of arsenic exposure on regulation of angiogenesis by VEGF-A and VEGFR-2 in Zebrafish
23.	**Rishika Vij**	National Dairy Research Institute, Karnal	Steven Singer, Georgetown University	Mucosal immune responses
24.	**Samadrita Bhattacharyya**	St. Xavier's College, Kolkata	Supriya G. Prasanth, University of Illinois at Urbana-Champaign	Cell cycle regulation and chromatin organization
25	**Sameer Jayanth Dixit**	Indian Institute of Technology, Guwahati	Aseem Ansari, University of Wisconsin-Madison	Identification of affinity levels of various DNA motifs to nuclear receptor heterodimer complexes
26.	**Sanjibita Mishra**	National Institute of Technology, Rourkela	Sandra Rodriguez Zas, University of Illinois at Urbana-Champaign	Bioinformatics and statistical genomics
27.	**Shachi Mittal**	Indian Institute of Technology, Delhi	Rohit Bhargava, University of Illinois at Urbana-Champaign	Classification of breast tissue using FT-IR imaging tools and random forests algorithm for histopathology
28.	**Srishti Batra**	Indian Institute of Science Education and Research, Mohali	William Pomerantz, University of Minnesota	Developing a new biophysical NMR tool to study protein-protein interactions
29.	**Surabhi Balagopal Nair**	National Institute of Technology, Raipur	M. Paranjape, Georgetown University	Electrochemistry

Viterbi – India Program

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An important aspect of engineering education in the 21st century is to provide the experience of international research to young scholars and a practical way to achieve this would be to foster their participation in international research programs. Such initiatives would offer them an array of experiences both academic and social that would help them gain a global perspective and prove invaluable in their professional careers through a cross-cultural exposure. To address this need for human resource development and capacity building in the field of computer sciences and electrical engineering, IUSSTF and the Viterbi School of Engineering at the University of Southern California partnered to support the ***Viterbi-India Program*** between Indian institutions and the Viterbi School of Engineering.

Under the ***Viterbi-India Program***, each summer for the last two years, 10 students from top Indian Institutions were hosted at USC for summer research. The goals were to provide an excellent opportunity for scholars to encourage them to pursue research, interact with students from all over the world, and foster education and research collaborations with students and faculty between US and India. Both students from Indian institutions and USC faculty participating in this program have expressed strong sentiments about how this program has been valuable to all concerned stakeholders. The Indian students who came to USC were typically toppers from high-ranking Institutions in India and were able to conduct outstanding research in a short amount of time. ***Keeping in view the success of the program thus far and the interest it has created among Indian students in just two years; the program has been extended and expanded to enable a larger number of Indian students to gain a transformative international experience which is expected to also provide the motivation to pursue scientific careers.*** This would be accomplished by allowing students (pursuing Computer Sciences, Electrical Engineering and Computational Sciences) from any recognized Indian Institution to compete for the 20 internships available each year.

The following twenty outstanding students have been selected for the program year 2014:

	Name	Parent Institution	Mentor at USC	Subject Area
1.	**Aditya Kamath**	Indian Institute of Technology - Hyderabad	Minlan Yu	Implementation of OpenSketch in OpenVSwitch
2.	**Ajay Singhvi**	Birla Institute of Technology & Science (BITS) - Pilani	Peter Beerel	Design and analysis of delay elements for 2-phase bundled data asynchronous circuits
3.	**Apratim Mukhopadhyay**	Jamia Milia Islamia, Delhi	Urbashi Mitra	Thread count analysis of paintings using 2-D discrete wavelets
4.	**Ashwini Pokle**	Birla Institute of Technology & Science (BITS) - Pilani	Yan Liu	Robust stochastic optimization
5.	**Asim Anand**	Indian Institute of Technology - Kharagpur	Richard Leahy	Cortical changes in autism
6.	**Dheeraj M N**	Indian Institute of Technology - Madras	Todd Brun	Quantum walks over graphs
7.	**Dhruva Kartik Mokhasunavisu**	Indian Institute of Technology - Guwahati	Urbashi Mitra	Sampling and navigation cost for target localization using mobile agents
8.	**Goutham Ezhilarasu**	Anna University, Chennai	Stephen Cronin	Analyzing the behavior (optical and electrical) of 2D nanocrystals of MoS2 when placed on different substrates and also fabricating opto-electronic devices based on these characteristics
9.	**Radhika Natesh**	National Institute of Technology - Surathkal	Paul Bogdan	SPH modelling; Analysis of social interaction of *Shewanella* bacteria using image processing
10.	**Raktim Pal**	National Institute of Technology - Trichy	Bhaskar Krishnamachari	SINR optimization with mobile robotic nodes
11.	**Ramnandan Sirumangalam Krishnamurthy**	Indian Institute of Technology - Madras	Craig Knoblock	Assigning semantic labels to data sources
12.	**Ranjan Anantharaman**	Birla Institute of Technology & Science (BITS) - Hyderabad	Murali Annavaram	Speeding up massive graph applications on GPGPU
13.	**Sanjana Singireddy**	Birla Institute of Technology & Science (BITS) - Hyderabad	Mike Chen	Linearization techniques in voltage controlled oscillator based analog-to-digital converters
14.	**Shrihari Amarendra Bhatt**	Indian Institute of Technology - Khargpur	Gerard Medioni	Structured sampling for 3D face recognition
15.	**Sidharth Gupta**	Indian Institute of Technology - Kanpur	Kristina Lerman	The friendship paradox in egonets
16.	**Soham Rajesh Phade**	Indian Institute of Technology - Bombay	Rahul Jain	Freeway traffic modelling using queueing theory
17.	**Sudipta Biswas**	Indian Institute of Technology - Kharagpur	Hossein Hashemi	Improving isolation in wireless transceivers capable of simultaneous transmit and receive
18.	**Sukanya Vijaysing Patil**	Indian Institute of Technology - Bombay	Alice Parker	Circuit implementation of neural network responsible for locomotion in *C. elegans*
19.	**Vaibhav Gandhi**	Indian Institute of Technology - Gandhinagar	Viktor Prasanna	High-performance online traffic classification using FPGA
20.	**Vaishnavh Nagarajan**	Indian Institute of Technology - Madras	Milind Tambe	Multi-agent team playing for computer go domain

S.N. Bose Scholars Program

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To address the need for human resource development and capacity building in science and technology, the Department of Science and Technology, Govt. of India, the Indo-U.S. Science and Technology Forum (IUSSTF) and the University of Wisconsin-Madison have partnered to develop a dynamic student exchange program between Indian institutions and premier U.S. Universities led by the University of Wisconsin at Madison. This program is named the **S.N. Bose Scholars Program** after the late Prof. Satyendra Nath Bose, a visionary Indian physicist best known for his work on quantum mechanics in the early 1920s, providing the foundation for Bose–Einstein statistics and the theory of the Bose–Einstein condensate. A Fellow of the Royal Society, he was awarded India's second highest civilian award, the Padma Vibhushan in 1954 by the Government of India. He made important contributions to the field of quantum physics in the 1920s that changed how particle physics has been studied ever since. The class of particles that obey Bose-Einstein statistics, Bosons, was named after him. The inception of this program would be particularly opportune as it would coincide with the discovery of the Higgs-Boson earlier this year at the Large Hadron Collider at CERN in Switzerland. It would honor an Indian scientist's fundamental contribution to the completion of the Standard Model of the Universe.

The S.N. Bose Scholars Program will provide an opportunity to Indian and U.S. students (enrolled in Bachelors and Masters programs in Atmospheric and Earth Sciences; Chemical Sciences; Engineering Sciences; Mathematical and Computational Sciences; and, Physical Sciences.) to undertake a research internship each summer for a period of 10-12 weeks in each other's countries.

The broad objectives of the program would be to:

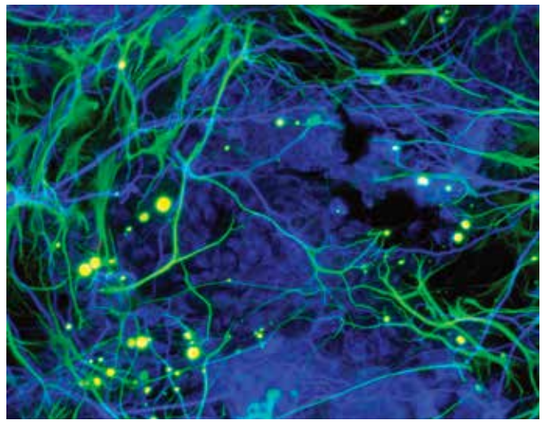
- provide an opportunity to best and brightest Indian students to gain exposure and access to world class research facilities in U.S. academia and labs;
- promote research and capacity building in frontline areas of science and technology;
- encourage and motivate outstanding students to take up research as a career path;
- pave the way for the next generation scientists and technologists from India to interact at an equal footing with American peers, thus helping to build long-term R&D linkages and collaborations; and,
- bring talented American students to research laboratories in India to build a deeper appreciation of the culture of innovation and long-standing tradition of scientific enquiry in India.

In 2014, the following 43 students were selected under this program:

	Name	Parent Institution	Subject Area	Mentor at USC
1	**Aadithya Kannan**	Indian Institute of Technology-Kharagpur	Fabrication of a continuous microfluidic vesicle swelling device and the study of shear on giant unilamellar vesicles	Noah Malmstad, University of Southern California
2	**Abhinav Gupta**	Indian Institute of Technology-Kanpur	Deterministic and stochastic modelling of coupled ocean biological-physical dynamics	Pierre F.J. Lermusiaux, Massachusetts Institute of Technology
3	**Aiman Khan**	Indian Institute of Technology-Roorkee	Manipulating uniformity of spatial and spin-spin interactions using anharmonic trapping and triangular rotating wall	Jim Freericks, Georgetown University
4	**Akshit Budhraja**	Indian Institute of Technology-Roorkee	Assessment of confidence level that is attached to each flaw classification in auto analysis detection results	Lalita Udpa, Michigan State University
5	**Amol Mittal**	Indian Institute of Technology-Delhi	Assigning semantic labels to data sources	Craig A. Knoblock, University of Southern California
6	**Anish Devendra Khandelwal**	Indian Institute of Technology-Bombay	Cost-Benefit Analysis (CBA) of cooking fuel alternatives in rural India: utility and implications	Pratim Biswas, Washington University in St. Louis
7	**Arkopal Dutt**	Indian Institute of Technology-Bombay	Adiabatic lapse rate in the Venus atmosphere	Sanjay S Limaye, University of Wisconsin- Madison
8	**Ashna Bindra**	Indian Institute of Technology-BHU	Nanometer-scale structural relaxation in Pd82Si18 bulk metallic glass	Paul Voyles, University of Wisconsin-Madison
9	**Chaitanya Krishna Phani Thota**	Indian Institute of Technology-Patna	Electrical Engineering	Parmesh Ramanathan, University of Wisconsin-Madison
10	**Chinmay Mangesh Saraf**	Indian Institute of Technology-Roorkee	Composite polymer gels for energy application	Sadhan Jane, University of Akron
11	**Dinumol Devasia**	Indian Institutes of Science Education and Research-Trivandrum	Single nanoparticle resolved heterogeneous catalysis	Prashant Jain, University of Illinois-Urbana-Champaign
12	**Gibran Ahmed Khan**	National Institute of Technology Karnataka	Calculations of van Der Waals forces between nanoparticles	Nicholas Kotov, University of Michigan
13	**Guneet Singh Mehta**	Indian Institute of Technology-Jodhpur	Implementation of image processing techniques for collagen analysis in cancer research	Kevin Eliceiri, University of Wisconsin-Madison

14	**Hafeezul Rahman Mohammad**	Indian Institute of Technology-Delhi	Predicting the impact of a traffic incident in real-time	Cyrus Shahabi, University of Southern California
15	**Himanshu Gurnani**	Indian School of Mines Dhanbad	Coal processing / mineral beneficiation	Jan D. Miller, University of Utah
16	**Hitesh Arora**	Indian Institute of Technology-Guwahati	Machine learning- neural decoding	Tomaso Poggio, MIT
17	**Jophin George Joseph**	Indian Institute of Technology-Hyderabad	Microfluidic centrifuging chip for blood cell separation	Zeta (Tak For) Yu, University of Michigan
18	**Kajari Bera**	Indian Institutes of Science Education and Research-Bhopal	Graphene liquid cells and their characterization	James John, University of Minnesota
19	**Kunal Sharma**	Indian Institutes of Science Education and Research-Bhopal	Coupling of normal modes (two ions) via parametric resonance	Hartmut Haeffner, University of California, Berkeley
20	**Linta Joseph**	Indian Institutes of Science Education and Research-Trivandrum	Quantum Computation	Selim Shahriar, North Western University
21	**Manisit Das**	Indian Institute of Technology-Kharagpur	Design of a high performance Surface enhanced Raman Spectroscopy integrated lateral flow immunoassay for biomolecular detection	Joseph Irudayaraj, Purdue University
22	**Md. Javed**	National Institute of Technology-Rourkela	Multi-agent Sysyten Control	Joydeep Mitra, Michigan State University
23	**Mihir Sudhir Kulkarni**	Indian Institute of Technology-Bombay	Format conversion of NASA Venus image data	Sanjay S. Limaye, University of Wisconsin-Madison
24	**Neha Singh Chauhan**	Indian Institute of Technology-Jodhpur	Developing interface for automated design of synthetic genomes	Parmesh Ramanathan, University of Wisconsin-Madison
25	**Neha Hemant Joshi**	Indian Institute of Technology-Madras	Cloud-level wind tracking in polar stereographic projected images in the atmosphere of Venus	Sanjay S. Limaye, University of Wisconsin-Madison
26	**Nikilesh Krishnakumar**	BITS-Pilani, Goa Campus	Quantification of permanent losses in granular crystal dynamics	Marcial Gonzalez, Purdue University
27	**Nilay Mukund Shah**	Indian Institute of Technology-Bombay	Sorbent enhanced water gas shift for pre-combustion CO_2 capture	Ed Rubin, Carnegie Mellon University
28	**Pawandeep Singh**	Visva-Bharati University, West Bengal	Developments and applications of the enaR software	Stuart R. Borrett, University of North Carolina Wilmington
29	**Prachi Pramod Bedekar**	University of Pune	Enhancements to the Venus express cloud tracking applet	Sanjay S. Limaye, University of Wisconsin-Madison
30	**Pranav Thirthahalli Bhat**	National Institute of Technology-Karnataka	Parallelisation of algorithms, and identification of synchronisation sections	Gurinder Sohi, University of Wisconsin-Madison
31	**Pranav Ajitkumar Shetty**	Indian Institute of Technology-Bombay	Synthesis of tin oxide nano columns for use as lithium ion battery anodes	Pratim Biswas, Washington University in St. Louis
32	**Pranav Suresh Puthan Naduvakatte**	Indian Institute of Technology-Madras	Investigate a turbulent flow over an open channel	Surya Pratap Vanka, University of Illinois at Urbana-Champaign
33	**Rohit Raj**	Indian Institute of Technology-Roorkee	Petro-physical models of a leachate plume	Priyank Jaiswal, Oklahoma State University
34	**Sahil Chhabra**	Indian Institute of Technology-Kharagpur	Quantum Phenomena modelled by interactions between many classical worlds	Dirk - André Deckert, University of California-Davis
35	**Sai Sneha Juturu**	Indian Institute of Technology-Madras	Energy storage technology	Surya Prakash and Prof. Sri Nrayan, University of Southern California
36	**Sayan Kar**	Indian Institute of Technology-Kanpur	S-difluoromethylationof aryl thiolsusing the Ruppert-Prakash reagent	Surya Prakash, University of Southern California
37	**Shivali Goyal**	Indian Institute of Technology-Delhi	Thin film block copolymer morphology using Self-consistent field theory	Venkat Ganesan, University of Texas at Austin
38	**Siddharth Venkata Ancha**	Indian Institute of Technology-Guwahati	Machine learning for natural language processing	Dan Roth, University of Illinois at Urbana-Champaign
39	**Srujan Singh**	Indian Institute of Technology-Kanpur	Developing optical biosensors	Joseph Irudayaraj, Purdue University
40	**Vamsi Krishna Vema**	Indian Institute of Technology-Madras	Decision support system for participatory watershed management	Indrajeet Chaubey, Purdue University
41	**Venkatavaradan Sunderarajan**	Indian Institute of Technology-BHU	Fabrication of 3D solid network structures through covalent bonding of nanoscale non-metallic structures	Pulickel M. Ajayan, Rice University
42	**Washim Alam**	Indian Institute of Technology-Kharagpur	Role of kinetic parameters in influencing the nature of MBE growth	Anupam Madhukar, University of Southern California
43	**Yogesh Kumar Modi**	National Institute of Technology-Rourkela	Investigating the formation and corrosion inhibition imparted to AA2024-t3 aluminium alloys by trivalent chrome process (TCP) coating	Greg Swain, Michigan State University

Resonance
An MIT-Harvard-IUSSTF-IIT initiative for focused learning



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In the domain of higher education in science and technology, India and the United States have two pressing needs. **India** has several outstanding institutions for higher education that provide world-class training in numerous disciplines. However, many of the more recent domains of research are not adequately represented in their programs. This limits their students' opportunities for pursuing higher studies in these areas and, more broadly, India's ability to have an impact on cutting-edge research.**The United States** has several outstanding young researchers, typically at the post-doctoral level, who have excellent training in specialized research fields, but have not had opportunities for teaching and mentoring students. This greatly limits their training as well-rounded scientists with good teaching and communication skills.Clearly, the two needs are complementary and provide perfect answers for each other. Resonance - the newly launched initiative formalizes this mutually beneficial confluence. It is structured as short, intensive instructional programs conducted by exceptional young US scientists for talented students selected from institutions across the India.

For the pilot course, neuroscience was identified as a key topic that would benefit from a Resonance program, and a summer school in neuroscience was organized in June 2013 in New Delhi. Three major institutions committed themselves to supporting Resonance: MIT, Harvard, and IIT Delhi (which served as the host). The Indo-US Science and Technology Forum saw the bilateral benefits that Resonance could yield and provided critical funding support.

The goal for Resonance 2013 was to provide an intensive introduction to neuroscience to students who might not yet have had an exposure to this field; among other things it would prepare them for undertaking higher studies or corporate R&D in this area. This program was designed so that a select group of students had the chance to spend two weeks with several scientists from MIT and Harvard, immersed in a rich set of experiences that include lectures that covered background material and also offered a glimpse of the cutting edge in neuroscience research, along with exercises that promoted hands-on learning. The student selection process was highly competitive and the class size was limited to 25 students. Lectures covered a wide range of key neuroscience topics and gave the students a sense of the interdisciplinary nature of neuroscience (encompassing molecular biology, genetics, physiology, engineering, physics and computer science). The evening demonstrations allowed students to get exposed to methods and tools of research in neuroscience. A vital part of the course was the discussions that continued through dinner and beyond, facilitated by housing faculty and students in the same location. These informal discussions were vital because it helped impart the culture of interactive exchange that is taken for granted in the US, but is not prevalent in India. These informal periods allowed fertile meandering of discussions, imparting a sense of excitement and wonder about the subject matter that may not become apparent in didactic lectures.

The program also linked up with industry in India through a Corporate Day, during which scientists and executives from the private sector discussed neuroscience opportunities. This link to industry was much appreciated by students and the teaching faculty, and has led to ongoing connections. GE India, IBM, Infosys, and government officials offered insight and awareness of research possibilities in top corporate laboratories and government as future career destinations.

Bilateral **Workshops** and Training **Programs**

ORGANIC SOLAR CELLS

24-26 June 2013
Golden, USA

Organic Solar Cell (OSC) technology is a promising and potentially disruptive technology for large area, high throughput and large volume production of Photovoltaic (PV) devices and modules. This area has seen remarkable success in research and has made remarkable progress in pushing power conversion efficiencies to over 10% in research labs. Better understanding of stability and lifetime of these devices have also been got in the past decade. These have led to the spawning of a few enterprises which are working to commercialise products using this technology. Many of the early discoveries and inventions related to this technology have been in the United States. The country continues to report path-breaking work related to OSCs at regular intervals. Many research groups in institutes across India too have been reporting a number of novel ideas and exciting discoveries over the last decade. OSC technologies are important for both the countries in the coming decade and are a critical area of research and development in these countries. Keeping this in mind, **S. Sundar Kumar Iyer** (Indian Institute of Technology-Kanpur) and **Vikram Dalal** (Iowa State University, Ames) organized a workshop on Organic Solar Cells to bring together scientists and researchers from the two countries in this important area to initiate new collaborative projects as well as to give a momentum to existing collaborative work.

MOLECULAR MATERIALS

15-17 July 2013
Bengaluru, India

The Indo-U.S. workshop on ***Molecular materials*** organized by **Uday Maitra** (Indian Institute of Science, Bangalore) and **Sanjay V. Malhotra** (Frederick National Laboratory for Cancer Research, Frederick) aimed at addressing key global challenges and providing solutions through chemical sciences. This summit brought together the best minds in chemical research from both India and the United States; and challenged them to propose innovative solutions for society's most pressing needs in the areas of health, food, energy, and the environment, through the application of chemical principles.

NeuroAIDS IN INDIA: CURRENT FINDINGS AND FUTURE DIRECTIONS

24-25 September 2013
Pune, India

One of the important non-opportunistic conditions that may affect the quality of life of HIV infected individuals is *HIV Associated Neurocognitive Disorders (HAND).* Neurocognitive consequences of HIV have gained attention since it was demonstrated that cognitive performance affects routine activities, employment, adherence to treatment and quality of life. The Indo-U.S. workshop on ***NeuroAIDS in India: Current findings and future directions*** organized by **Manisha V. Ghate** (National AIDS Research Institute, Pune) and **Thomas D. Marcotte** (University of California, San Diego) was aimed to help Indian scientists to develop protocols with experts who have extensive experience in this field. U.S. investigators gained exposure to the multiple factors that influence the development of HAND in the Indian context which encompassed issues of comorbidities often not found in Western countries, including infections such as tuberculosis, cytomegalovirus, as well as conditions such as low literacy. The workshop acted as a Forum to identify the gaps in the research done so far and to develop collaborative strategies for generating the data to plug these gaps.

THE EVOLUTION OF HUMAN COGNITION

17-20 November 2013
Pune, India

The nature of human cognition and consciousness is one of the oldest questions of our species, for which we hope to gain a clearer understanding in the 21st century. The subject is truly multi-disciplinary and recent studies on animal behaviour and their cognitive abilities have provided necessary insights into evolutionary origins of the human mind. The Indo-US symposium on ***The Evolution of Human Cognition*** organized by **L.S. Shashidhara** (Indian Institute of Science Education and Research, Pune) and **Ajit Varki** (University of California-San Diego, La Jolla) was structured keeping in mind the fact that the United States is currently the leader in this area of research and modern India with strong traditional strength in mathematics, logic and philosophy is rightly poised to take up a goal to pursue the understanding of human cognition and consciousness and its evolutionary origins. The aim of the workshop was to help forge bilateral research collaborations in this frontier of science and also help to encourage a new generation of students to take up research in cognitive neuroscience.

THE 3RD BANGALORE COGNITION WORKSHOP

8-21 December 2013
Bengaluru, India

An Indo-U.S. workshop titled ***Bangalore cognition workshop*** was organized by **S.P. Arun** (Indian Institute of Science, Bangalore) and **Thomas D. Albright** (The Salk Institute for Biological Studies, La Jolla) with a three-fold purpose: first, as cognitive and systems neuroscience in India is at a key point in its evolution, this workshop aimed to attract students from the best colleges in India and inspire them to work in neuroscience; second, the workshop served as an outstanding mechanism to facilitate scientific interchange between India and the United States; and third, the workshop focussed on the rapidly growing neuroscience community in India. The workshop was organized into four modules aimed at providing a focused introduction to the problems and concepts in various aspects of neuroscience. These modules were vision, attention and rhythms, motor systems and memory. Each module lasted for three days and consisted of 9 lectures, a panel discussion on open challenges, and a lab component.

BIO-INSPIRED SUPRAMOLECULAR AND POLYMER ASSEMBLY

15-17 December 2013
Trivandrum, India

Polymeric materials are unique in a sense that they are man-made, unlike minerals or wood and therein lies an opportunity for researchers towards structural variation to fine tune the properties to meet the ever increasing demand for versatile materials. The field of polymer research has witnessed a revolution in last two decades due to the influence of synthetic chemistry. This has helped to achieve molecular-level precision in macromolecular systems by using various controlled polymerization routs. In parallel, the field of supramolecular chemistry has grown to an extent where concepts related to strength of various directional non-covalent interactions and its implications in generating advanced materials with higher-order structure is well-established today. In this exciting era of multidisciplinary science, it is only appropriate that scientists from supramolecular and polymer fields come together to design bio-inspired advanced materials. The Indio-U.S. workshop on ***Bio-inspired supramolecular and polymer assembly*** organized by **Suhrit Ghosh** (Indian Association for the Cultivation of Science, Kolkata) and **S. Thayumanavan** (University of Massachusetts, Amherst) aimed at generating intensive discussions on scientific topics in polymer and supramolecular chemistry which are highly complementary in terms of design and development of new bio-materials. Specific research topics covered included synthesis development of biologically relevant macromolecules and their self-assembly, drug delivery, gene delivery, peptide-based assembly, bio-sensing, supramolecular assembly of pi-conjugated amphiphiles, interactions between bio-macromolecules and synthetic polymers, tissue engineering, stimuli-responsive polymer assembly and gels.

RECENT ADVANCES IN MICRO/NANO-SCALE HEAT TRANSFER AND APPLICATIONS IN CLEAN ENERGY TECHNOLOGIES

16-18 December 2013
Ropar, India

Microscale and nanoscale heat transfer plays a critical role in determining the efficiency of energy conversion processes. There has been an increased interest in experimental and theoretical research in this field due to exciting new potential applications in clean and renewable energy conversion. While on one hand, there is significant potential in the

application of micro/nanoscale heat transfer principles for high-efficiency energy conversion; there is also much promise in efficient thermal energy storage based on engineered materials and devices. Research in this field has been ongoing at institutions in both the U.S. and India, although interactions between the two countries have been somewhat limited. The Indo-U.S. workshop on ***Recent advances in micro/nano-scale heat transfer and applications in clean energy technologies*** organized by **Himanshu Tyagi** (Indian Institute of Technology, Ropar) and **Ankur Jain** (University of Texas, Arlington) aimed to bring researchers from leading institutions from the two countries on a common platform to facilitate discussions for possible collaborative research between the two countries. This workshop featured invited talks from leading researchers and a poster session with participation from graduate students and post-doctoral scholars.

LAND USE OPTIMIZATION FOR COORDINATING CONSERVATION GOALS AND REGIONAL DEVELOPMENT IN THE NILGIRI BIOSPHERE RESERVE, SOUTHERN INDIA

16-18 December 2013
Ooty, India

Biodiversity provides the basis for life on earth, and the economic value of ecosystem services is estimated to be higher than the world's GDP. Paradoxically, conservation of biodiversity is a challenge globally, because (i) development efforts in general ignore the irreplaceable value of a sound environment and (ii) business practices remain business-as-usual and have very little flexibility to encompass the need of the environment. The Nilgiri Biosphere Reserve (southern India) or NBR, is such a place where conservation interests seemingly runs against development. The most blatant evidence of a failed integrated management is the lack of a transition zone around the NBR. The purpose of the Indo-U.S. workshop on ***Land use optimization for coordinating conservation goals and regional development in the Nilgiri Biosphere Reserve, Southern India*** organized by **Priya Davidar** (Pondicherry University) and **Samuel Cushman** (U.S. Forest Service, Center for Landscape Science, Flagstaff) was to gather the main stakeholders of the NBR (Scientists, Forest Department, public administration, plantation, agriculture, tourism, energy, transport, etc.) to share visions and introduce the concept of appropriate land use for optimal economic development within the NBR. The United States is the leader of technology in remote sensing and geographic information systems, and has carried out cutting edge research on the use of these tools for conservation. The workshop aimed to explore areas of cooperation between the United States and India particularly relevant to experience sharing regarding sustainability; reinforcing best practices and cooperation; increasing technological and scientific know-how in remote sensing and Geographic Information Systems (GIS); and, building scientific cooperation and collaborations.

ICME FOR INTEGRATED REALIZATION OF ENGINEERED MATERIALS AND PRODUCTS

16-20 December 2013
Pune, India

Integrated Computational Materials Engineering (ICME) has emerged as an area of interest for both academic and industrial research communities. ICME provides opportunities for breakthroughs at the interface of IT and materials engineering leading to considerable savings in the cost and time for commercialization of new materials in industrial applications and integrated look at product design, material design and manufacturing process design. ICME as a discipline is in its early stages and a large focus is currently placed on computational materials engineering (CME) across length scales of the material to link composition-processing-structure-properties. While CME research is maturing to enable better predictability of material evolution, it is needed to look closely at product development from a functional component perspective in an industrial design and production environment. The Indo-U.S. workshop on ***ICME for integrated realization of engineered materials and products*** was organized by **Madhusudan Chakraborty** (Indian Institute of Technology-Bhubaneswar), **B.P. Gautham** (Tata Consultancy Services, Pune), **G. Phanikumar** (Indian Institute of Technology-Madras), **Farrokh Mistree** (University of Oklahoma, Norman) and **Surya Kalidindi** (Georgia Tech, Atlanta) to identify the state-of-the-art and gap areas towards the success of ICME for the industrial utility. The themes were past successes and lessons learnt; integration across scales and processes; and, enabling aspects such as standards, databases, IT platforms, design methods, experiments. It is expected that the workshop would enhance cooperation amongst researchers from India and the U.S. to work on joint research programs, and, aid various governmental agencies in identifying areas requiring governmental support for immediate and long term needs.

ADVANCED TURBO-MACHINERY: POWER GENERATION AND TRANSPORTATION FOR A SUSTAINABLE AND ENVIRONMENTALLY RESPONSIBLE FUTURE

06-07 January 2014
Mumbai, India

Turbo-machineries are an integral part of today's society and economy. They cover a large variety of machines such as gas turbines for power generation and aviation; wind turbines; steam turbines for coal-based, nuclear, solar thermal and geothermal power plants; hydro power plants. In fact, more than 98% of electric power that is added to US electric grid is aided by a turbo-machine, and almost 100% of passenger-miles are flown by turbine-powered airplanes. As the above systems involve significant capital investments with a long service life, and

since many of the newer technologies being proposed have uncertain or unknown long-term reliabilities, and have severe cost barriers, there is a need for more research and development, in complete partnership between academia and industry, in order to bring the newer technologies to the market at a cost that the society can pay. The Indo-U.S. workshop on ***Advanced turbo-machinery: Power generation and transportation for a sustainable and environmentally responsible future*** organized by **A.M. Pradeep** (Indian Institute of Technology-Bombay), **Bhaskar Roy** (Indian Institute of Technology-Bombay), **Jayanta Kapat** (University of Central Florida) and **Farrukh Alvi** (Florida State University, Tallahassee) intended to lay the foundation for vigorous discussions resulting in concrete plans for bilateral collaboration. The workshop identified the following key areas for possible collaboration between the two countries - advanced materials; coating and corrosion control; risk based inspection strategies; materials for environment; component dynamics of a system; multi-disciplinary optimization methodologies; and, additive manufacturing and materials technologies.

MASS SPECTROMETRY-BASED PROTEOMICS AND METABOLOMICS IN DISEASE BIOLOGY

23-24 January 2014
Thiruvananthapuram, India

Over the last decade, genomics and proteomics have been used as important tools to better understand the complexities in biology, and to discover diagnostic biomarkers and drug targets. To integrate the above two "omics" in systems biology, *metabolomics*, a new science is evolving for analysing the basic metabolic changes taking place in a living organism. Metabolomics is an emerging novel field of research tools concerned with the comprehensive characterization of small molecule metabolites generated in a particular cellular process. The Indo-US workshop on ***Mass spectrometry-based proteomics and metabolomics in disease biology*** organized by **M. Radhakrishna Pillai** (Rajiv Gandhi Center for Biotechnology, Thiruvananthapuram) and **K. Sreekumaran Nair** (Mayo Clinic, Rochester) aimed to bring together an outstanding panel of scientists and investigators to discuss how advances in analytical technologies and data mining tools could be exploited for addressing the challenges in the prevention and treatment of various diseases in India. The workshop emphasized on discussions around the current technological challenges in metabolomics such as defining and annotating the metabolome; spatially resolved sampling and temporal flux measurements; instrumentation, dynamic range, depth of coverage and infrastructure; and, informatics, databases, and standardization.

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

01-02 February 2014
Pune, India

Chronic Obstructive Pulmonary Disease (COPD) is a leading cause of mortality and morbidity both in the developed as well as developing countries of the world. COPD is the third leading cause of death in the United States, while it is one of the top five causes of death in India. By 2030, COPD will become the third leading cause of death in the world. COPD is a silent epidemic in India, with very little awareness about the disease amongst lay people, healthcare providers, healthcare policy makers and researchers. The Indo-U.S workshop on ***Chronic Obstructive Pulmonary Disease*** organized by **Sundeep Salvi** (Chest Research Foundation, Pune) and **Shyam Biswal** (Bloomberg School of Public Health, Johns Hopkins University, Baltimore) aimed to bring together American and Indian clinicians, healthcare providers, healthcare policy makers and researchers to bridge the gaps in knowledge that each country has in the field of COPD prevention, control and management. The main objectives of this workshop were to develop ideas that will guide future research and funding support in the area of interventional and preventive strategies for COPD, indoor air pollution and non-smoking factors related to COPD, respiratory infections and other co-morbidities to decrease the burden, mortality and morbidity associated with the diseases; bring together investigators from bpth countries on a common forum to exchange knowledge and expertise to improve the understanding of COPD, investigate the mechanisms of disease development and help develop novel prevention strategies directed to the affected population in the future; phenotyping and management of COPD; translation of basic research to develop novel therapies; medical education to combat COPD; risk communication and public awareness of COPD in Indian population; and, develop strategies to overcome funding, research and public health policy challenges.

COGNITIVE RESERVE IN DEMENTIA AND APHASIA: INTERACTION BETWEEN LIFELONG EXPERIENCES AND NEUROBIOLOGY

02-04 February 2014
Hyderabad, India

The recent years have witnessed a rising number of people with cognitive disorders coupled with an increasing interest in understanding their scientific basis. Significant advances made in clinical characterization of disease, use of advanced neuroimaging techniques, and evidence from longitudinal studies has shifted focus from pathology towards risk and protective factors for Alzheimer's disease and other dementias.

The Indo-U.S. workshop on ***Cognitive reserve in dementia and aphasia: Interaction between lifelong experiences and neurobiology*** organized by **Suvarna Alladi** (Nizam's Institute of Medical Sciences, Hyderabad) and **Mary Ganguli** (University of Pittsburgh) put together a research collaboration between neuroscientists in the United States and India, to further the understanding of cognitive reserve and develop prevention strategies from cognitive disorders in the Indian as well as international context.

ADAPTATION OF RURAL COMMUNITIES TO CLIMATE CHANGE: BRIDGING THE GAP BETWEEN ACADEMIA AND COMMUNITY WORKERS AND IDENTIFYING RESEARCH NEEDS

20-21 February 2014
Bengaluru, India

Climate change and its impact on livelihoods has been the center of research for the past decade, and will continue to be so in the coming years. The fourth assessment report of the Intergovernmental Panel on Climate Change states that "Climate change is projected to impinge on the sustainable development of most developing countries of Asia, as it compounds the pressures on natural resources and the environment associated with rapid urbanisation, industrialisation, and economic development". An Indo-U.S. workshop on ***Adaptation of rural communities to climate change: Bridging the gap between academia and community workers and identifying research needs*** was organized by **Harini Nagendra** (Ashoka Trust for Research in Ecology and the Environment, Bengaluru), **Pinki Mondal** (Columbia University, New York) and **Ruth DeFries** (Columbia University, New York) with the aim to learn from physical and social scientists working with geospatial technologies, meteorological station data, ground surveys, socio-economic surveys, census data and other data sources/techniques and understand ongoing and future climate change and its impacts on rural livelihoods. The other component of this event was to learn from community workers and/or non-governmental organizations that have on-the-ground experience with adaptive capacity of vulnerable communities.

VIRAL INFECTIONS OF THE NERVOUS SYSTEM

25-28 February 2014
New Delhi, India

Infections of the Central Nervous System (CNS) have devastating consequences ranging from death of the patient to neurological sequelae in survivors. Viruses are a common cause of CNS infections in humans. There is increasing evidence that new neurotropic viruses, mostly of zoonotic origin, emerge regularly. Many of these viruses can lead to outbreaks, thus increasing their public health importance. Concrete data on the burden of different neurotropic infections are however limited. The primary goal of the Indo-U.S. workshop on ***Viral infections of the nervous system*** organized by **Pankaj Seth** (National Brain Research Centre, Manesar), **Jayasri Das Sarma** (Indian Institute of Science Education and Research, Kolkata), **Lynn Pulliam** (University of California, San Francisco) and **Randall. J. Cohrs** (University of Colorado School of Medicine, Aurora) was to bring together the pioneers of this field on a single platform to nurture their research ideas as well as explore the potential collaborates in areas of mutual research interests. This meeting involved 50-60 basic researchers, clinical scientists and trainees working in the areas of neurology, neuropathology, neuro-pathogenesis, neurobiology, neuroimmunology, neuro-chemistry, and molecular virology of the CNS. One of the major themes was to discuss the molecular mechanisms associated with virus-induced neurologic diseases in humans and animal models.

Indo-US Joint
Networked Centers

3-D Engineered Electrodes for Electrochemical Energy Storage

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Indian Institute of Science
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USA

University of Houston
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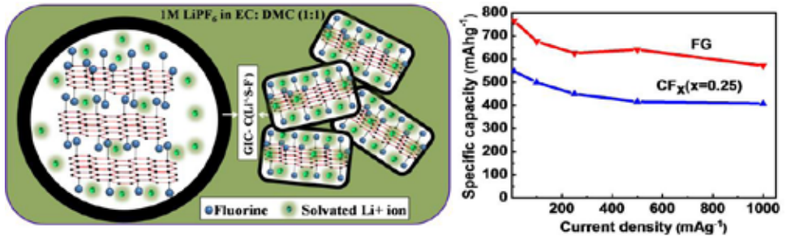
The objective of the center is to carry out cutting edge collaborative research between the partners on innovative ideas to design and build 3-D architectures using various nanostructures (including graphene, carbon nanotubes, polymers, metal oxide nanowires/clusters etc.) in order to incorporate them as active electrode components in electrochemical energy storage devices. Specific research goals to be met by the center are:

- Development of conformal and space filling methods for fabricating 3-D engineered architectures for thin film batteries and supercapacitors.
- Characterization of resulting devices in terms of their microstructures with particular reference to their electrode-electrolyte interfaces.
- Investigation of Electro-chemical performance of these devices, analysis and understanding the underlying physical phenomena of the hybrid configuration of the devices.
- Model/simulate optimized hybrid nanostructures for improved electrochemical energy storage.
- Explore new configurations/ designs for these devices to obtain vastly improved performances.
- Obtain easily integrated designs to build hybrid devices between storage formats based on battery and supercapacitors.

Achievements

Fluorinated graphene based high performance electrodes for primary lithium battery: Although rechargeable Li ion batteries have become the dominant power source for portable electronics applications, primary batteries are still used in applications like military and defense tools, and medical implants. The Center has demonstrated a single-step strategy capable of improving specific capacity, power density and faradic yield of a Li/CFx battery system using fluorinated graphene. The excellent electrochemical performance achieved using fluorinated graphene with a very low fluorine content (x = 0.22) could lead to the development



A schematic representation of lithiation of fluorinated graphite polymer and fluorinated graphene; comparison of specific capacities of (CF0.25)n and Fluorinated graphene (FG) at different current rates [Dijo Damien et al., RSC Advances, 3 (2013) 25702]

of highly efficient primary battery systems perhaps with low cost and minimum environmental impact.

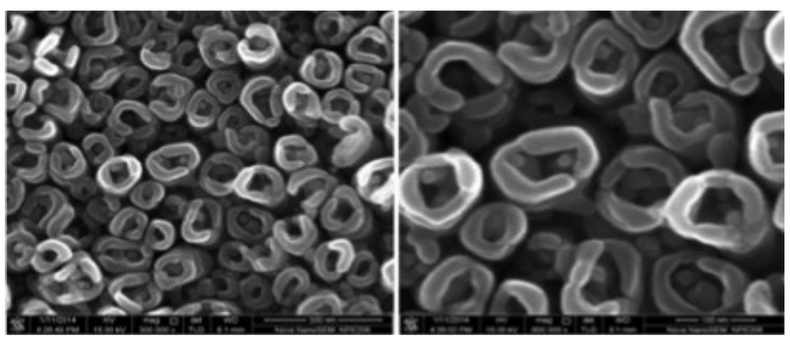
Synthesis of vertical arrays of TiO_2/$CoFe_2O_4$ hybrid nanowire electrodes for 3-D microbatteries: Synthesized vertical arrays of $TiO_2/CoFe_2O_4$ hybrid nanowires using a combination of electrochemical anodization and hydrothermal techniques. These hybrid nanowires are being tested for their electrochemical performance as efficient anodes for 3-dimensional microbattery applications.

Electrical transport studies on disordered reduced graphene oxide: A collaborative research between Central Electro Chemical Research Institute (CECRI) and Southern Illinois University Carbondale (SIUC) has been conducted on the development of stable conductive inks of reduced graphene oxide and their electrical transport properties. This was a fundamental study with an aim to use these inks in electrochemical devices after patterning them over substrates. This work has been reported in the journal 2D Materials.

Way Forward

Research activities in the area of 3D nanoarchitectures are being carried out for their application as efficient electrodes in energy storage devices such as electrochemical supercapacitors and rechargeable batteries. Some of the on-going and future works are summarized below:

- Development of 3-D scaffolds of graphene based nanostructures for supercapacitor applications.
- Various morphologies of 2-dimensional layered nanocrystals (MoS_2, WS_2 and their hybrids) are being synthesized using different approaches (Chemical vapor deposition, liquid phase exfoliation) and it will be interesting to study the lithium diffusion in these nanostructured materials.
- 3-dimensional nanoarchitectures using different metal oxide/polymer



Low and High resolution SEM images of $TiO_2/CoFe_2O_4$ hybrid nanowires.

will be fabricated using template approach and their electrochemical performance will be studied using cyclic voltammetry, Galvanostatic charge-discharge and electrochemical impedance spectroscopy.

- In addition to the electrochemical measurements, temperature dependent electrical transport studies will be carried out in detail for these materials.
- Theoretical modeling of different materials and electrode designs are being performed with a focus on the electrode/electrolyte interface.
- Planned to organize an international workshop on 'Advanced Electrode Materials for Electrochemical Energy Storage' under the auspices of the joint R&D virtual center, in 2015.

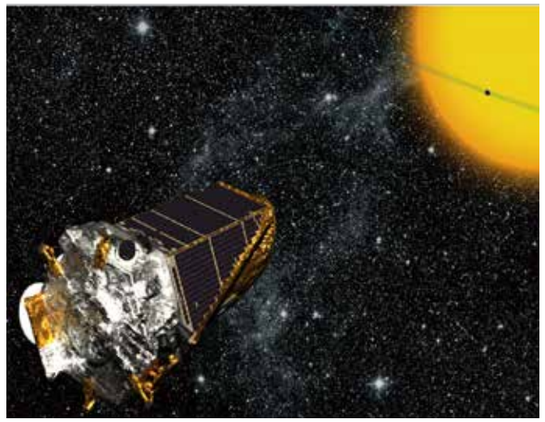
Under the auspices of Indo-US joint R&D Network Center on '3D Engineered Electrodes for Electrochemical Energy Storage', an Indo-US workshop on "Engineered Electrodes for Electrochemical Energy Storage" has been organized during April 3-4, 2014 at Chennai. The workshop was aimed at bringing the experts in electrochemical energy storage devices, from both the countries, particularly those who work in the novel aspects of electrode materials, to a common platform and to discuss their views in novel designs and materials for electrochemical energy storage applications.

In addition to the invited talks from experts, there were oral and poster presentations by young scientists as well as Ph.D. students related to a variety of energy related issues. There were 15 invited talks by experts from India and USA, 6 short talks by Ph.D students and about 30 poster presentations. The workshop was well balanced with discussions on both experimental and theoretical aspects of the topic. Three best poster prizes and one best oral presentation prize have been awarded to the students during the concluding session. From various feedback expressed by the participants, the workshop is believed to be well received and very successful. All the participants, especially the students and young researchers have been benefitted and were well exposed to several new directions in the materials science and electrochemistry of 3D engineered electrodes for energy storage.

Publications

- Damien D., Sudeep P. M., Narayanan T. N., Anantharaman M. R., Ajayan P. M. and Shaijumon M. M. (2013) *Fluorinated graphene-based electrodes for high performance primary batteries.* RSC Advances 3: 25702.
- Muchharla B., Narayanan T. N., Balakrishnan K., Ajayan P. M. and Talapatra S. (2014) *Temperature dependent electrical transport* of reduced graphene oxide. 2D Materials 1: 011008
- Vinod S., Tiwary C. S., Autreto P. A., Tijerina J. T., Ozden S., Chipara A. C., Vajtai R., Galvao D. S., Narayanan T. N. and Ajayan P. M. (2014) *Low-desnity 3-dimensional foam using self-reinforced hybrid 2-dimensional atomic layers* Nat. Commun 10: 1038/ncomms5541
- Jaison M.J., Vikram K., Narayanan T. N., and Vijaymohanan K. Pillai (2014) *Electric Field Induced Transformation of Carbon nanotube to Graphene Nanoribbons Using Solid Polymer Electrolyte.* Appl. Phys. Lett. 104: 153111.

Analysis of Variable Star Data



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By setting up an Indo-US Knowledge R&D Joint Networked Center for the Analysis of Variable Star Data, this Center is leveraging existing networking infrastructure to combine current expertise in variable stars in India and the US and consequently develop powerful new statistical methods to link the structure of variable star light curves to stellar physics. The Center has facilitated the application of these new methods to current and projected new variable star databases. The development and application of the Fourier decomposition methods along with accurate automated data analysis techniques like Principal Component Analysis (PCA) and Artificial Neural Networks to the analysis of variable star light curves. Specific research goals include :

- The extraction of fundamental stellar parameters from their light curve data – asteroseismology.
- A detailed study of the Oosterhoff dichotomy for RR Lyrae stars in the Milky Way and other galaxies such as M31.
- The development of the use of Cepheid Period-Luminosity relations in the infrared and mid-infra-red wavelengths using new and existing satellite and ground based data.
- The automated analysis of variable star data taken from DOME-A in Antarctica. The location of this telescope will provide unprecedented quality ground based variable star light curves.
- Analysis of the highly accurate Kepler and Gaia data on variable stars.

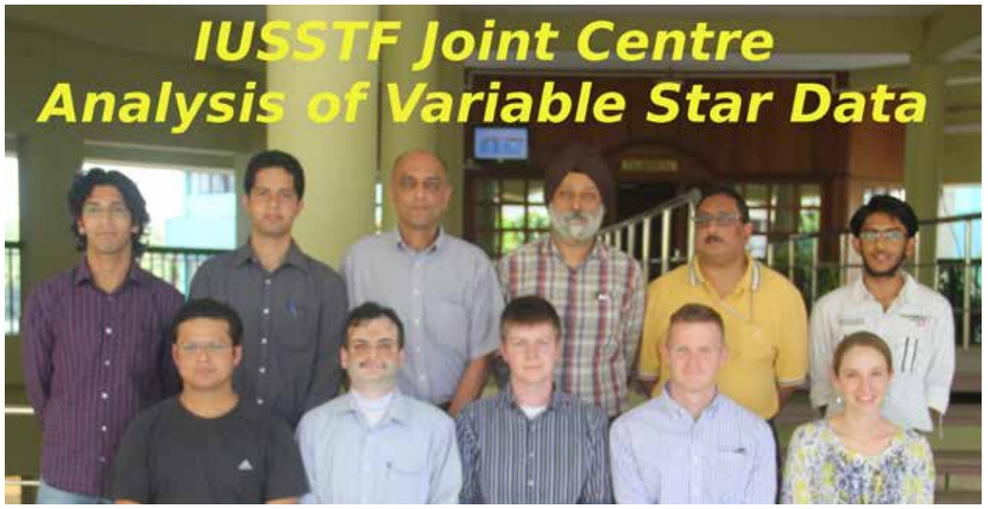
The Center is also providing extensive training to a new generation of globally engaged scientists by involving Indian and American undergraduate and graduate students jointly on these cutting edge research projects.

Achievements

- Developed collaborations between Texas A&M, University of Florida, SUNY Oswego, University of Delhi, IUCAA, Pune.
- University of Delhi and IUCAA faculty and students visited SUNY Oswego in December 2013. Two faculty and one post-doc spent 2 weeks each and one student spent 4 weeks there at Oswego.
- Faculty and students from SUNY Oswego, Texas A&M, University of Florida visited Delhi University and IUCAA, Pune in January 2014.
- 3 students from SUNY Oswego visited Delhi University in July 2014 funded by other sources but working on projects for the Joint Center.
- There was also a joint meeting with another Indo-U.S. Joint Center (CLASS ACT) that enabled collaborations between the two Centers was organized in Kerala in January 2014.
- S. Kanbur and a student from SUNY Oswego visited A Mahabal and M. Graham at Caltech Astronomy Department and the CLASS ACT Joint Center.
- S. Kanbur, L. Macri, R. Wagner-Kaiser, A. Bhardwaj presented posters/talks at the Space Telescope Science Institute Symposium on the Extra - Galactic Distance Symposium.
- D. Wysocki, a student from SUNY Oswego presented preliminary results on Principal Component Analysis of Variable Star Data at the summer meeting of the American Astronomical Society meeting in June 2013.
- S. Kanbur presented an invited talk at the MIAPP workshop on the Extra-Galactic Distance scale in Munich June 2014.
- H. P. Singh gave a talk on the theme of the Joint Center at Marburg University, Germany in May 2014.

Scientific value addition

- Paper [1] presents a careful and detailed light-curve analysis of publicly available data on fundamental mode RR Lyrae (RRab) stars of the Large Magellanic Cloud (LMC) obtained by the Optical Gravitational Lensing Experiment (OGLE). The study indicates that the formation of the LMC disk predates the formation of the inner halo. It has also been proposed that there is no metallicity gradient as a function of the galactocentric distance.
- Paper [2] provides new empirical Period-Color and Amplitude-Color relations for Cepheids and RR Lyraes in the Galaxy/LMC and SMC using the latest extensive and high quality data. This paper also provided a unique and innovative theoretical framework with which to explain the PC relations as a function of period, pulsation phase and metallicity. A primary result of this paper is that short period First Overtone Cepheids are just like Fundamental mode RR Lyrae stars in terms of Period-Color relations at minimum light.
- Paper [3] develops new methods for analysing data collected from small, remotely operated telescopes and has results in a large quantity of data that is currently being analyzed for the second year of the project.
- Paper [4] has resulted in the development of the most extensive and accurate Cepheid Period Luminosity relation for the LMC at JHK wavelengths. Together with recent work that provided a 2% distance to the LMC usign eclipsing binaries, this will provide a very secure anchor for the extra-galactic distance scale that will help to provide a CMB independent estimate for Hubble's constant that is accurate to less than 2-3%. Such estimates will be vital in order to place constraints on the dark energy equation of state. This paper also provides data with which to compute the structure of the LMC using JHK wavelengths.
- Paper [5] provides the first systematic quantitative study of the variation of Cepheid light curves as a function of period, wavelength and metallicity. These light curves were studied using the method of Fourier decomposition. The paper also studied the variation of the Hertzsprung progression with metallicity. The main results were a detailed set of quantitative light curve structure measures that can place strong constraints on theoretical stellar pulsation models.
- Paper [6] provides a novel twist to determining the quantitative structure of the light curves of



Periodic Variable Stars. A long standing problem in the Fourier decomposition of Variable stars is the determination of the order of the fit. The method presented in this paper describes a new technique that is almost always better than existing methods (Baarts condition). As such it will be a very useful technique for large scale wide field surveys such as OGLE IV and LSST.

Way forward

- The Center is currently analysing CSTAR data in order to :
  - Calculate the metallicites of 3 RR Lyrae stars observed by CSTAR.
  - Study the light curve structure of Delta Scuti stars observed by CSTAR.
- Study the consequences of new LMC JHK PL relation for various distance scale problems.
- Study the LMC JHK survey for other transient phenomena.
- Use the LMC JHK PL relation to calculate the distance to M31 and compare with distances calculated using a Galatic Cepheid PL JHK calibration.
- Use the new LMC JHK PL relation to determine the structure of the LMC.
- Collaborate with Italian researchers to:
  - Extend the analysis of the light curve structure of Cepheid variables at multiple wavelengths to the SMC.
  - Use the results of [4] to constrain theoretical stellar pulsation models.
- Use multiphase Cepheid PL relations to develop a novel measure of the metallicity dependence of the Cepheid PL relation.
- Use new methods is presented in [6] to new wide field surveys.
- Study the use of conditional entropy methods to detect the periods of variable stars.
- Strengthen the results of [5] using other statistical methods and connect these detected nonlinearities to changes in the light curve structure of variable stars.
- Use Artificial Neural Networks to classify variable stars based on their light curve structure.
- Undertake a chemical and structural analysis of the Small Magellanic Cloud using the fundamental mode RR Lyrae stars.

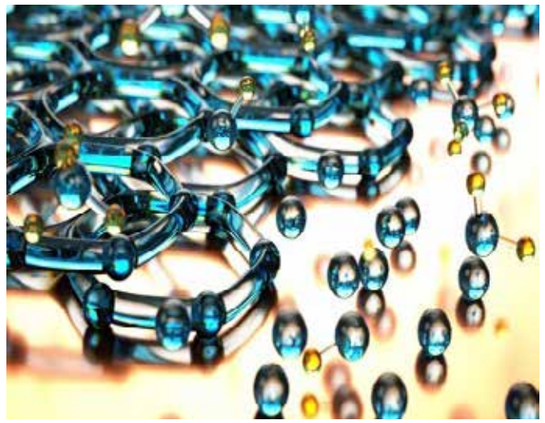
Publications

- Sukanta Deb and Harinder P. Singh (2014) *Chemical and Structural Analysis of the Large Magellanic Cloud using fundamental mode RR Lyrae Stars.* Monthly Notices of Royal Astronomical Society, Vol. 438, 2440-2455.[1]
- Anupam Bharadwaj, Shashi Kanbur, Haridner P. Singh, Chow-Choong Ngeow (2014) *Empirical Period-Color and Amplitude-Color Relations for Classical Cepheid and RR Lyrae Variables.* Accepted for publication in Monthly Notices of the Royal Astronomical Society [2]

Publications Planned

- Ryan J. Oelkers, Lucas M. Macri, Lifan Wang, Michale C. B. Ashley, Xiangqun Cui, Long-Long Feng, Xuefei Gong, Jon S. Lawrence, Liu Qiang, Daniel Luong-Van, Carl R. Pennypacker, Huigen Yang, Xiangyan Yuan, Donald G. York, Xu Zhou and Zhenxi Zhu (2014) *A Novel Approach for the Analysis of Defocused Images in a Crowded Field and its Application to 2009 CSTAR Observations.* Submitted in Astronomical J.[3]
- Lucas M. Macri, Chow Choong-Ngeow, Shashi M. Kanbur, Salma Mahzooni, Michael T. Smitka (2014) *Large Magellanic Cloud Near-InfraRed Synoptic Survey. I: Cepheid Variables and the Calibration of the Leavitt* Law. Submitted in Astronomical J.[4]
- Anupam Bhardwaj, Shashi Kanbur, Harinder P. Singh, Lucas Macri, Chow-Choong Ngeow (2014) *On the Variation of Fourier Parameters for Galactic and LMC Cepheids at Optical, Near-Infrared, and Mid-Infrared Wavelengths.* Submitted in Monthly Notices of the Royal Astronomical Society [5]
- E. Bellinger, D. Wysocki and S. Kanbur (2014) *Light Curve Reconstruction of Periodic Variable Stars using Fourier Decomposition.* Submitted in Monthly Notices of the Royal Astronomical Society. [6]

From Fundamentals to Applications of Nanoparticle Assemblies



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USA

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The Center is focusing on specific activities which are integrated to go from particle synthesis to applications. The center would complement Synthesis of Nanoparticles (NPs) where experiments with molecular theory and population balance models will address the open questions. Deliverables here include an experimentally validated, predictive theory for digestive ripening, and therefore NPs with any desired size and surface passivation.

In another aspect of the proposal the center seeks to learn from the small molecule surfactant literature and assemble the polymer grafted NPs into novel structures such as spheres, micelles and rods (relevant to drug delivery, self-healing materials), and periodic in both the NPs and the polymers (relevant to batteries, solar cells), and even more complicated structures. The studies will use advanced characterization tools, such as optical, confocal and electron microscopies, combined with X-ray diffraction and small angle X-ray and neutron scattering, and spectroscopy to elucidate structure and properties of the individual nanoparticles and their assemblies

Deliverables here are a much bigger tool kit from which we can select a desired NP superstructure, and understanding how these structures can be formed either under quiescent or driven conditions. The deliverables also include a theoretical rationalization linking the mechanical response of nanoparticle/small organic molecule hybrids to the assembly technique.

Achievements:

Established several connections between US and Indian Partners. Specifically, (i) between IITB, CSIR-NCL and Columbia University in the area of size-controlled synthesis of nanoparticles; (ii) between CSIR-NCL and Columbia University in the area of elastic macroporous scaffolds from particle assemblies; (iii) between IIT-Delhi and Columbia University in theory and modeling of nanoparticle interactions; (iv) between IIT-Patna/ IIT-Kharagpur and University of Houston in the area of polymer nanocomposites.

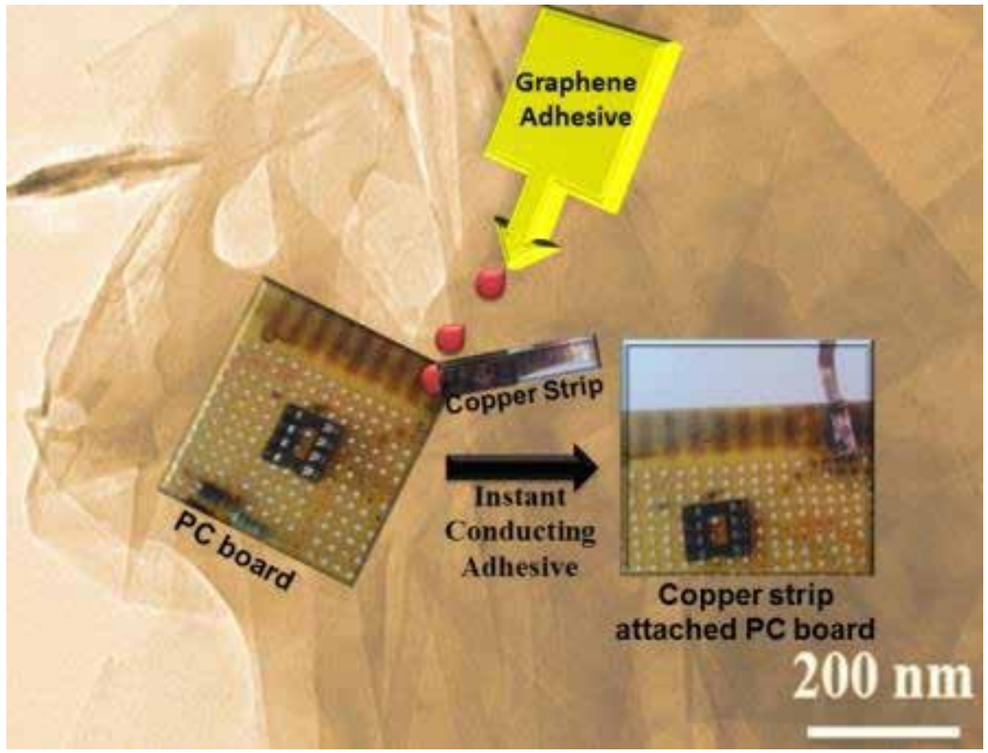


Fig. 1. Instant conducting adhesive from graphene.

Several Joint publications between US and India partners have been generated.

NOTE: Center's publication on elastic macroporous assemblies was highlighted in Chemical and Engineering News, a prestigious American Chemical Society news magazine.

Scientific value addition:

Between IIT-Patna/IIT-Kharagpur and University of Houston

Chemical modification of graphene to introduce functional groups in a site specific manner was carried out (IIT-Kharagpur/IIT Patna). These were then coupled with silane monomers and novel nanocomposites were prepared (Univ. Houston). Such polymer nanocomposite exhibited instant conducting adhesive behavior (Fig. 1). Furthermore, by introducing bulky pendant groups at the edge sites that exert stress on the basal plane of graphene, its band gap could be engineered (Fig. 2). The modified material demonstrated a semi-conducting behavior over the semi-metallic behavior of the pristine material IIT-Patnta/IIT-Kharagpur & University of Houston).

Fig. 2. Bandgap engineering by chemical modification of graphene.

An acrylamide based monomer using 2-aminotriptycene was prepared (IIT-Patna). A polymerization of this monomer using the wellknown ATRP polymerization protocol is being planned (University of Houston). The objective is to derive novel triptycene based polymers and study their properties.

Between NCL-Pune/IIT-Bombay and Columbia University

The NCL-Pune/IIT-Bombay and Columbia University partnership is focusing on (i) of size-controlled synthesis of nanoparticles and (ii) preparation of elastic macroporous scaffolds from particle assemblies. In the area of nanoparticle synthesis, the partners are trying to evolve a mechanistic understanding of the wellknown digestive ripening process. A series of model experiments have been planned and being executed at CSIR-NCL/IIT-Bombay. The results are being shared with Prof. Sanat Kumar's group at Columbia University who are trying to model the digestive ripening process. Other plans of this partnership include understanding the effect of polydispersity in grafting density of polymer chains on nanoparticle surface that influences the shape of nanoparticle-aggregates (IIT-Bombay) and preparation of macroporous monoliths (CSIR-NCL), comprised primarily of colloidal particles, that are elastic (Fig. 3). The latter work benefited extensively from the discussions the CSIR-NCL partners had with Prof. Sanat Kumar (Columbia University). The discussions with other scientists at Columbia, during the visit of Dr. Kumaraswamy (facilitated by the Joint Center) with Dr. Jacques Jestin and Prof. Jeffrey Kysar, resulted in further collaborations and different experiments on the elastic particle assemblies are currently underway in Prof. Kysar's group of Columbia University.

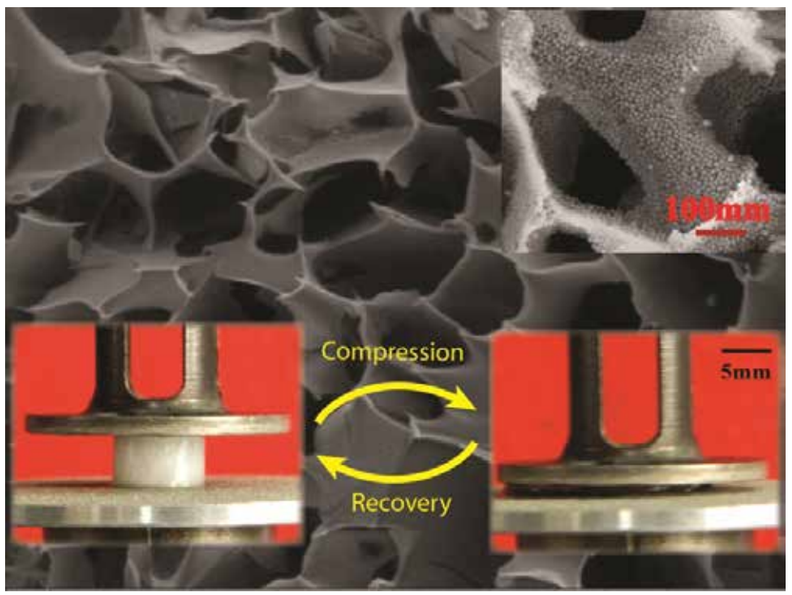


Fig. 3. Ultralight elastic porous 3-dimensional scaffolds from colloidal self-assemblies.

Between IIT-Delhi and Columbia University

The IIT-Delhi/Columbia University partnership is focused on probing the fluctuation driven anisotropy in effective pair interactions between gold nanocrystals that are densely passivated with short ligands. The results clearly suggest that for dense grafting regime, inclusion of anisotropic effects as well as many-body interactions is necessary to adequately describe the thermodynamics and assembly behavior of nanoparticles.

As part of the visitations associated with the Joint Center, one scientist from the US visited their Indian counterparts and three Indian scientists and one student visited their US partnering Institutions.

Way Forward:

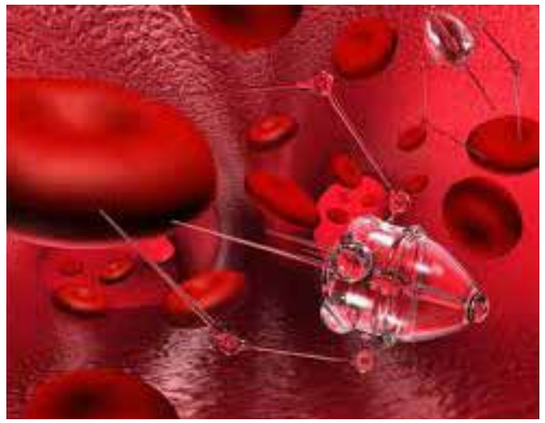
The Indian and US partners successfully bid for a Faraday Discussions on the topic of Nanoparticle Assemblies that will be held in Mumbai (at IITB) in January 2016.

The team has planned a unique workshop at the culmination of the Joint Center to bring together academics and industry, to understand the opportunities offered by nanoparticle assemblies (January 4-6, 2016). Several prominent researchers (including Prof. Daan Frenkel from Cambridge University, Prof. Vinothan Moharan from Harvard University and Prof. Oleg Gang from Brookhaven National Laboratory, Prof. Laximnarayanan from the Raman Research Institute), in addition to members of the Joint Center have agreed to conduct this workshop.

Publications:

- Mondal, T., Bhowmick, A.K., Krishnamoorti, R. (2014) *Conducting Instant Adhesives by Grafting of Silane Polymer onto Expanded Graphite*. ACS Appl. Mater. Interfaces, DOI:10.1021/am5040472
- Mondal, T., Bhowmick, A.K.; Krishnamoorti, R. (2014) *Stress Generation and Tailoring of Electronic Properties of Expanded Graphite by Click Chemistry*. ACS Appl. Mater. Interfaces 6:7244-7253.
- Sahu, P. and Prasad, B. L. V. (2014) *Time and temperature effect on the digestive ripening of gold nanoparticles: Is there a cross over from digestive ripening to Ostwald ripening?*. Langmuir 30: 10143□10150.
- Rajamanickam R., Kumari S., Kumar D., Ghosh S., Kim J. C., Tae G., Gupta S. S., Kumaraswamy G., Chem. Mater., 2014, 26, 5161□5168 (*Highlighted in C&EN, http://cen.acs.org/articles/92/web/2014/09/Strong-Springy-Materials-Made-Freezer.html*)

Nanomedicine for Head & Neck Cancer (HNC)



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New Delhi

Institute of Life Sciences
Ahmedabad University

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Boston

The joint center proposes to test an innovative sustained local drug release nanoplatform for Head and Neck Cancer (HNC) capable of locally radiosensitizing the specific HNC malignant site and minimizing systemic toxicity and reducing the radiation dosage. The proposed design involves using poly (lactic-co-glycolic acid) (PLGA) nanoparticles loaded with a model radiosensitizing drug Docetaxel (DTX) which will be administered intratumorally to provide localized *in-situ* delivery of the sensitizer to the tumor site. This is expected to avoid the toxicity associated with current systemic delivery of radiosensitizers. It is anticipated that the proposed nanoplatform will improve the therapeutic ratio of radiation therapy without introducing additional patient interventions. This innovative approach is expected to result in new modalities in localized chemotherapy (LCT) and localized chemo-radiation therapy (LCRT).

The overall scientific goal for the project is to study the efficacy of LCT and LCRT using docetaxel loaded PLGA nanoparticles. It was projected to achieve this goal through three specific aims where aim 1 constituted the significant part for first year study along with initial studies for aim 2 and aim 3.

Aim 1: Fabrication and characterization of DTX-loaded PLGA nanoparticles (DTX-PLGA-NP) and *in-vitro* kinetic studies to optimize release kinetics.

Aim 2: *In-vivo* time dependent intra-tumoral distribution profile using optical near infrared fluorescence imaging and therapeutic efficacy of LCT with the DTX-PLGA-NP administered intra-tumorally.

Aim 3: Studies of the efficacy of LCRT combining chemo- and radiation using DTX-PLGA-NP with brachytherapy I125 seeds.

Aim 4: Data analysis for planning the phase I clinical

studies of the DTX-PLGA-NP System.

Achievements:

- Successfully synthesized PLGA-DTX nanoparticles at Northeastern University (NEU), Boston and two students at NPL have been trained for the same by our collaborators from NEU during their visit.
- Carried out the preliminary in vivo imaging studies in tumored animals to evaluate the imaging potential.
- The release kinetics profile and in-vitro results are promising and formed the basis for further animal studies which are planned to be accomplished at IITR Lucknow.
- Synthesized fluorescent gold nanoclusters at NPL whose toxicity and feasibility for enhancing radiation therapy have been tested at NEU. Preliminary results are encouraging.
- As spinoff to these interactions, the center has planned to host an international conference on translational nanomedicine at, Institute of Life Sciences, Ahemdabad University during 15-17, December 2014, where the collaborator Prof. Rishi Shanker is working on *in-vivo* experiments.

As part of the visitations associated with the Joint Center, two scientists from the US visited their Indian counterparts and two Indian scientists visited their US partnering Institutions.

Novel magnetic structures and excitations in multilayers, interfaces, nanoparticles & bulk

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Partnering Institutions

India

Indian Institute of Technology
Delhi

USA

Argonne National Laboratory
Lemont

The objectives for the joint center are devoted for the investigations on the following topics.

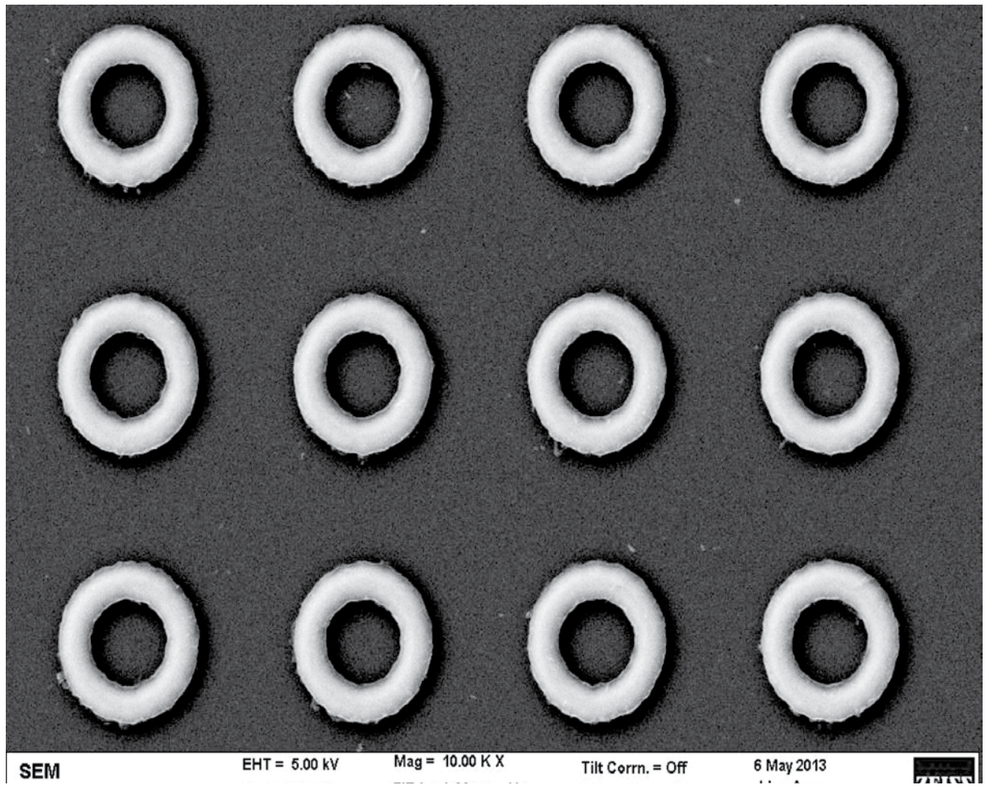
- **Rare earth free hard magnets:** to explore the stability of these materials after an optimized growth parameters with the desired phase formations. High performance magnets such as Mn-Al(-C) of hard magnetic properties are important without either ferromagnetic elements such as Fe, Co and Ni or rare earth ions. In this work the understanding and stabilizing the τ-phase (fct) among the various phases of this system; Є (h.c.p) and Є' (orthorhombic) phase is a challenging job. The τ-phase possesses hard magnetic properties. The development of rare earth free permanent magnets is exceptionally cost effective.
- **Multilayers and thin film nanostructures:** thin films of various kinds of magnetic materials need to be explored for the evaluation of magnetic field in conjunction with nano-grained microstructures, grain boundaries and the magnetic microstructures of various domain, domain walls and point and line defects obstructing the movements of domain walls.
- **Helimagnets of FeGe:** the compositional variants of helimagnets like $FeGe_{1}$-xSix will be studied to evaluate the magnetic twin structure, crystallization temperature, magnetic chirality across twin boundaries, magnetic fields, etc.

The objectives would be achieved by carrying out detailed electron microscopy observations to investigate the various microstructural and excitations pertaining to magnetic materials of various kinds in the form of multilayers, thin films, interfaces and bulk. Important case studies will be persuaded on FeGe and Perovskites based magnetic materials. In this work high resolution electron microscopy encompassing to the various techniques of Lorentz microscopy and Electron holography will be employed to evaluate the important aspects such as; (i) exploration of

magnetic structure of systems showing spiral magnetic order which leads to formation of Skyrmion, (ii) atomic scale magnetic Skyrmion lattice in two dimension, (iii) Skyrmion lattice in the doped semiconductors, (iv) phase interpretations of atomic scale image employing transport of intensity equation, (v) topological spin structure in the helimagnet FeGe, (vi) formation of Skyrmion crystal in thin films of the helimagnet FeGe, etc. Further to elaborate, the synthesis of rare-earth free hard magnets is a crucial problem. For example the τ-a magnetic phase in Mn-Al system is a metastable phase and needs significant experimentation towards its single phase formation in the alloy. Normally the powder metallurgy (ex. ball milling) and melting (arc melting, induction melting, etc.) are the methods of processing the basic material. In some cases a combination of these routes, melting followed with powder metallurgy are also tried. In these processes, the ε-phase (a stable phase) is formed first and by annealing of the ε-phase (between 400 to 600 °C for 10 to 40 min) the formation of τ-phase is expected. However in addition to τ-phase, the signals of β and γ-phases are also noted, which are stable phases at room temperature. Under such conditions, the in depth electron microscopy experiments are important to evaluate the material to recognize the formation of τ-phase, its uniformity in the alloy and chemistry of the material.

Following seminars / invited talks were organized during this period of the execution of the project:

- S.D. Bader, Spintronics: Implications for Energy, Information & Medical Technologies, Distinguished Scientists Lecture Series, National Physical Laboratory, New Delhi, India, December 10, 2013.
- R.C. Budhani, Novel electronic phases and phase transitions at oxide interfaces, Director's Special Colloquium, Argonne National Laboratory, USA June 3, 2014.
- Y. Zhu, Tracking Lithium Electrochemical Reactions and Probing Electron-Phonon Interactions using Ultrafast



NiFe nano-rings fabricated by Electron Beam Lithography

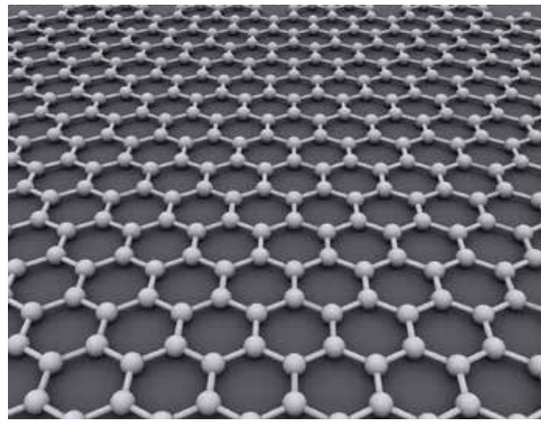
Electrons, Distinguished Scientists Lecture Series, National Physical Laboratory, New Delhi, India, July 8, 2014

- Y. Zhu, L. Wu, H. Inada, J. Ciston, R.F. Egertonand L.D. Mark, Atomically Resolved Surface Imaging Using Secondary Electrons with Aberration Corrected Scanning Transmission Electron Microscopes, International Conference on Electron Microscopy, New Delhi, India, July 10, 2014
- A.K.Srivastava, Electron Microscopy Evidence of Relevance of Microstructure – Property Correlations, Materials Science Division, Argonne National Laboratory, USA, July 22, 2014.
- A.K.Srivastava, Electron Microscopy Evidence of Relevance of Microstructure – Property Correlations, International Conference on Nanoscale Spectroscopy and Nanotechnology (NSS-8), Gleacher Center, Chicago, USA, July 28, 2014.

Publications:

- Rout P.K., Pandey H., Wu L., Anupam, Joshi P.C., Hossain Z., Zhu Yimei and Budhani R.C. (2014) *Two–dimensional electron gas-like charge transport at the interface between a magnetic Heusler alloy and $SrTiO_3$*. Phys. Rev. B 89: 020401(R)
- Das S., Rastogi A., Wu L., Zheng J.C., Hossain Z., Zhu Yimei and Budhani R.C. (2014) *Kondo scattering in δ-doped LaTiO3/$SrTiO_3$ interfaces: Renormalization by spin-orbit interactions*. Phys. Rev. B 90: 081107(R).

Theoretical Studies of the Correlated Electronic Structure of Graphene and its Fragments



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Partnering Institutions

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Indian Institute of Technology
Bombay

USA

Mississippi State University
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The principal research objective is to arrive at accurate correlated-electron description of graphene and wide quasi-2D graphene nanoribbons. In the context of graphene nanoribbons center's motivation is to determine how true two-dimensionality is reached as the width of the nanoribbons is increased in a controlled manner. The educational mission is to expose graduate students and postdoctoral fellows to modern techniques of computational and theoretical materials chemistry and physics.

The US and Indian researchers bring complementary techniques such as quantum chemistry with high order configuration interaction, the Density Matrix Renormalization Group and the Path Integral Renormalization Group into the effort. In all cases the motivation is to work in a highly collaborative environment in order to achieve the objectives. In addition, the researchers have established collaboration with the synthetic chemistry group of Professor Klaus Muellen of Max Planck Institute for Polymer Research (MPI), Mainz, who will provide samples of large PAH molecules and the attosecond spectroscopy group of Professor Arvinder Sandhu, who will perform one- and two-photon absorption measurements on the molecules supplied by the Muellen group.

The Center has performed theoretical research on the PAH molecules coronene, hexa-peri-hexabenzocoronene (HBC), circumcoronene and

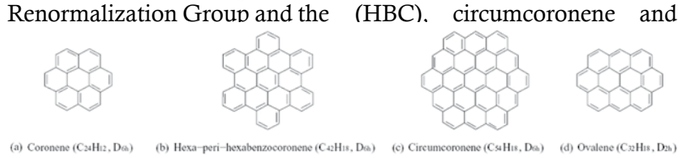


Figure 1: (a) Coronene (C24H12), (b) HBC (C42H18), (c) circumcoronene (C54H18), and (d) ovalene. The PPP-MRSDCI calculations were done for the full MO-space of coronene, and ovalene; for HBC and circumcoronene the outermost 5 and 8 pairs of MOs, respectively, were ignored in our calculation.

	One-photon states	$2^1A_g^-$	T_1	T_2	$^1A_g^-$ states ($\sim 2 \times T_1$)	$^1A_g^-$ states ($\sim 2 \times T_2$)
Decapentaene	4.12 ($1^1B_u^+$)	3.06	1.52 (1^3B_u)	2.45 (1^3A_g)	3.06 ($2^1A_g^-$)	4.81 ($3^1A_g^-$)
Ovalene	2.91 ($1^1B_{2u}^+$)	3.03	1.57 (1^3B_{2u})	2.65 (1^3B_{3u})	3.03 ($2^1A_g^-$)	5.27 ($11^1A_g^-$)
	3.56 ($1^1B_{3u}^+$)					
	4.18 ($2^1B_{2u}^+$)					
Coronene	4.11 ($1^1B_{2u}^+$, $1^1B_{3u}^+$)	3.96	2.38 (1^3B_{2u})	3.04 (1^3B_{3u}, 2^3B_{2u})	4.77 ($5^1A_g^-$)	6.07 ($12^1A_g^-$)
HBC	3.37 ($1^1B_{2u}^+$, $1^1B_{3u}^+$)	3.30	2.07 (1^3B_{2u})	2.72 (1^3B_{3u}, 2^3B_{2u})	4.12 ($5^1A_g^-$)	5.35 ($16^1A_g^-$)
Circumcoronene	2.66 ($1^1B_{2u}^+$, $1^1B_{3u}^+$)	2.75	1.50 (1^3B_{2u})	1.97 (1^3B_{3u}, 2^3B_{2u})	2.94 ($3^1A_g^-$)	3.68 ($8^1A_g^-$)

Table I: PPP-MRSDCI excited state energies for decapentaene and the PAH molecules of Figures 1(a)-(d)(in eV). The 1A−gstates in the last two columns have energies that are nearly twice those of the lowest triplets T1 and T2.

ovalene shown in Figure 1. In all cases sophisticated multiple reference singles and double configuration interaction (MRSDCI) calculations have been performed, whose precision was as good as quadruple-CI (QCI). Besides, a DMRG approach was employed to calculate electronic structure of nanoribbons and of nanodiscs. These are the largest CI

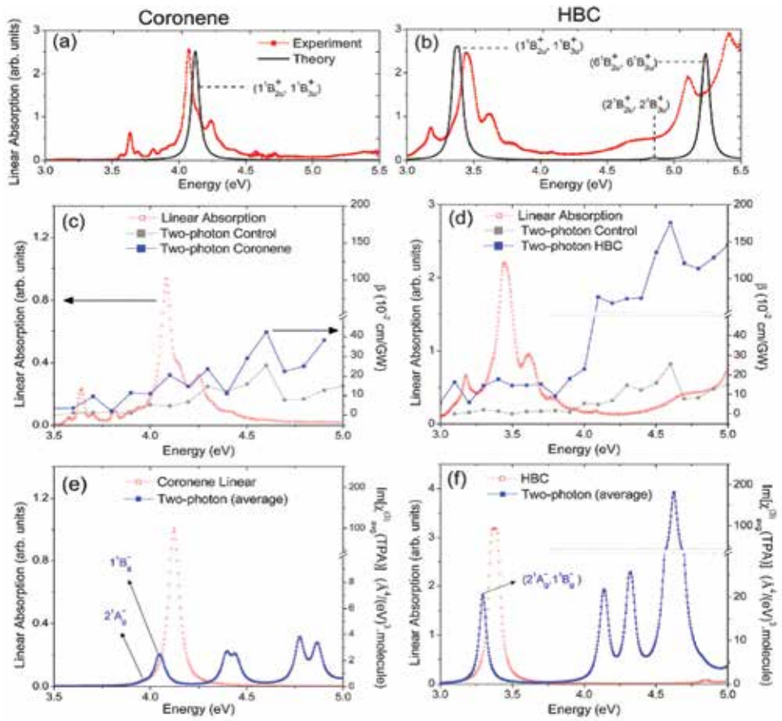


Figure 2: (a) Experimental (red) and calculated (black) optical absorption spectra of coronene; calculations are within the PPP model. The weak absorption at ~ 3.5 eV, missed in the calculation, is to a state that is optically dark within the purely electronic PPP Hamiltonian with nearest-neighbor electron hopping. (b) Same as in (a) for HBC. The lowest energy weak absorption is again to a dark state. (c) Experimental linear (red) and two-photon absorption (TPA) (blue) spectra of coronene. The gray curve gives the TPA due to the solvent. Notice the significant TPA of coronene below the linear absorption edge. (d) Same as (c) for HBC. (e) Calculated linear absorption (red) and average TPA (blue) for coronene. Two-photon resonances are to both 1Ag and 1B1g states (arrows) which are nondegenerate within the PPP model. (f) Same as in (e), for HBC.

calculations performed on 2D PAH molecules to date.

Within one-electron and Hartree-Fock theories, the lowest two-photon state in all cases is predicted to be significantly above the lowest one-photon optically allowed state. In contrast the calculated two-photon states are below the lowest one-photon state or nearly degenerate. This is strictly a correlation effect. Experiments on coronene and HBC confirmed the theoretical prediction. (Figure 2).

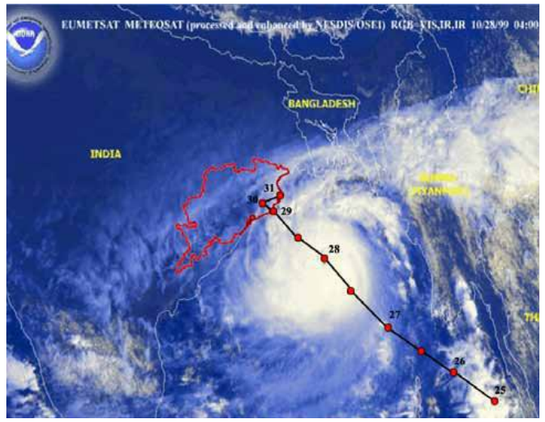
The team has discovered a peculiar role of geometry. The first three molecules in Figure 1 all have D6h symmetry. Although correlation effects are significant, it is found that these effects were weaker than that in linear polyenes. In the polyenes, the lowest two-photon state is at or nearly at the same energy as twice the energy of the lowest spin-triplet state, indicating that both the lowest triplet and the lowest two-photon state are covalent in the valence bond language. In the D6h PAH molecules, the lowest two-photon states are significantly below twice the lowest triplet energy, indicating the significant ionic contributions to both the triplet and the two-photon state. This is not entirely unexpected, as with three nearest neighbors per carbon atom (except the peripheral ones) the one-electron bandwidth in the 2D PAH molecules is much larger than that in the polyenes. What is surprising is that the lowest two-photon state is at twice the energy of the lowest triplet in D2hovalene (Figure 1(d)), which has the same bandwidth as the D6h molecules. (Table I)

As part of the visitations associated with the Joint Center, two scientists from the US visited their Indian counterparts and three Indian scientists visited their US partnering Institutions.

Publication

- Aryanpour K., Roberts A., Sandhu A., Rathore R., Shukla A. and Mazumdar S. (2014) *Subgap two-photon states in polycyclic aromatic hydrocarbons: Evidence for strong electron correlations*. J. Phys. Chem. C 118: 3331-3339.
- Aryanpour K., Shukla A. and Mazumdar S. (2014) *Electron correlations and two-photon states in polycyclic aromatic hydrocarbon molecules: A peculiar role of geometry*. J. Chem. Phys.140: 104301.

Advanced Modeling of Tropical Land-Atmosphere-Ocean System for Simulation of Extreme Weather Events



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The Center addresses the problem of improved forecasts of severe weather events over tropical regions within the Framework for India-U.S. Cooperation on Weather and Climate Forecasting and Agriculture. The aim of the center is to advance the Hurricane Weather Research and Forecasting System to a Regional Tropical Prediction System over India for improved forecasts of high impact weather events.

During the past two-three years, significant progress has been accomplished in the tropical cyclone (TC) track, intensity and structure forecasts under the auspices of and support from the United States (US) National Oceanic and Atmospheric Administration (NOAA)'s Hurricane Forecast Improvement Project (HFIP, Gall et al. 2013). In particular, for the first time, a very high-resolution (3 km) deterministic numerical weather prediction (NWP) model, known as the Hurricane Weather Research and Forecast (HWRF) modeling system, developed as a joint project by the Environmental Modeling Center (EMC) and the Hurricane Research Division (HRD) of NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) and implemented at the National Centers for Environmental Prediction (NCEP), has shown comparable and at times superior TC intensity forecast skills compared to the best performing statistical models. The HWRF model is now paving the way for removing the roadblocks to improvements in the operational TC intensity forecasts, which have had virtually stagnant skill for the last two decades. This modeling system was implemented in operations at the India Meteorological Department under the implementation agreement (IA) between MOES and NOAA. In order to share NOAA's advanced understanding and forecasting techniques acquired in the last few years, an Indo-US

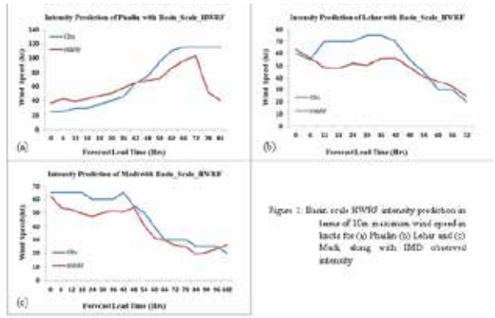

Figure 1: Basin scale HWRF intensity prediction in terms of 10m maximum wind speed in knots for (a) Phailin (b) Lehar and (c) Madi, along with IMD observed intensity

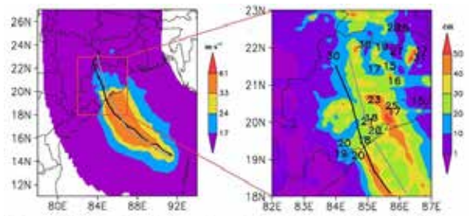

Figure 2: HWRF forecast of (a) 10m maximum wind speed in m s^{-1} and (b) rainfall swath in cm during the life-cycle of TC Phailin from 00 UTC 10 October 2013. The black and grey lines represent the JTWC best and HWRF model track respectively. Rainfall swath accumulated over 126 hr of forecast is zoomed over the rectangular region highlighted in (a) and the numbers in (b) represents the IMD station-observed accumulated rainfall for the landfall day(03UTC 12–13 Oct 2013) period.

workshop on Advanced modeling and data assimilation for tropical cyclone predictions with special reference to the hurricane weather research and forecasting (HWRF) system on July 09-14, 2014 was organized by U.C. Mohanty (IIT, Bhubaneswar) and Sundararaman Gopalakrishnan (NOAA).

Achievements

Based on the 2013 version of operational HWRF system, the Hurricane Research Division (HRD) of the Atlantic Oceanographic and Meteorological Laboratory (AOML) with its partners at Environmental Modeling Center (EMC), National Centers for Environmental Predictions (NCEP) have developed a basin scale HWRF system that can operate with multiple moving nests spanning at resolution down to 3 km over the Atlantic Ocean. The Joint Center configured the same system for North Indian Ocean (outer domain covers Westpac, north Indian Ocean) with the help of US counterpartners.

Initial testing and experimental runs have been conducted with the recent very severe cyclonic storms (VSCS), Phailin (Oct' 2013), Lehar (Nov' 2013) and Madi (Dec' 2013) over Bay of Bengal. This model clearly showed overall superiority at longer range forecast (4-5 days) in terms of track, intensity, size and structure. In all the cases, HWRF showed significant improvements in the evolution of intensity (Figure 1). Figure 2a provides wind swath of Phailin demonstrating that the system made landfall with very severe cyclonic storm intensity in advance of 3 days. The rainfall amount and structure is improved significantly, in case of Phailin showing peak rainfalls activity over Northern parts of Odisha as observed (Figure 2b). In case of Lehar, model indicated the dry air incursion into TC environment when the TC started interacting with the land which causes weakening of Leharover the Bay of Bengal itself before making landfall. The rarest track and intensity evolution (maximum intensification to VSCS and dissimilation over the Bay of Bengal without landfall) of Madi was also predicted more accurately.

Scientific value addition

The basin scale HWRF system has scientific capabilities

- To study multi-scale interactions such as largescale – storm scale and storm scale – storm scale
- As quality of initial conditions (storm intensity, position and structure) are important, this system has state-of-the-art vortex initialization and relocation technique to correct initial intensity, position and structure based on observations.
- Assimilation of environmental and storm scale observations can be done within this system using advanced

Hybrid EnKF data assimilation system which provides background error flow.

- Provides guidance much in advance whether the West Pacific/China Sea typhoons are emerging into Bay of Bengal and its movement and intensity.
- Provides sufficient large scale environment at high resolution.

Way forward

- Initial testing is underway to study the sensitivity of updating SST (6 hrly) during model integration on model performance.
- Hybrid data assimilation
- Development of customized land surface data assimilation system for Indian region to represent land characteristics (soil moisture and temperature profiles with depth) when a cyclone start interacting with the land for better structure of wind and rainfall during landfall.
- Coupling of ocean model with atmospheric HWRF model for North Indian region.

Elastohydrodynamic Lubrication Studies

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Elastohydrodynamic lubrication (EHL) is a common phenomena occurring within the non-conformal contacts of bearings, gears, cam-follower, valves etc. These tribological components are very critical and are of significant importance in the functioning of the elite mechanical systems. However, even after appropriate maintenance practices, these components fail unwarrantedly leading to severe loses. Hence, the IUSSTF funded Joint Centre on Elastohydrodynamic Lubrication envisages understanding the untouched domains of EHL and developing perspective methodology to understand the failure phenomenon in the elastohydrodynamic lubricated contacts.

During the one year span significant achievements has been attained by the centre in terms of gaining new knowledge pertaining to EHL and also strengthening and augmenting the strengths of the partnering institutions.

Achievements

- A generalized mathematical model for one-dimensional EHL line contacts has been developed using the Finite Difference and Discontinuous Galerkin techniques. The generalized EHL line contact model represents the contact geometry in roller bearings, gears, cam-followers etc.
- The initial smooth surface EHL line contact model was upgraded to the rough surface EHL line contact lubricated with non-Newtonian lubricants. The surface roughness in the model has been incorporated using stochastic and deterministic approaches (Figure 1). The non-Newtonian rheology of the lubricants is represented by Power-law lubricants.
- The model provides the film thickness distribution and the contact pressures within the contact under different operating conditions. The generalized operating parameters viz. Load, Speed and Material property forms the input to the model. Figure 2 shows the film thickness and pressure distribution within the

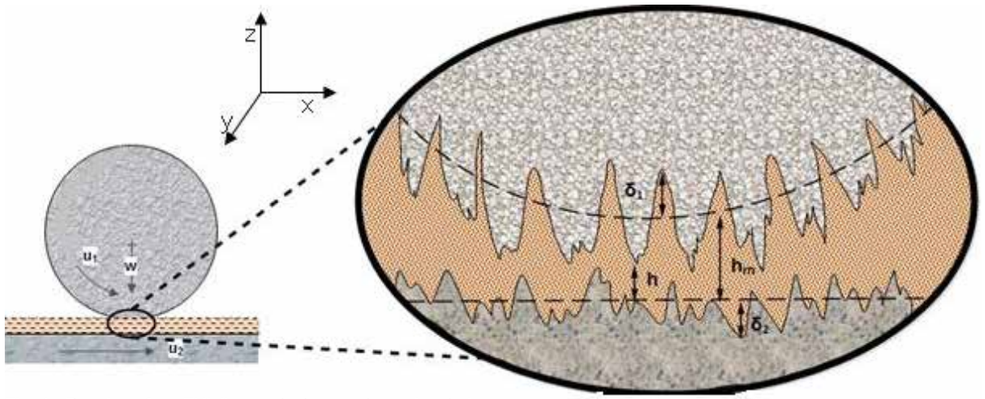


Fig. 1 : Rough surface EHL line contact geometry under study.

contact for a shear thinning fluid.

- The study undertaken has revealed that the speed, material parameter and the power law index have significant influence on the performance of the EHL contact as these parameters significantly influences the fluid film thickness. The sample results of this study are given in Figure 3.
- A CFX based model has been developed for a bump shaped asperity in an EHL contact. The contact pressure and the deformations have been investigated. The non-Newtonian rheology of lubricant has been employed using the Power Law concept.
- During the first year of the Joint center the research team from India visited the Northwestern University and University of Akron. During the visit the researchers discussed the plan of work and the future course of action of the center for successful attainment of the deliverables.

Scientific value addition

The outcome of the Joint center in the first year has resulted into development of theoretical model of EHL which has been upgraded to investigate more realistic contact conditions. The CFX approach followed is for the first time in the EHL studies. These studies will be of immense help in design and development of tribo-components and also to understand the failure phenomena associated with these components.

Way forward

The Joint center is determined to bring into more realistic approaches of mechanical systems with the help of theoretical models and experimental validation. As a way forward the activities pertaining to the development of failure models and the incorporation of real surface roughness into the investigation are planned for the second year. Further a joint collaborative workshop in order to disseminate the findings of the center is planned in the second year.

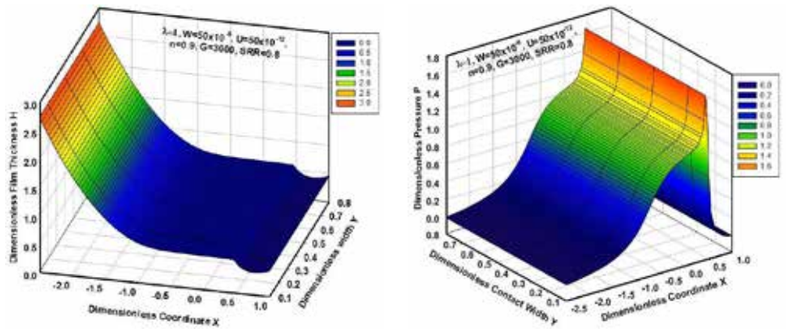


Fig. 2 : The film thickness and pressure distribution for (W=50x10-6, U=50x10-12, G=3000, SRR=0.8)

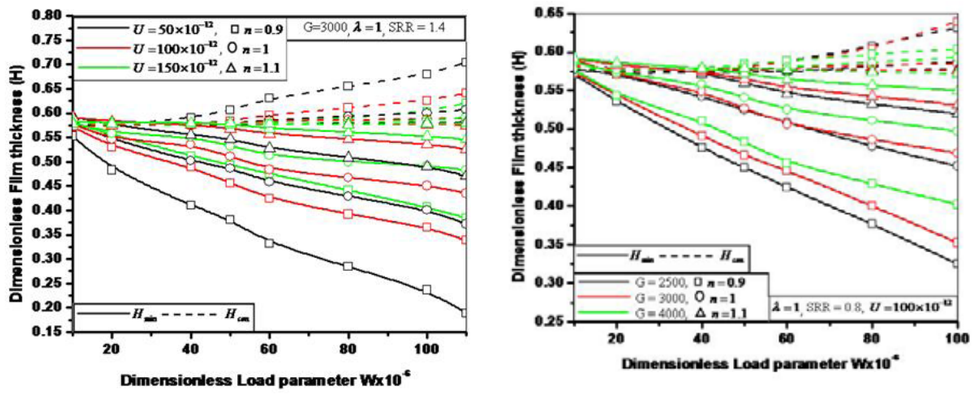
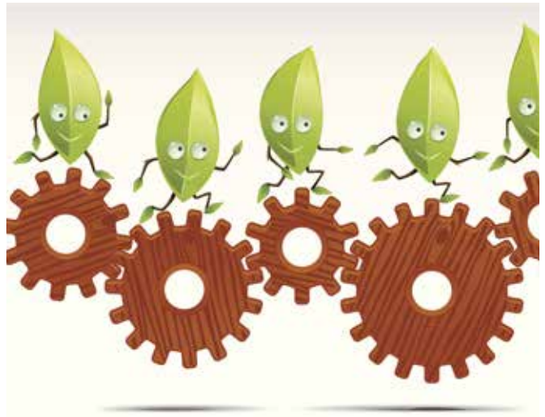


Fig. 3 : Influence of dimensionless load on the central and minimum film thickness at different (a) Speed parameter and (b) Material parameter.

Publications:

- Thakre G. D, Sharma Satish C, Harsha S.P, Tyagi M.R. (2014) "*A parametric investigation on the microelastohydrodynamic lubrication of power law fluid lubricated line-contact.* Proc. of IMech E Part J. (Communicated, Under Review).

Design of Sustainable Products, Services and Manufacturing Systems



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In the current networked and complex manufacturing environment, an integrated systems approach for sustainability requires the development of robust and cost-effective life cycle analysis and synthesis methodologies, standards, and tools so that designers and engineers can track and aggregate the overall sustainability of a product throughout its life and across the networked and distributed production system. Such data generation and aggregation is beyond the capability and missions of many of the manufacturing companies today, as it involves their entire global supply chain and significant gains can be achieved through India-US research and industry collaborations. To support development of sustainable manufacturing systems, the following are needed:

- Measures with which to assess sustainability of these systems.
- Suitable guidelines, methods and tools with which to generate such systems.
- Suitable standards, guidelines, methods and tools for evaluating/selecting such systems.
- Suitable training materials for training people in designing sustainable systems

The main objective of this Joint Center is to leverage the Indo-US research efforts in creating synergy between the needs of the emerging and advanced economies. The center will coordinate and carry out cutting edge research to benchmark and develop suitable measures for sustainability, develop a repository of suitable methods for use to improve sustainability, and develop a curriculum and training material using the above results for educating students to be 'sustainable designers'.

Climate Change and Health Adaptation

RED ALERT	Extreme Heat Alert Day
ORANGE ALERT	Heat Alert Day
YELLOW ALERT	Hot Day
WHITE	No Alert

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In response to excess mortality due to heat wave in May 2010, the Public Health Foundation of India (PHFI) through the Indian Institute of Public Health Gandhinagar (IIPHG) and the Natural Resources Defence Council (NRDC) have been working to develop a network of scientists, researchers and policymakers to plan, develop and implement an actionable heat health early warning system for the municipal corporation of Ahmedabad. For this purpose the center has conducted international workshops, researcher visits and is undertaking primary research including vulnerability assessment surveys.

The objective of the center is to reconvene scientific experts working on health adaptation research in India and the U.S. This scientific advisory group will continue to guide the assessment and strategizing process. Because scientific research on climate adaption is still nascent, this bilateral exchange will advance climate science by inviting health researchers, modelling experts, academics and policymakers in this field to discuss the state of existing scientific research and identify next steps in our efforts of development of a heat health early warning system in India. This will also serve as a venue to articulate principles for health adaptation in India and generate a list of climate health issues for consideration and prioritization. The activities of the center include vulnerability assessment surveys, focus group discussions, factsheets, posters and training and sensitization workshops.

Achievements

In Ahmedabad, Gujarat, strong local government leadership, which partnered with Indian Institute of Public Health-Gandhingar lead consortium of Indian and US institutions, enabled the development and effective implementation of a pilot Heat Action Plan – the first of its kind in South Asia. Launched in March 2013 and

continued into 2014, the Plan is based on robust scientific research and understanding of similar plans in the west. It builds prediction of heat waves, creates public awareness of the risks of extreme heat, trains medical and community workers to prevent & respond to heat-related illnesses, and coordinates an interagency emergency response to heat waves. Sharing international experiences and best practices helped change the perception among project stakeholders in Ahmedabad that heat was not a significant health threat. However, further awareness-raising is still necessary to convince the general public as well as administrators and medical practitioners.

The Ahmedabad Heat and Climate Study Group is a team of academicians and researchers from India and USA and consists of (in alphabetical order): Dileep Andhare (IIPH-G), Gulrez Shah Azhar (IIPH-G), Meredith Connolly (NRDC), Bhaskar Deol (NRDC), Priya Shekhar Dutta (IIPH-G), Partha Sarthi Ganguly (IIPH-G), Jeremy Hess (Emory University), Anjali Jaiswal (NRDC), Nehmat Kaur (NRDC), Kim Knowlton (NRDC and Mailman SPH, Columbia University), Dileep Mavalankar (IIPH-G), Ajit Rajiva (IIPH-G), Perry Sheffield (Icahn SOM at Mount Sinai) and Abhiyant Tiwari (IIPH-G). This partnership emerged from initial grant for an international workshop by the Indo-US Science and Technology Forum in 2011. This initial support catalysed a small grant from NRDC and it allowed the project team to leverage support from the Climate Development and Knowledge Network for international scientific collaboration which led to development of Heat Action Plan activities led by the Ahmedabad Municipal Corporation.

Key activities of the Ahmedabad Heat Action Plan are:

- Research activities on effects of heat on slum communities and outdoor workers
- Development of 7 days temperature forecasting for summer in Ahmedabad with help of CFAN centre at Georgia tech.
- Develop early warning system for extreme heat based on Meteorological Department and international forecasting models working with Ahmedabad Municipal Corporation.
- Sensitisation and training of hospital superintendents, physicians and '108 Emergency Response Services' to heat-health risks
- Health facility preparedness for dealing with heat stroke to reduce mortality: supplying ice packs at Ahmedabad Municipal Corporation hospitals and health centres and building capacity for heat-illness surveillance.

- Media engagement including workshops and meetings to raise awareness on extreme heat through television, radio and print outlets: 6,000 pamphlets distributed to school children and other vulnerable populations; large hoardings (billboards) displayed at a dozen locations around Ahmedabad; banners attached to rickshaws; digital visual displays (containing the temperature, information of heat; illness symptoms and precautions) Ahmedabad Municipal Corporation and project team.
- Dissemination of regular heat alerts and information to local agencies and stakeholders through emails and text messages
- Continuous monitoring of daily incidence of heat related illness cases and deaths by Ahmedabad Municipal Corporation during peak summer.
- Continuous monitoring of emergency calls for heat illnesses by GVK-EMRI.
- Analysis of completed activities and data collected during inaugural phases project team
- Reorientation of all medical and paramedical staff Ahmedabad Municipal Corporation and project team

Scientific value addition

As a research-focused initiative, the Ahmedabad heat health project delivered new cutting-edge scientific research on climate adaptation, with particular focus on public health for the most vulnerable populations in India. This includes

- Increasing knowledge of the events of 2010 Ahmedabad heatwave
- Analysis of the effects of extreme heat on vulnerable groups in Gujarat
- Translating knowledge to policy on heat waves and its effects
- Developing a heat wave early warning system for Ahmedabad

The good scientific research created a strong platform for international support and local action leading to credibility. This research focused on identifying vulnerable populations and formulating strategies to protect vulnerable communities. Such research is not happening anywhere else in South Asia (and probably anywhere else in the developing world) to best of team's knowledge, and is of great interest to the international scientific community. Access to data and the quality of existing data has been a challenge. The team has observed strong association of heat wave and all-cause mortality, but have not yet been able to show association with heat wave related

causes of mortality. This points to the need for further research on heat health impacts.

As part of the project, the team plans to expand scientific collaboration. It is also planning research exchange visits with key municipal officers, scientist and physicians from India and USA. There are plans to broaden Center's engagement with scientists in additional Indian states and cities.

Way forward

The Ahmedabad heat health project has been recognized nationally and internationally for its scientific and policy success in bringing heat health issues to the fore. There is now new interest in scientific research, climate-induced extreme heat preparedness and demand to scale up this project in India. Based on learning from the project's first phase, and interest from other state and municipal governments in India, the next phase will build on this momentum and deepen and expand scientific research and action on extreme heat.

Publications:

- Kim Knowlton, Anjali Jaiswal, Gulrez Shah Azhar, Dileep Mavalankar, Amruta Nori-Sarma, Ajit Rajiva, Priya Dutta et al. (2014) *Ahmedabad, Gujarat: Development and Implementation of South Asia's First Heat-Health Action Plan.* Int. J. Environ. Res. Public Health 11:3473-3492.
- Gulrez Shah Azhar, Dileep Mavalankar, Amruta Nori-Sarma, Ajit Rajiva, Priya Dutta et al. (2014) *Heat-related mortality in India: Excess all-cause mortality associated with the 2010 Ahmedabad heat wave.* PLOS ONE 9(3): 1-8.
- Khyati Kakkad, Michelle L. Barzaga, Sylvan Wallenstein, Gulrez Shah Azhar, and Perry E. Sheffield (2014) *Neonates in Ahmedabad, India, during the 2010 Heat Wave: A Climate Change Adaptation Study.* Journal of Environmental and Public Health, Article ID 946875, 1:8.
- Tran, Kathy V., Gulrez S. Azhar, Rajesh Nair, Kim Knowlton, Anjali Jaiswal, Perry Sheffield, Dileep Mavalankar, and Jeremy Hess (2013) *A cross-sectional, randomized cluster sample survey of household vulnerability to extreme heat among slum dwellers in Ahmedabad, India.* International journal of environmental research and public health 10, no. 6: 2515-2543.

Issue Briefs

- **Report Series:** Rising Temperatures, Deadly Threat (March 2013): Slum Community; Outdoor Worker; Medical Professionals; Local Government http://www.nrdc.org/international/india/extreme-heat-preparedness/
- **Report:** Climate Change and Health Preparedness in India http://www.nrdc.org/international/india/india-health-report.asp
- **Fact Sheet:** Fighting Climate Effects: Protecting People from Extreme Heat in One of India's Fastest Growing Cities http://www.nrdc.org/international/12012701.asp
- **CDKN Inside Story:** Addressing heat-related health risks in urban India: Ahmedabad's Heat Action Plan http://cdkn.org/wp-content/uploads/2014/05/Ahmedebad_Inside_Story_final_web-res1.pdf

Advancing Research and Education in Structural Fire Engineering

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Michigan State University in collaboration with University of Texas at Austin, CSIR-Central Building Research Institute, Roorkee and Indian Institute of Technology – Delhi, established an "US-India Virtual Fire Center" for enhancing fire safety in built infrastructure. The research terms at these institutions are developing methodologies, design tools and guidelines for performance based structural fire safety design. Under the virtual fire research center, the team will focus on exchanging and sharing research expertise, experimental facilities and test data for improving fire safety in two countries. Specifically, the team will develop engineering guidelines and solutions for overcoming fire problems in reinforced concrete beams. In addition the proposed center will help in knowledge dissemination among the academia, design professionals and construction industry through seminars and workshops.

The main aim of the "Indo-US Virtual Fire Center" is to establish collaboration among the partnering institutes in US and India for exchange and dissemination of information in fire safety field with respect to fire research, education, training and technology transfer activities in India to improve overall fire safety in built environment. The center will facilitate exchange of students, scientists as faculty amongst partner Institutions.

The partnering institutes are sharing their expertise, resources, and wealth of knowledge. Bilateral exchanges of researchers have been carried out. In order to exchange and disseminate the information in the field of fire safety a short term workshop has been planned during March 2015 at CBRI Roorkee. India. The topic of the workshop will be "Emerging Trends in Fire Safety Engineering". The participants will be the representatives of the industry working in the area of passive fire protection,

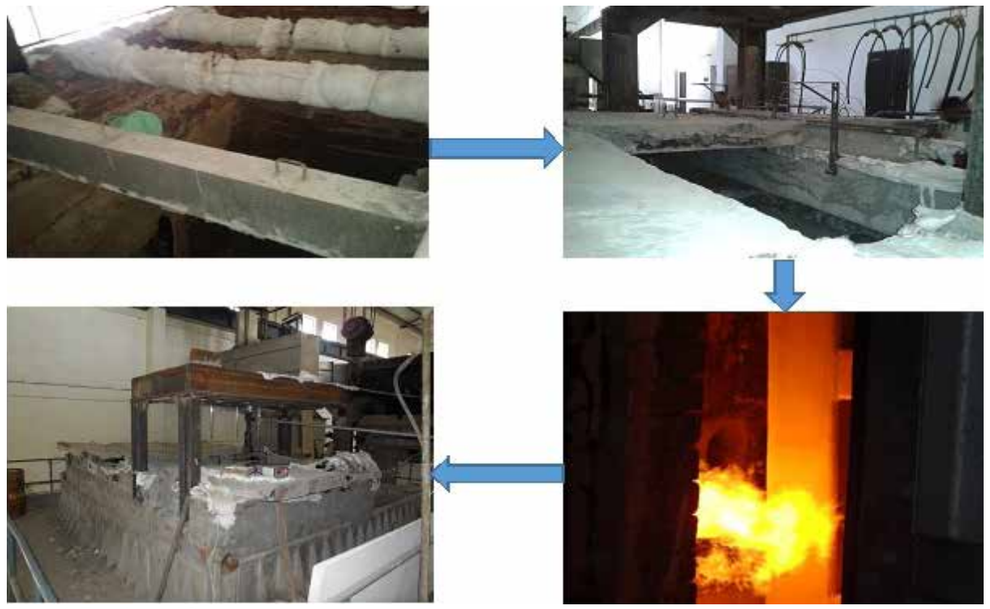


Figure 1: Experimental Set-up

academia, design professionals, construction industry, researchers, students and users from government, public and private sector.

Work is in progress for the development of a dedicated fire resource website. The basic purpose of the website is to provide information to the users working for the promotion of fire safety in built environment. Accordingly a site-map of the website has been finalised and it will include:

- Details of codes/ standards/ perspectives (adhering to copyright laws and regulations).
- Technical awareness on: analysis/ design procedures and software simulations.
- Test data sharing for possible benchmarking;
- Publications (details, direct links of textbooks, journals, SIF proceedings etc.).
- Up-coming events in the area of structural fire engineering; and
- Suggestions and comments by the visitors.

For the fire performance assessment of structural elements modeling studies will be carried out. For the validation of models required test data is to be generated. Experimental studies have been carried out and the test data has been generated on the fire performance of beams under loading conditions.

To study the fire performance of reinforced concrete (RC) beams under loading conditions, experiments were carried out through a well designed experimental set-up. The experimental set-up consists of a floor furnace to produce temperature and a reaction frame for applying loads, to which a structural member might be exposed during a fire in practice as shown in the Picture.

The tests include a series of eight experiments on normal and high strength concrete beams. To study the flexural behaviour of RC beams, two reference specimens of two different grades namely M30 and M60 were tested under two point loadings. The observations were made for the first cracking load, ultimate load and load at permissible deflection.

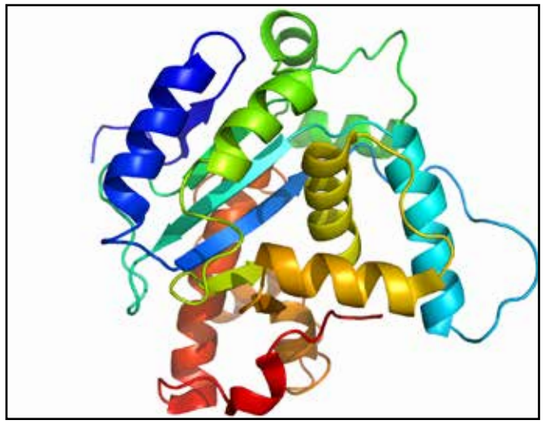
Further to determine the fire resistance rating, the experiments were carried out by exposing the reinforced concrete beam specimens to standard ISO 834 fire. The beams were preloaded with two point loads to a fixed percentage of ultimate strength at room temperature. After applying the loads on the beams, the beams were exposed to standard heating conditions. During the entire period of fire exposure the predefined load was maintained. The temperature of the furnace as well as that in concrete and rebars and deflection of beams were recorded during fire exposure.

On comparison of the results of normal and high strength concrete beams it was found that the temperature at all locations in high strength concrete beam was higher as compared to normal strength concrete beam during the entire period of fire exposure.

Similarly for the same loading of 15kN during fire exposure, the fire resistance rating of normal strength concrete beam was higher as compared to high strength concrete beam.

To develop high temperature properties of concrete the material property tests are planned. The material properties that may have significant influence on fire resistance and spalling are high temperature thermal and mechanical properties. The specimen of cubes and cylinders are under preparation at CBRI and will be shipped to IIT-D for undertaking property tests.

Protein Interactor Discovery and Structure



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The knowledge of protein-complex (quaternary) structure using X-ray crystallographic methods offer an atomistic glimpse into the basis of this interaction. Therefore, structural genomics of protein complexes has been one of the frontier areas in structural biology. However, structure solution of protein complexes must precede identification of natural/cognate binding partners in cell to allow attempt to protein co-crystallization and structure determination. As part of this Joint Center, the groups will enhance methodology of identification of natural/cognate binding partners of proteins in a genomics scale. An already established ProLinks database of genomic-context derived functional linkage information will be used to get an initial set of physically interacting candidates at 95% expected coverage. These candidates will thereafter be screened and ranked using our interaction forcefield and expectation maximization method. The sequences will be modeled to assess and interpret the basis of the interaction as rigid bodies, and subsequently subjected to molecular dynamics simulations to confirm the viability of the protein-interaction. The candidates will be experimentally tested for protein-protein interaction screening and if successful, followed up with crystallization and structure determination. The work is expected to give a significant boost to the structural genomics of protein complexes. The center is expected to bring forth new ideas and lay groundwork for long term future collaborations.

Biological Timing

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Biological clocks have evolved to interact with daily changes in our environment and time appropriate physiology, metabolism, and behavior to right time of the day or to the right season. Optimum timing events underlie increased biomass production by plant species, optimum growth, cell division, reproductive success, healthy lifespan and improved prognosis in animals and in humans. In contrast, disruption of the biological timing system as in genetic mutations affecting the internal clock or changes in environmental factors impairs fitness and predisposes to chronic diseases and early aging. Biological timing is a rapidly emerging field and it has profound implications in multiple fronts common to the national interests of both the USA and India. These areas include food security, energy security, public health, and ecosystem restoration. While biological timing researchers in the USA have been at the forefront of understanding the molecular basis of biological clocks in model organisms, Indian researchers have pioneered the understanding of physiology and behavior in complex organisms that are under daily and seasonal regulation.

The Indo-US center for biological timing will be the hub for research, training and education by involving two important Universities of India (University of Delhi and the University of Lucknow) and two important centers of research and education of the USA (University of California and Salk Institute for Biological Studies). The basic science collaborations will center on ongoing funded research with direct relevance to public health and ecosystem restoration. Research collaborations will form the platform for cross-training of researchers and students during short-term visits. These visits and online tools will be leveraged to generate and disseminate education materials on biological timing. Success of the research program will solidify collaboration between two countries while training and education efforts will expand bilateral collaboration. Activities

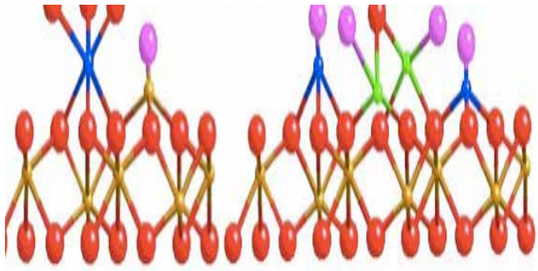
planned under this center are organized into three aims.

- Light modulation of activity, sleep, reproduction, regeneration, and migration.
- Circadian rhythm, eating pattern, and regulation of metabolic homeostasis.
- Scientific meetings, symposiums, and training schools.

The strength of the collaboration between partners of the joint center lies in the non-overlapping species and techniques followed in each center institute.

The third aim of this center is an important one to be achieved through this center. A website hosted will serve as the hub for center activities. It will highlight the executive summary of the center, research activities of participating principal investigators, list of meetings and symposiums in the subject area, link to other chronobiology centers, laboratories and relevant databases. For public outreach, the web site will also include education materials for educating the general public on chronobiology. Center members will use skype and other online communication tools for periodic web-based discussion and consultation. Center members' travel to US or India will be coordinated to maximize utility. The collaboration between the partnering institutions through this center will expand in future and the outcome in terms of research and knowledge from the project is envisaged to contribute to the information on public health and conservation of biodiversity in both countries.

Crystallization at Interfaces



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Partnering Institutions

India

Indian Association for the Cultivation of Science
Jadavpur

Saha Institute of Nuclear Physics
Kolkata

USA

Argeonne National Lab
Lemont

Northwestern University
Evanston

The Center aims to carry out fundamental research to understand self-organized mechanism in formation of Crystals at solid and liquid Interfaces. Under this broad theme our specific interests will be to understand the a) growth of crystals of atoms/molecules with symmetries that are generally absent in bulk, and b) growth of crystals of mono-dispersed nano-particles. It shall primarily use synchrotron scattering, high resolution microscopy and spectroscopy techniques in this collaborative project. A general interest in the above studies lays in development of materials for highly efficient energy conversion/storage and for ultra-low-power dissipation nano-devices.

Under the aegis of the Joint Center, special attention will be given to:

- Interfacial growth of crystals of atoms and molecules which cannot either be grown at all or grow with a different symmetry in the bulk crystals
- Growth of lattices, of three or lower dimensions, of nanoparticles of different shapes and sizes but with high size and shape monodispersity. Some of the areas under focus of the proposed Indo-US Joint Centre will be in-situ studies of MBE growth of oxide materials,ex-situ studies of MBE growth of Si-Ge quantum structures
- *In-situ* studies of crystallization of nanomaterials at the liquid-liquid and air-liquid interfaces,
- *Ex-situ* studies of organized nanostructures on silicon/quartz substrates, using x-ray scattering, microscopy and spectroscopy. While *ex-situ* studies will be carried out in the respective laboratories in India and US, *in-situ* studies will be performed at Advanced Photon Source, Argonne National Laboratory, USA and at the India-Japan Beamline (developed by Saha Institute of Nuclear Physics) in Photon Factory, KEK, Tsukuba, Japan.

Nanostructure Genomics

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Institute of Physics,
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IBM Research India

USA

Pacific Northwest National Laboratory
Richland

New York State Department of Health and University, Albany

State University New York

The goal of this center is to provide a vibrant INDO-US center on two important topics of mutual research interest: Nanostructure Materials and Biological Molecules. The proposed work plans to capitalize on expertise from both sides of Atlantic with particular focus on close collaboration between high performance predictive computational (HPPC) methods with the state of the art experimental investigations.

The center will provide a unique platform for basic scientists, engineers and physicians to interact actively addressing fundamental questions keeping in mind possible applications through design of new atomic scale materials and biomolecules. Specifically, the group will collaborate on the fundamental study of new and emerging nanostructured materials with potential applications in low power high speed transistors, chemical and biological sensors, energy devices such as super capacitors, growth and application of robust and novel substrates (using coherent inclusion of plasmonic materials in silicon substrates) for surfaces enhanced Raman Spectroscopy (SERS) that enable to detect single molecule detection, metal clusters controlled intein proteins that could be used as an anti-tuberculosis drug, designing of new protein-nanostructure interfaces that could control or provide superior biosensors. The team would focus on two broad thrust areas:

- Design of 2-dimensional Functional Nanostructures
- Design of Optimal Nano-Bio Interfaces.

Publications:

N. A. Lanzillo, J.B. Thomas, E.B. Watson, M. Washington and S. K. Nayak (2014), *Pressure-enabled photon engineering in metals. Proc.* Nat. Aca. Sci. 111:8712

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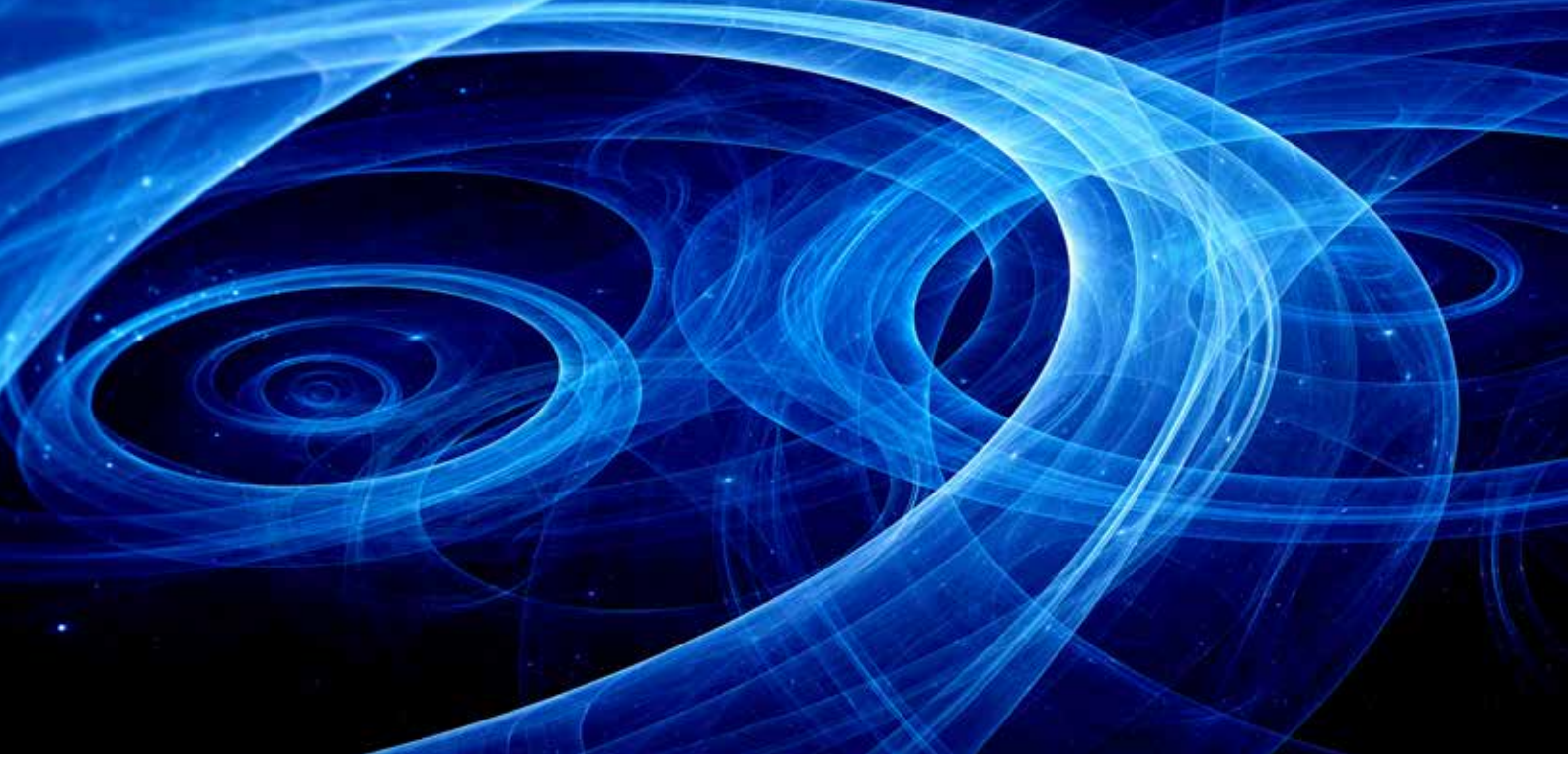

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